Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy.

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Abstract

The subject of patient safety with the objective of reducing avoidable harm has gained growing interest. Yet, despite this focus, harmful errors in healthcare continue to occur resulting in significant burden. Research in social sciences has recognised the influence of affect on behaviour and decision making. Therefore, knowledge of affect could be valuable to healthcare professionals. However, research on affect in healthcare remains overlooked.

The aim of this research was to examine the role of affect when a human error occurred within radiotherapy. To achieve this aim, eight participants directly involved in error were recruited from four UK radiotherapy departments. Employing four case studies, document analysis, memory work, and interviews were combined to reveal each participants' lived experience of the error. Interpretative phenomenological analysis (IPA) was used to present the uniqueness of each case prior to revealing the themes that subsequently emerged.

Affect contributed and was recognised in multifarious ways. Lively affectively charged worlds were portrayed, with the intra-actions of affected Radiographers within their surroundings resulting in unpredictable actions. Affect surfaced both above and below conscious awareness and resulted in different types of error. The affective consequences of losing control and running behind schedule was evident. The resulting affective states accumulated, swirled, and intensified and resulted in a sense of overwhelm becoming apparent. Flawed decisions were made by each affected Radiographer that resulted in errors.

Several areas for future research are suggested. Researchers could develop the findings by adding supplemental cases which examine the intra-action of humans within increasingly complex systems. Further evidence is needed to support the presented definition of a slip. The affective processes concerning loss of control, and associated need to rush, revealed an opportunity for future exploration. Whereas this research was undertaken within the specific field of radiotherapy, it could be replicated in other healthcare domains.

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Chapter One – Introduction

1.1. Introduction.

Experienced in employment in the Radiotherapy domain for over twenty-five years, part of my current role involves investigating errors that occur within my own workplace. An interest in the role of affect and its influence on patient safety has developed following the recognition of emotion and traces of affect being witnessed following the identification of these errors. The purpose of this chapter is to firstly introduce the context that situates this research. The subject of patient safety is defined prior to establishing why improvements to safety hold such importance. The reasons why knowledge of affect could be valuable to healthcare professionals are outlined, prior to acknowledging the dearth of pertinent research within the literature. The chapter continues by outlining the theoretical framework that positions this research; that is, the divergent philosophies of affect theory and patient safety. The acute concerns for high standards of ethical awareness required in healthcare research are recognised, before clearly defining the research aim and questions. The research design is summarised prior to describing the impact of the research in contributing towards improvements in patient safety. The chapter concludes by briefly outlining the structure of the chapters that form the thesis.

1.2. Background.

The subject of patient safety has been described concisely as avoiding harm from the care that is intended to help. Harm can be caused by doing something wrong or by not doing something at all. Harm is also often preventable and predictable and can have grave implications for the patient. Subsequently, the discipline of patient safety with the objective of reducing avoidable harm has gained growing significance within the various healthcare domains. Yet, despite this increased spotlight on reducing avoidable harm, errors in healthcare continue to occur. According to the World Health Organisation, millions of people suffer injuries or die from unsafe healthcare practices around the globe each year. This incidence of patient harm also provides a substantial burden financially for healthcare systems around the world. Estimates suggest that 10-15% of healthcare expenditure is expended as a direct consequences of patient harm events. Therefore, improvement of patient safety has become a global public health priority.

However, in the UK, the issues facing NHS organisations caused by chronic underfunding coupled with an ageing population has provided a context which impacts on the workforce.

The role of healthcare workers in patient safety has historically been neglected. However, humans are emotional beings and healthcare professionals do emotional work; emotions are expressed and managed daily in healthcare. Affect theory describes the body's potential to affect and be affected by others. Research in the social sciences have recognised that affect can have an influence on how we behave and act. How healthcare professionals feel, their affective state, may exert a significant, unintended influence in compromising patient safety. Therefore, affect is aligned to the emotion-saturated environment of the clinical setting. It therefore follows that knowledge of the work of affect could be valuable to healthcare professionals. However, a lack of literature concerned with the role of affect when things go wrong remains. Therefore, this research contributes towards addressing this gap in knowledge.

The purpose of this research study is to recognise the role of affect when errors occur within the clinical domain of the radiotherapy department. Increasing knowledge and awareness on the role of affect in patient safety could ensure that the maximum is learnt from error investigations with the aim of reducing the reoccurrence of similar errors in the future. The expression of affect will be examined when the participant recalls their involvement in a past human error event. The research will be designed to identify traces of affect within established methods such as document analysis, memory work, and interviews.

1.3. Theoretical Framework.

The concept of affect was first introduced by Spinoza in terms of a body's capacity to affect and be affected by other bodies. The 1990s witnessed affect regaining recognition in the social sciences. The important work of Sedgwick and Frank, as well as Massumi's interpretation of Deleuze and Guattari's reading of Spinoza proved influential in establishing a 'turn to affect'. Literature on affect has seen several 'splits' in theories. Contemporary theorists such as Massumi, Thrift, Brennan, and Clough focus on affect as an outside stimulus that hits the body before hitting the cognitive apparatus. Others,

such as Ahmed, Leys, Wetherell, Butler, and Blackman criticise the dichotomy of mind and matter.

Whilst sometimes used interchangeably with emotion, affect has also developed to be understood as a form of bodily feeling that is separate from emotion. Affect acknowledges both the 'internal' and 'pre-personal' nature of feeling. Pre-personal refers to phenomena that moves us and moves others but are beyond both of our control. Some of these energy flows may register as emotions. Others remain 'in the background' or as mysterious influences on our bodies, conduct, and experience. There is a range of phenomena that 'affect' us, but which remain difficult to comprehend, such as imitation and contagion. Other examples include hunches, atmospheres, and changes in bodily response when interacting with other bodies.

A review of the literature pertinent to safety in healthcare enabled an understanding of how current practices have evolved over the last thirty years. The work of Leape was fundamental in pioneering a move away from a culture of blame to one that acknowledged the unavoidable shortcomings of humans. Reason built on this by taking insights from the fields of ergonomics, physiology, and psychology to highlight the interactions between humans and the system. This has resulted in a greater emphasis on placing humans into healthcare systems that are designed to reduce the likelihood of errors. Reason also introduced the concepts of latent conditions and human errors as active failures into the healthcare domain, whilst also classifying the wide range of errors witnessed in the 1990s. Vincent progressed the work of Reason by focusing on the latent conditions and array of factors that indirectly cause safety issues specifically within healthcare. A final theoretical consideration when underpinning this research has been in recognising how an increase in complexity has resulted in a rise in harm to patients. Humans can interact with complex systems in expected ways as well as ways that could never have been predicted. Whilst humans provide a valuable contribution to complex systems, it is their inherent inconsistency in reacting to changing conditions that can lead to erroneous events. When errors do occur, an investigation is undertaken to uncover the causes with the aim of learning from the error and preventing it from happening again.

In comprehending the various factors that can contribute towards a human error, it was possible to assemble an understanding of how the perspectives on patient safety could entwine with affect theory. On the macro level, the institutional failings of NHS organisations will provide the factors that leave the incumbent workforce affected. Clinical departments are complex lively worlds that humans share and intra-act with various technologies, distractions, and objects. On the individual level, affect can intrude cognitive processes that are undertaken daily such as interpretation, judgement, decision making, and reasoning. Affect can play an important role in the mental shortcuts that help us react quickly to problems or situations confronted with. How we consciously or unconsciously feel about a patient or situation can also have a significant influence on safety. The literature review enabled the construction of a map of error which brought together the various safety viewpoints and merge them with sources of affect. This figure succinctly illustrates the theoretical framework that situates the study.

1.4. Ethical awareness.

Research that takes place in healthcare environments demand ethical standards that safeguard the health and wellbeing of all human subjects, be that the researcher, patients or participants. An involvement in human error can be a sensitive or difficult subject to talk about. Discussing situations where harm has occurred has the potential to cause upset in the participant. However, all errors present a learning opportunity and therefore it is routine healthcare practice to investigate and carefully scrutinise errors when they occur. Care was taken at all times throughout the research to avoid participant harm and to act in a sensitive manner. Research also has the potential to be harmful to the university, as well as the organisation in which it is situated. Therefore, established processes were followed to protect the rights, safety, and wellbeing of all relevant groups.

1.5. Research aim and questions.

The aim of this research is to examine the role of affect when a human error occurs in a radiotherapy department. On exploring the literature apposite to affective processes and patient safety, thoughts developed as to the optimal means of achieving this goal. The methods section will demonstrate how current proven error investigation

procedures were reflected upon and employed. Instructed by the theoretical frameworks, this thesis focused on answering the following principal research questions:

> What role does affect play in influencing human error?
>
> In what ways can we identify the influence of affect as a precursor to human error within radiotherapy?

As the research progressed, it became apparent that a set of related research questions had developed to supplement the principal research questions and contribute to the research impact of the study. These questions related to the anticipated contribution and value of the study in adding to current knowledge on affect and patient safety.

> How does enhancing our understanding of affect contribute to reducing the recurrence of human errors?
>
> What are the benefits of sharing rich experiential qualitative data on affect after human errors?

1.6. Research design.

In attending to the above research questions, a multi-method approach was exercised that included document analysis, memory work, and interviews. Chapters three and four provide details of the methods used. The research methods evolved as the study progressed due to challenges in recruitment, personal reflection, and a growth of knowledge in affective processes and patient safety literature. Four case studies are presented to reveal the lived experiences of eight participants directly involved in errors in four UK radiotherapy departments. Subsequent interpretation and analysis will expose the significance of affect to these cases.

1.7. Impact of the research.

Human errors occur in healthcare settings. When things go wrong (that is, there is an error) in healthcare, there can be an adverse effect on the patient and the staff involved. The patient can be harmed as a result of the error, and the healthcare professional involved can suffer psychologically. Investigating and reporting the cause of the error is also time consuming, and therefore has a cost to those undertaking the investigation.

The significance of this research project is to contribute towards knowledge in patient safety, by emphasising the role of affect when a human error occurs. A greater understanding of the work of affect in contributing towards human errors could help reduce the occurrence of human errors in the future. Therefore, a reduction in errors will be of benefit to the patients and staff involved, and ultimately the organisation.

There is the potential for this study to promote a policy change by mandating the need to examine for traces of affect as part of an error investigation. There is also the prospect for this study to impact on wider society as a piece of public value research. The research could operate as a critical case. That is, the research and finding could be replicated in other medical settings.

1.8. Structure of the thesis.

The remainder of the thesis is organised into seven chapters. The following chapter, (Chapter Two) titled 'Literature review' delivers an examination of the literature pertinent to this study. A review of the patient safety literature will provide an understanding of why human errors occur in healthcare. Subsequently, a review of affect within the healthcare literature will reveal how the affective states of healthcare professionals can impact on patient safety. Next, the theories and debates that occupy the domain of affect are uncovered. The chapter will continue by recognising various interconnected affective states, affect in discourse and materialism, and the contagious nature of affect. Finally, affect within the organisational literature will be examined.

Chapter Three, 'Methodology', will detail the methodological position used to investigate how affect can contribute towards human error in a healthcare setting. The chapter will proceed by outlining the philosophical basis of the study; that is, the relativist ontological and subjectivist epistemological considerations. Next, the use of phenomenology to study the structures of experience or consciousness will be revealed. Justification for the choice of qualitative data in a case study approach will be presented before concluding by setting the scene of the study; both within the specific context of the radiotherapy department, and within the wider challenges of the NHS. Potentially unfamiliar terminology specific to radiotherapy are defined in the glossary in Appendix J.

Chapter Four, 'Methods', will describe the technical and practical aspects of the methods used. In building on the methodological foundations provided in the previous chapter, a discussion of the use of document analysis, memory work, and interviews is provided. The ethical implication of the study is detailed, in taking account of the sensitive nature of researching errors in healthcare. Practical aspects of the research sites are revealed, including participation inclusion criteria, how the research sites are accessed, and justification for the sample size. Finally, a discussion of interpretative phenomenological analysis (IPA) will be presented, prior to validating the reasons for this choice of analysis.

Chapter Five, 'Findings', will follow Smith and Osborn (2003) in illustrating the empirical data produced from the methods described. The chapter responds to calls for greater attentiveness to the influence of affect in healthcare organisations (Croskerry et al 2008; 2010; Heyhoe et al 2016; Kozlowski et al 2017; Isbell et al 2020) and presents four distinct case studies as extracted from the experiences of the individuals involved in human errors. Accounts of how affect emerges and intensifies prior to human errors occurring are offered. The chapter concludes by presenting the findings from the local investigations that were undertaken on identification of the error occurring.

Chapter Six, 'Analysis and discussion', will discuss the findings revealed in the previous chapter with the existing literature. Interpretations of the complex interlinking themes that emerged across the cases are presented. This will provide the reader with an understanding of the experience of a group of Radiographers directly involved in human error. The chapter reveals how the inter-related challenges facing NHS organisations contribute towards the Radiographers becoming affected and provides a context that impacts on safety. Next, the chapter exposes the lively affectively charged and technologically saturated worlds that the Radiographers inhabit. The Radiographer's motivations to maintain control and remain on time are illustrated, prior to discussing how threats to these needs leave the Radiographers affected in different ways.

Chapter Seven concludes by restating the aim of the research in examining the role of affect when a human error occurs within a radiotherapy department. The chapter will describe how this aim has been achieved by responding in detail to the four research questions above. Subsequently, it reveals the varied contributions and implications of

the research for professional radiotherapy practice, error investigation, and patient safety policy in recognising the manifold ways in which affect influences the Radiographers. Following a discussion of the limitations of the research, the chapter ends by recommending notable opportunities for future research which emanate out of these findings and limitations.

Chapter Two – Literature review

2.1. Introduction.

This chapter presents a review of the literature that will be pertinent to this research. The review commences with an overview of the context and key concepts in explaining why research into safety in healthcare is important. The opening sections establish what is known about patient safety, why people are harmed, and how errors occur in organisations. In considering literature from both within and outside the healthcare domain, a map of error is produced to illustrate the problem.

The chapter proceeds by examining the role of affect in the healthcare literature. The affective nature of clinical work and the healthcare environment is considered which enabled the map of error to be updated with sources of affect. Importantly, a review of the affect literature from outside the healthcare domain is then undertaken. This highlights areas where theory and evidence of affect from other domains could help explain what is happening when an error occurs. This strategy provided insight into the individual and social processes, and workplace conditions that could impact upon patient safety.

A summation of affect theory is presented which highlights both the overlapping and contrasting nature of the subject. Subsequently, an examination of how affect could be identified within discourse is revealed prior to uncovering the related field of materialism. The contagious quality of affect is discussed, prior to describing how various affected states are interconnected. The review concludes by outlining how affect theory has been embraced within the contemporary organisational literature. The breadth of affects' involvement in organisational life establishes its potential for indicating its role when things go wrong.

2.2. Safety in Healthcare: Context and Key Concepts.

Patient safety has been defined as avoiding harm from the care that is intended to help (Berwick 2013; Findlay et al 2016). In healthcare, 'harm' is defined as an 'incident that results in harm to a patient such as impairment of structure or function of the body and/or any deleterious effect arising there' … [from the] … 'actions taken during the provision of healthcare, rather than an underlying disease or injury…' (WHO 2009). Harm

can be caused by errors of commission (doing something wrong) or omission (failure to do something) (Balogh et al 2015). This harm is often preventable or predictable (Balogh et al 2015) and can have serious consequences for the health and wellbeing of a patient (Aitken and Gorokhovich 2012). Consequently, the concept of patient safety and the reduction of avoidable harm to patients has attracted continued and growing emphasis amongst frontline clinicians, the organisations they work in, and the institutions that regulate them (Kohn et al 1999; Reason 2008; Vincent 2010; Francis 2013; Berwick 2013; WHO 2019).

Paradoxically, despite a heavy emphasis having been placed on the reduction of avoidable harm since at least the 1960s (Safren and Chapanis 1960; Leape 1994; Kohn et al 1999) medical errors still occur. The World Health Organisation (WHO 2019) asserts that each year, millions of people suffer injuries or die from unsafe healthcare globally. Poor quality practices and increasing risks are emerging as major challenges to patient safety. A significant burden of harm has developed due to unsafe care (Jha et al 2013).

Examples of this burden relate to medication errors, diagnostic errors, and radiation errors:

Medication errors are a leading cause of avoidable harm in healthcare. Worldwide, the estimated cost associated with medication errors is US$42 billion annually (Aitken and Gorokhovich 2012).

Diagnostic errors occur in approximately 5% of adult outpatient settings. More than half of these errors have the potential to cause severe harm (Singh et al 2014).

Radiation errors include the exposure of radiation to the wrong patient or wrong site (Boadu and Rehani 2009). Overdoses of radiotherapy can lead to serious harm or death, with some high-profile errors occurring (Knöös 2017; Eaton et al 2018).

Healthcare's burden of harm is comparable to the impact of chronic diseases such as multiple sclerosis and cervical cancer in developed countries, and tuberculosis and malaria in developing countries. Incidents resulting in patient harm are also a major financial burden for healthcare systems worldwide. It has been estimated that 10-15% of healthcare expenditure is consumed by the direct consequences of patient harm

(Panagioti et al 2019). Therefore, the improvement of patient safety globally represents a moral, professional, and public health priority (Balogh et al 2015).

The literature review will commence with a look back at the at the early years of safety research and the genesis of relevant models. A retroactive study will provide an overview of how key issues and concepts structure the field. This will allow an understanding of how these concepts emerged from historical, scientific, and social contexts. A retrospective review will help identify unexplored territory and potential research opportunities (Larouzee and Le Coze 2020).

2.2.1. Why people get harmed in healthcare organisations.

2.2.1.1. Research into safety in healthcare.

Up until the mid-1990s, error in healthcare was rarely mentioned in the medical literature (Vincent 2010). Leape (1994) was the first to actively tackle the concern for error in healthcare and brought new perspectives to bear (Vincent 2010). Leape recognised that error prevention in healthcare was characterised by what he called the 'perfectibility model'. This model inherent in healthcare settings suggested a 'train and blame' culture had existed; that motivated people were trained to high standards and expected not to make mistakes (Buerhaus 1999). If a mistake was to occur, then punishment by disapproval or discipline was the most effective counter to future errors.

However, Leape (1994), drawing on the psychology of error and human performance discarded this viewpoint. Accordingly, it was established that many errors are beyond the conscious control of the individual or caused by factors outside of our control. Leape (1994) recognised that reliance on error-free performance was doomed to failure, as is the dependence on discipline and training. Leape argued for a fundamental change in the ways that errors were viewed. He proposed the acknowledgement of human limitations and fallibility and suggested the changing of work processes rather than an emphasis on training.

Learning from other industries (and industrial incidents[1]), a paradigm shift occurred in healthcare which examined the way that work systems were designed following an error. Principles of *Human Factors* were applied that had been prominent in aviation and the military since the mid-1900s (Cafazzo and St-Cyr 2012). If an error did occur, an investigation examined why it happened, and how work could be redesigned to prevent it from happening again (Buerhaus 1999; Donaldson 2021).

2.2.1.2. Human factors in safety research.

> We cannot change the human condition, but we can change the conditions under which humans work (Reason 2000).

The work of Professor James Reason (1995) was fundamental in introducing the scope of Human Factors into healthcare systems (Cafazzo and St-Cyr 2012). The discipline of human factors is concerned with understanding the interactions between humans and other elements of the system. Individuals are at the centre of (work) systems, and therefore systems should be designed to optimise wellbeing and performance. In enhancing wellbeing and performance, it follows that high standards of quality and safety will be achieved (Carayon et al 2021).

The discipline of Human Factors emerged from the fields of ergonomics, physiology, and psychology. This specialty considers both the physical and mental characteristics of individuals within an organisational and socio-technical context. Systems and processes are designed and evaluated with a concern for human factors. Tasks, equipment, and working environments are assessed to ensure compatibility with needs, capabilities, and limitations of humans (CHFG 2021). This allows human errors to be designed out of a process or system (Vincent 2010). Therefore, individuals are protected from making errors when placed in an environment where the systems are well designed (WHO 2019). This approach has been increasingly adopted within healthcare (Karsh et al 2006).

[1] The Three Mile Island nuclear incident (1979), Bhopal industrial disaster (1984), Chernobyl (1986), Challenger (1986), Kings Cross (1987), Exxon Valdez (1987), the Herald of Free Enterprise (1988) and Piper Alpha (1988) all highlighted the need to investigate the organisational dimension of such events (Cafazzo and St-Cyr 2012; Larouzee and Le Coze 2020).

2.2.1.3. Reason's Swiss cheese model.

Reason attempted to reconcile three different approaches to safety management: the person model, the engineering model, and the organisational model (Reason 1997). Reason emphasised the importance of considering team, technical, and organisational factors in the design of safe systems. He also advocated a culture of understanding the root causes and how lessons could be learnt from errors. Using principles from Human Factors, Reason (1995) also introduced the concepts of active failures and latent conditions into the healthcare domain (Cafazzo and St-Cyr 2012). His metaphorical Swiss Cheese model[2] (Figure 1) encouraged a more system-based perspective to the occurrence of an error. The model illustrates how unsafe systems can provoke human error (Reason 1997).

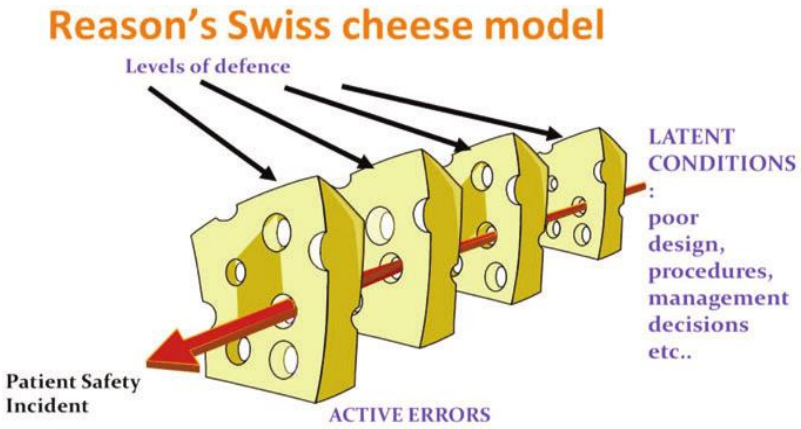


Figure 1. Reason's Swiss Cheese model (Carthey 2013).

This approach demonstrates that in any system there are many levels of defence. However, these defences are imperfect due to human fallibility combined with weaknesses in system design and operation (Carthey 2013). The solid slices of cheese are the system's defences, whilst the holes within are the weaknesses. The defences can be embedded in technology or may rely on human input (such as two individuals checking each other prior to a task). If a potential error escapes detection at one defence (slice of cheese) it may still be picked up at the next layer of defence.

[2] The Swiss Cheese Model developed from the resident pathogens metaphor (Reason 1988), John Wreathall's *defence in-depth* concept taken from nuclear engineering, and air-safety expert Rob Lee's Swiss Cheese metaphor (Larouzee and Le Coze 2020).

The holes in this model are fluid; they can open, realign, and close continuously. Thus, systems are dynamic; they evolve over time and can incite unexpected surprises (Carthey 2013). Some holes are unsafe actions such as mistakes or lapses of concentration that cause *active failures*. These failures are committed by healthcare professionals and may have an immediate impact on safety. Many more holes are caused by *latent conditions* created at the organisational level of design[3]. These are the underlying conditions for an error to occur (Donaldson 2021) and could lay dormant for days, months, or years (Cafazzo and St-Cyr 2012). Latent conditions can lead to weaknesses in the systems' defences. When these weaknesses are combined with an active failure an error occurs. That is, it is when all the holes in the defences align that an error or harm can occur (WHO 2019; Donaldson 2021).

Critics of the Swiss Cheese model argue that it can lead to a linear approach to error investigation (Hollnagel 2004; Dekker 2011). Dekker asserts that in searching for organisational deficiencies or latent failures, the blame is simply shifted elsewhere. Other critics include Leveson (2011) who described the model as an obsolete descendant of Heinrich's Domino Model from the 1930s (Larouzee and Le Coze 2020).

The distinction between active and latent failures has influenced investigations into the causes of harm for the last two decades. Its dominance has overcome newer models developed by Reason for understanding error in complex systems (Carthey 2013). For example, Reason (2004 and 2008) introduced a Three Buckets model and a Harm Absorbers model. Both instances recognise the role of intuition, expertise, and foresight in circumventing harm (Carthey 2013). All these models agree on the significant role that health professionals play in the healthcare system. It follows that an understanding of active failure and theories of human error within the system is of undoubted importance.

[3] Latent conditions or failures include lack of training or poor management decisions. They can be caused by higher management, regulators, governments, and manufacturers. Other examples of latent conditions include unclear policies and procedures, a culture where junior staff are unable to challenge unsafe practice, poorly designed equipment or poor induction practices for new staff (Carthey 2013).

2.2.1.4. Human error as an active failure.

The nature and causes of human's contribution towards error have long been studied. An action is only recognised as erroneous after the event; human error is therefore defined as a judgement made in hindsight (Woods and Cook 2002). Human error is primarily the result of our limitations in memory, perception, or attention (Reason 2000). Human error occurs when an individual's decision making, or actions contribute towards failures that negatively impact patient safety (Higham and Vincent 2021).

In 1990, Reason provided a much-needed taxonomy of the diverse range of errors being witnessed. In interpreting a catalogue of error reports in addition to his own observations, Reason (1990) divided errors into two broad types: slips and lapses, and mistakes. Derived from the study of accident reports such as those produced following Chernobyl, Reason also highlighted the term violation[4] (Larouzee and Le Coze 2020). Violations described deliberate deviations away from safe operating practices as opposed to an error which is unintended. In practice, the distinction between slips and lapses, mistakes, and violations is often unclear. Investigation of such cases requires careful exploration of the action, context, and personal traits of those involved in an error (Higham and Vincent 2021). Reason's conceptual structure remains important in clinical practice to this day.

Slips and lapses are errors of action; they follow 'when a person knows what they want to do, but the action does not turn out as they intended' (Higham and Vincent 2021). Slips are visible acts that are associated with failures of attention. They are skill-based failures where there is a failure to complete an action as intended (Reason 2000). Lapses are also skill-based but are described as internal events that are associated with failures of memory. Importantly, these skill-based failures occur predominantly during automatic performance of a routine task, often in surroundings that are familiar. A slip of action is 'associated with either distraction or preoccupation' (Reason 1990). That is, they occur either from 'the person's surroundings or their own preoccupation with

[4] In contrast to the unintended nature of errors, violations are deliberate acts. Violations are not necessarily acts of sabotage, but are linked with attitude, motivation, and the work environment (Higham and Vincent 2021). Reason (1990) provided three types of violation: a routine violation is akin to cutting corners, a necessary violation occurs as it seems the only choice available, and an optimizing violation which are for personal gain or need (e.g., to leave work early).

something in mind' (Higham and Vincent 2021), their environment *or* from their thoughts. Mistakes are different in that the action may go entirely as planned, but the plan itself was wrong. Reason (1990) suggests that mistakes are failures in knowledge; they result from changes in the world that have not been prepared for nor anticipated. The individual possesses no plan or solution to the novel situation encountered. They therefore emerge at a higher level during the mental processes responsible for planning, decision making, judgements, and problem solving.

Influenced by Rasmussen's (1983) generic models of cognition, Reason also differentiated between rule-based and knowledge-based mistakes. A rule-based mistake can result when an individual applies an incorrect rule or procedure despite being trained and experienced in what to do. Knowledge-based mistakes develop in unusual situations where the solution to an issue must be worked out immediately. However, the individual involved does not have an adequate 'mental model' of the situation to base their decisions on, still less a rule or procedure to follow. The situation encountered is unrecognisable and not planned for, and therefore relies on the 'cognitively effortful and error prone processes of reasoning' (Higham and Vincent 2021). Whilst 'efficient and accurate decision-making is critical to patient safety' (Prineas et al 2021), when examining flawed clinical decision-making, shortcuts in reasoning often become evident (Alti and Mereu 2021). The individual or group can perceive a situation incorrectly, and consequently make a wrong decision.

Humans are increasingly sharing the control of systems with automation thanks to ever-increasing advancements in technology. Rising levels of automation and complexity has led to a new distribution of human errors, with increasing errors of omission found versus commission (Leveson 2011). Inadequate communication between humans and technology has become an increasingly important factor in such errors. Human behaviour is influenced by the environment in which it occurs, and operators are at the mercy of the environment and system in which they work.

If there are operators in the system, they are most likely to be blamed for the error or accident (Reason 2000; Leveson 2011). This is not a new phenomenon, or specific to healthcare. It is common to see figures of 70-80% of aircraft errors being caused by pilots, or 85% of generic work accidents being the cause of unsafe acts (Leveson 2011).

Indeed, PHE (2016) reports that 70-80% of hospital-based errors are caused by human error. Such data is often biased or incomplete; the less that is known, the more likely an error will be attributed to the operator (Leveson 2011). Many incidents that are blamed on human error could more accurately be attributed to the environment or conditions in which they operate. Error investigations invariably discover other factors further back in the system (Leveson 2011). Organisational factors that can contribute to error will now be examined, before focusing on why an increase in complexity has resulted in an increase in harm.

2.2.1.5. Reason's organisational accident model.

Reason's (1997; 2000) organisational model (Figure 2) was originally developed to understand the anatomy of organisational accidents. The model was used to examine the factors involved in the rare but often catastrophic accidents born out of industrial systems. The model demonstrated the need to examine the chain of events leading to an accident.

Individuals are presented at the critical end as the inheritors rather than as initiators of erroneous sequences. Accidents can originate from management decisions and organisational processes. The latent conditions so created are transmitted along the various pathways to the workplace (the ward, the department etc.), where the local conditions are created for an error to occur. Many unsafe acts can be committed, but very few of them will penetrate the safety defences and barriers to produces erroneous outcomes (Higham and Vincent 2021). Whilst the failures of individuals can play a central role, their behaviour is influenced and limited by their proximal environment and wider organisational processes (Vincent 2010).

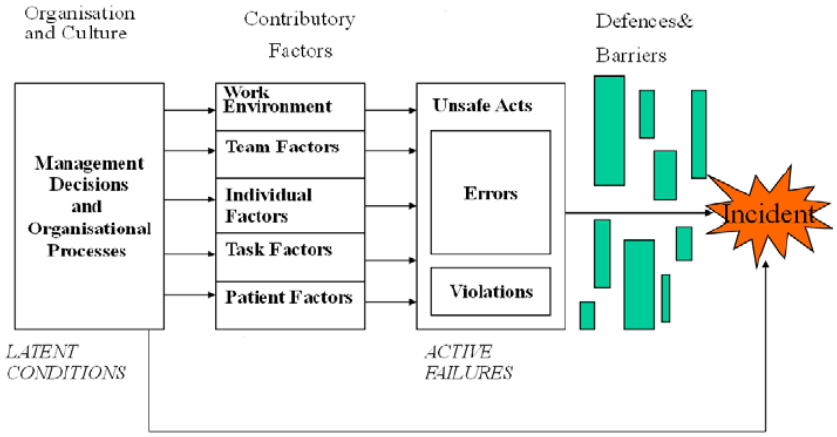


Figure 2. Reason's (1997) Organisation accident model (adapted by Vincent 2010).

On investigating an error, the first task is to identify the active failures described previously. These are the acts of omission or commission by those individuals directly at the scene. These are the actions by the pilots, nurses, or radiographers which have immediate adverse consequences: the slips, lapses of judgement, mistakes, or violations (Reason 1997; Vincent 2001; Higham and Vincent 2021).

Fundamentally, the investigator then looks back at the latent conditions in which the individuals were working. Examining the contributory factors in which the incident occurred is crucial (Vincent 2001). These latent conditions lay the foundations for incidents by creating the conditions for errors and failures to occur (Higham and Vincent 2021).

2.2.1.6. Vincent's seven levels of safety.

Charles Vincent has conducted much significant research into the causes of harm to patients. An expert in clinical risk management (Vincent 2001), the research of Vincent is concerned with understanding how healthcare can become safer (Vincent 2021). Vincent (2001) developed Reason's (1997) model to apply specifically to healthcare settings. The 'Seven levels of safety' (Vincent 2010) focused on the latent conditions and factors that can affect patient safety:

Patient factors: The patient's condition (complexity or seriousness) or behaviour has the most direct impact on the outcome. Personality, social issues, language, and any form of disability may also be important factors. Patients can be in extreme pain or suffering

from life-threatening illnesses. Effective communication of wellbeing, prognosis, and treatment are vitally important. Therefore, any factors that can impact on communication with healthcare professionals will influence the risk of error or harm (Vincent 2001; 2010).

Task factors are the characteristics of the tasks that the healthcare professional must undertake. These include features such as the number and types of technology present (and its propensity to breakdown), workflow, time pressures, level of control (autonomy), and workload (Karsh et al 2006). The design of the task, plus the availability and clarity of protocols can impact on the care process and affect the quality of care (Vincent 2010). Carayon (2009) also acknowledges that rotation between tasks, completeness of instructions, and distractions are significant safety considerations.

Individual factors: Human aspects including the knowledge, skills and experience of staff will affect their clinical practice (Vincent 2010). Healthcare professionals are often required to provide urgent responses to changing conditions in the patient. Levels of experience and therefore previous experience with a specific encounter or illness may impact on decision making and outcomes for patients (Croskerry 2009).

Team factors: Each staff member works as part of a healthcare team (or group). Safety will be influenced and constrained by team member interaction in the way that they communicate, support, and supervise each other (Vincent 2001; 2010). This can include verbal communication between different professions, the quality of written communication, and the availability of adequate supervision. In a clinical environment, healthcare professionals must share relevant clinical information and interpret patient signs and symptoms. Poor inter-disciplinary communication will affect decision making and impact on safety (Murray and Enarson 2007). Other team factors such as conflicting goals (McDonald et al 2005) and inter-group rivalry (Hewett et al 2009) are also important underlying factors in previous incidents.

Working conditions: The condition of the physical building, the actual work environment will have a major influence on the team effectiveness and efficiency. Excess light, heat, or distractions can affect the healthcare professionals' ability to function optimally (Vincent 2010).

Organisational factors: Individuals will be influenced by management actions and by decisions made at all levels in the organisation. These include policies for the use of agency staff, continuing education, training, and supervision (Vincent 2001; 2010). Management decisions will also influence the availability of the correct equipment and supplies. Organisational factors such as staffing levels and workload will impact on how the team can work. Systematic factors such as blame cultures and weak leadership (Francis 2013) will have major impacts on patient safety. Avoiding dealing with signs of failure, the inability for junior staff to challenge senior colleagues, and ignoring whistle-blowers can lead to harm (Donaldson 2021).

Finally, the organisation itself will be affected by the institutional background. Factors including financial constraints, the work of external regulatory bodies, and the broader economic and political climate are significant (Vincent 2010). Also, local laws and the demographic make-up of the community are important external factors (Karsh et al 2006).

2.2.1.7. Complexity as a cause of harm.

Healthcare settings are important examples of complex systems (Reason 2004; Vincent et al 2010; Braithwaite et al 2021). However, complexity makes humans more prone to error (WHO 2019). In the twenty years since Reason produced his organisational model, an increase in complexity has resulted in a rise in harm to patients in healthcare facilities. Therefore, a greater concern for patient safety has emerged with the evolving complexity in healthcare systems (Vincent 2010; Braithwaite et al 2021).

Vincent et al (2010) describe the similarity of healthcare to *high reliability* domains such as naval aviation and air traffic control. Within these systems, high levels of safety are required in the face of considerable operational complexity. Understanding such settings demands a comprehension of its complexity, social density, and variety (Braithwaite et al 2021). Healthcare settings are composed ‘of a set of seemingly discrete but actually interdependent components, defined not just by their inter-relations but by the permeable and shifting boundaries between them’; the components constantly change. For example, new technologies and processes are continually introduced (Braithwaite et al 2021).

Cohn et al (2013) describes a 'dynamic and constantly emerging set of processes and objects that not only interact with each other but come to be defined by those interactions'. This systemic coherence of relationships produces roles and behaviours that emerge from these interactions. The components of the system combine and interact in organised and expected ways, as well as opportunistic and unexpected ways. What follows are outcomes such as referrals, treatments, discharges, or regrettably error and death (Braithwaite et al 2021).

Therefore, humans contribute towards the complex system, the dynamic interconnections of which can result in surprising ways. Braithwaite et al (2021) suggest that these systems and the behaviours within them are inherently uncertain and unpredictable. Humans can amplify this complexity and unpredictability (Pomare et al 2018). Therefore, robust and resilient systems are required to be able to deal with this uncertainty. It is individuals, and their inherent variability, and propensity to both get things right, and to err, which provide value to these complex systems. It is the human inconsistency and dynamic adjustments to emerging conditions, that contributes to their success and failures (Braithwaite et al 2017).

2.2.1.8. Map of error.

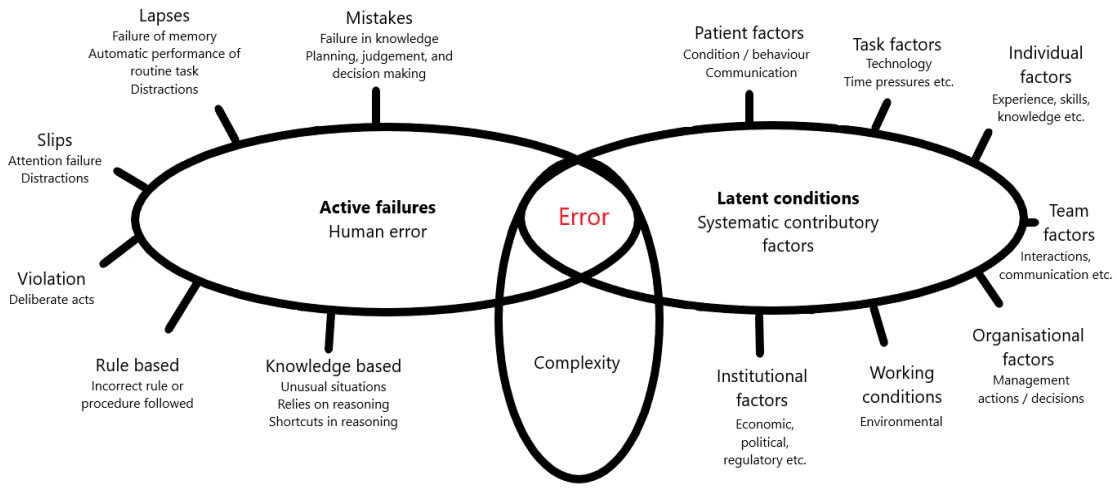


Figure 3. Map of error.

A review of the patient safety literature has provided the knowledge to plan a map of error (Figure 3). Reason's taxonomy of human errors gained from a cross-section of industries, and Vincent's focus on the latent conditions that exist in healthcare are

combined. Knowledge that an increase in complexity has resulted in an increase in patient harm has prompted the addition of complexity as a separate factor. This map illustrates the interplay of active failures and latent conditions in producing the circumstances for an error to occur. In demonstrating this systematic interaction, the map provides a detailed picture of why harm happens in healthcare organisations.

2.2.2. The importance of learning from errors.

In 2000, The Department of Health in the UK, produced the report 'An organisation with a memory: learning from adverse events in the NHS'. As the title suggests, the report focused on what can be learnt from errors. The publication contrasted learning in the NHS with other high-risk industries. It was confirmed in the report that all humans working in complex systems are subject to comparable pressures and prone to similar errors regardless of industry.

Reason (2004, 2008) later introduced the term 'error wisdom' to describe the importance of learning from errors to enhance safety within complex systems. Frontline staff were encouraged to acquire knowledge of situations that are likely to promote error. Therefore, analysing and learning from the underlying root causes of errors is important in preventing them from happening again.

Despite this interest and guidance, safety concerns still exist in healthcare (Berwick 2013). On a large scale, the Mid Staffordshire scandal may be the most notorious recent case of harm in the NHS in England (Francis 2013). The report by Berwick (2013) condensed the various accounts of Mid Staffordshire and provided the overarching goal: '…[healthcare] should continually and forever reduce patient harm by embracing wholeheartedly an ethic of learning'.

At a departmental level, in domains such as radiotherapy, the most valuable learning has also evolved from the reviews of serious harm events[5] (Graveling 2020). The publication of Towards Safer Radiotherapy (Donaldson 2008) was key to establishing a national reporting and learning system for radiotherapy. This system has enabled the quantitative analysis of error data and the sharing of generalised learning. The literature

[5] Significant errors at Beatson Oncology Centre, Glasgow (Johnston 2006) and Cookridge Hospital, Leeds (Toft 2004) prompted the publication of Towards Safer Radiotherapy.

shows a complex picture of error causation in radiotherapy; human behaviour, communication, technical issues, and poor human factors being significant factors (Graveling 2020).

However, in the years since the publication of the report there is limited evidence that safety is improving in radiotherapy (Graveling 2020). Graveling (2020) highlights the lack of qualitative data as limiting the potential for learning from similar events in other disciplines. Toft and Reynolds (2005) introduced the term *organisational isomorphism* to explain the commonality of errors across industries and disciplines. Learning from errors in sociotechnical systems is dependent upon rigorous enquiry, situational knowledge, and the culture of the organisation (Toft and Reynolds 2005). A thorough understanding of the latent issues is important to maximising learning opportunities, and therefore isomorphic learning. How to provide and share this qualitative information to compliment the vast amounts of quantitative data remains a challenge to the radiotherapy profession.

The following section will examine literature that points to the important role of affect in shaping our behaviour and interactions. In influencing the ways in which we act and relate to others, affect offers a promising line of enquiry into why errors still happen. In understanding the work of affect, the map of error (Figure 4) will be revised. The illustration of potential causes of harm will be expanded with potential sources of affect. This will provide a theoretical foundation for a study of the contribution of affective processes when things go wrong in healthcare.

2.3. What is known about Affect?

2.3.1. Affect in healthcare organisations.

The role of healthcare workers in patient safety has been neglected in terms of sustaining safety in fallible clinical systems (Taylor-Adams 2008; Long et al 2011). Whilst it is important to be mindful of the complex interplay of organisational and contextual factors in healthcare, the human aspect is fundamental. At the frontline, the maintenance of patient safety will be affected by the behaviour of individual professionals (Long et al 2011). Yet little attention is paid to the affective states that

influence healthcare professionals' responses to these factors; how they interact and react to team-members, situations, and patients.

Humans are emotional beings; and healthcare professionals do emotional work. Pain, joy, anxiety, hope, loss, and anger are dealt with daily in healthcare organisations (Heyhoe et al 2016). Croskerry et al (2010) suggest 'how [healthcare professionals] feel, their emotional or affective state, may exert a significant, unintended influence on their patients, and may compromise safety'. Therefore, affect appears ubiquitous to the emotion-saturated environment of the clinical setting. It therefore follows that knowledge of the work of affect would be of significant value to healthcare professionals.

It is useful to step back and reflect on what is at stake when healthcare professionals are confronted with the often unusual or uncertainty of daily work. Patients arrive at the unfamiliar and often fearful scene of the clinical setting with varying levels of expectations and emotions. Yet it is accepted that the healthcare provider will deliver a service that is timely and professional. It is also expected that the optimal decision will be made concerning the patients care taking account of factors such as the level of urgency, skills, and knowledge of the provider, and the resources at their disposal. Baumann and Kuhl (2002) highlight that every day individuals will solve problems and come to decisions. Some days this will be done almost intuitively without being able to explain the way that we got there; an individual *knows* without any use of conscious reasoning (Kump 2021). However, at other times decisions will be made that demand more analytical strategies that rely on explicit step-by-step knowledge. The distinction between these processes that occur daily in healthcare will now be explored.

Higher-level cognitive processes exist such as interpretation, judgement, decision making, and reasoning[6] (Blanchett and Richards 2010). Collectively, they are tools used

[6] Interpretation is the 'process through which one meaning is extracted from ambiguous information in order to construct a mental representation.' Resolution of ambiguity is integral to our everyday interactions with the world. Judgement describes the 'process by which individuals consider and evaluate evidence and estimate the likelihood of occurrence of different outcomes.' These estimates being the key ingredients of decision making. Decision making explains how individuals 'chose one out of several options, with a particular focus on how individuals select or avoid options that carry different levels of risk.' (Blanchett and Richards

to help navigate the complex world, anticipate the future, and make choices about potential actions. Historically, the principal view in medicine and healthcare in general is that clinical decision-making should be objective and free from contextual affective issues (Croskerry et al 2008). The focus on decision making research has been rational, cognitive processing where potential alternatives are exhaustively weighed up (Slovic et al 2007; Västfjäll and Slovic 2013). It is difficult to be objective and rational if emotion enters the reasoning process. Healthcare experts would consider it a professional virtue to rise above the emotion of a situation and deliver unequivocal analytical judgements. However, affect intrudes into almost every decision we make (Croskerry et al 2008). Therefore, the importance of affect in these processes has become increasingly recognised (Slovic et al 2007; Västfjäll et al 2016).

Evidence has developed that decision making occurs via a combination of two separate systems (Croskerry 2005; Croskerry et al 2008). Taken from the fields of psychology, affect is considered an integral part of what has become known as 'dual process theories' of thinking. This process describes the interaction between affective experiential systems (labelled system one: fast thinking) and deliberative systems (system two: slow thinking) (Slovic et al 2007; Kahneman, 2011). Thus, individuals capture the world in two separate ways: the first is fast, intuitive, automatic, natural, nonverbal, narrative and experiential. A feature of this experiential system is its affective foundation and the need for fewer resources to prompt a decision. The second system is more conscious, analytical, slow, deliberative, verbal, and rational (Epstein 1994; Minda 2015). This system is affect-free and resource intensive (Croskerry 2005; Croskerry et al 2008). Therefore, the reliance on affect is a quicker, easier, and efficient way of navigating complex uncertain situations. The experiential system is linked with the experience of affect, the subtle feelings that people are often unaware of (Epstein 1994). Therefore, our first response to any situation is often an affective one. This can also influence the future direction of our relations with others. We tend to stick to our first impressions and therefore the importance of affect in decision making appears

2010). 'Decisions ... are often reached by focusing on reasons that justify the selection of one option over another.' (Shafir et al 1993). Reasoning defines the 'process by which participants use the information available to them to draw [conclusions].' (Blanchett and Richards 2010).

undeniable. Importantly, most errors of judgement occur in system one where affect predominates (Croskerry et al 2008).

Recent technological advancements and normative changes have led healthcare organisations to be aware of the need to manage risks in these increasingly complex environments. Risk management is crucial as it addresses the risks that may impact on patients and staff at work. Effective risk management relies on all healthcare professionals being aware of and acting on risks that can occur in the workplace. Risks in healthcare are determined by factors relating to the system, the environment, and the interplay of individuals within (Cagliano et al 2011). One area of decision making that appears entangled with affect is the realm of risk perception and judgement (Slovic and Peters 2006; Skagerlund et al 2020). A similar dual process approach to risk appears to be enacted. That is, on one hand a 'risk-as-feelings' exists which are automatic intuitive reactions to adverse events or danger which demand an immediate response. Also, a 'risk-as-analysis' occurs, where judgements on risk are logically reasoned and deliberated. Human evaluation of risk is therefore driven by affect where individuals exploit an affect heuristic. People make judgements on objects or events that are marked with valenced affect; we save time and effort by consulting the affective impression of which something is tagged.

Therefore, in system one, heuristics and biases also occur (Croskerry et al 2008). A potential challenge to the thinking process is the tendency for humans to rely on heuristics and to show biases when making decisions. A heuristic is generally defined as a cognitive shortcut. When people use heuristics, they are relying on prior knowledge to solve a problem or arrive at a solution, rather than a more active thought process (Minda 2015). The affective heuristic is a mental shortcut that may substantially shape judgement and decision making (Croskerry et al 2008). Choosing something you like or find intuitively pleasing is easy and requires little mental effort. The affect heuristic allows us to make decisions based on our gut feelings (system one) rather than using system two rational judgement (Minda 2015). Croskerry et al (2008) suggest that this affect heuristic may provoke affective responses from healthcare professionals towards patients. Sometimes these responses are positive, but other times may be negative and lead to a compromise in safety. Patients can be labelled negatively as difficult,

complainers, or high maintenance. This labelling not only influences the healthcare professionals' thinking but can also compromise decision making.

Croskerry et al (2008) also describe how daily interactions with others are influenced by conscious and unconscious social transference and countertransference[7] phenomena. These occurrences are affectively polarised from the subtle to the substantial. Negative or positive exchanges with patients are dependent on previous experiences. A related process is fundamental attribution error, where patients can be judged negatively on dispositional qualities such as obesity. In calling for a greater awareness of the work of affect in clinical situations, Croskerry et al (2008) recognised the influence of the immediate environment or work conditions. Lastly, safety can be reliant on endogenous (internal) affective states, so called because they occur due to our own streams of thought or recalled memories. Such endogenous states elicit responses that strongly resemble emotional responses to external stimuli (Engen and Singer 2015; Holmes and Mathews 2005). The generation of such states play an important role in emotional regulation (Speer and Delgado 2017).

[7] Transference is the unconscious transfer of feelings and attitudes from a person (e.g., a patient) in the past to a person (e.g., a Radiographer) in the present. That is, a patient may unwittingly project a previously experienced relationship (e.g., from a parent) onto a person in the present (e.g., a Radiographer). Transference can increase in vulnerable people that are anxious about their physical or psychological safety. Any setting where an individual has his or her needs attended to promotes transference. Countertransference is the response elicited in the recipient (e.g., Radiographer) by the other's transference (Zinn 1990; Hughes and Kerr 2020).

2.3.1.1. Map of error updated with sources of affect.

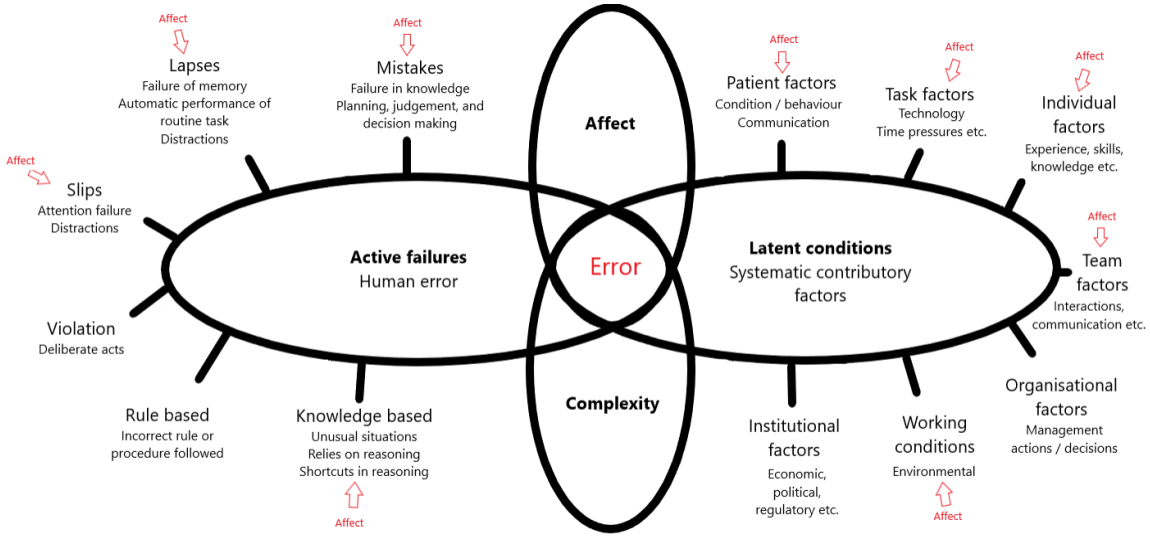


Figure 4. Map of error with potential sources of affect.

The map of error (Figure 3.) has been updated with potential sources of affect found in the healthcare literature (Figure 4.). This illustration substantiates Croskerry et al (2008) in evidencing that affect could influence decision making and patient interactions, and therefore patient safety. For Croskerry et al (2008) there was a growing imperative to understand and integrate such knowledge into clinical training.

Despite these calls to investigate the impact of affect and emotion in healthcare providers on patient safety, there is little evidence that the issue has been addressed (Heyhoe et al 2016; Isbell et al 2020). Research on affect and emotions in healthcare remains overlooked. There is a reluctance to let go of the traditional view of health professionals employing cold, rational, cognitive processes when making clinical decisions (Kozlowski et al 2017). Although several significant publications have brought attention to the impact of emotion (Croskerry et al 2010; Heyhoe et al 2016; Kozlowski et al 2017) and the centrality of affect in patient safety (Iedema et al 2009) little research has focused on the affective triggers that can provoke such emotion.

The review conducted by Kozlowski et al (2017) demonstrates that the published research on the work of affect and emotion in healthcare remains limited (Isbell et al 2020). Therefore, the next sections will examine what can be learnt from studies of the broader affective turn in the social sciences and from affect within contemporary organisational studies. Pertinent literature will be scrutinized to complement the

healthcare research on affect. This will be used to provide a background of what could be happening affectively when an error occurs.

2.3.2. The history of affect theory.

The concept of affect was first introduced in the seventeenth century by the Dutch philosopher Baruch Spinoza in terms of the body's capacity to affect and be affected (Gregg and Seigworth 2010; Leys 2011; Massumi 2015). As Gregg and Seigworth (2010) define:

> Affect arises in the midst of *inbetween-ness*: in the capacities to act and be acted upon. …affect is found in those intensities that pass body to body (human, nonhuman, part-body, and otherwise), in those resonances that circulate about, between, and sometimes stick to bodies and worlds, *and* in the very passages or variations between these intensities and resonances themselves. Affect, …, is the name we give to those forces—visceral forces beneath, alongside, or generally *other than* conscious knowing, vital forces insisting beyond emotion—that can serve to drive us toward movement, toward thought and extension, …

Affect has become a flourishing subject of interest in areas as diverse as organisational studies, cultural studies, psychoanalysis, sociology, politics, and literary studies (Fotaki et al 2016; Houen 2020). Wetherell (2015) reflects on the recent attention to 'the ways in which bodies are pushed and pulled in contemporary social formations, in the 'engineering' of affective responses, and in how workers and citizens become emotionally engaged and affectively interpellated'. Following years of neglect, academic theorists and critics invited a *turn to affect* in response to what were seen as the limitations of post-structuralism[8] and deconstruction[9] (Clough 2008; Earlie 2017).

Two publications in the mid-1990's were widely reputed to have influenced this affective turn: Sedgwick and Frank's 'Shame in the Cybernetic Fold' and Massumi's 'The Autonomy of Affect' (Leys 2011; Houen 2020). The work of Sedgwick and Frank considered the importance of psychologist Silvan Tomkins' opus on affect. American

[8] Post-structuralism is a movement that aligns ideology and thought with language, signification, and semiotics. Post-structuralism is a group of theories that claims that we are incapable of confronting or contesting the views of ideologies that we form. In contrast, Spinoza had affirmed that we contest such views using reason, imagination, and intuition (Belsey 2002; Gatens 2014).

[9] Derrida's concept of deconstruction which denoted a critical reading or analysis of text to uncover its true meaning or signification (Earlie 2017).

psychologist Tomkins' theory was founded in a framework of basic or innate emotions. Massumi's affects as non-linguistic bodily intensities were derived mostly from Deleuze and Guattari's reading of Spinoza's *Ethics*.

Despite their contrasting roots of inspiration, both accounts have advanced affect as a form of *bodily* feeling that is separate from emotion, cognition[10], and language (Leys 2011; Houen 2020). Emotion refers to the nameable dimensions of feeling; the impulses and sentiments of which individuals can consciously identify (Damasio 2003). Affect, by contrast, exceeds these 'feelings' and refers to the impulses and sentiments that have yet to be recognised as impacting the individual. This distinction is important in that it recognises the nature of feeling that is internal and prepersonal (individuals may be moved through means that are out of their control). Some phenomena may register as emotions; other phenomena such as imitation or contagion remain 'in the background' or 'behind the scenes' as incomprehensible influences that 'affect' our bodies, conduct, and experience (Iedema and Carroll 2015).

Likewise, Gregg and Seigworth (2010) demonstrate the importance of Tomkins, Sedgwick, Deleuze and Guattari, and Massumi in the evolution of affect theory. However, whilst the aforementioned theorists (alongside others such as Thrift, Brennan, and Clough) focus on affect as an outside stimulation, hitting the body first prior to reaching the cognitive apparatus, a contradictory school of contemporary scholars rose to prominence (Knudsen and Stage 2015). According to Knudsen and Stage (2015) this group, 'consisting of [Sara] Ahmed …, Ruth Leys, Margaret Wetherell, Judith Butler, and Lisa Blackman, criticize the inherent dichotomies of mind and matter, body and cognition, biology and culture, the physical and psychological'.

Thus, the affective turn has prompted both excited optimism as well as sceptical critique (Kristensen 2016). Whilst for authors such as Cvetkovich (2012) for whom a long history of an interest in affect within feminism has explained a reluctance to use the expression 'affective turn', for others there has been heated debate. Kristensen (2016) explains how the disputes reflect classical philosophical debate in terms relevant to affect theory:

[10] In simple terms, cognition refers to the mental processes involved in acquiring knowledge and comprehension. Cognitive processes include thinking, knowing, remembering, judging, and problem-solving (Cherry 2020).

between cognitive judgement (mind) and affective corporeal existence (body). Gibbs (2010) expands on the debate:

> Beyond these two major affect theories [of Spinoza and Tomkins], there is widespread disagreement both between and within the various disciplines that claim a stake in affect— psychology, the neurosciences, biology, sociology, cultural studies, anthropology, and so forth—about whether to conceive of affect as innate or socially constructed, how to formulate its relationship with cognition, emotion, and feeling, and what these sorts of decisions might entail theoretically and politically.

The key concern of whether affects are autonomous from cognitive appraisal will have important implications on this research in the role of affect as an antecedent to human error. Authors such as Ahmed (2004, 2007, 2014) have strived to go beyond the ontological dichotomy of affect and cognition. Fundamental to this research will be the argument succinctly notated by Kristensen (2016) that '…primacy of affect over cognition leads to affective determinism in which affects prime human judgements without much scope for the intellect to intervene in the course of forming judgements and deciding upon action'.

In the following section, a study of literature pertinent to affect will commence with an exploration of the work of Spinoza. These writings proved fundamental to the foundations of contemporary theories of affect (Burnett and Merchant 2020). Following Spinoza, the influence of Deleuze and Guattari, Massumi, Tomkins, Sedgewick and Frank, and Ahmed on affect theory will be outlined (Clough and Halley 2007; Seigworth and Gregg 2010; Houen 2020). The review will conclude with literature concerning affect within discourse and materialism, affect as contagious, affect within the group, affective states, and affect in organisational studies.

2.3.2.1. Spinoza.

The accounts of Spinoza are seen as a crucial foundation for the affective turn (Colebrook 2020). Spinoza's style of writing, described as the 'geometric method' is composed by propositions, proofs, and axioms. The importance of Spinoza is in part because of his critique of Descartes' substance dualism (Robinson 2020). Gatens (2014) describes Spinoza's ontology as a dual aspect monism where every bodily thing (affect) has a corresponding idea in thought. For Spinoza, 'thought and extension [embodiment]

are not separate substances but aspects of one underlying substance'. There is no dualism or split between mind and body; they are two attributes of the same substance that are always correlated and are seen as thoroughly fused with each other (Spinoza 2001 (1677); Cook 2008; Robinson and Kutner 2019; Houen 2020; Robinson 2020).

Protevi (2020) asserts that in order to understand affect in the philosophy of Spinoza we must first comprehend his metaphysics:

> … "God or Nature" is a single, self-caused, necessarily existing substance. Every finite thing is an expression of God / nature, a modification or mode or way that God / nature is. There are two attributes of God / nature to which we have access – that compose our being – extension and thought: our body is a finite mode, and so is our mind. Each state of our body has a parallel state of our mind, and each state is produced by chains of efficient causes such that there are laws of physics and psychology that in principle explain our physical and mental states: "there is no affection of the body of which we cannot form a clear and distinct conception".

Murphie (2020) clarifies this by explaining that there is only one substance (God, all of nature, or the world in general). That is, everything that exists is simply a variation of this substance. There are infinite possibilities of this substance of which two are mind and embodiment. There are also infinite modes in which substance expresses itself. Substance then, is all that cannot be divided, and which comprises all which can be divided (Robinson and Kutner 2019). The immanence of substance is central to Spinoza's ontological monism and diverges away from Cartesian concepts of dual substances: that of mind and body. Spinoza used the concept of mode to describe manifestations of substance-as-thought and substance-as-extension. Thought and extension (that is, matter) being the only two aspects of substance that the human intellect can comprehend. In summary, Robinson and Kutner (2019) describe the 'physical body [as] a mode of extension, the *idea* of the physical body is a mode of thought, and these two modes are united as the same substance under different attributes'.

Turning to affect, Spinoza (2001 (1677)) defined the concept of affect (Latin *affectus*) in terms of power and capacity as the body's desire, and the ability to affect and be affected by other bodies:

> By affect I understand affections of the body by which the body's power of acting is increased or diminished, aided or restrained, and at the same time, the ideas of these affections.

Therefore, an ethical dimension infused a view of affect as 'enabling someone to act'. Spinoza establishes that there are only three basic affects: joy, sadness, and desire, from which all emotions are derived (just as all colours are produced by mixing primary colours (Uhlmann 2020)). These affects can be conjoined with certain ideas and with each other to form a near endless inventory of further emotions (Cook 2008). For example, the emotion of love is joy combined with the idea of an external cause; the emotion of hatred is sadness combined in a similar vein. In distinguishing between positive and negative affects using the terms joyful and sad, Spinoza acknowledged their overlaps and inconsistencies as well as their dynamic and imperfect nature (Pullen et al 2017). For Spinoza, sad affects can also give rise to joyful affects.

To understand desire, we must comprehend 'conatus'. Conatus is the endeavour to remain in existence that all things have at its essence; it is an expression of God / nature's power to be and to act (Uhlmann 2020). Every individual's conatic essence or nature is to persevere in being (that is, survive), seek pleasurable things, and avoid painful ones. The more an individual succeeds in this endeavour, the more power is manifest and the more he is endowed with virtue. Thus, claims of conatus and power, pleasure and pain, good and bad, form the foundations of Spinoza's ethical views (Cook 2008).

For Spinoza, our affects are fully expressions of nature's power (Protevi 2020). The mind is the active conceptual comprehension of the processes and patterns of such within the body. On encountering a body, our body is changed, and our mind grasps that change. Affects are the changes in bodily composition from encounters with other bodies (being affected) by which our power of acting is increased or decreased, alongside the awareness of that change. When our power is increased or when our being is augmented, we are affected with joy or uplift which leads us towards true knowledge. Conversely, when our power is decreased or when our being is diminished, we are affected with sadness or downfall which leads us away from true knowledge (Robinson and Kutner 2019; Uhlmann 2020).

Spinoza (2001 (1677)) also teaches us that affects can be active and passive. When we are the 'adequate cause' of an event we are said to be active; an event is caused through our own nature or power of acting, and our understanding thereof. Passivity refers to something that happens in us of which we are the 'partial cause'. A passive affect occurs when an encounter with others causes a change in our body. Spinoza writes poignantly about freedom and the power of the human mind to control and repress the emotions (Protevi 2020). Passive emotions can be converted into active forms by gaining adequate ideas or understanding of them. If we can untangle the cause of a passive emotion of changing body following an encounter, we can disentangle what our nature creates from that encountered thing.

When we understand that the emotion that we emitted was necessary due to our nature's encounter with the nature of the thing, then we have increased our mind's power. The more we comprehend this nature from reflecting on our actions in a diverse range of situations (our causal history), the more powerful our mind becomes. Gatens (2014) describes affect as associationist because affects are caused, even when we are oblivious to the cause, 'which often involve devious lines of causation'. These devious lines of causation which influence our action and limit our freedom are deeply rooted in our social formations, and the associations and biases that accompany them.

2.3.2.2. Deleuze and Guattari.

Gilles Deleuze is described as one of the most influential and prolific philosophers of the second half of the twentieth century (Dosse 2011; Smith and Protevi 2018). Beginning his career in the rigorous intellectual environment of 1940s Paris, Deleuze early influences included Nietzsche, Bergson, and Heidegger (Fox 2012). Deleuze produced many important works in solo and in collaboration with others such as the psychoanalyst Felix Guattari (Deleuze and Guattari 1987). The intellectual partnership of Deleuze and Guattari was established after the May 1968 Paris revolt by students and workers. Guattari had been a psychoanalyst under Lacan during the 1960s. However, his rejection of Lacan's theoretical mix of Freud and Saussure in favour of a Freudian-Marxist blend provided the basis of his association with Deleuze (Fox 2012).

Deleuze and Guattari revived the importance of Spinoza's *Ethics*, outlining a detailed biography and offering a comprehensive understanding of this text. In its most simple

terms, 'affect' is what happens to us when we feel an event. Fear, depression, or laughter are all possible affects; affect is the response to an experience (Colebrook 2002). This is developed by Deleuze and Guattari, for whom 'affect' refers to changes in bodily capacity (Hickey-Moody 2013). Alongside Guattari, Deleuze applied Spinoza's focus on body relations and its capacities to affect and be affected (Kristensen 2016). The key question followed: what can a body *do*? For Deleuze and Guattari, the body does what it does because of the interaction of two factors:

The first is the inward and outward relation that a body has with its physical and social context. This concerns the connections between body, self, and the social world; the body's capacities (or potential) to engage with the world around it (Fox 2012). Fox (2012) explains: 'Intrinsic to Deleuze and Guattari's position is the recognition of the link between body, subjectivity and culture. Bodies' physical, psychological and cultural relations, and their capacity to affect and be affected by these relations, are the substrate for embodiment and identity…'. Our subjectivity (that is, our own individual morals, feelings, or behaviours) is the result of the embodied accumulation of our actions, with every human mind being as different as its body. Thus, in following Spinoza's body as an extension of substance (thought and extension), we can see that human bodies (and minds) are continuously reshaping themselves through their ideas and actions: the relations, interests, and environments by which they live (Hickey-Moody 2013). Hickey-Moody (2013) presents an example to demonstrate these changes in the body:

> …a car screeches to a halt, narrowly missing a woman pushing a pram. The busy intersection stops. The woman screams and her hands shake. The composition of her body has changed – as she responds to stress, her body reacts. The mental image of the near accident impacts not only her physical form, but her imagining of the intersection at which the near miss occurred. The place is changed in her embodied mind. She approaches it differently.

Therefore, the visceral nature of affect lives on beyond the events in which we first experienced them; it leaves a residue on our life (Michels and Steyaert 2017). The body remembers them, and there are times when individuals or experiences take you back to a previous encounter (Pullen et al 2017). As Deleuze and Guattari suggest, 'the person

who experiences the force produced by an affect can retain this force and be changed as a result of their experience' (Hickey-Moody 2013).

The second factor is the active, experimenting, engaged and engaging body, with its ability to form new relations and its motivation to do so. This contrast with a deterministic biological or social theory which suggests that the body is 'written' by its genes or culture with little scope for originality (Fox 2012). We know from our own experiences that humans do not necessarily respond like computers to stimuli. Instead, we respond in complex and sometimes unpredictable ways that implies an active, motivated engagement with living, and the ability to make choices and actions based on the world around us (Fox 2012). What develops is a 'kind of chaotic network of habitual and non-habitual connections, always in flux, always reassembling in different ways' (Potts 2004).

Deleuze (2003) and Deleuze and Guattari (1987, 1994) describe the outcome of these bodily relations and motivations as *assemblages*. An assemblage is a *becoming*, the fluid coming together of human and non-human phenomena. A body[11] or thing is the result of a process of connections and interactions. A human body is an assemblage of genetic material, ideas, powers of acting, and a relation to other bodies, the effect of the genetic, social, and historical. A group is an assemblage of bodies; the makeup of any assemblage is created by its relationships. Therefore, for Deleuze and Guattari, the history of politics is the history of affects. Primitive cultures experienced affects collectively; a common affect united or assembled a group of bodies (Colebrook 2002). As all life is a plane of becoming, it follows that affects are also becomings (Uhlmann 2020). Affects are always in process, changing, and transforming (Coleman and Ringrose 2013).

Deleuze and Guattari (1987) describe the body that emerges from this union of relations and creative potential as the 'body-without-organs'; the limit of what a body can do. According to Deleuze, a body is distinguished not by 'its organs and functions' or 'species or genus' but by the affects of which it is capable of (Uhlmann 2020). Affects define

[11] The body, it is important to note, is not necessarily human; it is a degree of power held within an *assemblage* (Hickey-Moody 2013)

what a body can do; the more an individual is capable of being affected, the more powerful that individual is (with humans capable of being affected in many ways). Therefore, affects extend or decrease the limits of what a body (an assemblage) can do. An affect expresses an increase or decrease in a body's capacity to act (Hickey-Moody 2013).

Deleuze also held a particular interest in the latter parts of Spinoza's *Ethics*, with an emphasis on the concept of individual modes. Each of us, as modes, have an *intensity* (or measurable degree of power) that makes us what we are and distinguishes us from all other things. The term intensity for Deleuze, was identified not with affect but with the modes (individuated entities), yet the two concepts are connected. This can be explained though the infinite shades (or intensity) of colour (Uhlmann 2020) or differences in language (May 2003). Deleuze and Guattari (1987) develop this further by describing how the intensities that affect an individual then, are other modes (other individuals). Affects are therefore defined as that which registers a shift in power (Uhlmann 2020). For Cole (2009) affect appears as a connective element that takes ideas and points of intensity and makes them open to reabsorption and usage in different ways. Deleuze and Guattari (1987) explain:

> …intensity is that which allows the mode to be distinguished from other modes; further, the mode is affected by intensities (other modes) and these affects mark the shifts in power of the mode as it is affected. These affects in turn are registered as various mixtures of joy (which involve the sense of our power increasing) and sadness (which involve the sense of our power decreasing).

In engaging with Spinoza, Deleuze (2007) noted that the '…power of being affected is really an intensity or threshold of intensity'. Sad affects can pass into those that are joyful and vice versa. It is the passing between sad and joyful affects, which affects us so much that we are overwhelmed, so little that we are under-stimulated, or so much that our capacity to affect others is enhanced. We are moved by routine encounters that generate affective experiences in our bodies. Experiences that live on in our flesh, layered as new events unfold that remind the body how it feels to feel. These everyday events register in a shift of affects, and they recur and spiral with intensity; they build momentum (Pullen et al 2017).

That Deleuze and Guattari claimed that all acts of criticism are first or foremost acts of creation (Mackenzie 1997), it is important to note that the collaborations of the two have prompted several critiques. Theories of bodily experience leave contemporary critical theorists with a choice of Tomkins' pragmatism or the imaginative flights of Deleuze (Hemmings 2005). Hallward (2006) dismisses Deleuze's assertion that *being* is necessarily creative and always changing. For Hallward, this offers no understanding to the actual conditions of existence and provides only a philosophy that is 'other-worldly'. For Rée (1995), Deleuze and Guattari's post-structuralist work (1994) on subjectivity was doing 'philosophy for philosophy's sake'. Žižek (2004) also criticises Deleuze's theory of subjectivity. In reducing the subject to 'just another' substance, Deleuze misses the 'nothingness, a void that exists' of which Lacan used to define subjectivity.

2.3.2.3. Massumi.

Brian Massumi is a contemporary political theorist and professor of communication at the University of Montreal. Responsible for promoting the widespread use of Deleuzean philosophy, Massumi is credited as being one of the founders of the affective turn in the mid-1990s (Gregg and Seigworth 2010; Houen 2020; Ritchie 2021). For Massumi, the turn to affect was about 'opening the body to its indeterminacy', the uncertainty and precariousness of its autonomic responses (Clough 2008). Massumi also had a fascination with the political. For Massumi, in so far that politics is a feature of everyday life, affect and politics interact, overlap, and fold in an out of each other. Change is what is central to affect, and this is what makes it immediately political. This is reflected in Spinoza's expression as it includes an active (to affect) and receptive (to be affected) agent (Kluitenberg 2015). Massumi (2015) explains: 'To affect and be affected is to be open to the world, to be active in it and be patient for its return activity. This openness is also taken as primary. It is the cutting edge of change. It is through it that things-in-the-making cut their transformational teeth.'

Massumi refers to the theories of Spinoza, Deleuze and Guattari in a strategic way to situate his arguments. However, it is evident that he develops quite distinct views that are incompatible with the stances of his predecessors (Uhlmann 2020). A considerable gap appears between Massumi's concept of affect and the definitions presented by Spinoza and Deleuze. What develops under Massumi is a distinct dichotomy between

cognitive judgement and affects (Kristensen 2016). Massumi defines affect in terms of bodily responses, autonomic responses which are in excess of conscious states of perception or meaning (Hemmings 2006; Clough 2008). Massumi proceeds to think of affect in terms of the virtual and unliveable. It is this participation in the virtual that gives affect its autonomy; affect escapes from the thing that embodies it.

Whilst the terminology used is familiar, the meanings often differ. For example, Massumi (1995) is explicit in equating the term intensity with affect. However, this concept of affect (or intensity) is distinct from that of Spinoza, Deleuze and Guattari. For Massumi, intensity is disconnected from consciousness or meaning. This is irreconcilable with the concepts outlined by Spinoza, Deleuze, and Guattari for whom affects are immediately meaningful (Uhlmann 2020). Massumi (2002) adds clarity to this use of affect as intensity. Affect indicates the non-conscious and unnamed, but nevertheless registered experiences of energy and intensity that arise in response to stimuli impinging on the body. Thus, affect is a bodily response to a stimulus before they are cognitively processed and consciously registered (Kluitenberg 2015). Cognitive processing is not instantaneous – a lapse in time occurs between the stimulus and it conscious register. Massumi referred to Libet's (1985) experiments which concluded that this lapse could take an average of 0.5 seconds. That we do not register 'Libet's lag' is because we are constantly occupied in a continuous flow of stimuli and therefore do not register any delay. Massumi (2002) explained what happens in 'the missing half second': 'the half second is missed not because it is empty, but because it is overfull, in excess of the actually-performed action and of its ascribed meaning.'

Thus, the half second is not void, but over-filled with sensation and content that has not yet assigned any conscious register. It is the moment before raw feeling is converted to objective fact through the application of language, be it verbal or visual. Connections between previously unrelated experiences, thoughts, and impressions are formed at the very threshold of consciousness. An interesting discovery has been that while the cognitive system requires this half a second of processing time, the body responds in half this time. This implies that affect moves at approximately twice the speed of consciousness. Clearly, this puts consciousness on an unstable and unequal footing with

affect (Kluitenberg 2015). This point will be of interest to this research which explores the role of affect as an antecedent for erroneous actions.

Massumi's focus on affect as an outside stimulation, in some way hitting the body first before reaching the cognitive apparatus was also inspired by Stern[12] (Knudsen and Stage 2015). For Massumi (1995), 'Intensity [or affect] is embodied in purely autonomic reactions most directly manifested in the skin – at the surface of the body, at its interface with things'. This is developed further as 'intensity is [...] a nonconscious, never-to-conscious autonomic [virtual] remainder'… 'It is outside expectation [beliefs that occurrences may take place in the future] and adaption [the ability to adjust to new information], as disconnected from meaningful sequencing, from narration, as it is from vital function'. Therefore, affect takes place below and before human cognition, and thus escapes the 'speaking subject'. Affect attends to the organisation of bodies through the transmission of forces or intensities that move across them (Clough 2010).

In echoing the sentiments of Spinoza, Massumi (1988) defined affect as 'a pre-personal intensity corresponding to the passage from one experiential state of the body to another'. Consequently, it is through changes in what we experience that we are affected. Affects are infused with forces of desire and power to the extent that they shape and are shaped by social processes. Passing between bodies at varying speed, duration, and intensity, affects influence how we live and work. Affects are invested in institutional and ideological constructs, as well as the political acts that challenge them. Conversely it could be argued that monotonous work can desensitise us and leave us unaffected. The intensities of affect are therefore amplified through the pressures, constraints, and boundaries that increase or reduce what bodies can do (Pullen et al 2017).

In addition to a theory of affect as autonomous from cognition, a philosophy is developed that is contingent upon a distinction between affect and emotion (Uhlmann 2020). Massumi (1995) dismisses the erroneous use of affect as a synonym for emotion.

[12] Massumi was inspired by Stern's (1985) distinction between categorical and vitality affects (Knudsen and Stage 2015). Originally conceptualized by Darwin, the categorical affects are affects of content (e.g., happiness, sadness, fear, anger, disgust, surprise, interest, shame, and the combinations thereof). The vitality affects refer to the vital processes of the body which occur at the moment of emotional activation.

For Massumi (1995), 'It is crucial to theorize the difference between affect and emotion'. It is argued that '…emotion and affect … follow different logics and pertain to different orders.' Robinson (2020) clarifies that '… affect is raw intensity, and emotion is affect taken up into consciousness, language, culture: emotion is affect given shape and meaning'. Massumi (1995) asserts that affect is unqualified; it is neither ownable nor recognisable:

> An emotion is a subjective content, the socio-linguistic fixing of the quality of an experience which is from that point onward defined as personal. Emotion is qualified intensity, the conventional, consensual point of insertion of intensity into semantically and semiotically[13] formed progressions, into narrativisable action-reaction circuits, into function and meaning. It is intensity owned and recognised.

Emotions stands in dialogue with agency (the human capability to influence one's functioning and the course of events by one's actions (Bandura 2006)), belief, or self-narration. Whereas affect conjures a 'neglected realm of inarticulate sensations' (Uhlig 2020). For Massumi (2002), affect is 'unformed and unstructured' with emotion being the verbal or written register of the experience through its supposed 'function and meaning'.

Massumian theory of affect has been strongly criticised, both in terms of its relation to the work of Spinoza, and from its relation to scientific theory (Hemmings, 2006; Leys, 2011; Blackman, 2012; Uhlmann 2020). Gatens (2014) takes issue with Massumi's interpretation that bodily affect is autonomous from thought, and therefore separate from meaning and signification. Gatens argues that this misreading of Spinoza introduces a body/mind dualism that Spinoza was keen to avoid. Hemmings (2006) laments a misreading of Deleuze and rejects the fascination of affect as outside social meaning. Hemmings argues that 'affect might in fact be valuable precisely to the extent

[13] Semantics is the study of the meaning and reference of linguistic expressions (language), while semiotics is the general study of signs of all kinds and in all their aspects. Semiotics comprises semantics as a part. (Føllesdal D. 1997) Semiotics is the study of sign processes (semiosis), which are any activity, conduct, or process that involves signs, where a sign is defined as anything that communicates a meaning that is not the sign itself to the sign's interpreter. The meaning can be intentional such as a word uttered with a specific meaning, or unintentional, such as a symptom being a sign of a particular medical condition. Signs can communicate through any of the senses, visual, auditory, tactile, olfactory, or gustatory.

that it is not autonomous'. Leys (2011) and Hemmings (2006) are united in concern that the positions' decoupling of the affective autonomy responses of the body which places it outside the reach of reflection and interpretation. Pullen et al (2017) argue that affect as virtual and incorporeal is disconnected from actual lives. Affect is reduced to undifferentiated, latent, and disembodied tendencies of which have little bearing on the lived range of human experience.

Massumi has been criticised for offering little beyond contemporary neuroscience and psychology than offering vague and abstract speculation (Pullen et al 2017). Leys (2011) also disputes Massumi's use of science in the distinction between affects and emotions, with his psychological underpinnings described as 'flimsy'.

Wetherell (2014) articulates her criticism fervently:

> …versions of 'affect theory' that posit affect as a pre-personal extra-discursive force hitting and shaping bodies prior to sense making are simply unsustainable... It has been seriously unhelpful to posit a generic category of autonomous affect (applied to relations between all bodies human and non-human). Human affect and emotion are distinctive because of their immediate entanglement with very particular human capacities for making meaning. These entanglements organize the moment of embodied change and are crucial to the ways in which affect articulates and travels. They need to be centre stage in any social theory of affect and emotion.

The assertion that meaning-making and embodied affect separate chronologically (with affect first), dividing into different 'tracks', would be seen by many affective scientists as implausible (Leys 2011; Wetherell 2013). For Wetherell (2015), '…the presentation of affect as something pre-conscious, to do with just bodies and events, makes little social psychological sense. It is also a methodological nightmare and creates some formidable and unnecessary blocks for empirical research'.

2.3.2.4. Tomkins.

Silvan Tomkins was an American 'grand theorist' born to Russian Jewish parents that had emigrated from Eastern Europe prior to the first world war. Tomkins' analysis of the role of affect in human experience, and his theories of the positive and negative affects opened a new path of study in the field (Alexander 1992; Smith 1995). Central to Tomkins' concern for understanding human motivation was the question: 'What do

human beings really want?' (Demos 1995). What follows is a theory where affect is considered as critical to motivation and is central to cultural meanings and values. We all endure a quest to maximise positive affect and minimise affect of a negative valence.

His magnum opus, *Affect, Imagery, Consciousness* appeared in four volumes (1962, 1963, 1991, and posthumously in 1992) and demonstrated his novel conceptions which departed from his Freudian routes (Smith 1995). Tomkins also went beyond the traditions of Darwin to construct a comprehensive theory of the biological basis of affects (Demos 1995). Tomkins was also interested in the relationship between affects and personality formation. His work deeply influenced the conceptual foundations of others such as the use of facial affect developed by Paul Ekman[14] and Carroll Izard in the 1970s and 80s (Demos 1995).

Tomkins (1962) was the first to establish a separation of affect from its confounding with Freudian drives[15] and cognition (e.g., perception and memory). Tomkins argued that affect comprises of one of the five distinct basic systems of human function with: homeostasis[16], drive, cognition, and motor (movement) systems. He provided descriptions of each system and argued that each had evolved to be able to function independently, interdependently, and dependently with each other (Demos 1995). The dynamic union of affect and cognition is fluid, and dependent upon the state one happens to be in. This view can be compared to Spinoza's affect as a felt idea of the passage from one affective state to another (Houen 2020). Tomkins' theory allows a

[14] Paul Ekman was a student of Tomkins. Ekman turned Tomkins' innate genetically determined 'affect programs' into an elaborate paradigm of research named the 'basic emotions'. This paradigm dominated the psychology of emotions in the 1970s through to 1990s (Wetherell 2015).

[15] Freud's theory of drives (also known as life instincts) are believed to be responsible for much of our behaviour. Freud proposed that all instincts fall into two categories: life and death instincts. Life instincts (Eros) or sexual instincts relate to survival, pleasure, or reproduction. These drives also include sleep, thirst, and hunger, and create energy known as libido. This drive encourages people to engage in prosocial actions that promote our own health, wellbeing, harmony, and cooperation. Eros is opposed by forces of the ego that are self-destructive death instincts (Thanatos). Death instincts are often channeled outwards, e.g., aggression. However, when these instincts are channeled inwards self-harm can result, where traumatic experiences can be reenacted. Drives are described as motivational forces that activate emotions, cognition, and behaviour. Drives arise from the physiological needs of the body (Solms and Zellner 2012).

[16] Homeostatic autonomic mechanisms are feedback systems within the body that help maintain balance (Demos 1995).

dynamic means of 'joining, disjoining, and rejoining' amongst each system in response to internal or external stimuli (Demos 1995). This allows us to account for the multiplicity of ways in which affects can combine with cognition and drives. It also explains those situations when one's emotions change rapidly in the absence of a change in drive, or when one feels an emotion for no reason.

One of the fundamental tenets of Tomkins' theory is that nine basic affects, and not the drives, are the primary motivators of human behaviour (McIlwain 2007). These affects, according to McIlwain (2007) are 'technically six basic affects: interest–excitement, enjoyment–joy, surprise–startle, fear–terror, distress–anguish and anger–rage; one affect-auxiliary: shame; and two drive-auxiliaries: disgust and dissmell'. Interest-excitement and enjoyment-joy are sets of positive affects, surprise-startle is defined as neutral, whilst the others are considered negative affects (Lucas and McManus 2015). In Tomkins (1987) shame is regarded as an affect auxiliary, a theoretical construct, in relation to feeling inferior or immoral towards different objects or sources. In Ekman (1995), however, shame appears in the construct 'shame-humiliation' and is described as one of the primary affects.

Each affect is named within an affective range at both moderate and high intensity. Tomkins use of a hyphenated format (anger-rage etc.) emphasised that the qualitative aspect of an affect can occur at different intensities. Hyphenation captures the dynamic approach of an affective experience and rejects the traditional noun-based nomenclature (Lucas and McManus 2015). Thus, interest at high intensity is called excitement (Ekman 1995) and 'rage is anger with the volume turned up…' (Lucas and McManus 2015). Dissmell (a rejection to noxious odours) and disgust (a reaction to noxious tastes) are innate defensive responses to the hunger, thirst, and oxygen drives (Tomkins 1987). Contesting the dominance of drive theory, Tomkins (1962) suggested that drives have motivational effect only when amplified by the affects:

> The drive system is ... secondary to the affect system. Much of the motivational power of the drive system is borrowed from the affect system, which is ordinarily activated concurrently as an amplifier for the drive signal. The affect system is, however, capable of masking or even inhibiting the drive signal and of being activated independently of the drive system by a broad spectrum of stimuli, learned and unlearned.

As Tomkins contemplated the ways in which the affect system is involved with our responses to the stimuli of the world, *script theory* emerged (Carlson 1995). Tomkins' work sought to answer how such varied internal and external stimuli, memory, imagination, thinking, words, and other affects all trigger the discrete responses defined as the nine basic affects (Holinger 2010). Tomkins theorised the ability of each affect to 'combine' and 'coassemble' with objects, other affects, memory, sensation, perception, and action (Houen 2020). This combination of affects with each other and any form of experience contributes towards our unique (individual or cultural) personality configurations (Alexander 1992).

The work of Tomkins has been harnessed and extended by several former students operating under the banner of the Tomkins Institute (Holinger 2010). Tomkins' theories of affect and script have been applied in various aspects of life and work. An understanding of Tomkins can help us comprehend the work of emotions (such as empathy) and apply it to relationships. Reflection of how we are hard-wired emotionally can facilitate healthy dealings with others. This comprehension can also help us to modulate strong negative emotions such as fear and rage. Alternatively, the consideration and sharing of emotion can help enhance positive emotions. Tomkins' frameworks have provided the affective management tools to de-escalate difficult situations, heal harm, and resolve conflicts. Knowledge can also help us build an uplifting environment that addresses the emotional impact of incidents and helps prevent them in the future. Tomkins also helps us consider motivation, what makes us do the things we do, and how we manage our responses to tensions in our life. Thus, application of Tomkins' theories can enhance individual and collective emotional competence that creates safer and harmonious workplace cultures (Deppe 2018).

The theories of Tomkins have been subject to much criticism (Leys 2011). In following a 'quasi-Darwinian' lead, with a focus on 'innate-ist' genetically determined 'affect programs' Tomkins has gone against the grain of critical theory and towards a frank biology (Gregg and Seigworth 2010; Wetherell 2015). Leys (2011) suggests that the experimental evidence of Tomkins' work 'is seriously flawed and that the theory underlying the paradigm is incoherent'. Evidence too is pointed at powerful critiques of the position (Russell and Fernandez-Dols 1997) with interpretation of experimental

results deemed unsupportable (Leys 2011). Ortony and Turner (1990) criticise the construction of a list of biologically 'basic' (hard-wired) emotions. Contrary to those seen in Tomkins (1962 and 1963) these lists are considered unhelpful in accounting for the entire range of emotions experienced. According to Ortony and Turner (1990), the generative basis of emotions resides in the subcomponents rather than in a small set of innate emotions. It is considered that a divergent explanatory focus should now be on how a large set of subcomponents combine. Barrett (2006) suggests that Tomkins' 'natural-kind' paradigm of emotions has outlived its scientific value. For Barrett, the emotional categories of Tomkins 'do not have an ontological status that can support induction and scientific generalization or allow for the accumulation of knowledge'.

2.3.2.5. Sedgwick and Frank.

The work of Sedgwick and Frank (1995) contributed towards a resurgence of interest regarding theories of affect (Gregg and Seigworth 2010; Houen 2020). In 1995, Eve Sedgwick was professor of English at Duke University, North Carolina, whilst Adam Frank was an English graduate at the same institution (Sedgwick and Frank 1995; Halford 2009). Sedgwick's provocative meditations on 'touching, feeling, and texture' conducted with Frank helped affect emerge as a key site for social and cultural research (Wetherell 2015). Sedgwick advocated a return to the qualitative experience of individuality and community; with affect considered the key to that sensory mixing because of its ability to link us to others (Hemmings 2005).

Sedgwick and Franks' broad aim was to draw on Tomkins' biological theory and his analysis of affect and personal history. For Sedgwick and Frank, a return to Tomkins would encourage attention to studies of embodiment and experience which had long been neglected. Sedgwick and Frank acknowledge the rather strange and transgressive nature of Tomkins' writing that attracted them (1995; Sedgwick 2003)[17]. They introduce the work of Tomkins because of its implicit challenge to the 'heuristic [simplifying] habits and positing procedures of theory today'. Sedgwick and Frank delighted in the fact that critical scholars will not like Tomkins' theories (Gregg 2004). It was deemed provocative

[17] The essay 'Shame in the Cybernetic Fold: Reading Silvan Tomkins' was published in *Critical Inquiry* in winter 1995. The essay was subsequently published as a chapter (3) in Sedgwick's book 'Touching Feeling: Affect, Pedagogy, Performativity' in January 2003.

to turn against the grain of critical theory and advocate a theory which parsed and classified emotions (Wetherell 2015).

For Sedgwick and Frank (1995):

> …to be responsive to the great interest of his writing seems also, continually, to make graphic the mechanism of what would seem an irresistibly easy discreditation. You don't have to be long out of theory kindergarten to make mincemeat of, let's say, a psychology that depends on the separate existence of eight (only sometimes it is nine) distinct affects hardwired into the human biological system.

Gregg (2004) described the post-structuralist hysteria towards science, and the 'anti-essentialists'[18] renunciation of the biological. However, Sedgwick and Frank (1995) point to the rich phenomenology of emotions provided by Tomkins, and of the writings 'brash generosity'. They describe their addiction to reading Tomkins' work which left them 'excited and calmed', and at the same time 'inspired and contented'.

Affect is synonymous with the 'free radical' that can attach itself to anything. Affect attaches itself all over the place (Hemmings 2005); 'it is hard to think of an arena of life that is not suffused with affect' (Sedgwick 2003). In following Tomkins, it is posited that 'affects can be, and are, attached to things, people, ideas, sensations, relations, activities, ambitions, institutions, and any number of other things, including other affects. Thus, one can be excited by anger, disgusted by shame, or surprised by joy' (Frank 2004).

Affect is of interest because it is unusual, unexpected, and unforeseeable. Attention to affect should always be to everyday experience, and importantly for Sedgwick, affective attachments must be *unpredictable* (Hemmings 2005). We create associations with feelings and contexts that are often surprising. What results is our character becoming a record of the individual histories in which emotion has initiated durable and structured

[18] Essentialism refers to the classical or Aristotelian view of concepts, according to which each concept has a set of necessary or defining (essential) features. In biology, essentialism has been used to refer to the pre-Darwinian species concept, where each species has an eternal, changeless nature shared by all specimens of its kind. Within social and critical studies, essentialists claim that social distinctions have deeply rooted biological underpinnings, which are historically invariant and culturally universal. Their boundaries are sharp and not susceptible to socio-cultural shaping (Haslam et al 2000).

changes to the self and our relationships (Sedgwick 2003). This freedom of affect in combination with its contagious quality, results in what Sedgwick describes as its capacity to transform the self in relation to others (Hemmings 2005). Sedgewick (2003) uses the example of disgust-shame as exemplary for demonstrating affective freedom. Shame can attach itself to many objects and can surface unexpectedly in relation to an object that was previously in favour (Hemmings 2005). 'Shame in the Cybernetic Fold' explored Tomkins' structural idea of shame as an affect motivated by internal and external systems in reaction to the strange (Borchers 2016). For Tomkins, shame is the perfect example for discussing affect as it is felt by the individual, it is expressed bodily, and it is perceived by others.

Sedgwick endorsed the work of Tomkins and Ekman, not least because of its emphasis on the role of contingency (what *may* happen) and error in emotional life (Leys 2011). Sedgwick follows Tomkins in recognising the vulnerability of humans to err. For Tomkins (1963), '…human cognition is as vulnerable to error as it is to wisdom'. Feelings of shame may be experienced from within or without when evaluating such error; 'one may feel inferior because someone so regards me, or because I so regard myself'. For Sedgwick and Frank (1995), we learn by making mistakes. The ability to be wrong and to feel shame at error acts as a motivation for learning:

> …it is the inefficiency of the fit between the affect system and the cognitive system - and between either of these and the drive system - that enables learning [from mistakes], development, continuity, differentiation. Freedom, play, affordance, meaning itself derive from the wealth of mutually non-transparent possibilities for being wrong about an object-and by implication, about oneself (Sedgwick and Frank 1995).

Therefore, Sedgwick (2003) follows Tomkins in recognising affects as distinct from drives and social meaning. The affective system becomes a motivational system that is more complex than the drives, with affects not being constrained by aim nor object. Thus, as an affect, shame is a bodily reaction triggered by *error,* but is not tied to the object that triggers it. The object of shame remains peripheral, and consequently acts as a motivator for change (Borchers 2016). In a similar vein, affects can also be triggered by virtually any object or 'stimulus' without the cognitive systems knowledge (Leys 2011). This disjunction between emotion and cognition (and drives) is attractive to Sedgwick in

that a subject can attach itself to objects without having essential relation to them. What matters in the experience of shame is not our conscious or unconscious wishes towards an object, but our subjective feelings in all their singularity (of one's own separate affective experience) and difference from those of others (Leys 2011).

It is intelligible that critics of Sedgwick and Frank would correspond to the criticisms of Tomkins discussed previously (Russell and Fernandez-Dols 1997; Barrett 2006; Leys 2011). Wetherell (2015) also notes that the critics mocked by Sedgwick and Frank (1995) are likely to favour the alternative social psychologies of the time. Wetherell (2015) and Leys (2006) suggest that evidence provided by Schacter and Singer's (1962) experiments demonstrate that emotions are deeply social experiences. This research indicated that affective arousal required engagement with the social context in order to be categorised as a particular classification of emotion. This would contradict the view shared by Sedgwick and Frank (and Tomkins) that emotion categories are pre-determined. This contradictory view would consider that the individual's interpretation of their body would be determined from their surroundings and the responses of others.

2.3.2.6. Ahmed.

Sara Ahmed is a writer and independent scholar, who works at the intersection of affect, feminist, and race studies. Ahmed is primarily concerned with how bodies and worlds take shape, and how power is acquired and challenged (Ahmed 2021). Ahmed was inspired by seventeenth century philosophers of the passions such as Descartes, (John) Locke, and Spinoza. Despite their differences, Ahmed recognised that in common they all describe how we make a judgement of something depends on how we are affected by that thing (Ahmed 2014). Ahmed (2010) explains:

> I do not assume there is something called affect that stands apart or has autonomy, as if it corresponds to an object in the world, or even that there is something called affect that can be shared as an object of study. Instead, I would begin with the messiness of the experiential, the unfolding of bodies into worlds, and the drama of contingency, how we are touched by what we are near.

Alongside other prominent feminist authors such as Ngai[19] (2005), Ahmed employs the terms 'affect' and 'emotion' interchangeably in her work (Gorton 2007; Berg et al 2019; Knudsen and Stage 2015). For Ahmed (2014) it does not make sense to separate affect from emotion. Yet she does recognise the contemporary theoretical need to separate things to make sense of the world. Ahmed understands the process of separating affect from emotion can be akin to cracking an egg in order to separate the yolk from the white. We can separate different parts of a thing even if they are attached. However, 'that we can separate them does not mean they are separate' (Ahmed 2014).

Ahmed situates herself in a school of theory with Leys, Wetherell, Butler, and Blackman that criticises the inherent dichotomies of mind and matter, body and cognition, biology and culture (Knudsen and Stage 2015). Unlike Sedgwick and Frank (1995), Ahmed (2014) is not persuaded by the psychology of basic emotions. Instead, Ahmed is influenced by the social constructionist arguments that focused on the inherent sociality of emotion (Wetherell 2015). In following the work of Schacter and Singer (1962), this field acknowledges the integration of affective episodes with memory and cognition. As such, this view ties affect with human meaning-making. Ahmed turns away from the 'dumb view' (Spelman 1989; Wetherell 2015) of emotions and towards a phenomenological account of emotion (Wetherell 2015). Phenomenology introduced the language of intentionality and was key to Ahmed's model with a focus on objects. Ahmed's model explores how emotions are directed towards objects: 'We feel fear *of* something' (Ahmed 2014). Thus, for Ahmed (2014) emotional experience is directional:

> Emotions are intentional in the sense that they are 'about' something: they involve a direction or orientation towards an object…. The 'aboutness' of emotions means they involve a stance on the world, or a way of apprehending the world…. Emotions are both about objects, which they hence shape, and are also shaped by contact with objects. Neither of these ways of approaching an object presumes that the object has a material existence; objects in which I am 'involved' can also be imagined [or from memory].

[19] Ngai (2005) explains her synonymous use of affect and emotion: 'At the end of the day, the difference between emotion and affect is still intended to solve the same basic and fundamentally descriptive problem it was coined in psychoanalytic practice to solve: that of distinguishing first-person from third person feeling, and, by extension, feeling that is contained by an identity from feeling that is not'.

Emotion can be *about* an object; the emotion constructs an object as a specific type of entity. As such, an emotion such as hate can organise its object as hateful. It shapes the object and provides a performative identity. Conversely, emotions can be shaped by contact with objects. Thus, objects are anything that triggers an emotional response. They can include other people's actions, texts, memories, situations, or material objects (Wetherell 2015).

For Ahmed (2014), emotion does not have a location, emotions are not in people – they shape people. Affect is not 'inside', expressed and owned by an individual (Wetherell 2015). Emotion forms the individual and their 'shape' and 'surface' presented because the type of object the affect has formed. Similarly, Ahmed argues that emotion cannot be situated 'outside' either, as a package or script. Instead, affect resides inbetween the objects and subjects since emotions construct them in such way that makes an emotional reaction certain (Ahmed 2014). Wetherell (2015) endorses that affect is distributed; it is an in-between, relational phenomenon.

Ahmed (2014) explains how subjects and objects are formed through performativity and reiteration. Following Butler (1993) and performativity theory, Ahmed emphasises the fundamental nature of emotional performances, and the effects of these processes over time. '… [T]hrough reiteration [repetition], affective performances materialize and fix the 'nature' of subjects and objects and the boundaries between them' (Wetherell 2015). Therefore, emotions shape the surfaces of bodies, they take shape through repetition of an action over time. When one surface of a body comes into contact with another (or near), an emotional impression is made. The repetition of such impressions collect over time resulting in a *stickiness*. This stickiness is an 'effect of the histories of contact between bodies, objects, and signs' (Ahmed 2014). It is the histories of contact that differentiate between stimuli and bind objects and emotions together (Wetherell 2015).

Ahmed (2004) describes '…how emotions work by sticking figures together (adherence), a sticking that creates the very effect of a collective (coherence)…'. For Ahmed, emotions have a rippling effect. They move sideways through 'sticky' associations

between signs[20], figures and objects, as well as backwards (e.g., with memories of fear). Emotions move (movement is explicit in the etymology of emotion; from the Latin *emovere* 'to move, to move out') through the circulation of objects. Such objects become sticky, seemingly saturated with affect. The term stickiness implies that emotions can become unstuck and re-stuck. Thus, emotions move and connect us to this or that; the relationship between movement and attachment is fundamental.

Ahmed (2004) posited how emotions accumulate using the Marxist critique of the logic of capital. Whilst Ahmed's reference to Marx (2004) is metaphorical (Lehmann et al 2019), affect becomes like the surplus value found in Marxist theory. Affective economies describe the processes of affective circulation, accumulation, and exchange (Ahmed 2004):

> Affect … is an effect of the circulation between objects and signs (= the accumulation of affective value). Some signs, that is, increase in affective value as an effect of the movement between signs: the more they circulate, the more affective they become, and the more they appear to "contain" affect.

For Ahmed (2014), affective economies are an analytical tool used to describe the creation of collective identities (Lehmann et al 2019). One of the earliest uses of approaches to affective economies was found in Lawrence Grossberg's work. Grossberg (1997) focused on the potential of affective intensities to empower and consequently have political implications. Like Grossberg, Ahmed (2014) examined the political dimensions of affective economies, with a particular interested in the 'politics of fear'. In her study of right-wing discourse, Ahmed demonstrated that the circulation of affects and emotions is crucial to performatively define and demarcate individual and collective bodies (Lehmann et al 2019).

> … emotions *do things*, and they align individuals with communities—or bodily space with social space—through the very intensity of their attachments (Ahmed 2004).

[20] In semiotics, a sign is anything – a colour, a gesture, an object, fear – that stands for something other than itself. The word red is a sign because it does not stand for the sounds r-e-d that comprise it, but instead for a specific primary colour, a traffic signal that means stop, a signal for danger, a red flag etc. Signification is what happens in our mind when we use or interpret a sign (Danesi 2004).

Ahmed (2010) also analysed the use of emotionally charged language and the arousal of feelings by conservative politicians to influence mass audiences. For Ahmed (2004), emotions '…work to align some subjects with some others and against other others' and shows how these alignments, [circulate] '…between bodies and signs'. Ahmed demonstrates how the use of emotion words in rhetorical propaganda construct and portray subjects and groups in aligning them with or against each other. Interestingly, alignment is not so much grounded in knowledge, but rather in the register of affecting and being affected (Berg et al 2019). Affect is relevant for the very 'skin' of subjects.

> …that portraying a group, an individual, an idea, or an object in the registers of affect contributes to its bodily creation and perception. Abstract social entities, such as social categories, communities, groups or nation states, which are ascribed feelings or affective capacities are, in a sense, discursively constructed bodies (Berg et al 2019).

Thus, the … '(re-) production of these borders and divisions between individual and collective bodies appears to be a crucial element of affective economies' (Lehman et al 2019). Ahmed builds on Butler (1988; 1997) in focusing on the individual processes of embodiment and internalisation (the integration of attitudes, values, and opinions of others into one's own identity) of such economies of fear. However, in the collective dimension, Ahmed concludes that the example of right-wing groups demonstrates the substantial accumulation of affects. The social nature of affect as contagious will be examined further in a later section.

Wetherell (2015) provides a critique of Ahmed's theory of affect. Wetherell argues that the bridge constructed between the psychology of affect underpinning Ahmed's theory and her cultural theory is questionable. For Wetherell, the place and power given to 'emotion' with its flowing movement is hard to comprehend. Wetherell questions whether 'emotion' is the correct unit of analysis and conceptual focus. She suggests that a substitution for 'affective practice' would provide a more flexible, yet robust basis for understanding. Such an alternative term would help 'de-mystify' Ahmed's circulating affect and help refocus attention to context.

For Wetherell (2015) too, the positioning of affect as surplus value in Marxist theory is 'deeply enigmatic'. It is suggested that alignment with Marx undermines her work; the

obscurities becoming apparent when attempting to employ this approach beyond textual analysis within cultural studies. As a result, Wetherell claims that affect is decontextualised. It becomes a kind of mysterious social actor, fixing and separating objects and subjects 'in a depersonalised landscape'. 'Paradoxically [for Wetherell], we end up with something which functions rather like a basic emotions view'. Pullen et al (2017) also criticised Ahmed's notion of affective economies. In recognising how affect circulate between bodies, affect is reduced to a surface matter of emotions. For Pullen et al (2017), Ahmed ignores how the social expression of emotions are informed, and overwhelmed, by a variety of lived experiences and visceral feelings.

2.3.3. Affect in discourse and materialism.

Significant debate has existed as to the potential of discourse as a medium for analysing affective phenomena (Kolvraa 2015; Knudsen and Stage 2015; Ayata et al 2019; Berg 2019; Houen 2020; Burnett and Merchant 2020). Followers of Massumi, who as noted, pursue Spinoza and Deleuze in believing that affect describes dimensions of the body that are beyond the scope of language categorization (Berg et al 2019). That is, affect is a pre-cognitive realm of intensity that is not linked to thought let alone language. For Deleuze, affect is a force which disturbs the stability of signification and discursive construction (Kolvraa 2015).

For critics of Massumi, who reject the dichotomy of body and cognition, language would be considered capable of expressing affects. Scholars such as Leys, Blackman, and Wetherell claim there should be no inconsistency between language and the categories that form the shaping of bodies (Knudsen and Stage 2015). Others such as Houen (2020) and Riley (2000) hold a more centrist belief that whilst affect is not reducible to the 'architecture' of language, we must think of affect, language, and cognition as thoroughly conjoined and open to interaction, co-assembly, and fusion. Butler (2015) suggests that affect and discourse are closely connected, with affect being crucial for the origination of discursive subjects. When analysing discourse, it should be remembered that even if affect and signification exist on different 'planes' of social reality, analysis must consider how they are co-articulated (Grossberg 1992; Kolvraa 2015).

Berg et al (2019) described an approach for the affective analysis of textual discourse. Firstly, the materiality of the text should be considered; how the written language could

be formed and structured to express affect. Figures of speech, such as metaphor[21], metonymy[22], and onomatopoeia[23] are described as covert forms in which affectivity becomes tangible in discourse, with forms of hyperbole and linguistic excess being comparatively explicit. Hyperbolic and linguistic excess are rhetorical techniques often witnessed in bold statements, with hyperbole particularly associated with exaggerated emphasis or tone. Kolvraa (2015) also suggests that it is the style of the text that is of importance. Provocative challenges or ironic[24] statements can be interpreted as a 'playful' means of signaling the subjects' affective investment. Alternatively, witticisms or light-hearted humour may be witnessed. Jokes are not simply a rhetorical performance but have an affective function of their own. Statements where the non-literality of its contents are discreetly evident are termed as an insincerity. Such frivolous accounts' distance from any claim of the literal truth of its content can be taken as a signal of its affective property.

The structure of language is at the heart of the affects we form. Punctuation, vocabulary, grammar, and syntax can all form and inform our affective life. Quotation or exclamation marks can modify a statement, in a similar way that it can be affected by tone (Riley 2005; Houen 2020). Repeated words, such as *like* marks an affective overflow in speech that reflects the tone of the moment (Willink and Shukri 2018). Vocabulary, and the words we choose to use to describe an object or event can carry different affective charge (an example being the use of 'died' or 'kicked the bucket' to describe a person's death) (Houen 2005). Ahmed (2014) uses an emotion-bound vocabulary to illustrate the relational affective dynamics in which bodies are attracted or repulsed. Berg et al (2019) suggest that it is two aspects of affect, its relational and bodily dynamics, that are particularly relevant when analysing text. Analysis of affect therefore means to investigate the social connections between various bodies within and

[21] Metaphor is a word or phrase applied to an object or action to which it is not literally applicable. That is, writing a word while referring to something else. Of particular relevance to affective study are metaphors assigned to characteristics of human bodies. Metaphor is a type of analogy. An analogy describes something by comparing it to something else which is similar.
[22] Metonymy - a word that is referred to by the name of something closely associated with that word.
[23] Onomatopoeia refers to words used to imitate sounds (Berg et al 2019).
[24] Irony is the use of words that signifies the opposite, typically for humorous, or emphatic effect. It is similar to sarcasm (Kolvraa 2015).

throughout text. Whilst language can make use of a vocabulary of emotions (e.g., fear, anger) and the attribution of feelings to individuals or groups, the focus of affect should be on the relational and bodily properties surfacing in the text.

The signification of affect can alter as it circulates across a space (Kolvraa 2015). For example, one individual's own expression of anger can be transferred contagiously by being re-signified to affect others with different grades of anger. Also, instances can occur where feelings of anger can result from being affected by different emotions (such as fear) felt in another individual. Thus, anger and fear can be interpreted as being part of the same re-signified affective circuit. Therefore, affective contagion can be comprehended as a phenomenon that is 'charged' where the intensity of various bodies in that collective space are raised, even if this is to signify or orientate in a different of opposing way. It is therefore possible to perceive that affective contagion can stick between subjects that are antagonistic towards each other. Therefore, enmity or resentment can be 'excellent conductors for affective contagion' (Kolvraa 2015). Accordingly, techniques are required which seek to understand the affective intensity that is not simply stated, but which is in excess of its meaning. Words used to describe feelings or emotions may not be uttered or transcribed in identical ways in order to be seen as linked to the same affective episode.

Performativity theory (Butler 1990) challenges the representationalist[25] belief in the power of words to represent preexisting things; that is, the belief that there are representations and separate entities waiting to be represented (Barad 2003). It opposes the excess power that is granted to language to determine what is real. Instead, performativity shifts the focus to matters of practice, doings, and actions. That is, that language can function as a form of social action and have the effect of change. Barad reminds us that Nietzsche warned against the inclination to take grammar too seriously. Representationalism believes that the structure of language reflects a prior reality of matter and characteristics; and allows us to shape or determine our understanding of the world. However, Barad claims it is worth questioning the belief that grammatical

[25] Representationalism separates the world into two distinct and independent types of entity, words and things. That is, there is a distinction between representations and that which they claim to represent (Barad 2003).

categories reflect the underlying structure of the world. For Barad (2003), 'matters of "fact" have been replaced with matters of signification. Language matters. Discourse matters… the only thing that doesn't seem to matter anymore is matter'.

Barad progresses Butler's theory of performativity by emphasizing and redressing its apparent omission of matter (Harding, Gilmore, and Ford 2022). Barad (2003) proposes a posthumanist[26] account of performativity that incorporates material and discursive, human and nonhuman; and examines how their boundaries are stabilized and destabilized. Barad's posthumanist performative account of the production of material bodies rejects the representationalist need for 'words' and 'things'. She instead advocates a causal relationship between material configurations of the world (that is, discursive practices and configurations rather than 'words') and specific material phenomena (that is, relations rather than 'things'). This causal relationship is one of 'intra-action'. This concept of 'intra-action' diverges from the familiar 'interaction', which presumes the prior existence of independent bodies. All bodies, not just human bodies come to matter through frequent repetitive intra-actions, its performativity.

Barad (2003) stresses that discourse is not a synonym for language; it does not refer to signifying systems, grammar, or figures of speech. Discourse is not merely spoken or written words forming descriptive statements (representationalism). Instead, discourse is that which constrains and enables what can be said. It defines what counts as meaningful from the statements and subjects that emerge out of a field of possibilities. Discursive practices are the local conditions that enable and constrain practices such as speaking, writing, thinking, and concentrating. Such practices are boundary-making practices that produce, rather than describe the subjects and objects.

Barad (2003) asserts that the primary unit of knowledge is not independent 'things' or objects with inbuilt boundaries and properties; it is phenomena. Phenomena are dynamic reconfigurations and entanglements, with reality composed of things-in-phenomena. Phenomena denotes the inseparability of intra-acting components. It is through intra-actions that the boundaries and properties of the components within

[26] Posthumanism questions the assumption of the difference between human and nonhuman. Humans are inseparably entangled with the nonhuman (Barad 2003).

phenomena (that is, what we conceive as ‘subjects’ and ‘objects’) become definitive and particular embodied concepts become important. Matter is the materiality of phenomena (not a fixed independent object), it is not a passive and unchanging surface awaiting signification (meaning). Instead, matter is ‘substance in its intra-active becoming’. It is not fixed, not a thing, but a doing. Matter is a stabilizing and destabilizing process of frequent intra-activity. Thus, matter and meaning are mutually articulated; neither are prior nor take precedent. Matter emerges out of the ongoing reconfiguring of boundaries. Therefore, materiality and discourse are mutually caused and reconsidered in terms of intra-activity.

Materialism highlights the corporeal interfusion of human bodies with material entities and theorises a posthuman subject wholly enmeshed with their surroundings (Ronda 2020). Echoing the assemblages of Deleuze and Guattari (2003) and Tomkins’ coassembly’s (Houen 2020), Braidotti (2000) describes a folding-in of external influences and a simultaneous folding out of affects. Ronda (2020) argued against a view of active subjects and passive objects; and towards a world of ‘lively and essentially interactive materials’ and complexly entangled human and nonhuman bodies. Bodily affects are theorized as existing in a shared ontological field. Through affect, we conceive ourselves as transversal rather than bonded subjects, composed of mutual processes and forms. Materialism portrays the world as affectively charged with a liveliness that we participate in as bodily beings. Materialism focuses on the ways in which shared affect reveals broader intercorporeal relations and describes enmeshed environments that highlight immanence and transcorporeal immersion. It is attentive to the ways in which affects appear as shared and impersonal; of interest is the dynamics and uncanny relationships that develops ‘in-between’.

Highmore (2010) used the term aesthetics to describe material experiences, the ways that the sensual world meets the sensate body, and the affective forces that are generated in-between. Aesthetics covers both ‘the vehement passions’ such as fear and the ‘minor and major affects’ which include irritation, anxiety, disdain, surprise etc. It is attuned to perception, sensation, and attention (for example, distraction and concentration), and to the body. Most importantly for Highmore (2010), it is concerned with the ‘utter entanglements of all these elements’. Therefore, aesthetics is the way

that we communicate through the senses (Postrel 2003). We create reactions (without words), through the look and feel of people, places, and things. As noted in Ahmed (2014) and contradicting Barad (2003), the power of objects (or things) is described as crucial to aesthetics. Objects are understood as being involved in multiple overlapping negotiations with human being, and not simply passive and inanimate (Thrift 2010). Objects are not a feature of human perception that only exist when attended by a human subject. They are a feature of reality on many levels at once, some of which intersect human presence and perception, and some of which do not.

In defining affect as the 'ability to affect and be affected', affect in materialism appears as an intensity which is common across a range of entities, human and nonhuman (for example, technologies). Murphie (2020) describes the '(a)modal shimmering' at the junction of humans and digital technologies of all kinds. For Murphie it is little wonder that 'strange feelings' arrive. The performative presence of the human and non-human becomes a constantly negotiated presence that fold into each other, and out of themselves, in unexpected ways. The environment becomes a medium of mediums, a constant transformer of information, with a thoroughly unpredictable force and complexity. It is unsurprising that there is sometimes a kind of blankness felt in response. What we understand as impacting our attention, or even confusion, is perhaps the process of adapting to the constant relational transitioning and modulation.

2.3.4. Affect as contagious.

Whilst Tarde, Le Bon, and Freud shaped mass psychology through their concern for affect and the often-irrational transmission of emotion at the turn of the nineteenth century (Blackman 2008), several scholars have recently advanced the idea of affects as contagious, building on the work of Silvan Tomkins (1962) among others (Ahmed 2010). Affective or emotional contagion describes the primitive subconscious transfer of emotions from person to person. Such contagion presents with a strong inference of a split between active and passive roles. The passive individual is hit, entered, or haunted from outside by an active affective influence. The semantics of contagion proposes a process where the affective state of the 'sender' is copied or synchronised by the 'receiver' (Muhlhoff 2019).

Of particular interest to Tomkins (and later Ekman) was the facial expressions activation of a mimetic impulse in response to a facial expression of an observer. Tomkins asked us to contemplate the contagious nature of a yawn, smile or blush. He noted how they transfer to others and double back, seemingly increasing its original intensity. For Gibbs (2010), it is difficult not to respond to a smile with a smile of one's own; the same affect (joy) has been elicited in each. Therefore, affect places the individual in a *circuit* of feeling and response (Hemmings 2005). The innate affects of Tomkins are powerful purveyors of affective contagion since they are communicated rapidly by the face, voice (Gibbs 2010), and body movements (Knight and Barsade 2015). The unique neurological profile of each affect correlates with a specific physical sensation. Thus, mimicry leads the perceiver to feel affect, effectively catching it from another person (Knight and Barsade 2015).

> Bodies can catch feelings as easily as catch fire: affect leaps from one body to another, evoking tenderness, inciting shame, igniting rage, exciting fear—in short, communicable affect can inflame nerves and muscles in a conflagration of every conceivable kind of passion (Gibbs 2001).

Contemporary affect studies has borne several concepts to describe the social and relational dynamics of affect (Muhlhoff 2019). Gibbs (2001) describes the 'catchy' way in which feelings affect the body towards a model of affective contagion which is progressed further by Ahmed and Brennan.

In an earlier section, a focus on the theories of Sara Ahmed explored what emotions *do* and how they circulate (2004; 2010; 2014). This circulation concept represents a one-directional mechanism founding the circular movement of affects (Muhlhoff 2019). Muhlhoff describes circulation as an elaborate form of transmission. Ahmed's essay 'Happy objects' relates the movement of happiness within a group to a circulation of goods or objects. For Ahmed (2010), objects are 'sticky' because they have been assigned as good or bad, happy, sad etc. Groups gain social bonds because they gain orientation towards something being good, bad, or happy (amongst others). Thus, in Ahmed's work, 'happy objects are passed around, accumulating positive affective value as social goods'; happiness is passed around – it is contagious.

Ahmed points to philosopher David Hume whose work on emotions was positioned explicitly on a contagious model of happiness. Hume (1975) offers 'others enter into the same humour, and catch the sentiment, by a contagion or natural sympathy'… and that cheerfulness is the most communicative of emotions: …'the flame spreads through the whole circle; and the most sullenly and remorse are often caught by it'. Theorising affects as contagious helps us challenge an 'inside-out'[27] model of affect and demonstrates how affects pass between bodies and affect bodily surfaces. However, Ahmed (2010) notes that to think of affects as merely leaping or passing from one body to another is overly simplistic. What this view ignores is the importance of contingency; becoming affected is contingent on how we feel, or as an effect of how objects are given.

A concept related to contagion is the idea of affective or emotional atmospheres. The term 'atmosphere' lends itself to a form of temporary organisation of a field of heterogenous (human and non-human) elements and forces (Muhlhoff 2019). Anderson (2009) defines affective atmospheres as the ambiguous 'singular affective qualities that emanate from but exceed the assembling of bodies' present. Thrift (2006) rather more modestly terms atmospheres as 'swirls of affects'. Affective atmospheres are the prepersonal and transpersonal intensities that emerge when bodies affect and are affected by each other (Massumi 2002).

Anderson (2014) describes the expression of atmosphere as 'vaguely and interchangeably with mood, feeling, ambience, tone and other ways of naming collective affects'. Moving through an organisation means passing through its atmospheres, which are 'like floating in the sea through warmer and colder layers of water, moving through regions of affect, which enlist us for a time, physically take over our bodies and then release us' (Wetherell 2012). What is noticeable when walking around a space (such as a Radiotherapy department) is that some areas or rooms can feel palpably different, and the incumbents of each area can be acting very differently. Reckwitz (2012) suggests

[27] Ahmed (2014) proposes inside-out and outside-in models of emotion. The inside-out logic posits that I have feelings, which then move out towards objects and others (and may even return to me). An outside-in model suggests that emotions come from the outside moving inwards.

that these ‘atmospheres offer rich potential for an analysis of affects’. Like Wetherell (2013), Anderson (2009, 2014) seeks to understand how affects bring a specific feel to episodes, encounters, and events. Affective atmospheres develop and offer a ‘way of attending to moments of change in which social life is reordered and other possibilities may be glimpsed’ (Anderson 2014).

For Brennan (2004):

> Is there anyone who has not, at least once, walked into a room and "felt the atmosphere"? … The transmission of affect, whether it is grief, anxiety, or anger, is social or psychological in origin. But the transmission is also responsible for bodily changes; some are brief changes, as in a whiff of the room's atmosphere, some longer lasting. In other words, the transmission of affect, if only for an instant, alters the biochemistry and neurology of the subject. The "atmosphere" or the environment literally gets into the individual.

Therefore the ‘atmosphere’ is absorbed by the individual. Ahmed (2014) describes this as comparable to her ‘outside-in’ model, which is a fundamental component in the theory of crowd psychology. However, Ahmed highlights that Brennan (2004) soon offers an alternative model: ‘If I feel anxiety when I enter the room, then that will influence what I perceive or receive by way of an “impression” …’. Ahmed (2010) agrees, as highlighted with her significance of contingency. For her, anxiety is sticky (‘like Velcro’), but importantly it gives us a particular kind of angle on what comes near. Bodies seldom arrive in neutral, so what we receive as an ‘impression’ will depend on our affective situation. How we enter a space, a room, a situation, will affect the impressions we receive.

Edensor (2015) argues ‘that it is inappropriate to isolate affect as the key ingredient of atmospheres’ as the latter ‘folds together affect, emotion and sensation in space’. Edensor (2015) proposes the need to follow the messiness between ‘affects, emotions and sensations in the production and experience of atmosphere, a thorough melding of these stimuli and intensities’. Wetherell (2012) criticises the use of metaphors such as floating in affect, affective atmospheres, auras etc. Whilst seductive, Wetherell questions whether this is the best way of understanding how people move in and out of affective practices. Wetherell also finds the term affective circulation problematic. The term ‘circulation’ suffers by implying that ‘affect is an ethereal, floating entity, simply

“landing” on people’. Wetherell suggests that the term contagion as dating back to nineteenth century psychology as more suitable. Blackman (2008) is critical of viewing affects such as happiness as something we ‘catch’; Affect is not a contagious virus we catch like a cold. Blackman calls for a more sophisticated theory of affective transmission than those that have been provided. Instead, Blackman highlights the complexity of affect as revealed through ‘the linkages and the connections of the body to other practices, techniques, bodies (human and non-human), energies, judgements, inscriptions and so forth that are relationally embodied’. Happiness, for Blackman, could never be a property of an individual or a contagious force which you may catch.

A final concept related to contagion is that of morale. Morale describes the moods and state of minds of a collective; that is, a group temper or mentality. The population that makes up morale is not simply a collection of individuals grasped in terms of a preconscious, autonomic, bodily affectivity. The population is itself an affective structure. Groups of individuals can be exposed to a perceived myriad of events that can leave them damaged. Morale promises, therefore, to enable bodies to keep going despite the present. Use of language such as morale, conjures visions of the hardship and suffering of war in which the battle-weary body is potentially affected by ‘weakening influences from within (fatigue, reluctance, anxiety, irritability, conflict, despair, confusion, frustration) and from without (obstacles, aggression, rumours)’ (Anderson 2010).

Morale in the management and organisational literature is used to describe the overall outlook or satisfaction that employees have of the organisation. Higher morale means happier employees that are less stressed, whereas, morale can decrease during stressful periods of instability, change or high staff turnover (Totman et al 2011). The resulting demoralization describes a collective hopelessness and helplessness (Clarke and Kissane 2002). Staffing levels are fundamental to employee perceptions of morale. However, the strongest positive influence on morale was peer support within a close-knit team. Also, empowering staff and giving them greater autonomy was recognised as a way of enhancing morale, as was providing opportunities for training and development (Totman et al 2011). This mirrors the research of Deakin (2022) in highlighting the

impact on morale caused by workforce shortages and overstretched healthcare staff working under sustained pressure.

The following section will examine the role of contagion within the concept of group affect. This concept is of interest due to the group-based practices found in healthcare organisations. The influence of convergent affective states, as well as the role of leadership and group-member interdependence will also be examined.

2.3.5. Group affect.

Researchers have examined the mechanisms that underlie affective transfer across a broad range of groups in a wide range of contexts (Knight and Barsade 2015). The term group affect has developed in contemporary literature to describe the generation of affect in groups through interpersonal interactions (George 1990; Walter and Bruch 2008; Barsade and Gibson 2012; Barsade and Knight 2015; Knight and Eisenkraft 2015). Barsade and Knight (2015) conceptualise group affect as an integration of affect, moods, and emotions within a purposive group. Purposive groups are defined as 'an intact social system, complete with boundaries, interdependence for some shared purpose, and differentiated member roles' (Hackman and Katz 2010). Purposive groups (or teams) are universal in modern organisations and are abundant within healthcare settings such as the Radiotherapy Departments of which this study is situated.

Walter and Bruch (2008) highlighted the complex and dynamic processes of collective affect within organisational groups. These researchers proposed a cyclical model of affect where mechanisms of affective sharing gave rise to a self-reinforcing upward spiral between affective similarity and group relationship quality. High-performing groups were found to enable emotional contagion and convergence in positive affect (such as happiness) which further enhanced the interpersonal relationship amongst the group members. Kelly and Barsade (2001) had previously revealed how the nature of collective affect can fluctuate over time. In suggesting that group affect is dynamic, they described how affective experiences feed back into the group's composition. In turn, these momentary encounters shape the group members' appraisal of future events and experiences. In a similar concept, Hareli and Rafaeli (2008) argued that reactions and responses to an initial expression of emotion were observed to spread and spiral throughout the group over time.

The concept of group affect as a convergent affective experience has been extensively researched (George 1996; Barsade and Knight 2015; Knight and Eisenkraft 2015). Collective positive or negative affect emerges as individual group members converge in their affective experiences (Barsade and Knight 2015). Knight and Eisenkraft (2015) discovered that groups that converge in positive affect benefit from greater social integration, are more cohesive, and perform better. George (1990; 1996) found that long-term work groups were characterised by unique homogenous collective affect. However, many work groups such as those seen in healthcare settings are relatively fluid due to flexible working patterns and unpredictable work demands. Healthcare is a dynamic task environment, and team members need to adapt quickly to changing conditions or demands (Prineas et al 2021). For these groups, homogenous affective states will not have the opportunity to develop.

Also, the relationship between group members can have a direct influence on levels of affective convergence. Totterdell (2000) examined the importance of group member interdependence as a key mechanism in emotional contagion. In this research, he observed that affective convergence peaked during times of interdependent collective working. Totterdell et al (2004) developed this theory by arguing that interpersonal relationships act as channels through which collective affect flows. Social ties were also found to be important for affective convergence as witnessed in the shared moods seen in close-knit groups. Thus, the more interconnected the group members are, the greater likelihood of affective experiences being shared (Barsade and Knight 2015). Convergent affective processes such as emotional contagion are essential for effective leadership (Tee 2015; Humphrey et al 2016). Leaders have a significant impact on the affect that emerges within a group, with management of the groups' affective dynamic a key function of the group leader. In holding formal power, leaders can infect the group members with their own affective states (Barsade and Knight 2015) and influence a wide range of outcomes (Tee 2015; Humphrey et al 2016).

Whilst the convergence of collective affect has been widely researched, opposing hypotheses of group affect have also developed (Tekleab and Quigley 2014; Kaufman and Wagner 2017). Kaplan et al (2013) found that a diversity in positive affectivity had a disruptive influence that impeded group effectiveness. Hentschel et al (2013) researched

individuals' perceptions of group diversity as an antecedent for group affect. It was discovered that groups perceived as more diverse shared more negative feelings (such as anger or anxiety). This aligns with primitive social viewpoints that would allow early groups to identify out-group members as differing in prominent qualities. Throughout the literature, ambiguity remains how affect can influence decision making within a collective group. The influence of group affect on decision-making is complex and dependent on context (George 2011). Barsade and Knight (2015) call for the crucial dissection of the processes at play between group affect and decision-making. According to these researchers, 'further investigation of the influence of positive and negative affect on collective cognition in groups is sorely needed'.

2.3.6. Affective states.

This section will define and uncover the complex interconnecting affective states that are unveiled during the practical elements of the research. The primacy of control, and its link with surprise is exposed. The consequences of rushing, pressure, and stress are also illustrated. The section continues by outlining the subtle differences between anxiety, apprehension, annoyance, and frustration, prior to concluding with an overview of the affective state of confusion.

Everyone has a need to feel that they are in control; the importance of control is emphasised with its close relationship with longevity (Furnham 2005). The perception of being in control is a psychological and biological necessity and is likely to be adaptive for survival. Exercising control is necessary to nurture beliefs of self-worth. Terms such as agency and self-efficacy describe the belief is one's own ability to exert control over our surroundings and act as an agent capable of producing desirable results. Autonomy and self-determination are terms used to describe an individual's motivation to act as an independent and causal agent upon their environment. The belief in one's own ability to exert control over our environment and produce desirable results are fundamental psychological needs and are essential to our general wellbeing (Leotti et al 2011). If a desire for control is essential for survival, it follows that the neural bases of these adaptive behaviours are found in regions of the brain involved in affective processes. Leotti et al (2011) suggest that perceived control influences cognition and behaviour by modulating affect. In threatening situations, the ability to exercise control can alleviate

stress by engaging mechanisms of emotional modulation. The opposite of control, that is powerlessness, and the closely related feelings of helplessness and hopelessness, are major causes of stress (Furnham 2005). Those circumstances that are perceived as uncontrollable are more likely to activate stress responses than those circumstances that are deemed as being under control (Kemeny 2003). Anything that challenges the perception of control can be harmful to an individual's well-being (Leotti et al 2011).

Surprise is the sense of astonishment and wonder that an individual feels towards the unexpected. Ekman et al (1983) described surprise as a basic emotion alongside anger and fear. We disproportionately notice and focus on events that are surprising (Mellers et al 2013). The feeling of surprise is linked to our need for control. When faced with surprising or unexpected circumstances an individual can feel out of control. A sense of control provides safety and familiarity, but when surprising events occur, uncertainty causes this control to be threatened. We feel safer in familiar settings, so uncertainty affects our ability to plan ahead and can cause anxiety. Unexpected changes to our routine, or an uncertain future can leave us feeling threatened and the resulting anxiety can become intertwined with stress (Murray and Nadelhofer 2023).

Within modern life, a perceived shortage of time is frequently experienced. Being rushed focuses on the subjective emotional feeling of time passing away too quickly. Feeling rushed is related to the subjective experience of being short of time, being worried, and feeling a sense of pressure. As a component of the experience of time pressure, feeling rushed can give rise to apprehension and frustration. However, the negative sense of feeling rushed can progress to the extent where time concerns generate anxiety and worry (Szollos 2009). At it's extreme, the term 'hurry sickness' was coined by Friedman and Rosenman (1974) to describe the constant feeling of being rushed. This extreme sense of time urgency often leads to physical health issues caused by stress due to being in a near continuous state of anxiety. Negative responses to hurry sickness include fatigue, irritability, or lack of empathy (emotional numbness). The affect heuristic can increasingly come into play when there is significant time pressures (Finucane et al 2000). When rushed, we become more reliant on heuristics as we do not have sufficient mental resources to make effortful, well-reasoned decisions.

Pressure is the subjective experience of 'any factor or combination of factors that increase the importance of performing well' (Baumeister 1984; Mitchell et al 2019). As witnessed with responses to various sensations and social energies, different pressures can become embodied and can influence human life (Houen 2020). At work, individuals endure the pressure or urgency to perform well, that is, attain desirable outcomes and avoid negative consequences. Also, heavy workloads, long hours, time pressures, and performance feedback can add additional pressures. Failure to meet expectations can lead to harmful outcomes. Therefore, the pressure to perform can stimulate psychological, emotional, and physiological reactions such as anxiety. Pressure can represent a significant source of stress for individuals (Mitchell et al 2019). The mood or affective state of the individual can influence how pressures are appraised; and can elicit different coping processes. When feeling negative, individuals are more likely to appraise pressures as threatening. Such pressures create a focus on the potential harm, or difficulties associated with addressing the situation. When in a comparatively positive mood, individuals are more likely to rise to the challenge and become engaged with the cause(s) of pressure. These pressures create a focus on potential opportunities and growth. Thus, pressure elicits both functional and dysfunctional behaviour (Mitchell et al 2019).

Whilst stress is often used to refer to our body's response to pressure, the term stress has been used inconsistently to refer to a stimulus, a response to a stimulus, or the physiological consequences of that response. Stress can be defined as a state of worry or mental tension caused by a difficult situation. Stress is a natural human response that prompts us to address challenges and threats in our lives (Folk 2022; WHO 2023). Therefore, stress is essential for survival, and low levels can enhance cognitive function, memory, and learning (McEwen and Akil 2020). How we respond to stress can affect our overall well-being (WHO 2023) and stress can become problematic when prolonged or overwhelming. If left unaddressed, psychological issues such as depression can follow. Such issues occur due to dysfunctional regulatory systems and can cause heightened reactivity to stimuli, an inability to cease the stress response, or suboptimal affective responses to the external environment (McEwen and Akil 2020). Importantly, stress can

impact negatively on an individual's ability to make effortful decisions (Soares et al 2012).

Stressors are defined as circumstances that threaten goals such as the maintenance of one's own physical or psychological wellbeing. The term distress describes a negative response to such threats and can include a variety of affective states such as anxiety, sadness, frustration, or overwhelm. Numerous properties of stressful circumstances have been investigated and found to influence the response. These include controllability (that is, our ability to affect outcomes), ambiguity, level of demand, novelty, and duration. Those circumstances appraised as uncontrollable are more likely to activate stress responses than situations perceived as controllable. Also, research has indicated that individuals have fluctuating capacity to control their responses to stress. Controlled behaviour occurs when the individual has the energy to deal with the stressor. However, when resources are depleted, inappropriate behaviours can occur. The social world also has a significant role in how we react to stressful situations. When our social status or self-esteem are threatened by performance failures, we can react by feeling stressed (Kemeny 2003).

The words anxiety and apprehension are often confused and used interchangeably. Anxiety may be defined as a tension or uneasiness that stems from the anticipation of danger. Anxiety describes a general feeling of nervousness or worry about something that may happen in the future; there is an uneasiness of mind about some form of contingency. Therefore, anxiety refers to a more generalized sense of unease at a variety of things (Griffin 1990). Related to fear, anxiety manifests as a complex mood state consisting of cognitive, affective, physiological, and behavioural responses to anticipated events perceived as threatening (Chand and Marwaha 2023). As a response to these anticipated threats, feelings of anxiety can bias our decision making towards safer and more certain options (Hartley and Phelps 2012). In addition to affective indicators such as restlessness or irritability, physical symptoms such as increased heart rate can accompany states such as confusion, difficulty concentrating, and memory loss (Griffin 1990; Chand and Marwaha 2023). Alternatively, apprehension describes a fear about a specific future concern. When someone is apprehensive, they may feel hesitant or reluctant to take action (Griffin 1990).

Feelings of annoyance and frustration describe comparable mild states of anger. Whilst also often used interchangeably, subtle differences exist. Being annoyed occurs when something disturbs you or is against your wishes (Wierzbicka 1994). Annoyance always requires an object; you are annoyed at someone or something. Alternatively, frustration relates to a goal that an individual is trying to achieve (Pruitt et al 1997). The object of annoyance must be unpleasant without being harmful. It must also be intermittent, unpredictable, and occur for an uncertain period of time (Palca and Lichtman 2011). Whilst annoyance is highly subjective, a stimuli that was once neutral can become annoying when repeatedly experienced. Annoyance can develop into the intense emotional state of anger (Pruitt et al 1997). Frustration is experienced whenever the goal you are expecting does not align with the effort you are applying. Sources of frustration can be internal (that is, self-perceptions of one's own ability) or external, such as other individuals obstructing our goals or being perceived as wasting our time. Frustration can develop into a broad range of states including aggression, loss of self-esteem, stress, and depression (Berger 2005).

The affective state of confusion indicates an uncertainty about what to do next or how to act (Craig et al 2004). Individuals feel confused when they receive information that they cannot align with that which they know or believe to be true. Therefore, confusion entails that individuals are trying to figure out the information that they are presented with and how it aligns with their existing knowledge. Confusion can stem from appraising something as novel (that is, new or unusual, and reflects a state of uncertainty) or hard to understand. Confusion has a valenced experiential quality in that it is a familiar experience that individuals can describe. The state of being confused can be described as the feeling of not being able to think clearly. Confused individuals can also feel disorientated or have difficulty focusing or making decisions (Silvia 2010). Confusion can accompany an episode of anxiety or stress; this anxiety causing a difficulty to concentrate (Barraclough 1997). Individuals should use confusion as a signal that they need to act, such as by asking for help, consulting with experts, or by taking a break (Silvia 2010).

2.3.7. Affect in organisation studies.

Whilst the affective turn is immersed in the social sciences, there are signs of a growing interest within management and organisational studies (Fotaki et al 2012; Beyes and Steyaert 2012; Kenny and Fotaki, 2014; Thanem and Wallenberg, 2015; Pullen et al 2017; Michels and Steyaert 2017: Rothman and Melwani 2017). This section will demonstrate how the affective theories examined in the previous sections have been employed in contemporary research. The literature has established the central role of affect in organisational life whilst investigating affects associated with leadership, power, learning, and change (Dashtipour and Vidaillet 2017). For Pullen et al (2017), it is important to consider affect in ways that matter for people and our bodies. It is critical that the lived and actual intensities of affect within or around organisations are explored. Pullen et al (2017) stress the need to avoid getting caught up in concepts that reduce affect to surface-level categorised emotions. What is more important is to examine how real people and real bodies experience work, their lived expressions and visceral experience. 'We must acknowledge how affects bring people together by passing between us, without ignoring the nuanced and differential ways in which the … organisation affects us, and is affected by us, across the corporeal and political registers of social and organisational life' (Pullen et al 2017).

For Dashtipour and Vidaillet (2017), any organisational critique should be founded in the centrality of work in the subjects' affective life. These authors were inspired by the affective, subjective, and embodied experience of *working.* Work is fundamental to human life, and if the context allows, individuals will derive pleasure from it. However, factors may be in place that obstruct working well and create suffering due to the burden of work. Of interest was how suffering can be turned into pleasure, subjective expansion, and freedom at work. Negative affects envelope organisations: they can drag us down, take our energy, and sap the joy out of our lives. Yet individuals can learn how to endure these organisations and allow joyful affective encounters to punctuate it.

Affects involve us in a sociality that springs out of embodied interaction. This sociality includes all the attractions and repulsions, sympathies and antipathies, alterations and expansion that affect all kinds of bodies in their relation to one another (Deleuze and Guattari 1987). This is precisely the sociality that founds organisations. The potential of

any individual depends on embodied interaction with others and the possibilities that develop. Even though we are constantly constrained by organisational attempts to regulate and protocolise us, we are capable of change and innovation (Pullen et al 2017). Affect oscillates and connects (Michels and Steyaert 2017); it holds us together (Anderson 2014) and makes us feel attached (Kenny 2012). Anderson (2014) describes an affective excess; how affect emerges as the 'potentialities' of encounters exceed the forces and processes that mediate them. This excess of affect envelops bodies and keeps them together until the moment of encounter fades (Michels and Steyaert 2017).

Organisations are both enabled and subverted by a complex interplay of affects where disgust (Oaten et al 2018; Hadjittofi et al 2018), anxiety (Gilmore and Anderson 2011), and shame (McManus 2018) are scrambled with pride, excitement, and confidence (Pullen et al 2017). Affect is central to the politics of organisations (Beyes and De Cock 2017). Negative affects such as shame and anger can provide a foundation towards an affective politics; they offer a platform for disrupting the status quo and creating possibilities for change. Such affect is contagious; it turns into a collective that joins individuals with similar experiences. Whilst shame and anger can give way to contempt, there is also the potential for organisational change. Such affects are not simply negative but can trigger radical (but not predetermined) actions. Here, by responding positively, individuals can multiply each other's power through interaction which both exceed and disrupt the organisation (Pullen et al 2017).

Beyes and Steyaert (2011) describe how organisational spaces are in process, alive, and unstable and how they provoke unfamiliar and uncanny affects. These spaces are enacted through an ongoing social process of being together and joint interdependence (Michels and Steyaert 2017). Organisational life is fluid; the duality of affect (Wetherell 2013; Anderson 2014) helps us understand the uncertainties that exist between the extraordinary and the everyday. Affect can stimulate a reaction to a situation, e.g., comfort or discomfort. When a situation is unfamiliar, affect provokes responses such as feelings of unease ('something is not right'). This should prompt the individual to gather more information or engage in more extensive sense-making (Prineas et al 2021). Prineas et al (2021) suggest that this function of affect is like the role of 'hunches' in

instant decision-making. These hunches are affect or visceral points which move us to act (Hickey-Moody 2013).

Affect is a transindividual force of organising; it emerges from and is experienced in encounters among all kinds of bodies, human and non-human (for example noise (Cunha and Silva 2015), colour etc.). Unforeseen individuals and objects can enter the process and fundamentally affect its unfolding. Each body comes with the capability to affect and be affected, and therefore has the potential to alter (Seyfert 2012; Michels and Steyaert 2017). Affect is at work in all corners of the organisation: in the supervisor's office, in meetings, corridor conversations, and during lunch breaks (Michels and Steyaert 2017). Organisational environments such as hospital departments are saturated in colour and affect: fluorescents, neon signs, luminous screen savers, and brightly coloured multiscreen installations. Such a cacophony of colours and affects must have effects; they do something to the settings and bodies that inhabit and pass through them (Beyes and De Cock 2017). Colours strike human bodies. Tints and tones, hues and brightness have the capacity to affect and be affected. Colours are moving, transient, and relational forces that animate matter and influence humans – as Deleuze (2005) wrote - colour is affect.

Studying affect brings both the dramatic and everyday back into social analysis (Wetherell 2012). Something emerges as affect that is unstable and unpredictable that intensifies the senses (Michels and Steyaert 2017). Affect exists in the textured, roughened surface of the everyday (Stewart 2007). Something throws itself together in a moment as an event and a sensation; a something both animated and inhabitable (Stewart 2007). Affect reaches out to an individual during their routine daily life and envelopes them. For Stewart (2007), it is these affects that are the capacities to affect and be affected. They provide organisational life with a feeling of fluid relations, scenes, and contingencies.

A review of the literature relating to affect has demonstrated the evolution of theory from its foundation with Spinoza in the seventeenth century. An affective turn has rekindled an enthusiastic interest and in the field. Whilst the resulting theories are interconnected in many ways (see figure 5), many disparate viewpoints and arguments have emerged.

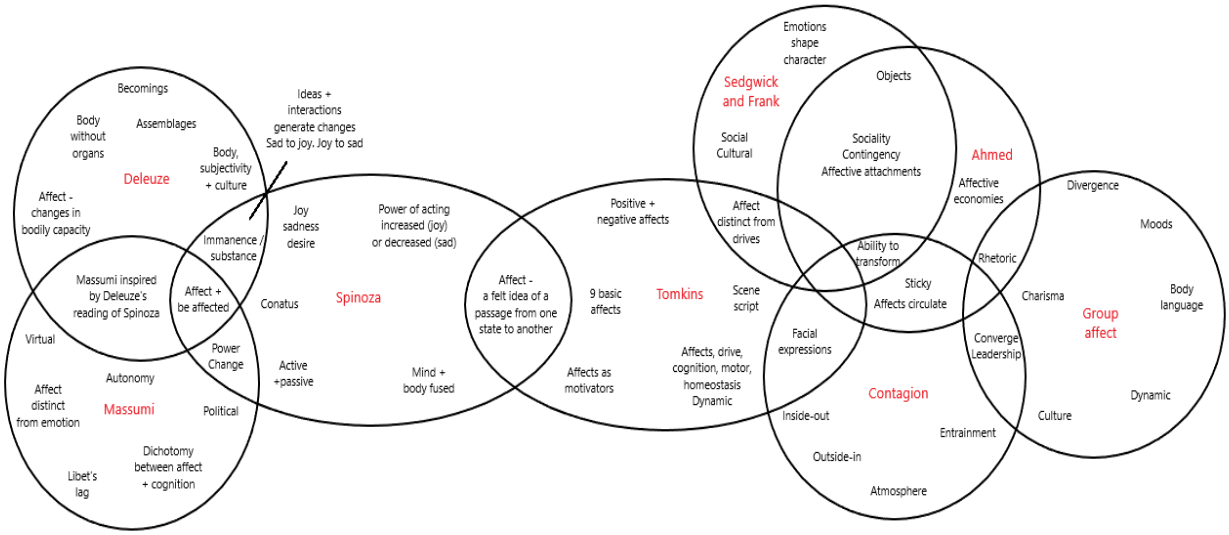


Figure 5. Illustration of interconnected nature of affect theory.

Whilst the turn to affect was founded in the social sciences, interest is growing within contemporary management and organisational studies. As this section has shown, many aspects of affect theory are relevant to organisational life. The organisational and management literature has extracted pertinent points from across the affective theories. A summary of key points from each section of affect theory is provided in Appendix A.

2.4. Conclusion.

This chapter has highlighted the emergence of patient safety as a global health concern. The scale of harm evolving from healthcare processes imposes a huge burden worldwide. Yet an increase in complexity in modern healthcare has seen harm to patients rise further. Individuals contribute hugely to the system, and this human element intensifies its complexity and unpredictability. Humans can devalue complex systems by relying on mental shortcuts to make the simplest decisions. Flawed judgements, decision making, and reasoning have been found to be significant contributors towards errors. Whilst it was beneficial to move away from a blame culture, the move away from a focus on humans towards the system has not resulted in a reduction in harm; errors still occur in healthcare.

The philosophy of Spinoza was revealed to have influenced the work of Deleuze and Guattari, and subsequently Massumi. An understanding of affect is further developed in

examining the views of Tomkins, Sedgwick, and Ahmed. Debates concerning affect in discourse are uncovered, prior to revealing the relationship with materialism. The contagious nature of affect is exposed with its related theories of atmospheres and morale, prior to examining affect within purposive groups. Definitions of the complex overlapping affective states unveiled during the practical aspects of this research are provided; prior to concluding by emphasising the centrality of affect to organisational life.

Several gaps and recommendations were revealed within the literature. The chapter called for greater awareness of the work of affect within clinical situations. Patient safety will be affected by the behaviour of individuals, yet inadequate consideration is paid to the affective states of healthcare professionals. Purposive groups are prevalent in modern organisations such as healthcare settings, and further research is called for at the intersection of group affect and decision-making. The chapter also highlights a lack of qualitative data in the radiotherapy error literature as limiting the potential for learning from other disciplines.

Chapter Three – Research Methodology

3.1. Introduction.

This chapter frames the methodological approaches of the research and outlines the strategy in which the study is undertaken. It commences by detailing the challenges that confront a researcher interested in affect. The section describes the role of reflexivity throughout the research from influencing the philosophical underpinnings selected to the choice of research design. I will then proceed to discuss why qualitative case studies were chosen to answer the research questions, and how the methodological approach would impact on the methods used. The chapter concludes by setting the scene of the empirical focus of the study.

3.2. Affective methodologies.

> A body's affect system is about being affected and able to affect in turn, and thus is all about being in relation to a world populated by other beings and things… In other words, affects arise from social conditions as those conditions are encountered by a being with physiological properties; affect is a body's processing of social conditions, of its context. (Gould 2009)

Developing methodologies for the identification and study of affective processes offers unique challenges (Kenny 2012; Coleman and Ringrose 2013; Knudsen and Stage 2015; Michels and Steyaert 2017). How can we gather data on affect when the idea itself appears too elusive to be collected in conventional methods? (Ayata et al 2019). As I continued to explore the wealth of diverse literature published about affect in the months between ethics forms submission and approval, I found the above quote by Gould (2009) helped focus my thoughts. I engaged in attentive reading to build a persuasive account on how affect could be observed in text, speech, and bodily actions (Gould 2009; Ayata et al 2019).

Blackman (2015) demanded an affective investment in the subject under investigation and considered 'whether we can only do research with which we are already entangled'. In the months prior to the practical elements of the research, I refined my sensitivity to the ways that affect is performed in practices; through 'atmospheres, fleeting fragments and traces, gut feelings and embodied reactions and in felt intensities and sensations'.

Following Gould (2009), I became absorbed in developing awareness of the affective states at play within my own workplace.

As described further by Gould (2009):

> Introspective, emotional self-knowledge allows one to observe and read in a manner that can pick up the unspoken, the repressed, the less-than-fully conscious, the inarticulable. We are all emotional beings and as such have implicit knowledge about feelings, about what gives rise to various feeling states, about what sorts of actions they tend to prompt, and about how they tend to be expressed in various contexts. We also have self-knowledge about inchoate affective states, at least the knowledge that they exist and affect us and some sense of how they make us feel. In addition, because affects always arise in context, knowledge about the context one is studying, coupled with emotional self-knowledge, can point one toward the possible or probable affective states, given the specific historical conditions. In short, then, the opacity and untidiness of affect need not preclude its study.

As advocated by Ayata et al (2019) and Willink and Shukri (2018), I had begun to cultivate affective self-knowledge early in the research process. A catalogue of affects and emotions expressed in the self and in others was documented. Nurturing awareness in this way helped me attend to the affective traces before and during the research interactions. This augmented the exchanges themselves, resulting in richer data, and helped shape the interpretive findings.

3.3. Reflexivity.

The concept of reflexivity has evolved to become a defining feature of qualitative research (Finlay and Gough 2003; Berger 2015; Subramani 2019). The etymological root of the word ‘reflexive’ means to ‘bend back upon oneself’ (Finlay and Gough 2003). In other words, it relates to the thoughtful, self-awareness of the intersubjective relationship between researcher and researched. Reflexivity requires a self-critical lens that allows us to reflect on how our background, assumptions, behaviour, and positioning influence our research (Finlay and Gough 2003). In turning the lens back onto oneself we acknowledge how our own situatedness can affect the setting, the people being studied, and the eventual outcome. Relevant positions include the researchers age, gender, beliefs, biases, and personal experiences. Reflexivity is used to

monitor such positions; credibility of the research is enhanced by accounting for these personal, contextual, and circumstantial aspects of the process (Berger 2015).

Reflexivity has been borne out of an increased awareness of the self in knowledge creation. It challenges the need for independence and objectivity (Berger 2015) and has converted the issue of subjectivity in research from a problem to an opportunity (Subramani 2019). We no longer seek to remove the researcher's presence from a study. Instead, the researcher is recognised as a central actor who actively constructs the selection, collection, and interpretation of data. Thus, subjective research is a joint product of the researcher, participants, and the relationship thereof (Finlay 2003a). The subjectivist epistemological stance of the study will be outlined further in section 3.5.

Reflexivity is a critically conscious process of meaning-making that occurs at all phases of the research (Subramani 2019). Gilmore and Kenny (2015) are mindful of ensuring that reflexivity is significant and not simply relegated to a token 'formulaic afterthought' at the end of the methods section. Gilmore and Kenny (2015) also expose often ignored aspects of the reflexive process that can add value to the research process. An example being the need for researcher attentiveness to their own emotions in revealing important aspects of the observation experience. A further example highlights the power relations between researcher and researched. Researchers can feel powerless by the experience of being immersed in an unfamiliar setting (Gilmore and Kenny 2015). Conversely, reflexivity also addresses power concerns in the opposite direction (Berger 2015). This ethical function situates the researcher as 'non-exploitative' and helps maintain compassion towards the research participants (Berger 2015; Subramani 2019).

The term reflexivity encompasses a broad range of 'reflexivity's' that make it challenging to apply in practice. Reflexivity can be used as a methodological tool for demonstrating the trustworthiness of qualitative research, a scale for measuring quality and rigor, as well as situating the nature of a study. Finlay (2003a) asserts that there is no longer debate about whether reflexivity is needed, but rather how it is done. Various forms will be used throughout this research, such as self-reflexivity during question formulation and interviewing, (Berger 2015; Gilmore and Kenny 2015) plus intersubjective and hermeneutic reflection during data analysis (Finlay 2003b). A journal will be kept for 'self-supervision', and for creating an audit trail of thoughts and decision making

throughout the study (Berger 2015). I will be mindful of how my worldview and background in radiotherapy could affect the way I construct the world, use certain language, pose questions, and filter data that is gathered from participants.

In sum, a reflexive approach ensures that careful consideration is given to concerns ranging from choice of philosophical position to how I conduct myself in the field (Finlay and Gough 2003; Berger 2015; Subramani 2019). Reflexivity increases awareness of the factors that influence these research choices. Attending to the interconnecting relationships between context, epistemology, and methodology enhances transparency in how knowledge has been constructed. That is, being reflexive exposes the knowledge (findings and conclusions) construction process and ensures that the researcher can be held accountable. An understanding of the philosophical approach used in this research will commence with an examination of ontology which asks, '*what exists?*' (Wallace and Wray 2016).

3.4. Relativist ontology.

Ontology describes the 'study of being' (Crotty 1998) and ponders the 'nature of reality and the nature of human being in the world' (Denzin and Lincoln 2005). Debate continues as to whether the nature of reality exists independently of human consciousness and experience, or whether reality exists within our consciousness and only through experience. 'Do things exist independently of our mind, or is our world something constructed from our thoughts?' (Levers 2013).

A relativist ontology believes that multiple realities exist; two people's worlds and experience thereof will be different. Reality is a finite subjective experience, and nothing exists outside of our thoughts (Denzin and Lincoln 2005). For relativists, reality is indistinguishable from the subjective experience of it (Guba and Lincoln 2005); the phenomenon studied will have multiple realities.

> With multiple interpretations of experience come multiple realities—there are as many different realities as there are people. The purpose of science from a relativist ontology is to understand the subjective experience of reality (Levers 2013)

Therefore, methods used to gain knowledge in the social sciences cannot be the same as those required in the physical sciences. Humans interpret their world and then act on

such interpretations while the world does not. Interpretivists adopt a relativist ontology where a single phenomenon can have multiple interpretations rather than being something that can be measured (Hammersley 2013). In recognising that multiple realities exist, attention can turn to epistemology, which questions '*how can we know what exists?*' (Wallace and Wray 2016).

3.5. Subjectivist epistemology.

Epistemology describes the nature of knowledge and helps us understand and explain 'how I know what I know' (Crotty 1998). Epistemological inquiry examines the relationship between the knower and the knowledge and asks how we make meaningful sense of the world (Denzin and Lincoln 2005). Epistemology is important as it influences how researchers structure their research in their attempt to acquire or produce knowledge. Examining the relationship between a subject and object helps us to formulate a research design that will allow us to answer the research questions. Whilst an objectivist epistemology assumes that reality exists independently of the individuals mind, subjectivist research reveals how an individuals' experience shapes their understanding of the world; individuals will impose meaning on the world and interpret it in a way that makes sense to them (Moon and Blackman 2014).

Interpretivist research is conceptualized as having a relativist ontology and a subjectivist epistemology (Levers 2013). Interpretivist enquiry is guided by the researchers beliefs about the world and how it should be understood. Knowledge is subjective, and exists in multiple forms, as interpretations by individuals. In accepting multiple meanings and ways of knowing, interpretivists acknowledge that objective reality can never be captured (Denzin and Lincoln 2005). These assumptions will provide the foundation on which I will study and make claims about the social world. All claims to knowledge must also take account of what is right; that is, what is worth paying attention to, and what is the right thing to do ethically. Axiology concerns the role of the researcher's values in the research practice. For an interpretivist researcher, values inform the focus of the study and its interpretation. These values are emphasised through reflexivity about the impact of the researcher on the phenomena studied (Wallace and Wray 2016). In attempting to examine the 'lived experience' being studied, I recognised that my values and lived experience could never be separated from the research process, especially in

such close interdependent interactions with participants. I acknowledged and described my own values but did not attempt to eliminate them (Ponterotto 2005).

Therefore, in adhering to an interpretivist approach as a researcher I strived to collaborate with the participants and be part of the research. I interpreted the data collected and was therefore never fully objective and removed from the research. As a researcher I was interested in specific conceptualized environments and recognised that reality and knowledge are not objective but influenced by the participants therein. In accepting that such subjective research can be subject to bias, I aimed to understand and interpret meanings in human behaviour as opposed to seeking generalisations (Gray 2014). The following section will introduce the subject of *phenomenology*, which is linked strongly to the philosophical choices outlined and will be integral to this study.

3.6. Phenomenology.

Evidently, phenomenology is the study of 'phenomena'; it is defined as the study of structures of experience, or consciousness. Phenomenology is interested in the appearance of things as they occur in our experience, or the meanings things have in our experience. For phenomenologists, consciousness is experienced from a subjective viewpoint; the field is both distinguished from, and intertwined with ontology, epistemology, and axiology (Smith 2018). Phenomenology has two important historical roots; the transcendental and the hermeneutic (Larkin and Thompson 2011). Transcendental phenomenology, established by Edmund Husserl (1859-1938) aims to identify the core essentials of a given experience through a process of 'reductions'. For Husserl, phenomenology aimed to *transcend* our everyday assumptions; that is, identifying and suspending our assumptions ('bracketing' off context etc.) to get at the *essence* of a given phenomenon, as it presents itself to consciousness. Phenomenology is a school of philosophical study beneath the umbrella of interpretivism. Whilst phenomenology may be descriptive in inclination, it can only ever be interpretive (hermeneutic). During interaction with phenomena, humans interpret them and attach meanings to different actions or ideas and construct new experiences (Larkin and Thompson 2011). How phenomenology and interpretivism are conjoined to analyse the data will be described in the data analysis section (4.10.). Next, I will justify the use of

qualitative data in attempting to interpret, or make sense of, what is taking place in the field.

3.7. The value of qualitative research in healthcare.

Quantitative research is deductive in nature and uses statistical methods to gain an understanding of the relationships between specific variables. Statistics can be used to draw conclusions or generalise findings from selected samples to larger populations. Quantitative methods focus on objectivity and is appropriate when analysing quantifiable measures to discover trends and frequencies (Balvanas and Caputi 2001; Watkins 2012; Queiros et al 2017). In healthcare, quantitative methods such as randomized controlled trials adopt structured procedures and formal instruments to systematically measure the effectiveness of new treatments or interventions and determine if specific cause-effect relationships exist (Hariton and Locascio 2018). Whilst healthcare research has traditionally been founded on quantitative methods, the value of qualitative approaches has gained greater recognition and acceptance in recent decades. The complex nature of healthcare work has meant that a variety of methods are needed to fully understand its intricacies. Qualitative methods can complement and enrich areas of healthcare research not responsive to quantitative methods (Al-Busaidi 2008).

Qualitative research does not concern itself with aspects of reality that can be reduced to quantifiable variables, but instead focuses on understanding the complex dynamics of social relationships (Queiros et al 2017). The purpose of qualitative research is to help us understand social phenomena in its natural settings, whilst emphasizing the means, experiences, and views of the participants (Al-Busaidi 2008). Such research is conducted in environments where people naturally interact, with the detailed words of the individuals studied, documented, and analysed (Berg 2004). In healthcare research, qualitative methods are valuable because of the significance they place on a persons' lived experience. Thus, qualitative methods are well suited to uncovering the meanings that people place on the events and processes they experience in their social environments. Consequently, a qualitative approach is appropriate for a study of affective interactions in healthcare settings. In the following section, I will rationalize the

use of a case study approach to provide the qualitative data needed to answer the research questions.

3.8. The value of case studies in healthcare research.

> A case study is an empirical inquiry that… investigates a contemporary phenomenon in depth and within its real-life context, especially when… the boundaries between phenomenon and context are not clearly evident. (Yin 2003)

The case study is an established research design that is employed in a wide variety of disciplines including business, law, social sciences (Crowe et al 2011) and organisational studies (Baker 2011). The use of the qualitative case study approach has also increased within healthcare research (Luck et al 2006; Boblin et al 2013). The approach is pertinent to the healthcare researcher due to its likeliness to the conceptually (and etymologically) familiar 'case report' or 'case series' that have a long tradition in healthcare practice. Such presentations of detailed critiques aim at providing understanding of aspects of patient (health) care with the aim of illustrating broader lessons that can be learnt (Crowe et al 2011). Like all research methods, case studies can be used to explain, describe, or explore phenomena in the natural context in which they occur (Yin 2003). Case studies investigate real people in real situations (Willis 2007). They rely on inductive reasoning, and by gathering rich detailed data can illuminate the researcher's understanding of the phenomenon being studied.

A review of the case study literature highlighted that the work of Robert Yin and Robert Stake is often quoted in support of this method. However, Boblin et al (2013) emphasised the need to be mindful of the contrasting philosophical orientations that can be applied. For Yin (2003) a postpositivist assumption dictates that reality is objective with the researcher remaining detached and independent to the subject being researched. Yin attempts to control the biased views that can influence case study researchers. Elements of Yin's research is cause and effect oriented with the aim of identifying relationships. Alternatively, for Stake (1995), a subjective reality is an essential part of understanding. This viewpoint of Stake is appealing as I aim to interact with the phenomena with an almost-insider view of what is being experienced. For Stake, the value and bias-laden nature of research is accepted. Findings and interpretation will occur concurrently, with interpretation being the primary method of

understanding. Therefore, the case study has broad methodological flexibility that can respond to the complexities of real-life healthcare settings and offer a 'bridge across the traditional research paradigms' (Luck et al 2006).

Stake (1995) provided a detailed taxonomy of three main types of case study: intrinsic, instrumental, and collective (multiple). An intrinsic case study is used to develop knowledge about a uniquely distinct phenomenon. An intrinsic case is selected because of its genuine interest to the researcher rather than because it is representative of all other cases. This contrasts with an instrumental case which uses a 'typical' example to gain a broader understanding of a situation. Distinct from the intrinsic case, there is less significance placed on selecting a particular case for an instrumental study. A collective case study involves the study of multiple cases either concurrently or sequentially to generate a broader comprehension of an issue. The careful selection of multiple cases allows clearer understanding to be made. However, Crowe et al (2011) illustrate that the three types are not mutually exclusive categories; individual studies can develop into other types of case study as data is generated. From these categorizations, I can understand that my research would be described as intrinsic in that I will be specific in the type of case I carefully select for investigation. Also, the desire for improving patient safety practices will mean a more collective approach will be demanded. Multiple cases will provide a 'better understanding, and perhaps better theorizing, about a larger collection of cases' (Stake 1995).

With the aim of developing a comprehensive understanding of a phenomenon, a case study approach encompasses the collection of multiple sources of data. Multiple sources of data collection, from qualitative techniques such as interviews and document analysis is referred to as data triangulation. Approaching the phenomenon from different angles in this way can reveal convergence and corroboration in the study (Bowen 2009) and help provide a holistic picture of the issue (Willis 2007). Being holistic supports the concept that much of what we know about human behaviour can be understood as lived experience in a social context. Using multiple sources in this way has been advocated as a means of addressing issues of validity and reliability in a qualitative study (Crowe et al 2011). By triangulating data, the researcher aims to present 'a confluence of evidence that breeds credibility' (Eisner 1991).

Case studies have been used previously to develop knowledge in the fields of patient safety and affect. Padgett et al (2017) used a qualitative single case study design to explore the perceptions and experiences of nursing and respiratory staff at a subacute Medicare facility in the United States. This design was appropriate because the researchers wanted to investigate if strategies introduced within the institution were useful in reducing risks to safety. Cresswell et al (2013) employed multiple case studies to examine a purposefully selected diverse range of professionals involved in the provision of undergraduate patient safety education. In an institutional case study of a newly established emergency department, Pedersen et al (2018) discovered that a lack of communication and collaboration existed between the staff of different departments. The study provided an illustrative example of how contextual and situational factors can affect the work environment and ultimately patient safety. Outside of the healthcare domain, James and Jones (2008) undertook a single instrumental case study to examine the experience of affect in response to organisational change within an educational context.

A definitional flaw has been to confuse case studies with ethnographies (Yin 2003). As Willis (2007) suggests, case studies and ethnographies are more similar than they are dissimilar. However, on scrutinising their key features, clarity was gained as to the differences between these two methods. An ethnography describes a detailed study of people and cultures where the researcher spends a considerable time immersed in the field. Conversely, the focus of a case study is a single event or situation of interest. As the focus of this research is on the affective processes when an error event occurs (rather than a long-term study of these interactions over an extended period) a case study is appropriate to answer the research questions that have been formed.

Despite the increased acceptance of case study research in healthcare and other fields, limitations of this method remain. As highlighted previously, followers of Yin (2003) would lament the bias of the researchers own subjective feelings, and a lack of scientific rigor in those demanding generalisation. Also, the volume of data required and depth of analysis of qualitative data needed could result in a time consuming and expensive study (Baxter and Jack 2008). A final limitation of case study research is often the challenge of gaining access to relevant participants from whom data can be extracted. To overcome

this issue, I am fortunate in that I can engage with professional contacts within the field of radiotherapy to approach research sites that may otherwise have been inaccessible. This chapter will conclude with a section that introduces the environment in which the research has taken place, and the key participants in the process.

3.9. Setting the scene – the Radiotherapy Department.

This study is situated in the clinical setting of a radiotherapy department. Radiotherapy departments are a typical example of a complex hospital environment, the complexity of which can lead to unintentional errors (Potters et al 2015). Radiotherapy uses ionising radiation to treat malignant disease (cancer) and other benign conditions (SOR.org, 2018a). A multi-step process is employed that requires multi-disciplinary involvement at all stages of the pathway (Donaldson 2007), with new technologies and techniques continuously introduced. Radiotherapy is described as a complex sociotechnical system that combines hardware, software, and human operators (Potters et al 2015). Combining technical and human (social and cultural) components in this way can introduce quality and safety issues (CIEHF 2016; Higham and Vincent 2021). Errors can arise due to the interaction between these different elements.

Therapeutic (Therapy) Radiographers are specialist healthcare professionals qualified in the planning and treatment of diseases using radiotherapy. Radiographers provide technical expertise and support whilst ensuring that accurate planning and treatment is provided. Accuracy of the Radiographers' work is critical, with the aim often to eliminate disease whilst minimising damage to surrounding healthy tissue (SOR.org, 2018b). Radiotherapy has an excellent delivery safety record with the chances of being injured extremely low. However, whilst being a relatively safe treatment modality, errors can still occur which can have significant consequences to the patient. As with all organisational settings, a wide range of human and systemic measures are put in place to lower the risk of errors occurring and to mitigate the consequences if they do. If an error does occur, the human and systemic background to the error is investigated. PHE (2016) advocates this viewpoint, in that while the immediate cause of an error can be a specific action or omission, closer inspection can often reveal a series of departures from safe practice.

3.10. Setting the scene – NHS challenges.

The NHS is a complex healthcare system that faces various inter-related challenges such as insufficient funding, staff shortages, a backlog of patients exacerbated by covid, and an ageing population (McKee et al 2021). Radiotherapy departments are not exempt from these same issues seen across the NHS. Underfunding and poor planning by governments across the UK, has resulted in insufficient up to date equipment to treat cancer in a timely way. As demand for healthcare services continues to rise, inadequate funding puts additional pressure on resources and leads to increased waiting times and an inability to invest in new technology.

Equipment failures

Chronic underinvestment in radiotherapy, coupled with crippling bureaucracy has resulted in the inability to commission new technologies. This has resulted in many centres using older inefficient equipment that reduces capacity (Radiotherapy UK 2022). Older equipment has a higher risk of failure and breakdown and can lead to crucial delays and interruptions to patient treatments. Also, operating costs will be higher in older equipment, with maintenance often difficult due to the unavailability of parts (Brkljačić et al 2014). The many complex mechanical components of a linac undergo wear and tear from their sustained use. Faults to these components can be disruptive and can require repair by engineers before treatment can resume (Agnew et al 2021). Such interruption can be stressful for patients and have a detrimental impact on staff workload (Wojtasik 2020).

Busy departments

Waiting times for cancer treatment have steadily increased since 2013, with the covid pandemic exacerbating the existing backlog of patients (Price et al 2022). Clearing the backlog requires additional resources that increase capacity and provide efficient patient pathways. An ageing population has resulted in an increased incidence of complex conditions such as cancer which require specialist treatment. Early-stage cancers are often being curable, and the resulting drive for earlier diagnosis has increased demand for radiotherapy (Radiotherapy UK 2022). The pressures caused by this increased demand has resulted in stress, burnout, and low morale; and presents a threat to staff

retention (Thomsen 2023). A common means for radiotherapy departments to increase capacity to meet this demand is to work shifts or extended days (Routsis et al 2006). However, the risks of working shifts are well recognised (Westwell, et al 2021). Shift working upsets the body's natural circadian rhythm, is disruptive to sleep, and ultimately affects the health and wellbeing of healthcare professionals. Fatigue associated with sleep deprivation can result in reduced productivity and impact on patient care and safety.

Staff shortages

Significant staff shortages are being experienced throughout UK radiotherapy departments. In 2021, an 8% shortfall of Therapy Radiographers existed in the NHS, with a shortfall of Clinical Oncologists expected to reach 26% by 2026 (Thomsen 2023). A failure to recruit and retain a sufficient number of specialist cancer professionals has resulted in significant challenges and has led to delays in treatment (McKee et al 2021). The shortfall in the radiotherapy workforce worsened during covid (Thomsen 2023) and added to the exodus of specialist healthcare staff following Brexit (McCarey 2023). Low staffing puts pressure on the existing workforce and leads to increased workloads and compromised care (McKee et al 2021). Workforce shortages also limits development opportunities which impacts on the skills and experience of the remaining staff. Low staffing equates to greater levels of sickness in the existing workforce (McKee et al 2021). Absence related to anxiety, stress, and depression increased by 26% between 2019 and 2022. Therefore, sickness absence disrupts patient care and is also associated with a higher likelihood of the workforce leaving the service (Palmer and Rolewicz 2023).

Agency staff

The need for agency (locum) staff within radiotherapy is complex. Fluctuating demand for the service and staff absence can exacerbate staff shortages. Therefore, agency staff is considered an ad hoc response to recruitment issues and ensures that care is uninterrupted. Additionally, the shortage of permanent staff increases the reliance on specialist locums in fields such as radiotherapy. Whilst agency staff can provide a crucial role, their financial cost is substantially higher than permanent staff. Agency staff in radiotherapy demand higher pay than their permanent colleagues due to their

temporary nature. The excessive expenditure provides several notable challenges. High agency costs can impact on funding to other critical areas such as equipment procurement. Frequent turnover of temporary staff can lead to a lack of continuity of care. Unfamiliarity with local departmental procedures can impact on patient satisfaction and the quality of care provided. Also, a reliance on agency staff can lead to low morale amongst permanent staff who will be aware of the inequalities in pay and benefits. An increased likelihood of conflict between permanent and agency staff exists. Permanent staff can feel pressurised by the need to constantly supervise agency staff, often without adjustment to their own workload (Runge et al 2017; Dorney 2024)

New graduates

Efforts to address staff shortages in recent years has seen a greater number of graduate Radiographers entering the workforce (SoR 2021). However, having a high number of inexperienced staff in the workplace presents new challenges in the short-term. Radiotherapy is complex and it will take several years before these graduates gain comprehensive experience. Newly graduated staff need supervision which adds to the pressure of the existing staff who must combine this supervision with their own workload (van Dam et al 2023). Also, as healthcare systems strain under the pressure of reduced staffing and increasing workloads, inexperienced staff can feel anxious, under pressure, and unsupported if not supervised sufficiently (Friary et al 2023). Finally, inexperienced staff may feel unable to raise patient safety concerns if witnessed.

3.11. Chapter summary.

In summary, this chapter has positioned the methodological framework employed in investigating how affect can influence human error in clinical practice. The chapter commenced by outlining the challenges and opportunities of studying for affect, and the necessity for reflexivity in qualitative research. Reflexivity was found to be integral to the thorough deliberation of philosophical assumptions and research options. The section proceeds by outlining the philosophical constituents of ontology, epistemology, and axiology and how they provide a basis for the study. A relativist ontology was found to recognise that multiple realities can exist, with two individual's perceptions of the same event being different. A subjectivist epistemology revealed how a person's experience influences their comprehension of the world. I also considered how my

values and experience could never be truly detached from the research process. These components were all found to be intertwined and linked to the relevant field of phenomenology, the study of structures of experience. Together, these elements informed the methods used for generating data. The chapter progressed by outlining and justifying the reasons why qualitative data and a case study approach were chosen to answer the research questions. In drawing a conclusion to the section, I set the scene for the environment in which the study will be located and introduced the principal actors that will participate and the inherent challenges they face. In the following chapter, Chapter four (Methods), I will commence by building on the foundation which has been set within this chapter, by outlining what takes place when an error occurs in a radiotherapy department. The chapter will proceed by describing the technical and practical components of the methods used.

Chapter Four – Methods

4.1. Introduction.

This chapter continues to outline the methodological background of the research. In building on the previous chapter, I will describe what happens when an error is discovered in a clinical setting such as a radiotherapy department. I will also demonstrate how this investigation process has been developed to identify the affective processes taking place. In the previous section, I described how the methodological choices made influenced the methods required to obtain knowledge. Here, a timeline of events is presented, before a detailed discussion on how each method was employed in distinguishing the role of affect. This section will introduce the ethical implications of applying the methods used in the research design of this study. Features of the participating sites and individuals will be described, prior to concluding with a discussion of how the data was analysed.

4.2. Discovery of an error in radiotherapy.

Following the discovery of an error in high-risk industries such as radiotherapy, a safety investigation takes place. This can be a relatively straightforward process following minor incidents or can be more comprehensive for errors judged to be significant (See section 4.6. (Participation inclusion criteria)). The London Protocol (Taylor-Adams and Vincent 2004) methodology remains well aligned with international, cross-industry best practice in the analysis of clinical incidents (Forsyth 2016). That is, statements are collected from those involved as soon as possible after the incident has occurred. This information is supplemented with interviews to 'allow the members of staff to effectively collaborate in the process of investigation and analysis' (Taylor-Adams and Vincent 2004). Adhering to the London Protocol results in rich data being obtained from proven case study methods such as document review and interviews. However, authors such as Knudsen and Stage (2015) called for new and innovative ways of identifying affect. In accordance with Ayata et al (2019), expanding the 'methodological boundaries' will enable us to be more permeable and open to affecting and being affected. After deliberation, memory work was integrated to complement the other methods and add a further layer of data.

The aim of the investigation process is to identify the cause(s) of the error, with the purpose of preventing similar errors from reoccurring. A record is made of the investigation and the subsequent findings (CQC 2020). For significant incidents, an investigation report is produced and sent to the appropriate enforcing authority (e.g., Health Inspectorate Wales). For less significant incidents, an internal investigation will take place that ascertains any local lessons that can be learnt. Guidance from Taylor-Adams and Vincent (2004) states that establishing the timeline of the incident is important. Therefore, a narrative chronology of events is provided in the final investigation report that records the details of significant errors.

4.3. Chronology of methods used.

At the outset of the research, the original methodological intention was to seek involvement in a 'live' error investigation. That is, following confirmation of capacity and capability in the host sites, I requested to be notified by the respective safety specialist following the identification of an error. As noted previously, the safety specialist would obtain written statements as soon as possible from each team member directly involved in the error. On receipt of the statements, the safety specialist would review the submitted accounts for evidence of a human (as opposed to technical etc.) cause. If a human element was evident, it was agreed that the safety specialist would approach potential participants about their willingness to participate in the research study. Following informed consent, it was anticipated that I would analyse these witness statements, prior to engagement with the remainder of the investigation process. At the next stage of the investigation, the team members involved in the error would each be interviewed by the departmental safety team. I intended to observe the questioning of the team members involved in the error to gain evidence of the local practice of error investigation in the work environment. Following this observation, I planned to ask the Radiographer interview questions of my own pertaining to affect. Following the thorough examination of the data, I proposed to moderate a reflexive focus group session involving myself as researcher, the safety specialist, and the Radiographer team member(s) involved in the error. The objective of this focus group was to encourage the participants to collectively discuss various aspects of the error with the aim of collecting a further level of rich detailed data (Carey and Asbury 2012; Barbour 2018).

However, during the second year of the research it became evident that these methods were proving unsuccessful in obtaining relevant data. Despite being notified by the safety specialists of errors in the host sites, it was proving difficult to secure Radiographers willing to participate in the research. On reflection, it was understandable that these healthcare professionals would be feeling emotional and self-conscious following their involvement in an error. Following consideration, an alternative approach emerged that was sensitive to the participants in avoiding the rawness of being involved in a 'live' error investigation. Instead, it was decided to utilise investigation reports and witness statements to access errors that had happened in the past. This was acceptable, and many final PhD studies will differ greatly from the initial proposal (Petre and Rugg 2010). It is typical to reframe the research on multiple occasions, reformulating research questions, and abandoning unproductive ideas, whilst integrating new insights discovered in the field. This was all greatly reassuring and provided great development as a researcher.

Memory work was used to help the participants recall these past events. Also, a video recording (appendix H) of a presentation was produced to outline my background as a Radiographer, my experience in error investigations, and the purpose of the research. This video recording was significant in helping to building trust with the potential participants. These modified methods were successful in acquiring participants who were willing to discuss the sensitive subject of their involvement in human error. Therefore, the following table 1 will add clarity by outlining the methods used in the research process. Whilst separate sections have been illustrated for document review, interviews, etc., it is important to note that these methods (and the ethical implications thereof) have not been performed in isolation. Each approach informed and impacted on each other in different ways. That is, being attentive to affect within the document analysis was the same as that used when examining the interview recordings and transcripts (see section 2.3.3.). Therefore, as described by Ayata et al (2019), the interactions and reflections will merge into an affectively charged assemblage of data.

The error investigation report.

As noted, the safety specialist within the host site obtained written statements as soon as possible from each team member directly involved on identification of an error. These statements form part of an investigation report that identifies the cause(s) of the error and recommends actions to prevent similar errors from being repeated. Following the investigation process, the hospital (via the safety team) submit the investigation report into significant errors to the appropriate enforcing authority no later than twelve weeks after the incident was discovered (CQC 2020). These reports are retained within the host sites' quality system for future reference.

The safety specialist reviewed past investigation reports and examined the embedded witness statements for evidence of a human (as opposed to technical etc.) cause. If a human element was evident, the safety specialist approached potential participants about their willingness to participate in the research study. If interested in being involved, participant information sheets (Appendix B) and a video recording (Appendix H) were provided to the Radiographers which clearly described the purpose and outline of the study. This ensured that the participants had sufficient time and knowledge to decide about taking part in the research. On providing a willingness to participate, the host safety specialist shared the potential participants' contact details with me.

Informed consent

On confirmation of a willingness to engage with the research process, informed consent was obtained from the Radiographer participants in line with guidance from HRA (2017). As a result of the covid-19 pandemic, adoption of contemporary approaches to consent had become universal (Gaba and Bhatt 2020; Thunberg and Arnell 2021). Therefore, I was able to explain the details of the study and obtain informed consent via university licensed video conferencing services (for example, Microsoft Teams) where in-person consent was impractical. The consent was recorded in writing on separate consent forms for each element of the research (Appendix C). The participants were given at least 24 hours after signing the consent form before the research commenced. This provided the participants

with adequate time to reflect fully on the implications of taking part in the study and ask any questions they may have had.

Informed consent also made clear that it was being requested that data be recorded via audio or audio-visual means. If audio-visual recording was not deemed acceptable by the participant, permission to use only audio methods was sought. The researcher was aware that visual recordings carry a higher risk than audio recordings in terms of anonymity and confidentiality (Allen 2017). I ensured that all data collected complied with the Data Protection Act and code of confidentiality as illustrated in the Cardiff University protocols. To protect against the loss of data, recordings were stored securely and confidentially on Cardiff University One drive files. University protocol was to upload files as quickly as possible to a university password protected computer and store these on a secure drive such as Cardiff University One drive. If for any unavoidable reasons the data needed to be stored temporarily on a laptop or other device, the data was encrypted then transferred to the University One drive at the earliest opportunity.

<u>Document review.</u>

Once I had secured informed consent from the participants, the host safety specialist shared via email the relevant error investigation report and witness statement document(s) obtained from the Radiographers directly involved in the error. The data was handled on an anonymous basis. I requested that the local safety specialist assigned a code or pseudonym to each participant as soon as possible to anonymise the data prior to sending the document to me via email. I also ensured that any personal details relating to these codes / pseudonyms were communicated and stored separately.

The study commenced in following a qualitative document analysis approach of the statements. A written or typed account outlined the Radiographer's recollection of events along with any background information that could be of relevance. Each statement contained details such as the sequence and timing of events, an account of the participants' involvement, along with any issues or problems faced. The contents of these documents were used to guide the interview questions (Taylor-Adams and Vincent 2004).

As I, as the researcher, was not present in the clinical area when the error took place, these sources of data were valuable in capturing the Radiographer's memories of events.

As the researcher, I demonstrated the ability to separate pertinent information in the statements from that which was not relevant to the study (Corbin and Strauss 2008). In this research, documents were used to allow me to intrinsically select a case for study. Errors in complex clinical environments such as radiotherapy departments can occur from a diverse range of reasons. On receipt of the documents from the safety specialist, I would examine the statement and check for human (rather than technological etc.) elements and for the expression of traces of affect. On confirming a relevant case, a more thorough examination of the data was carried out. I was mindful to review and evaluate the documents in a method where empirical knowledge could be produced and understanding developed. As described by Bowen (2009), 'as the subjective interpreter of data contained in documents, the researcher should make the process of analysis as rigorous and as transparent as possible'. I made written notes of my thought processes and decision making during this crucial part of the research.

The use of document analysis is discussed further in section 4.4.1.

Memory work

As the relevant errors could have taken place months or years previously, I asked the participants to recall their memory of the event prior to the interview. I informed the participants that I would ask them to verbally recall their memory of the error prior to commencing the interview. Whilst this approach would provide some overlap of responses, it was important to gain a thorough understanding of the participants' experience of being involved in human error.

The use of memory work is discussed further in section 4.4.2.

Interviews

The document review was supplemented by interviewing the participants via university licensed Microsoft Teams. Prior to commencing the interview questioning, the participants had been asked to verbally recall their memory of the error. Subsequently, interview questions were asked to each Radiographer that focused on affective processes

(Appendix I). Semi-structured interviews were employed using open-ended questions as a means of engaging with the individuals involved in the error. I was mindful of how power imbalances can occur between interviewer and interviewee (Anyan 2013). To this end, I aimed to keep the interaction as conversational as possible. Also, prior to the event I corresponded with the participant(s) in a courteous manner, explained my role as a researcher, and outlined the nature of the interview. I was aware of the need to rapidly develop a positive rapport and establish a safe and comfortable space for sharing the interviewee's experience. These steps helped to reduce the uncertainty and stress levels for the participants and enabled productive interaction (DiCicco-Bloom and Crabtree 2006). Learning from Ayata et al (2019), I employed a gradual approach to enquiring about personal memories that could invoke intense emotional or bodily reactions. Revisiting the past and remembering significant moments (such as an error) alongside its corresponding feeling may be uncomfortable for the participants.

It was important to plan when the interviews took place to maximise their productivity. I scheduled interviews early in the day to ensure that energy levels (in the researcher and participants) would be at their highest. Whilst I could not control where an interview took place, I suggested locations that were quieter to minimise distraction and drains on the participants' attention. I wanted to maximise the empirical data produced by the interview by enhancing the ability to be 'present' in the encounter (Brennan 2004; Willink and Shukri 2018). Being present enhanced my ability to remain focused throughout the whole interview. Remaining focused on the present allowed me to be aware of affect within the live encounter of the interview. Following Willink and Shukri (2018), being 'present' and aware of affect was something that I had practiced continuously in the months leading up to the research. By cultivating my capacity to harness and sustain attention, I was able to educate the senses through attuning to the sensory 'fleshy languages' that could impact the interview. Honing these capabilities over time helped prepare me for understanding what was happening in the interview.

Ayata et al (2019) emphasised that cultivating an awareness of affective intensities encourages greater attentiveness to the non-lingual dimensions of the interview. Likewise, Knudsen and Stage (2015) also advocated attending to bodily expressions during the

interview process. Affect resides between bodies, objects, and the atmosphere (Willink and Shukri 2018). Therefore, I was attentive to the description of bodily states that could reflect the immediacy of affect. When enquiring about the memories of the feelings felt at the time of the error event, I was mindful of how these 'narratives often reverberate the affective intensities of the past moment' (Ayata et al 2019). According to Stewart (2007), past scenes have an *afterlife* that cannot be contained; affect residing in memories have the capacity to shape the interview. Past affective traces re-emerged in the unfolding of the interview, with '… affect reverberating through the words and the human bodies' (Willink and Shukri 2018). Memories expressed themselves not only through content, but through tonality that affected the dynamic atmosphere (Manning 2013). I remained sensitive to the different tones that were brought to the surface of the interview.

The use of interviews in research is discussed further in section 4.4.3.

Table 1. Chronology of methods used.

4.4. Discussion of methods used.

This section will discuss the methods used in the previous chronological section (4.3). Further detail will be provided on each method, why each technique was employed in this research, and evidence of use in other relevant studies. Each discussion will conclude with a recognition of the challenges that are inherent in the use of each method. Awareness of these limitations helped the researcher to enhance the quality of the research.

4.4.1. Document analysis.

Document analysis refers to the systematic process of selecting, reviewing, and evaluating documentary material (Bowen 2009; Love 2013; Rapley 2018). Comparable to other forms of qualitative research methods, document analysis demands that data is examined and interpreted to develop empirical knowledge. Examples of documents used for methodical evaluation include diaries, organisational reports, and public records (Bowen 2009). Documents are useful sources of contextual information about past events that cannot be directly observed (Stake 1995; Boblin et al 2013). That is, they contain text that has been assembled without the researchers participation (Bowen 2009). Document analysis merges features of content and thematic analysis (Bowen

2009). Content analysis describes the organisation of information relating to the research questions. Whereas thematic analysis refers to the sensitive, more focused review of the data where emergent themes relating to the phenomenon are extracted. In gaining a deeper understanding of the document, codes and categories were formed to supplement and inform the other methods used (Stake 1995; Boblin et al 2013).

Document analysis has been used previously in research examining affective processes as well as research with safety themes in healthcare. The method was applied by Hite et al (2018) as part of a study that examined students' affective states when learning and processing new material. Glinsner et al (2018) completed a document analysis of organisational data used in the regulation of employee conduct at several public employment agencies in Europe. Document analysis of 'affective competences' guided subsequent observations and semi-structured interviews which examined perceptions of gendered affective work practices. Document analysis has also been utilized to develop quality indicators in healthcare settings. Linton et al (2019) undertook a qualitative document analysis approach in response to the type of data (guidance documents and business cases) and the availability of rich, relevant, and uncollated resources. Content and thematic analysis were exercised to provide a framework used for directing the allocation of resources. Brummell et al (2021) also employed a document analysis method to study an NHS safety improvement programme. Thematic analysis was used to describe the quality of reporting, descriptions of lessons learnt, and accounts of actions taken.

There are several potential limitations to using document analysis as a research method. Bowen (2009) reminds researchers that they must remain attentive to the point that the documents were produced for a purpose other than research. Consequently, they may not provide sufficient detail to answer a research question, or in the case of this research, guide me towards a potentially significant case. Retrievability of documents can be difficult, or as noted by Yin (2003), access to organisational documents relating to specific events or individuals may be blocked. However, given the efficiency and cost-effectiveness of the method, it is likely that document analysis offers advantages that outweigh these weaknesses (Bowen 2009).

4.4.2. Memory work.

The memory work of Haug (2008) focused on the act of remembering one's own experience as a method of uncovering social meanings. Memory work is beneficial in that it enables the researcher to tap into the past and has been applied in diverse fields of research including sociology, psychology, education, and management (Onyx and Small 2001). Memory work, as a method for qualitative research, is not conceived as a set of fixed unchanging practices (Stephenson 2005; Haug 2008). Instead, memories are formed and analysed according to the following flexible guidelines: a memory of a specific event is noted, in the third person, in as much detail as possible, without the immediate import of interpretation or self-explanation (Stephenson 2005).

Examination of a particular event in this way aims to uncover alternative meanings and overlooked practices. Writing (or remembering) in the third person invites participants to observe aspects of themselves. As Stephenson (2005) eloquently asserts 'Rather than simply perform coherent selves and affirm our own practices, it serves to release us from self-justification'. Memorizing in the third person allows us to stand back and think about our experience; this separation creating a space for interrogation. Providing the richest description possible, including seemingly inconsequential detail with the avoidance of explanation avoids the production of a '[self]-justified account which resists unravelling' (Stephenson 2005). Instead, detailed accounts of memories were formed that were open to analysis.

Memory work adopts a hermeneutic approach to knowledge production; knowledge constructed by this method is interpretative and reflexive (Willig 2008). Memory work therefore aligns itself well within (or as an alternative to) IPA research in addressing questions of experience. Chang-Kredl, Wilkie and Ghaznavi (2016) incorporated memory work into an IPA study that examined the lived experiences of participants within an educational setting. Cromby (2012) also highlighted the use of memory work in the study of affect. The use of memory work was also evident within the healthcare literature, with Hammond et al (2016) employing the method in a study of professional identity within a group of physiotherapists.

However, Cromby (2012) asserts the problem that memory work (as well as IPA and other qualitative analyses) 'strongly emphasise language, and so implicitly privileges a

realm of rationality, reflection and presumed control'. Requesting that participants write an account of the past event can also serve to exclude some potential participants. For those lacking in literacy skills, the prospect of writing can be disconcerting (Stephenson and Kippax 2017). Therefore, when requesting each participant to recollect their memory of the error event, writing an account was used as a suggestion rather than an instruction to stimulate the memory prior to the interview.

4.4.3. Interview.

Kvale (1983) described how the purpose of the interview in social research is '…to gather descriptions of the life-world [experiences and understandings] of the interviewee with respect to interpretation of the meaning of the described phenomena'. An interview is a conversation used for research processes that enables a researcher to access the lives, experiences, and opinions of others (Brinkmann 2013). Talk of affects, emotions, or atmospheres are ordinarily disregarded as a disturbance to the objectivity of the data (Ayata et al 2019). Yet, research on affect aims to challenge the importance of rationality; both in theory and in method. How then, can we consider interviews beyond the comprehension of them as straightforward conversations? Ayata et al (2019) and Willink and Shukri (2018) propose a turn to the interpretative research paradigm will allow us to consider the affective and relational dimensions of the interview process. Instead of disregarding the glimmers of affect as disturbing factors, these moments of embodiment and intensity between the interviewer and interviewee should be considered as part of the interview process. The visceral, yet fleeting shifts in energy can influence an event or encounter; affect animates the interview (Willink and Shukri 2018). To understand live, relational events such as interviewing, there is a need to attend to the senses and embodiment in interpretation and analysis.

Interviews are emergent, they 'are shaped by the people, objects, atmosphere, and affective tonalities'. Interviews unfold 'relationally between bodies, memories, language, and the environment that affect, and are affected by one another through the transmission of [conscious and unconscious] affect'. Affect connects the interviewer, interviewee, the site, the future, and the past (Willink and Shukri 2018). As an interviewer I was aware that I was not separated from the interviewing experience.

Instead, I was caught up within the unfolding of the event, the words and movements, the atmosphere, all working together to animate the interview.

> …an interview is not limited to the moment in which it actually occurs, but rather spans a constellation of different affective temporalities (Ayata et al 2019)

Ayata et al (2019) describe the qualitative interview as an affective encounter, where a dynamic relationship between interviewer and interviewee is shaped by discrete relational intensities. These intensities can unfold and develop prior to the event. Therefore, the interview 'conversation' should be viewed as part of a broader process. A systematic approach where data concerning the settings, individuals, and contexts requires careful interpretation. I was mindful to document the dynamic thoughts and interactions that occur prior, during, and after the interview conversation. The notes, records, and reflections regarding the affective dynamics were used to help contextualize the interview beyond a mere analysis of the interview transcripts.

Benefitting from my professional background, I am relatively experienced at turning error investigation interviews into rich written texts. Willink and Shukri (2018) highlight however, that we seldom devote the same rigor, detail, and interpretive resources into analysing the affective dimensions of the interview. Whilst the words expressed are important, I also attended to the silences, openings, and sudden strange feelings that imposed themselves (Ayata et al 2019). That is, the responses that particular words, tones, sidesteps, and memories inspire (Willink and Shukri 2018). A glance, a memory, or certain words can change the pace or shift the tone of the interview, often in unanticipated ways. Being attuned to the affective, I developed an ability to feel, to register, and to sense the otherwise imperceptible dynamics of the interview. How something *feels* can be as insightful, if not more insightful, than the transcribed text itself (Willink and Shukri 2018). Emulating Stewart (2007) I was open to the ways in which 'rhythms, valences, moods, sensations, tempos, and lifespans' can influence the interview. When attending to the interview transcript, I added aspects of the non-verbal notes made during the conversation (Ayata et al 2019). The notes expressed the atmosphere and extra layers of data that occurred at a non-verbal level between the interviewer and interviewee. These layers offered '… a glimpse of the affective attachments that develop… and illustrate the embodied and affective narration…'.

Willink and Shukri (2018) progressed this concept as being attuned to the body's relation with other bodies, objects, environments, pasts, and futures.

Graziotin et al (2015) used face-to-face open-ended interviews as part of a study to make sense of software developers perceptions, experiences, interpretations, and feelings. The research was used to broaden understanding of affect experienced while programming and the impact these affects had on programming performance. Semi-structured interviews were employed by Tamminen et al (2016) to understand the perceptions of athletic teams' individual and shared emotions. This study demonstrated how the team was affected by events or 'stressors' experienced in an individual; the expression of affect in an individual was also perceived to impact on the functioning and performance of the team. Padgett et al (2017) also applied the use of semi-structured interviews alongside document reviews. Semi-structured interview questions were used 'to allow flexibility and consistency' in examining a change of safety culture and subsequent patient safety improvements within an organisation.

Like other research tools, interviews can be fraught with weaknesses. Whilst interviewing is among the most prominent methods used in research, it can be deceptively difficult (Alshenqeeti 2014). An interview can elicit subconscious biases; as a social interaction, the participants' response can be influenced by the interviewer's characteristics such as gender, age or appearance. Conversely, the interviewer can subconsciously express their own attitudes, opinions, or expectations by means of tone, verbal, or non-verbal communications (Clark et al 2003). Conducting research using interviews can be time consuming in both data collection and subsequent transcription and analysis. The open-ended nature of the questioning can produce responses that are difficult to code. Interview studies also lack anonymity which can provide apprehension for the participants. I was therefore conscious that involvement in an error in the workplace is a sensitive subject that some participants may find difficulty in talking about freely and honestly.

4.5. Ethical responsibilities.

Research undertaken in healthcare settings demands that we consider the ethical implications of the entire study. Research can be harmful to those involved, be that the researcher, the participants, the university, or the organisation in which it is situated

(Stevenson et al 2015). Therefore, mechanisms were put in place to protect the rights, safety and wellbeing of all the relevant entities (HRA 2021).

Each method contained distinct concerns that potential participants would need to be informed about and merited consent. Firstly though, participant information sheets were provided for the Radiographers involved in the error (Appendix B). Information such as the purpose and outline of the study were presented so that each participant had adequate time[28] to decide whether they wished to take part in the research. Clarity was offered about the steps that would be taken to ensure that all data provided and recorded was stored securely and confidentially. One concern was raised by the university ethics committee that the Radiographers involved in the error may feel pressurized by the safety specialist to participate in the study. I discussed this concern with the safety specialists in advance, with the aim of managing such an issue sensitively. If interested in participating, it was advised that I should approach each Radiographer about their willingness to take part in the study. As involvement in a human error can be a sensitive subject to talk about, I was mindful not to coerce the Radiographers into involvement in the study if they did not wish to do so.

On ascertaining a willingness to be involved in the study, separate informed consent was obtained from each participant. The consent was recorded on separate consent forms for each method used (Appendix C). All participants were provided with at least 24 hours after signing the consent forms before the research commenced. This provided adequate time for the participants to withdraw from the study if they decided that they did not want to be involved.

When considering the ethical issues surrounding the study, it was also difficult to ignore the Covid-19 pandemic which has affected the way that we all work and conduct research (Jowett 2020; Alsiri et al 2021). Whilst technological advances (such as using video conferencing) have made it possible to virtually replicate face-to-face interactions, it is important to contemplate the complex ethical issues that have developed at this time. Jowett (2020) highlighted that the health and wellbeing of participants and

[28] All participants were given at least 24 hours to review the participant information sheet before being asked to sign the consent forms (HRA 2021).

researchers should be prioritised over research timelines and deadlines. To this end, a move from full-time to part-time study was made as priorities at work and home changed. I took time to pause and reflect on the need to delay data collection. Early in the pandemic I was fortunate in that I could focus on desk-based elements of the research such as the reviewing of literature. I also considered whether adding to the stress of healthcare professionals by asking for their participation in research at this time would be appropriate. The pandemic had affected the mental wellbeing and behaviour of the population, and I was mindful that this could impact on the validity of the research (Alsiri et al 2021). As the pandemic evolved, I was also aware that any modification to data collection methods should be reported to the ethics committee for prior review.

4.6. Participation inclusion criteria.

The participants[29] included in this research were Therapy Radiographers that had been part of a team directly involved in an error in the radiotherapy environment. Due to the nature of their work, the Radiographers can be implicated in errors from a wide range of sources. The type of error that was of interest to this study is an error with a human element, as opposed to those errors caused by a technical or other factor. Recognition of a relevant human element will be determined following scrutiny of the statement documents and / or local error investigation report.

Errors in radiotherapy have previously been graded with regards to the severity of the incident to allow safety professionals to decide the level of investigation required (Donaldson 2007). Some incidents are deemed minor, a near miss, or other non-conformance. Rudimentary investigations would be undertaken locally in response to these events. However, more significant incidents demand reporting to the nations' enforcement authority and are followed by thorough investigation into the cause(s). Previous guidance in Donaldson (2007) has been succeeded by CQC (2020) following the updated release of Ionising Radiation (Medical Exposure) Regulations (IR(ME)R) 2017. CQC (2020) defines those accidental and unintended exposures that are judged to be 'significant' (SAUE). Depending on the circumstances of the error, if the incident meets

[29] A second type of participant, the host site safety specialist, was removed following the decision to disregard the reflexive focus group as a method of research.

the criteria for a SAUE the organisation must notify the appropriate enforcing authority as soon as possible. Following this notification, the local radiotherapy safety team must undertake a detailed investigation into the circumstances of the erroneous exposure. A SAUE demanding a comprehensive investigation would be deemed appropriate for inclusion in this study as a detailed error investigation report with accompanying witness statements would be accessible.

Therefore, the participation inclusion criteria for this study consists of:

Participants must be members of a team of Therapy Radiographers directly involved in an error.

The error must be defined as a SAUE under IR(ME)R (2017), and thus result in an investigation report following a thorough investigation into the cause(s) of the erroneous exposure.

The error must contain a human element, as opposed to an error caused by a technical or technological factor.

4.7. The research sites.

The researcher is employed in a radiotherapy department in the UK. However, an awareness of the power dynamics and possible biases that can occur when undertaking qualitative studies resulted in a search for research sites where participant insights and experiences would be shared more freely. Therefore, the research was not situated in the radiotherapy department in which I am employed. Instead, the research was undertaken in other radiotherapy departments in the UK of which were accessed via professional networks. A summary of each research site will follow:

4.7.1. Westtown hospital.

The radiotherapy department is part of a small cancer centre that specializes in a range of oncology services in a state-of-the-art environment. Available services included chemotherapy, immunotherapy, and CT and MRI scanners in a comfortable rural setting.

4.7.2. Access to the research site.

I benefitted from existing professional relationships and contacts to gain access to the research site. Whilst I knew some of the radiotherapy management from mutual

employment elsewhere, I had never been employed directly at Westtown hospital. This meant that the staff knew me from within the radiotherapy community and trusted me sufficiently to permit me into the hospital. However, as I had never worked directly with the treatment Radiographers, I was able to inaugurate myself into the role of a researcher.

4.7.3. Midtown hospital.

The radiotherapy department is part of a large general university hospital located in the city centre. The hospital hosts a range of services such as acute assessment and medicine, maternity and neonatal care, as well as diverse haematology services.

4.7.4. Access to the research site.

Again, I profited from professional acquaintances to gain access to Midtown hospital. I had previously developed relationships with the departmental management via professional quality and safety fora. My experience in the field of error investigation ensured that I was entrusted into the radiotherapy department. I had never worked directly at this research site, so was able to establish myself principally as a researcher.

4.7.5. Southtown hospital.

The radiotherapy department is part of a large teaching hospital located on the outskirts of Southtown. The hospital hosts a range of specialist services such as Clinical Genetics, Clinical Immunology, as well as a large surgical unit.

4.7.6. Access to the research site.

Again, I was able to benefit from professional acquaintances to gain access to Southtown hospital. My experience in the field of error investigation ensured that I was entrusted into the radiotherapy department. I had never worked directly at this research site, so was able to establish myself principally as a researcher.

4.7.7. Northtown hospital.

The radiotherapy department is part of a small specialist cancer centre. In addition to radiotherapy, the hospital hosts a radiology department, chemotherapy inpatient unit, and several wards.

4.7.8. Access to the research site.

Again, I benefitted from professional contacts to gain access to Northtown hospital. Professional friendships with key individuals within the radiotherapy department meant that I was entrusted into the research site as a researcher.

4.8. Sample size.

The sample consisted of eight participants taken equally from four separate research sites. The idiographic nature of IPA research justified the need for small sample sizes (Smith 2004) with between five and fifteen participants suggested by Smith et al (2009). The reason for including eight participants was that securing additional individuals prepared to discuss their involvement in errors was extremely challenging. Following negotiation of the various hurdles of the ethics approval processes several potential participants were found to be unwilling to participate. This also provided an associated limitation of the research in that only two Radiographers from each case agreed to take part. The Radiographers would have worked in teams of three or four, so the experiences of these other individuals may have provided data that was different from those that participated. However, I was acutely aware of the sensitive research subject, and the precarious nature of securing potential participants. Therefore, I was thankful to those that did wish to participate, and the research was successful in gaining a detailed analysis of the experiences of these individuals.

4.9. Data analysis.

The following section will describe the procedures used in analysing the data uncovered in the field. An outline of the approach will be provided prior to discussing its inherent benefits and disadvantages. Deriving from the exploration of ancient texts, interpretive elements of the method were found to complement the document analysis required at the onset of the research. Also, the idiographic nature, the prominence of experience, and the necessity for reflection emerged to align emphatically with the requirements of this study.

4.10. Interpretative phenomenological analysis.

Interpretative phenomenological analysis (IPA) is an approach to qualitative data analysis that is concerned with a meticulous examination of how individuals make sense of a personal lived experience (Larkin and Thompson 2011; Eatough and Smith 2017).

IPA necessitates giving voice to detailed, reflective, first-person accounts from participants, and provides an established phenomenological approach to the interpretation (making sense) of these descriptions (Larkin and Thompson 2011). First articulated in the 1990s as an approach to health and clinical psychology (Eatough and Smith 2017), IPA has seen its engagement proliferate into diverse fields such as organizational studies (Gill 2015; Gill and Burrow 2018), healthcare studies (Cassidy et al 2011; Cuthbertson et al 2020) and affect theory (Linge 2011; Sari and Gencoz 2015). The main theoretical underpinnings of IPA will now be discussed: its idiographic base, its phenomenological interest in experience, hermeneutics, and reflection (Tuffour 2017; Peat et al 2019).

4.10.1. Idiography.

IPA is committed to an idiographic level of analysis, which implies a focus on *the particular* (Larkin and Thompson 2011). Thus, analysis using IPA always commences with the intensive examination at the individual level, with close, line by line analysis of an experience as described by the participant (Smith et al 2009). In its simplest most idiographic form, IPA can attend to a single person case study. However, case studies can offer much more than this; more noteworthy aspects of knowledge can be achieved by connecting the unique life of the individual with others (Eatough and Smith 2017). Therefore, an idiographic approach focuses on gaining the detailed and unique insights and feelings of the individual, prior to pooling across to other individuals (Molenaar 2004). The potential for IPA is to design research with multiple foci of experience with the aim of highlighting patterns of meaning across historical and social eventualities. Any generalisations or universal structures that may occur are grounded in this idiographic base. Crucially, IPA research 'uses small and situated samples so that each individual can be attended to idiographically before attempting a comparative analysis of participant material'. The researcher provided an exhaustive account of each case before attempting to look for convergence and divergence of experiences (Eatough and Smith 2017; Tuffour 2017).

4.10.2. Experience.

A key feature of phenomenology is the significance of experience, and the belief that the close study of experience can present valuable understanding of the real and meaningful

world of human being. IPA attends to all aspects of this lived experience, from our feelings and motivations to the way that they manifest themselves in action and behaviour. As introduced in section 3.6. (Phenomenology), in adhering to the work of Husserl, a transcendental phenomenology uncovers the essential structures of a phenomenon in its purist and elemental sense. Husserl expressed the phenomenological intention to describe how the world is formed and experienced through consciousness. This involves 'stripping away' our assumptions, biases, and preconceptions, and uncovering the *essence* of the phenomenon. For Husserl, this involves a sequence of *reductions* which remove the clutter of life and leads us back to the structure of experience itself (Larkin and Thompson 2011; Eatough and Smith 2017).

However, the aim of IPA is not simply for transcendent knowledge. Instead, IPA gains from theories developed by Husserl's successors Martin Heidegger (1889-1976) and Maurice Merleau-Ponty (1908-1961). These scholars argued that we can never truly make Husserl's reduction to the abstract, because our assumptions are always made from *somewhere*. Likewise, the term description implies that what has been described has already been interpreted 'as' *something*. Hence, the contribution of hermeneutics in adding value to 'particularity, variability, and possibility'. Heidegger proposed that a human being is a *Dasein* (literally 'being there' or 'being-in-the-world'). People and the already existing worlds in which they live in (or are *thrown*) are socially and historically contingent and contextually bound (Eatough and Smith 2017). Individuals are inextricably linked in the world, and in relation to others (Larkin and Thompson 2011). Thus, Dasein rejects Cartesian dualism with people mutually involved and related 'with things and others'.

The mutuality of Dasein is advanced by Merleau-Ponty who describes the body as a *body-subject* which reveals the world to each of us in individual ways; interpretation comes from our own perspective or being-in-the-world. For Merleau-Ponty, individuals are always embodied (Eatough and Smith 2017), and therefore the researcher must pay attention to their own body as well as that of the participant. New understandings can be formed through collaboration. A researcher can train themselves to be more receptive to bodily (nonverbal) cues in themselves and their participants. The researcher's body senses differences and commonalities that are provoked by situations

and participants. This requires self-awareness on the part of the researcher as well openness to others (with these states being documented in a reflective journal) (Larkin and Thompson 2011; Frechette et al 2020). The importance of reflection in IPA will be discussed further in section 4.10.4.

Experience is subjective because what we experience is a phenomenal reality, which connects people and events in the context of how they seem to us. Therefore, IPA commits to 'clarifying and elucidating a phenomenon (… an event, process [etc.]) but its interest is in how this process sheds light on experiences as they are lived by an embodied socio-historical situated person'. IPA is appealing as it attempts to grasp the texture and qualities of lived experience. Of interest is the sense that each subject makes of significant experiences rather than the phenomenon itself. That is, the researcher focuses solely on those experiences which '*matter* to individuals because they recast aspects of their lives through a demand for meaning making' (Eatough and Smith 2017).

4.10.3. Hermeneutics (interpretation).

A key concern of IPA is the rich synthesis provided in complementing the description of a particular experience with interpretation. The term hermeneutics is derived from the Greek *to interpret* and aims 'to make meaning intelligible'. Originating in the analysis of bible texts, hermeneutics has developed into a concern with the process of understanding. In addition to texts, hermeneutics can also be applied to lived experience (Eatough and Smith 2017). Supporting the interpretative endeavour of IPA are three key concepts: the hermeneutic circle, Heidegger's notion of appearing, and the double hermeneutic.

As a means of exploring lived experience, the hermeneutic circle encourages the examination of the data in a dynamic, iterative, and non-linear way. That is, it advocates a back-and-forth movement between the whole and parts of the story. Moving between the parts and the whole, immersing oneself in the data in its entirety before zooming into key sections, meanings start to emerge. The process involves being open to the shifting ways of thinking about the data. The part can be understood as a single word with the whole being the sentence in which the word is set (Smith et al 2009). Alternatively, the part can correspond to the researcher's encounter with the

participant, with the whole drawing on their knowledge and experience (Tuffour 2017). The process can also be conceptualized in data triangulation, with each method informing the other through a back-and-forth movement. Importantly, the part is never fully removed from the whole and how it makes sense of other parts. The whole must be continually kept in view for the parts to stand out (Frechette et al 2020).

> '…any interpretation necessarily involves an essential circularity of understanding - a hermeneutic circle in which the interpreter's perspective and understanding initially shapes [their] interpretation of a given phenomenon, and yet that interpretation, as it interacts with the phenomenon in question, is open to revision and elaboration, as the perspective and understanding of the interpreter, including his biases and blind spots, are revealed and evaluated' (Tappan 1997).

An active engagement with the hermeneutic circle ensures that a voice is given to the experiences of the participants, as well as the researchers interpretation of their account. Findings should highlight the important shared themes while also presenting the idiographic uniqueness of the individuals' lived experience (Peat et al 2019).

Heidegger's notion of appearing is used to suggest that interpretation is comparable to the work of detection. The researcher *mines* the material for possible meanings which allows the phenomena to 'shine forth' (Smith et al 2009). Critical examination and appraisal of these meanings is undertaken, along with the researchers' evolving constructions. However, the shining forth of the phenomenon always relates to 'the context of the lifeworld of an embodied situated person'. The related concept of the *gem* is also proposed by Smith (2011a) as a useful interpretative tool. The gem describes a singular remark or extract that shines out at the researcher and illuminates the participants understanding of their world. Smith describes a spectrum of three types of gem: shining, suggestive, and secret. In unambiguous terms, each expression equates to the level of obscurity and effort required to uncover the gem.

IPA involves an interpretative process on the part of both researcher and participant. The double hermeneutic, as outlined by Smith et al (2009) describes how 'the researcher is trying to make sense of the participant trying to make sense of what is happening to them'. Thus, the double hermeneutic describes how interpretation and understanding is synthesized; the participants' sense-making is supplemented by that of the researcher

during analysis. IPA entails navigating between different *layers* of interpretation by engaging deeply with the texts of participants' experiences. Citing the work of (Ricoeur 1970), Eatough and Smith (2017) describe a dual interpretative engagement as invoking the double hermeneutic. A hermeneutic of empathy is employed to understand what it is like to be the participant. This produces rich experiential understanding of the participants meaning making and phenomenon under investigation. A second hermeneutics of suspicion is used to unravel the hidden levels of meaning. This requires the researcher to set aside previous preconceptions to cultivate a textured multitude of potential meaning. This endeavour necessitates a sustained immersion in the data to produce fine-grained interpretations.

4.10.4. Reflection.

IPA aims to expose what a lived experience means to an individual through a process of in-depth reflective analysis (Smith et al 2009; Peat et al 2019). Interpretive phenomenology opens the door for reflection on *being* a researcher, *being* a participant, etc. (Frechette et al 2020) and allows the researcher to reflect upon their role in producing interpretations (Larkin and Thompson 2011). A reflective journal (or diary) is an essential tool for documenting these reflections on one's own being-in-the-world, enhancing our own self-awareness and attunement to our surroundings (Smith 2004; 2005; Frechette 2020). Larkin and Thompson (2011) propose that reflection is a useful place to start research, with an ongoing reflective process continuing throughout the life of the study. Documentation commences with a reflection about what brings the researcher to the study at hand (Frechette et al 2020). Larkin and Thompson (2011) also suggest that the beginning is an important time for researchers to reveal their biases and consider the influence of their own experiences and preconceptions. Reflection will permit a more systematic and consistent focus to take place whilst minimizing the impact of any preconceived ideas.

Mezirow's (2000) theory describes reflectivity (labelled transformative learning in North America) as an opportunity for individuals to reflect upon their situation and consider new perspectives. Reflectivity describes an awareness of specific perceptions, meanings, behaviours, or habits. However, Mezirow also recognised that reflectivity demanded both affective and cognitive elements. Affective reflectivity allows awareness of how the

individual feels about what is being perceived, thought, or acted upon. For Willink and Shukri (2018) … 'it is not enough to simply understand the words and context of the interview, but to thoughtfully investigate the performance of sharing such affectively charged narratives'. I examined the notes made of compelling moments during the interactions. These were the instances where it felt something significant took place; 'affective undercurrents carried within words, labels, and seemingly innocuous phrases'. How the 'affective potency of language and memory came together in this moment'.

Being reflective during the research exchanges permits us to 'consider *how* bodies, memories, language, and atmospheres affect, and are affected by, one another through underlying yet impactful affective tonalities' (Willink and Shukri 2018). Reflectivity allowed me to interpret how affect fused within the memories allowed the interactions to unfold in the way it occurred. As with all memory events, we reflect 'to taste life twice, in the moment and in retrospect'. We engage in meticulous reflectivity to make sense of the 'after-taste' of the event (Nin 1976; Willink and Shukri 2018). Willink and Shukri (2018) used a form of retrospective sense-making to reflect on the affects, rhythms, and intensities that illuminated an interview. Attentiveness to affect enriches the analysis; how a look, a feeling, or a hesitation changed the course of the interview. Reflecting in this way helped me make sense of the ways in which moments occur, how words elicited a reaction, and how memories tainted or developed during the interaction. Reflectivity made visible the affects that permeated the brief, subtle moments with significance and meaning.

Willink and Shukri (2018) also employed the work of Stern (2010) to reflect on the imperceptible sensations that can shape an interview without reducing it to an analysis of emotion. Stern's vitality form of *movement* refers to flow, flux, and qualitative changes that accompany encounters. *Force* is the quantity of affect experienced and can vary from intense to barely perceptible. *Time* provides a chronological guide for movement, allowing us to feel changes along the duration of the interview. Finally, movements are going somewhere; they have *directionality*. Together, these forms combine to permeate affective experience and provide focal points for analysis of the interaction through reflectivity.

Whilst refection took place throughout the research process, several instances of reflection were notable in providing significant personal and professional growth. When this research commenced, I was influenced by my own experience of involvement in error investigations. However, a deep understanding of the lived experience of a Therapy Radiographer when an error occurs developed as a result of reflection throughout the course of the research. As noted in section 4.3., reflection enabled the adaption of the unproductive initial research methods. Further adaptability was demonstrated when one of the researcher sites, an independent private hospital, went into administration just as access to the site was being established.

Furthermore, during the research, I was involved in an error investigation in my own workplace. One of the Radiographers involved was upset following the error, and on explaining the investigation process, I explained that a statement should be completed as soon as possible whilst the details of the error were fresh in the mind. The Radiographer recoiled at the word 'statement' and alluded to this being a harsh term more suitably used when reporting a crime. I reflected on this comment and used more temperate language such as 'written description' or 'account' when referring to a statement during the research.

Reflection following the initial cases enabled the refining of document review, memory work, and interviewing technique for the subsequent cases. In developing an ability to encourage the participant to firstly 'talk me through the incident', the resulting discussion allowed the memory of the error to be described in great detail. These initial cases were extremely valuable and my interview technique in particular, improved case by case. A more narrative, dialogical style of questioning was developed, which complimented the initial request for participants to recollect their memories.

4.10.5. Why use IPA?

IPA adopts a creative and imaginative approach that provides researchers with *ways of thinking* about subjects of interest (Eatough and Smith 2017). IPA promotes itself as an evolving dynamic means of undertaking research, which is in keeping with its phenomenological and hermeneutic roots. Whilst researchers are encouraged to be imaginative and flexible in their design, Smith (2011b) has proposed a set of criteria for assessing the quality of an IPA study. These include: 'a sustained focus on a particular

aspect of experience, rich experiential data, assessment of the thematic structure using a measure of prevalence, careful elaboration of themes, and of course, a detailed interpretative engagement with the material'.

This analytical framework is appealing as it provides a structured guide for the research. An important aspect of IPA is its idiographic nature. I had time constraints in undertaking this study, and recruiting willing participants was challenging. Therefore, when a relevant case (and agreeable Radiographer) presented itself, I required the means to extract a lot from a little. Competent use of systematic hermeneutic analyses of these lived experiences enabled the minutiae and granular detail of the phenomena to become visible. IPA explores experiences that are of considerable import to the participant, such as when a healthcare professional is involved in an error that causes harm. These occurrences matter: they are transformative, demand reflection, and interpretation from the participants involved. What results are patterns within the study, a focus on meaning making, and an attention to bodily feeling (Eatough and Smith 2017). The embodied experience of affect; the feelings and emotions sensed at the time an error occurs can be intense and recognizable, or fleeting and subtle. The embodied nature of phenomenological research appeared to align itself with the affective focus of this study (Cromby 2012).

As Eatough and Smith (2017) demonstrate, 'the challenge, and the opportunity, [for the researcher] is to design and conduct high quality research exploring the full potential of IPA while retaining its core commitment to the importance of sustained engagement with the individual's attempts to make sense of their personal lived experience'. Whilst there is no requirement in IPA to use the interview method, semi-structured interviews are the most common method used in producing data for analysis. The real-time interaction with the participant offers flexibility in exploring their lived experience (Eatough and Smith 2017). However, the exploration of human experience is best served by a combination of methods and paradigms which facilitate a better understanding of the complexities of human experience and interaction (Shaw and Frost 2015). Therefore, the continuing development of IPA as a multi-dimensional approach is reflected in the number of studies that employ multi-modal data collection methods to complement the

proven semi-structured interview such as document analysis (Murray 2004; Gill 2015) and memory work (Chang-Kredl, Wilkie and Ghaznavi 2016).

4.10.6. Limitations of IPA.

A limitation of IPA is its assumption that language will provide participants with the tools necessary to capture their experiences (Noon 2018). Therefore, the IPA researcher requires a certain level of fortune in acquiring participants able to contribute the in-depth responses required. Involvement in human error can be a difficult subject to talk about, so participants and researchers must have the requisite communication skills to articulate the nuances of an experience (Tuffour 2017). Therefore, I was aware that for those individuals that have difficulties expressing themselves, responses may be sparser and gaining access to their experiential worlds will be more challenging. I made note of this criticism and was attentive of the need to collect rich data from the participant. Noon (2018) suggests that the use of visual prompts (e.g., photographs, audio-visual recordings etc.) has gained interest in qualitative analysis and can help in such situations (Cromby 2012). As the ways in which we experience feelings or events are not always available to verbal description 'multimodal semiotic-discursive' methods can help capture the meanings that would otherwise escape analysis.

IPA researchers can also be confronted with a conflict between a commitment to idiography and the search for convergence across cases (Noon 2018). A desire for commonality of cases can lead to the neglect of the significance of individual experiences. In recognising this tension, it was possible to be aware of interesting similarities between participants, whilst highlighting the unique experiences and peculiarities of each. A related criticism of IPA is its lack of transferability and reluctance to make general claims. However, Smith and Osborn (2003) argued that IPA should be considered in respect of its theoretical generalisation rather than those made empirically. Therefore, a reader should be able to draw their own conclusions between the interpretations described in an IPA study, the existing literature, and their own experiences. That is, through the gradual accumulation of similar studies, general claims can be made (Noon 2018).

4.10.7. How the methods were operationalised using IPA.

The approach described by Berg et al (2019) in Chapter 2.3.3. for the affective analysis of textual discourse was merged with an eye on the principles of IPA outlined in this chapter (for example, Smith (2004, 2005, 2011)). Written transcripts were generated from the interviews undertaken via Microsoft Teams. Each transcript was read multiple times. Initially, the transcript was read whilst listening to the audio-visual recordings to confirm accuracy and correct any inaccuracies in auto-transcription. The purpose of this stage was to gain familiarisation with the data, add comments, and note any initial observations (Smith et al 2009). As a case study approach was followed, this was undertaken in combination with the witness statements and investigation reports so that initial thoughts could be recorded. Repeated reading provided active and progressively deeper engagement within the data.

Initial coding allowed the development of a greater understanding of the participants' experience. Colour coding systems were discovered in the IPA literature (for example, Smith et al 2009; Love et al 2020) which were adapted for use in this study. Appendix K demonstrates an example of the colour coding employed on an extract of the transcription taken from the interview with Barbara. Use of colour coding allowed for clear and transparent structures to form from the initial thoughts and allowed an audit trail of concepts or superordinate themes to emerge. The data had now grown significantly due to the addition of notes and reflections. Therefore, the next stage of the analysis was the removal of larger superfluous sections of the transcripts. This allowed the engagement with smaller pieces of the data, to allow for a more focused understanding and interpretation of the more relevant aspects of information that was disclosed.

Once the themes had been organised, interpretation allowed the emerging themes to be developed and clustered into broader groups (Smith and Osborn 2003; Smith et al 2009). The last stage enabled the broader groups of themes to be compared and 'mapped' across all of the cases. In separating from the individual, context and meaning was developed from the data as a whole. The recurrence of superordinate themes was checked (and re-checked) at the individual and collective level. This ensured adherence to IPA's idiographic foundations whilst acknowledging the value of using multiple

experiences. This phase of the analysis was creative and allowed a fluid process of fluctuation from the individual to the whole. Broader themes continued to emerge as initially overlooked aspects gained significance, whilst other themes were re-examined and re-classified (Smith et al 2009). Discussion of the data and analyses with the research supervisors enhanced the credibility of the subsequent findings.

4.11. Chapter summary.

This chapter continued to build on the methodological foundations by providing detail regarding the methods used to examine affect when a human error occurs. A chronology of the methods was provided prior to a detailed discussion of the techniques employed, and evidence of their use in supplemental studies. Practical issues were presented such as how participants were chosen and how I gained access to each research site. The ethical implications of undertaking research in healthcare settings were considered; whilst highlighting the sensitive nature of discussing events where harm has occurred. The chapter concludes by illustrating why IPA was selected to analyse the broad range of data generated. IPA appeared well aligned to capture the participants experience of being involved in an error. The approaches' idiographic, interpretive, and reflective nature was appealing, whilst I also made note of its potential limitations. The following chapter will express the empirical data produced in using the methods described in this chapter.

Chapter Five – Results

5.1. Introduction.

This chapter presents the research findings from the study. As stated in Chapter One, the aim of this research is to examine the role of affect when a human error occurs within the radiotherapy department. In order to gain an understanding of the lived experiences of Therapy Radiographers when a human error occurs, a comprehensive literature review provided a grounding of knowledge on the subjects of affect and why errors occur. This understanding facilitated the document review of witness statements and subsequent memory work and interviews of the individuals involved in human errors in four radiotherapy departments.

Smith and Osborn (2003) proposed a choice of two methods of presenting data in an IPA study. The first method contains the emergent thematic analysis within a results section, and a separate chapter linking the analysis to the existing literature. An alternative method is to link the literature to the presentation of each theme in a single results and discussion section. For this study, the former method of presentation will be applied. The chapter will reveal the findings of four separate case studies, that expose a broad range of affect. Data is revealed from the witness statements, the participants recollection of their memory of the error, and answers provided to questions relating to affect. The subsequent chapter will provide an analysis and discussion of these findings along with the affective themes uncovered.

As a consequence of the challenges noted in section 4.3, cases were produced from four human errors that had occurred in the past. Table 2 illustrates the length of time between the error and the research.

Case	Length of time between error and research
1	Approximately 3 years.
2	11 months.
3	4 months.
4	6 months.

Table 2. Length of time between each case and the research.

The results will commence with a case involving a paediatric patient whose distress resulted in significant anxiety for the Radiographers. The subsequent case contains a patient requiring an uncommon type of treatment that caused confusion for the team. The third case involved a patient in pain during a challenging time in the host site, whilst the final case portrayed a scene of significant annoyance which developed between the patient, participants, and various others.

5.2. Case study 1 – the paediatric patient.

The first case will introduce and illustrate the unfolding of an affective episode that culminated in a human error occurring, as extracted from the witness accounts (Appendix E) taken from the individuals involved. This case will describe the prelude to an error being identified on a five-year-old child receiving radiotherapy to the central nervous system (brain and spine). Based on national guidelines, the patient was prescribed for 30 fractions[30] (number of treatments) of radiotherapy to be delivered equally over the course of six weeks (Monday to Friday). For young children, completing a course of radiotherapy can be extremely challenging, as their parents are unable to remain in the treatment room with them during the treatment. Fear of being alone in unfamiliar new surroundings can make accurate delivery of radiotherapy difficult. The ability for the child to stay still during treatment is fundamentally important to ensure that radiotherapy can be delivered where it is intended, whilst minimising dose to surrounding healthy tissues. General anaesthetic is commonly used when treating children who are unable to adhere to this requirement to stay still during the procedure. However, general anaesthesia for children poses its own challenges; therefore, it is only used where absolutely necessary. The need for general anaesthetic was considered for this patient, but as the child appeared to cope well with the initial Planning CT procedure it was decided that such anaesthesia would not be required. The Radiographers were happy to attempt treatment on the understanding that an anaesthetic would be reconsidered if the patient could not keep sufficiently still for the treatment.

Introducing Terri

Terri is a Band 7 Planning Radiographer with twenty years' experience at Westtown Hospital. Terri liaised with the paediatric department at the hospital and led the Planning procedure on the patients' first visit to the department.

Introducing Emma

Emma is a Band 6 Treatment Radiographer with five years of experience.

[30] All radiotherapy doses and fractionation adhere to standard evidence-based guidance from the RCR (The Royal College of Radiologists) (RCR 2024).

It was the patient's first day of treatment. Terri was called by Emma to attend Linac 1 as soon as possible as there was confusion about the patients' treatment set-up instructions. The patient was lying on the treatment couch, but despite being accompanied by his father was clearly upset by the strange surroundings he found himself in.

> 'The patient was on the treatment bed, they were obviously distressed, and his father did not seem to have much control of him'. (Witness statement extract (Appendix E)). (Terri)

The young patient was wriggling around hysterically on the treatment couch. Due to the level of distress evident, the decision was made to discontinue with the attempt to treat the patient on this day. Terri escorts the patient and father back to the Planning department where the patients' set-up position and instructions can be clarified away from the time pressures of the Linac 1 treatment room.

> 'Whilst in the [Planning department] the patient was still distressed and exhausted, however we were able to confirm the [patient positioning]'. (Witness statement extract (Appendix E)). (Terri)

The patient's father was given an appointment time to attempt the treatment again the following day. Terri contacts the patient's Consultant Oncologist and the anaesthetic department to discuss the option of anaesthetising the patient for future treatments. However, the following morning, Terri receives a phone call from the patients' specialist nurse who has been in discussion with the father following the events of the previous day. The nurse informed Terri that the patient did not respond well to male staff and suggested that a change to an all-female team may lead to a better outcome. On discussion with the Linac 1 team, a plan was put in place for Emma to attempt the treatment later in the day. The nurse also suggests that the act of the Radiographers placing their hands on the patient to rotate him into the correct position was causing upset. The patient had three permanent pin-point tattoo marks marked on his skin at the Planning appointment (similar to photo 1). These tattoos were used by the Radiographers to align the patient each day by rotating the patient into the same position as when they received the Planning CT scan. Aligning the tattoos promotes the ability to accurately direct the treatment onto the same area on each day of treatment.

Photo 1. Permanent pin-point tattoo mark placed on the skin.

> 'We also discussed how to speed up the process by not using the tattoos for alignment as this caused the patient to become more distressed'. (Witness statement extract (Appendix E)). (Terri)

Not using the tattoos would make the accurate positioning of the child difficult. Emma was uncomfortable with this suggestion, and questioned if an anaesthetic would be a preferable option. Terri was aware that the involvement of the anaesthetics team required a lot of organising which would take days to arrange. Emma was persuaded that the best course of action would be to attempt the treatment again without anaesthesia.

The patient arrived later that day where treatment would again be attempted. It was early afternoon and Linac 1 was already running behind schedule. Emma recalls that it was a busy day, and due to the difficulties encountered on the previous day, Emma does not want to leave the child waiting in the waiting area.

> 'The patient attended at 2pm for treatment, it was very busy on that day, and the machine was running late which put the team under pressure. I felt anxious to treat the patient on time…'. (Witness statement extract (Appendix E)). (Emma)

As well as the need to treat the patient without delay, Emma recalled her apprehension in remembering how distressed he was on the previous day. Emma was concerned with how the team were going to be able to treat the patient at all.

> '…. [I] was also apprehensive at the level of distress the patient had experienced the previous day and was concerned how the team were going to be able to manage to treat the patient'. (Witness statement extract (Appendix E)). (Emma)

A play therapist also attended on this occasion with the patient and his parents. To minimise distractions, it was usual practice to keep the number of persons in the

treatment room to a minimum (that is, two Radiographers and the patient). On the previous day, as the patients' father appeared to be unable to control the patient, the Radiographers had planned to use their experience to calm the patient down themselves. However, without notice or invitation, the parents and play therapist accompanied the patient into the treatment room. Due to the previous day's events, Emma, whilst annoyed, felt powerless to raise her concerns.

> 'When [the] patient was taken into treatment room, [the] parents and play therapist came in as well. I was not expecting them all to come in but felt unable to approach them with regards to keeping the individuals in the room to a minimum, as a result of the previous day's events'. (Witness statement extract (Appendix E)). (Emma)

At this point, Terri arrives at the scene to provide their expertise. Terri could sense the collective anxiety of the Radiographers, which was exacerbated by their annoyance of having to contend with the additional individuals in the treatment room.

> '…everyone was getting drawn into the emotion of the situation as we were all concerned about [the patient] receiving treatment'. (Witness statement extract (Appendix E)). (Terri)

Photo 2. Radiotherapy treatment room with treatment machine (linac) and couch.

It was usual for paediatric patients to bring their favourite music with them to help distract them from the unusual surroundings. On entering the treatment room, Terri shuddered at the noise of the loud high-energy repetitive beat being played. Adding to

the sense of disorder, the patient had also already begun to scream out in fear of what was going to happen next.

> 'There was loud music playing in the room (as per usual in these treatments - and on patients request), the patient was screaming…'. (Witness statement extract (Appendix E)). (Terri)

The Radiographers were used to working in pairs and it was important for them to be able to clearly communicate instructions to each other so that the patient can be accurately positioned as quickly as possible. The Radiographers were having difficulty communicating with each other as the parents and play therapist were shouting words of encouragement at the patient.

> 'It became difficult to communicate and hear [Terri] as the play therapist and the parents were shouting encouragement loudly trying to engage with the patient to maintain their compliance with the treatment'. (Witness statement extract (Appendix E)). (Emma)

The Radiographers were unable to position the patient as they normally would do, as the child became distressed at any attempt to touch him. This increased the feeling of pressure in the room as Emma felt unable to position the child correctly.

> '… We were unable to use pelvic tattoos as patient became more upset as we tried to use them. This increased the pressure'. (Witness statement extract (Appendix E)). (Emma)

Emma became frustrated as it became difficult to attend to the patient as the additional individuals in the room were moving around the patient and being repeatedly in the way.

> 'It became difficult to align the patient as the additional individuals in the room were often in the way and moving around the patient. This made it difficult to access the patient and the equipment. This was due to the individuals not realising they were in the way and their enthusiasm to get the patient through the treatment'. (Witness statement extract (Appendix E)). (Emma)

> '…his father and the play therapist were talking to him, trying to encourage him to comply, however this did mean that they were often in the way, and close to the treatment [couch]'. (Witness statement extract (Appendix E)). (Terri)

The feeling of pressure was also intensified as the parents and therapist enthusiastically told the patient that the treatment was going to be quick, even though this was untrue.

The Radiographers knew that this was not helpful and felt pressurised to oblige in working quickly.

> ‘The parents and play therapist were continually telling patient that treatment was going to be quicker than [the Planning] scan – which is not the case - this added additional pressure’. (Witness statement extract (Appendix E)). (Emma)

Terri was not finding the presence of the play therapist useful. The therapists’ emotional bond with the child hindering the situation rather than helping the patient remain still for treatment.

> ‘The play therapist did not seem to be very helpful, as she seemed to be emotionally attached to the patient – she was saying things to the patient to make it seem better rather than fact (i.e., how long the treatment would take)’. (Witness statement extract (Appendix E)). (Terri)

Terri appealed to the father to control the patient as he became more distraught.

> ‘I spoke to the patient’s father in relation to him taking control of the situation if the patient became upset’. (Witness statement extract (Appendix E)). (Terri)

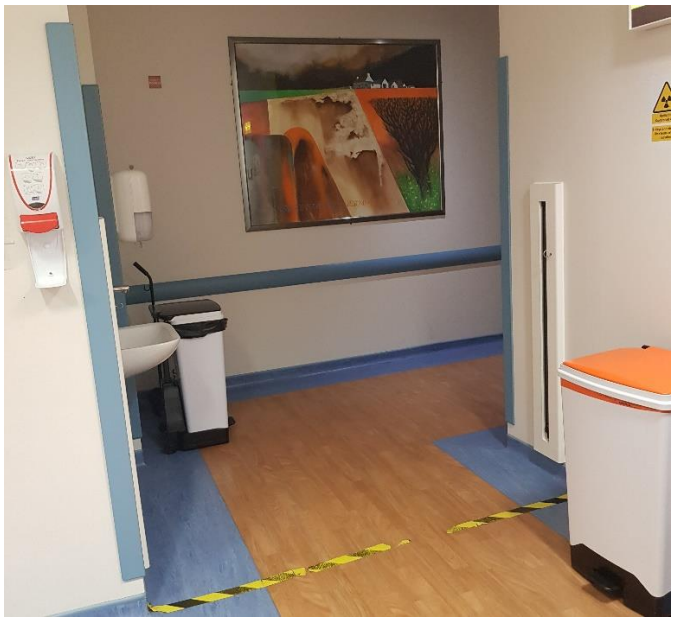


Photo 3. Entrance to treatment room with 'safety light curtain' interlock on the walls.

With the patient correctly positioned on the treatment couch, it was time for everyone to leave the treatment room so that the radiotherapy to the patient’s treatment could be delivered.

Terri instructed the child to remain still whilst the treatment was being delivered.

> ‘I spoke to the patient firmly to get him to keep still…’. (Witness statement extract (Appendix E)). (Terri)

The Radiographers were relieved to vacate the treatment room. The patient was given the end of a long piece of ribbon to hold, with his father holding the other end at the entrance to the room (photo 3).

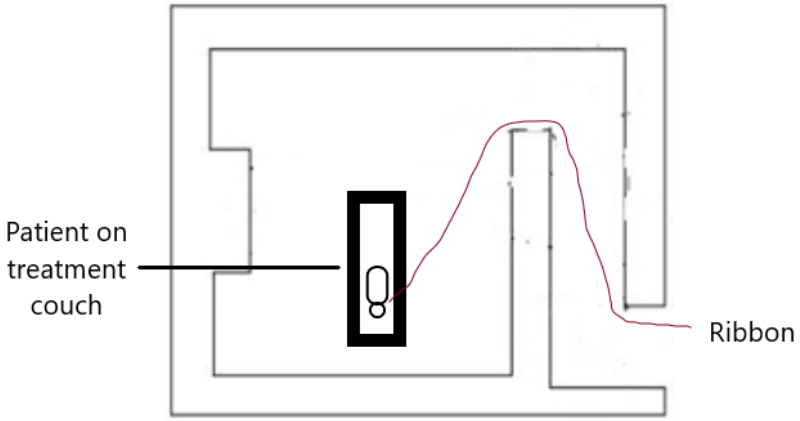


Figure 6. Layout of the radiotherapy treatment room illustrating the use of a ribbon.

As illustrated in figure 6, the ribbon was used to help the paediatric patient know that his parents were nearby when they were on their own. The parents were shouting words of encouragement to the patient from the entrance and into the treatment room. However, annoyingly for Emma, the parents kept breaking the safety interlock at the entrance to the room (a safety mechanism where the radiation beam terminates when the light path is broken) with the ribbon. The parents were again instructed to ensure that the ribbon remained at floor level (that is, below the interlock) at the entrance to the treatment room, to prevent the interlock from breaking.

> ‘…and during the treatment I conveyed instructions to the parents to pass on to the patient to maintain the treatment position. During this time the parents kept “breaking” the interlock with the ribbon that is used to link the patient and their parents (as is standard in paediatric treatment). There were a lot of distractions during the set up and treatment’. (Witness statement extract (Appendix E)). (Terri)

With the door interlock being repeatedly ‘broken’, Emma had to re-enter the treatment room several times to reset the interlock before the images (to check the treatment

position is correct) and the radiotherapy treatment could be delivered. This added extra time onto the duration of the treatment.

> 'Cranial [brain] fields were treated with difficulty as parents and play therapist kept inadvertently breaking the interlock – several times - whilst trying to communicate with the patient. All parameters were checked and ok'. (Witness statement extract (Appendix E)). (Emma)

Following the treatment to the brain, the Radiographers now had to re-enter the treatment room to position the linac for the spinal treatment fields. The child had been lying on the treatment couch for more than twenty minutes by now. He was understandably getting fed up with lying down, was feeling cold, and was starting to wriggle. Terri pleaded with the parents to encourage him to stay still.

> 'Next, we set up the spine fields – we decided to do the images first – we moved the couch [longitudinal] to what was thought to be the spine [treatment area] using the movements for reference ([brain] reference used in error … […]…). [We] checked all other parameters and [Terri] communicated with the parents so that they knew if the patient was moving and what instructions to give them. [The parameters were] checked and ok. Field visualised on the [patient] looked ok…'. (Witness statement extract (Appendix E)). (Emma)

The Radiographers, parents, and play therapist again vacated the treatment room. The Radiographers hastily took and reviewed a verification image. The image was of poor quality, but appeared to show that the treatment was aimed in the correct place. Therefore, the Radiographers proceeded to verbally check all the treatment parameters and deliver the radiotherapy as prescribed. Terri, the therapist, and the patient's father entered the treatment room and informed the child that the first treatment had finished.

Emma noted that due to the poor quality of the verification images produced, input from an imaging specialist Radiographer should be requested.

> 'The quality of images poor, therefore the [patient's details] was given to imaging specialist for image review, the error was detected on revision of images'. (Witness statement extract (Appendix E)). (Emma)

On review of these images by the imaging specialist Radiographer, an error in the positioning of the spine treatment was identified. The treatment Radiographers were

informed that part of the process must have been carried out incorrectly. An investigation into the cause of the error commenced; the findings of which are presented in table 3.

5.3. Case study 2 - the electron treatment.

It was a September morning in Midtown radiotherapy department. The summer lull in demand was now a distant memory for the Radiographers as the respite had given way to schedules full to capacity. All four linacs in the department were working from 7.30am to 6pm each day with one Radiographer arriving early to undertake the daily machine QA (quality assurance) checks at 7am. There were forty patients to treat on Linac 2 that day, with a broad range of patient types on the schedule including: breast patients, prostate patients (who required their bladders to be full whilst receiving the treatment[31]), and a patient requiring electron treatment. Each patient had a fifteen-minute appointment.

This case will outline the events that led to an error being identified on the patient receiving electron treatment. This patient was having treatment delivered to disease on the skin on the top of his head. Due to the nature of the growth on his skin, the patient was prescribed for treatment using electrons, rather than high energy x-rays which would have made up the vast majority of the Radiographers typical daily workload. Advancements in prevalent treatment techniques resulted in the use of electron treatments being relatively infrequent.

Based on the diagnosis and treatment site, patients were referred to an appropriate radiotherapy pathway. In this case, the skin pathway was followed with the patient prescribed for 66Gy (Gray) of electron treatment to be delivered equally in 33 fractions[32] over six and a half weeks. Radiotherapy to the skin was planned by a Consultant Oncologist who marked the area to be treated on the patient's skin with a pen. The pen marks drawn on the patient's skin can be seen in photo 4 (below). The inner pen marks indicated the position of the visible tumour. The outer pen marks indicated the margin

[31] Some patients receiving treatment to the pelvis (e.g., prostate) are scanned and treated with full bladders. This involves the patient drinking a specific volume of fluid (e.g., 500 ml), at a specific time (e.g., 30 minutes) before their scan or treatment. This ensures that the bladder is a consistent size for every treatment. Filling the bladder in this way pushes a section out of the small bowel out of the treatment area. This can reduce the chances and severity of diarrhoea being experienced (Smith et al 2022). The practice of bladder filling can be stressful for this vulnerable patient population. Sometimes, prostate patients may experience the urge to empty their bladder if kept waiting for more than the expected 30 minutes. These patients will also fear the need to urinate whilst they are lying on the treatment couch (McCullough 2020).

[32] Typical dose and fractionation for this patient type based on national guidelines (RCR 2024).

added to the treatment field to account for any possible uncertainties due to patient positioning, movement (e.g., when breathing), or unobserved disease. The intention of the treatment was to treat the area within the outer pen marks for each of the 33 treatments. A pre-existing skin graft can also be seen to the left of the treatment area.

Photo 4. Photo of treatment area (and adjacent skin graft) drawn on the patient's skin.

The local work instructions dictated that the pen marks were photographed (photo 4). The photograph was attached to the patients' 'setup' information and allowed for visual confirmation of the treatment area each day of treatment. The setup information instructed the Radiographers how the patient should be positioned to ensure accurate reproducibility of the treatment area each day. Accurate and reproducible patient setup is fundamental in radiotherapy; the aim of radiotherapy is to treat the exact same area during each treatment.

Towards the end of the patient's course of radiotherapy (the patient had received 31 out of the 33 treatments), a Radiographer raised questions on how the patient had been treated on the previous day. The query suggested that the patient may have been treated incorrectly due to the position of the pen marks which had been drawn on his skin.

Following an investigation, it was confirmed that the Radiographers had set up and treated the patient incorrectly on the previous day. The patient had failed to keep the pen marks in place between treatments, with the pen marks subsequently being redrawn on the skin erroneously. Despite a photograph being available for verification of the treatment area, not all the Radiographers used this photo to check the position of the treatment. Some Radiographers reported that the radiotherapy may have been

centred on the skin graft instead of the tumour. The magnitude of the displacement was estimated to be between 1 and 1.5cm.

The patient had received an underdose to part of the intended treatment area and an overdose to the corresponding section of healthy tissue. It is possible that the tumour could recur as a result of this underdose. However, it was concluded that these skin tumours by nature can have frequent local recurrences. It would be impossible to know whether any potential future recurrence would be the result of aggressive disease or because of this error.

Introducing Eva

Eva was a band six Radiographer with five years' experience at Midtown radiotherapy department. She had been promoted to this role five months previously. This promotion provided Eva with the opportunity to develop her leadership skills in enabling her to manage and develop less experienced band five Radiographers on a linac.

Introducing Faith

Faith was a band five Radiographer in her early twenties who had worked at the department for two years. Faith had gained very limited experience of working on Linac 2.

An early start

Eva was in work early at 7am carrying out the daily linac QA checks.

> '[It's] the morning, you've had your coffee and you're more awake and you run up [the linac] and you've got this, … you're clear headed.' (Eva)

Whilst undertaking the QA checks, a fault[33] occurred on the linac. Eva frantically tried to locate the engineers by phone so they could attend to the linac and address the fault as quickly as possible.

[33] The linac is a complex electrical device with many components and interlocks (that ensure that the x-ray and electron beam is safe). When the linac faults it can result in a range of actions to remedy it. This can vary from a quick clearing of an interlock by an engineer, to the replacement of a defective part (some of which may need to be delivered from the manufacturer in either the US or Europe) (Agnew et al 2021; Wojtasik 2020).

> ‘[The machine] breaks, they break down so much that you think, ohh, okie dokie, you think, cool, another one[!], there we go…and you get good at like damage control, … in organising…’ (Eva)

An engineer arrived in the treatment console area and started working on attending to the fault. Eva’s relief at seeing this support arrive was immediately punctuated as a phone call was received from a colleague explaining that they were unwell and that they would not be coming into work that day. Following the machine breakdown and the staff member phoning in sick, Eva was no longer feeling so fresh and composed.

> ‘Well, the machine [is] breaking down…. and like I said, I've been on run up as well… so, from 7 [am], so instead of coming in afresh, … and then staff are ringing in sick and things, things like that…’. (Eva)

Despite the frustration of this staff absence, Eva remained pragmatic and contacted her Superintendent (line manager) by phone asking for assistance.

> ‘You think, here we go again!, but it's OK. I'm always quite positive, I'm always pretty positive’. (Eva)

<u>Help arrives.</u>

The Superintendent asks a Radiographer, Faith, to move from another work area to help Eva on linac 2.

Faith recalled entering the workplace on the morning of the error in a less than happy mood.

> ‘I wouldn’t go as far as saying positive… [said jokingly with a wry smile alluding to the fact that she was at work…]’. (Faith)

Faith recollected that she was not enthusiastic to cover for this unexpected staff absence. Following the request by the Superintendent, Faith arrived at the treatment machine feeling aggrieved at having to move and change her plans for the day. A sense of resentment from Faith was palpable towards the Superintendent in suggesting that ‘they’ just move staff from place to place; as if done without reason or good intention.

> ‘I have been thinking about it a lot, and I remember that I wasn't actually supposed to be on that set [linac] that day…. I think I should have been somewhere else completely in the department, and one of the things that I think that attributes to errors in our department is they just pull you from set to set so

> you can't look down the list and say, OK, we've got this, that, and the other, you can't plan ahead…'. (Faith)

The fault on the machine was cleared, providing relief for Eva in that she could proceed with the QA. However, even at this early time in the day, the team were already running behind schedule. The Radiographers were aware of the need to work hastily in order to try to catch up.

> 'And you know, especially we were a bit late even at that time in the morning. So, I think… the machine had broken down a bit. So, it was a bit of a rush but… I know it's not an excuse, but you know how it is.' (Eva)

Faith recalled a feeling of pressure on arriving at the treatment machine to discover that they were already behind schedule. This need to rush, in an environment that was unfamiliar and unexpected, made her feel stressed.

> 'Uh, it felt rushed in the department in general because I got pulled from elsewhere, so it did feel rushed - a bit like ohh stress, pressure [emphasised], but yeah, other than that, I was feeling alright and everything…. Yeah, probably a bit stressed just because I've been pulled from a different machine and it's about like, ohh, what's happening now, but otherwise alright... It was just the stress of having to move…. umm, more the pressure really…. at the time that you just think, oh God [exclamation], right, I've got to get on with it…'
>
> '[I felt] stressed [emphasised]. I find it stressful… Yeah, you can't prepare… but it does stress you out. It does put pressure on you and because it's like, OK, what am I getting into now… when you've already mentally prepared for something else in the department, if that makes any sense.' (Faith)

Faith remembered that this feeling of being rushed due to running behind affected her ability to plan. It meant that decisions had to be made quickly.

> 'And so yeah, you don't have much time for planning or anything like that, always running behind, and you do rush a bit. I mean, …. but you do have to kind of make a decision there and then'.
>
> '[We were feeling rushed] you know, in the normal radiotherapy way, yeah. Where you have to make a decision…. It's normal. It shouldn't be, but sadly it is [emotional tone]'. (Faith)

Eva recalled the department being short-staffed at the time, so even with Faith arriving to help, the team had the pressure of working with only three Radiographers instead of

the normal four. In a team of four, the Radiographers could split into two groups of two Radiographers and share the workload of physically treating the patients and also undertaking the administrative duties of the linac throughout the day.

> '…there was only three of us on set because I don't know… people were off sick… so, there was only three of us, and it does put a bit more pressure on you because when there's only three of you, …, you end up treating the entire day basically, which is a bit … it makes your head a bit more tired, doesn't it?'. (Eva)

Faith also remembered being short-staffed on the day of the error and recalled inconsistencies in the team throughout the day that added to the feeling of stress.

> 'Oh yeah, yeah, for the rest of the day there was people swapping and changing and somebody else joined us at one point… because we were short staffed. It shouldn't be [the case], but sadly it is, [Faith shakes her head dejectedly] … it doesn't help… Yeah, everybody's stressed… It's very stressful[!]'. (Faith)

Faith portrayed quite a tense working environment at the time, with the stresses of understaffing leading to a collective feeling of low morale in the department.

> 'Morale's never been high, really. No one has a nice thing to say…'. (Faith)

<u>Planning ahead</u>

Whilst completing the QA checks, Eva's thoughts moved to the day ahead and what needed to be done for the first few patients on the schedule.

> '[The electron patient] was mostly the first patient of the day…. when you're getting ready for the day, and we have 'drinkers' [prostate patients who must fill their bladders prior to treatment] afterwards, so I suppose maybe you are thinking ahead of it. So, you are thinking about your next hours' worth of patients, you are thinking we need to get him drinking, he needs to go there, you need to do that… right…' (Eva)

Eva illustrated these thought processes further by describing the contrasting need of the Radiographer to focus on the patient that they are treating, before switching thoughts to managing the requirements of the upcoming patients. Eva was also mindful of the needs of her teammates; all of which was made more challenging when the team were running behind schedule.

> 'My mind's normally trying to think a few steps ahead... The machine I'm on with our drinkers, you have to tell them when to drink and you have to sort of

> organise them, so you've sort of always got to be thinking an hour ahead, planning, and then thinking about breaks and how you're going to work breaks. But I say again, I think once you've once you've got that patient on the [treatment couch] and until you press the beam on button [to deliver the treatment], and until they beam off… you're 400% [hyperbole] focused on them, but then your brain switches to, right, what's happening now?...'. (Eva)

Faith used the word 'flappy' to describe how Eva, and then subsequently she herself were acting. This presented an image of two Radiographers hurriedly scurrying around in tandem trying to prepare for the first few patients of the day.

> '[Eva] was a bit flappy that day… but to be honest, I was as well … We were like, oh, we need to do this, we need to do that, we need to get this person in next and yeah, because we're trying to clear the list, but at the same time you're trying to concentrate on what you're doing and things and…' (Faith)

Faith recalled that both individuals used nonverbal cues to communicate with each other.

> '… we used expressions [to each other] and I joined in because [Eva]'s very similar to me…. It's how she is as well, we get on very, very well'. (Faith)

Faith was surprised to see that an electron patient was the first patient of the day, but she was happy to work with Eva, whom she'd had positive experiences of working with previously.

> 'No, and I wasn't expecting to treat an electron [patient]. It's just, go and join [Eva]… and I've worked with [Eva] on many occasions and she's absolutely brilliant…'. (Faith)

With the linac having experienced a fault, in addition to her colleague being absent, Eva was already aware and anxious that the day ahead was going to be challenging, especially due to the complex needs of some of the patients.

> 'And when you've got a long day ahead and you know you've got some technical [complex] patients because there's a few electrons on at the time, and you know you've got difficult patients coming up because there was a difficult breast lady and I think you're thinking [about them] … yeah, that's it... apprehensive about the day… a little bit worried… not worried really, you are just…. [pause]… maybe…. maybe anxious, but then at the same time you're still… you're still in the moment with the patient that's on the [treatment couch]'. (Eva)

Eva recognized that others around her were also showing signs of stress, as the challenges of the day became apparent in what was a very busy time of the year.

> ‘I suppose everybody gets a little bit more stressed, don't they? Everybody does get more stressed, and it was September, wasn't it?’. (Eva)

With Eva’s colleague being off sick, the team were left inexperienced with the arrival of Faith. Eva recalls being affected by this change within the team. In stating that she felt on edge, this indicated a feeling of nervousness or being worried about what might happen.

> ‘I know, that's awful, isn't it? But I think, depending on who you're with changes how you are. So, some people work very quickly, you know, like the older people [Radiographers] that have done it for a while [embarrassed laughter] … so there's some people that work very quickly, and you sort of get swept up along with it and you've put your confidence in them because they've done it more… But the people I was with, there was someone who'd been there for like, a year or so, I think as a [band] six, and then a newer band five as well. So, it was a relatively like new team, but then in the same sense, …, it makes you more on edge, but it makes you more conscientious because you're with them in a way.’ (Eva)

Eva remembered being new in her role following a recent promotion. She painted a picture of a Radiographer that was anxious about something going wrong due to her recently acquired increase in responsibility.

> ‘… I [had] recently become band six, so I think I've been doing it for about five months-ish. And I know that's a long time, but it's still new … but I think when you first become band six, you're the one with that responsibility and you know when things go wrong, it's on you. And I feel like I was “mega on it” and “super checking everything”, a “bit of a scared thing” if you know what I mean… whereas now a lot more, you know, you use your knowledge… I don't know if it's on edge, or very conscious that if anything goes wrong then it's your responsibility, which when it's with patients and people's lives that makes you feel a lot more….’ (Eva)

Eva recalled that due to her lack of experience, she may not have dealt with the situation as composedly as she now would.

> ‘I suppose as well, being a newer band six, you're not quite so good at “calm management”, are you? …. But then now me looking back thinks, ohh well, … “why did you stress at that?” You just let it happen and you, you could have managed that better looking back.’ (Eva)

Despite working in a team of three instead of the usual four, Eva recalled that the team was working well on the day of the error. She alluded to the constant pressure of needing to keep on time which results in the Radiographers being alert and ready to react to anything that may happen.

> 'I think we worked well. I think you still work well and when you were [in a team of] three as well, you're more on the ball, everyone's more on the ball because you know that you can't afford to be late or have mishaps or not, perhaps held back because it's more, more difficult if it is [running late]. So, I think everyone had quite a good team working relationship really I think being in a [team of] three.' (Eva)

Eva recalled interacting and working well with Faith. Both Radiographers set about treating the patients, whilst the third member of the team undertook paperwork in the control area. By stating that the two Radiographers were 'in sync', Eva indicates that the two Radiographers were on the same wavelength, almost being able to read each other's minds about what needed to be done.

> 'You're always working in a two [to treat the patients], aren't you? And it's a team [effort] to keep everything moving…. So, me and the other person we are like, we come out of the [treatment] room, and we sort of, you do each other's [hand gestures towards the head] … you're so in sync, aren't you?'. (Eva)

<u>The patient</u>

The patient was positioned in a head and neck mask (similar to below). The mask was made of moulded plastic and was used to secure the patient to the treatment couch and ensure that the patients' head was in the same position for each day of treatment. Following placement in the same position every day, each treatment would take approximately one minute to be delivered.

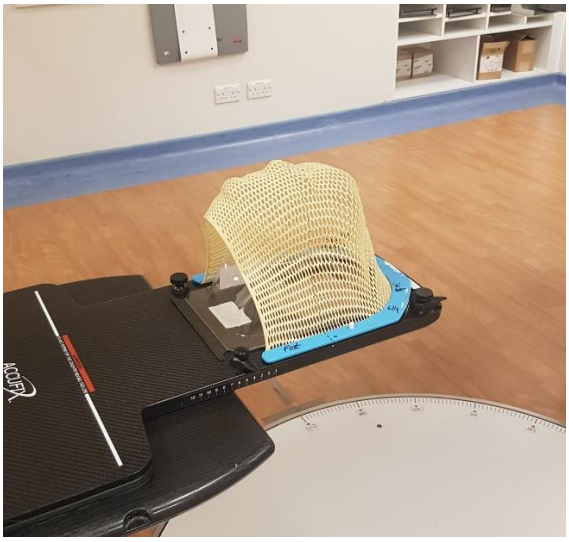


Photo 5. An example of a plastic mask used for treating a patient's head.

The mask

The patient did not like the mask that he had to wear for treatment. This resulted in the Radiographers feeling under pressure to treat the patient as quickly as possible each day.

> 'The patient also did not like the mask therefore additional pressure to work swiftly but ensuring the position was correct'. (Witness statement extract (Appendix F)). (Eva)

> 'He was fair, was very calm. If we were late, he would never kick off or anything. And I think it's because it was such a quick treatment as well… He didn't like the mask. I remember that he didn't like the mask [repeated to emphasise the point] … And then you've always got that pressure of to do it as quickly as you can because he doesn't like the mask. But…[pause]… it's just before we put it on, he would say ohh be quick, ohh just be quick now'. (Eva)

Eva remembered that the patient's usual calmness quickly turning to stress when he saw the mask.

> '…but like I say, he was very calm most of the time… but then he saw the mask a little bit… I just remember that he didn't really like it… And then when you're outside the [treatment] room [delivering the treatment], you're watching him all the time as well. And, you know, he is not happy, and all of that, but…'. (Eva)

Eva recalled that there was a large hole cut out on the patients' mask so that the Radiographers could see the area on his skin that needed to be treated.

Photo 6. A plastic mask with hole cut out for visualisation of treatment area.

For Eva, it was usual for a hole that is cut out of the mask to be the same size as the area being treated. The hole was cut out a lot bigger than the treatment area for this patient. This caused confusion for Eva as the hole did not correlate to the treatment area.

> 'The patient's thermoplastic mask was also misleading as the hole cut out was much larger than the area needed to be treated, again not usual practice, and may have caused confusion'. (Witness statement extract (Appendix F)). (Eva)

> 'So, he was a scalp [patient] …and he's in an orfit head and neck mask that had a lovely big hole cut out and he had a skin graft, but instead of the hole just being around the skin graft from where we were treating, the hole was actually a little bit bigger…'. (Eva)

Adding to the confusion for the Radiographers, the treatment area was next to a skin graft (see photograph 4 above) from a previous surgery that had taken place years previously. From the statement provided, Eva was unaware that the skin graft was unrelated to the treatment area.

> '… the treatment area only covered half of the skin graft (which is unusual practice, as usually for these patients the entire graft site is covered by the treatment field) this was not made clear or highlighted. We weren't provided with measurements or any additional set up information making this clear'. (Witness statement extract (Appendix F)). (Eva)

> '… and the treatment area was actually not centred on the graft, which is what's normal, so what you'd expect. So, every day you go in, you pop the mask on, you set up… [you] do all the checks you do, and then you leave [the patient in the

> treatment room] and treat, and you are happy, and it's normal… you go through all the normal processes, you know the normal checks…. And then, because you've done it before as well, you've got that confidence in yourself…'
>
> '… [but] the unusual thing was how it [the treatment field] was centred. It wasn't centred on the graft; it was centred a little bit off the graft. But thinking back, I can't remember if I knew that at the time, or if... but it's OK, yeah, it's weird… when things are unusual, you know… and it makes you a bit unsure, doesn't it? It does make you feel unsure, and then in our job as well, unsure can be quite dangerous, can't it?' (Eva)

Faith remembered feeling apprehensive about what was required for this patient. On finding out that Eva had treated the patient previously, this feeling of apprehension turned to relief as her concern subsided. However, Faith admitted that she had little confidence in what was necessary but was willing to follow her colleagues' lead.

> '…I remember asking my colleague…. had she treated that patient before? [She had] … and that made me feel a bit better. And together we did work it out, but I had a lot more faith in my colleague than I did in myself, to be honest… [I felt] apprehensive… but at the same time relieved, because of the colleague I was working with'. (Faith)

Eva described a scene of the two Radiographers standing over the patient, trying to make sense of the confusing task in front of them. This confusion was compounded further by their need to work hastily as they were mindful of the consequences of running further behind schedule, as well as the patient on the treatment couch calling out for them to be quick.

> 'Yes, because you are thinking, well if that's where you're treating, why is it [the hole in the mask] twice the size? … shouldn't the hole just be where you are treating? And also, the fact that the graft as well you think, it's confusing because you think, why has it been done like that? This isn't as clear, but then when you think about it more, when you are stood there and [you] try to work it out more, then it made - well it didn't make sense because I still don't know why it was cut bigger… Even though you're confused to start with… and I think if you're more confused, I think it makes you think more about it, do you know what I mean? So, it makes you spend more time trying to figure it out. So, then you feel more confident after, but that's why it was confusing just because it was… it wasn't normal… it wasn't normal [repeated to emphasise point].'

> ‘You think, “Oh dear!”. I always think there must be a reason, like there's got to be a reason, there must be some kind of reason for it. I don't know what it was, but because everyone that's done this has done it for years…. I'd love to know what the reason was because.... I thought there's got to be a reason… let's leave it at that. And then at the end of it all you think, “ohh, bloody hell!”, well, what's the reason?’ (Eva)

Faith was able to provide an explanation for the mask being cut out in this way but pointed to a confusing situation which seemed all too familiar to her.

> ‘… it was to do with the way it [the patient’s mask] was cut out. And I know the consultant who did it was trying to cut out as much as possible, so it didn’t catch [rub against] the skin graft… but I think it just got very confusing in the end. So, at the time it's just confusing because you’ve got this great big graft, the markings… I remember thinking, ohh you should cover the graft, but then it's like no, it's [the treatment area] only covering part of the graft… so I think if that have been made a bit more clear, it would have helped...’ (Faith)

Faith was emotional in recalling this challenging setting that she had found herself in.

> ‘As bad as it sounds… we're kind of used to it… as bad as it sounds [emphasised rhetorically by repeating] …. It's nothing you can do about it, so just get on and treat the patient sort of thing. I know it's not good…’. (Faith)

<u>The shims</u>

A ‘shim’ (as pictured below) is a thin piece of plastic that the headrest rests on and was used to counteract any shrinkage in the mask or patient swelling.

Photo 7. A shim.

> ‘…I recall the patient wanting shims removing from under his headrest, which altered his position very slightly’. (Witness statement extract (Appendix F)). (Eva)

Removing a shim from under the headrest would keep the patient comfortable whilst maintaining the correct position if the radiotherapy causes the treatment area on the patient to swell.

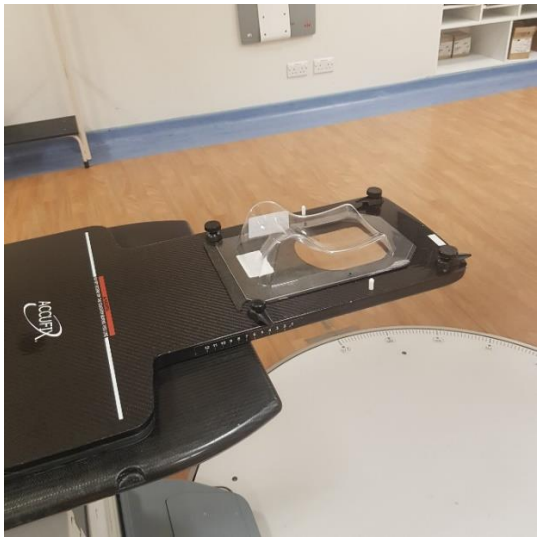


Photo 8. Position of a shim under a headrest.

The plastic mask can also shrink slightly over time, so it was normal to remove a shim towards the end of a course of treatment if required. The patient requesting for the shim to be removed suggests that the mask would have felt tight and uncomfortable. The Radiographers would have had to remove the patients' mask, lift the patients head and head rest, before removing the shim. With the shim removed, the patient would have been refitted into his mask. This would have been time consuming for the Radiographers who would have been mindful of the need to work as quickly as possible.

<u>The photograph</u>

The photograph (photo 4 above) had been provided of the treatment area so that the Radiographers could check the positioning of the skin marks (pen marks drawn on the patients skin) on each day of treatment. However, for Eva, the photograph was blurry and didn't provide the clarity that it should have.

> 'The photograph provided wasn't the clearest, and could have been interpreted differently by each Radiographer, there were no measurements, or orientation indicating which direction was superior [towards the head], inferior [towards the feet], or laterality [left or right] and as the treatment area was relatively circular again this was made more difficult.' (Witness statement extract (Appendix F)). (Eva)

> '… it was because of where it [the photo] was taken. It was taken from like the top-down and it was hard to tell which was ant [front of the patient] and which was post [back of the patient] because he was bald…. you might have been able to see his glasses, … it was a little bit blurry and then the orientation because it's

> a circular thing [isn't clear]. Which is left, which is right, which is…? … But then again because it's a circle and because you've got the marks…. You justify yourself, don't you? You use your own common sense'. (Eva)

As a consequence of the lack of clarity with the photograph, Eva put greater emphasis on the skin marks that were drawn in pen and remained on the patient's head from the previous day's treatment.

> 'Well, because you're [using] the marks that are drawn, the photograph isn't quite so important. If you're confident in the marks, …. So, the reason you didn't take action with the photo before is because these are the marks that the doctor has drawn himself and has seen [recently] and is happy with. So those marks have to stay on, and if they come off a little bit, then you get someone who marked them up to top them up. So, you've got full confidence in the marks [drawn on the patient], but the photo was a bit blurry. So, in a sense, you couldn't quite see where the graft ended and … where the normal skin started.' (Eva)

Eva recalled that if the patient lost the pen marks on his skin, a doctor would be called to redraw the marks on. For Eva, this negated the need to actively process if the pen marks on the patients' scalp were in the correct position. As only the doctor would have drawn them on, for Eva, the skin marks *must* have been correct. This provided reassurance for Eva, especially as the patient was calling out asking for the Radiographers to be quick.

> 'Yeah, but the thing is our doctor sees them on day one … and then they'll always top up the marks because they're just drawn on. But there is no, like, contingency if [the patients] lose their marks. The doctor has to record them again... So, you've got that safety net of its right because the marks are there. So, I'm seeing it. So, yes, yes, it's weird, but… only the doctor could have drawn the marks on... So yes, they must be right…'. (Eva)

However, for Faith, the inability of the patient to preserve the pen marks on his skin from day to day led to confusion which also contributed towards the error.

> 'I don't think the patient was being very proactive at keeping them [the skin marks] on, but it just ended up leading to a lot of confusion…'. (Faith)

<u>Electron treatments</u>

The patient was treated using electrons as the tumour was on the surface of the skin. This involved attaching a heavy electron applicator (photo 9) to the linac.

Photo 9. An applicator attached to the linac for electron treatments.

For electron treatments, the patient is raised and positioned very close to the electron applicator. The Radiographers would use fine adjustments to ensure that the applicator is parallel to the area being treated. This would require the two Radiographers to stand on either side of the applicator close to the patients' head so that they could visualize the treatment area. They would need to communicate the need for any fine adjustments to couch height, rotation etc. to each other, so that the beam is parallel to the patient's skin. Faith found the need for these small, complicated movements to be challenging. They made her feel apprehensive.

> 'Electron treatments can be quite fiddly…'. (Witness statement extract (Appendix F)). (Faith)
>
> '… they are fiddly…. I find it apprehensive'. (Faith)

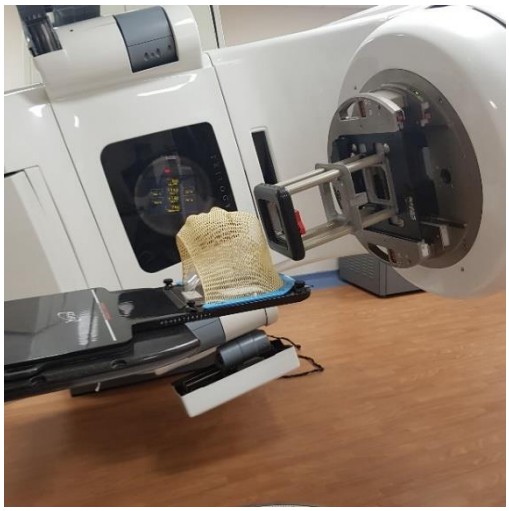


Photo 10. The linac and couch are positioned to direct the electron treatment.

Eva suggests that there was a lot of flexibility in the way electron patients are treated in Midtown department. This flexibility, compared to the rigidity of other treatment techniques used, meant that issues such as the treatment area being slightly offset from the graft were not questioned by the Radiographers.

> ‘Electrons have always been quite free hand and not quite so regimented if you know what I mean? … so, it didn't come up as unusual’. (Eva)

Faith stated that this flexibility caused confusion.

> ‘So, a lot of the confusion lay with… [pause] in our department, there doesn't seem to be a set pathway for electrons… with electrons it seemed to be … a bit of, if it fits, go for it, so there was a lot of…, a lot of discrepancies…’. (Faith)

Adding to the confusion for Faith, the department had two electron techniques; categorized as ‘planned’ and ‘unplanned’.

> ‘I think [the patient] was unplanned, … it really doesn't help because with plans, you've got a bit more guidance, but with unplanned it is a free-for-all and this is why I don't like them at all’. (Faith)

This lack of guidance meant that Faith had a strong dislike for this technique.

> ‘If I'm being honest with you, I've always hated electrons because there's no guide. It is just, if it fits, …, go for it, and there was at the time, I couldn't remember seeing any paperwork. The pictures… occasionally we had a picture [photograph of the treatment area], if we're lucky [said jokingly], for the electron patient to help us, but again it was [because] there was no hard and fast rule…’. (Faith)

Faith recalled expressing her upset at having to treat a patient with electrons.

> ‘Umm… Well, I've never liked electron [treatments], never liked [treating] skins, and I was like, oh, you know “for f**k’s sake[!]”. OK, you’ve just got to get on with it…’. (Faith)

Eva also admitted that she didn’t like the electron technique in this department, and wishes it was done the same way that she had experienced elsewhere.

> ‘It's very different to where I trained, the way they did electrons where I trained… whereas here it's a lot more chilled and a lot more… use your common sense… of course it looks right... Ohh, I always have [wished it was done differently here], I know this is awful, but since starting I've been here five years, nearly five years…. I've never really let go of how they did it. In fact, I remember when I first started here and I was watching and setting the electron up and everyone left the room, and you are like, is that it?!...’. (Eva)

Eva explained that the electron technique made her feel anxious. For a typical x-ray treatment, the Radiographers would take an ‘image’ to check that the treatment position is correct. This cannot be done when using electrons. Also, their infrequent use added to Eva’s anxiety.

> ‘… in the back of my mind, I’m always on edge with electrons because you haven’t got that verification of imaging… [I feel] a little bit more edgy … edgy is not the right word, do you know what I mean? It’s as if you're very … very on edge but, so you are checking everything because it's not something you're wholly, wholly familiar with, so it would be extra hard…. I'm maybe anxious, maybe anxious, but more conscientious, maybe a little bit anxious’. (Eva)

Faith agreed with Eva in also suggesting that a lack of familiarity, combined with the lack of assurance provided by imaging verification resulted in a dislike for electron treatments.

> ‘Electron treatments are quite few and far between, we do not get many come through and can be planned or unplanned which can confuse things’. (Witness statement extract (Appendix F)). (Faith)

> ‘Another reason I've never liked them is because there's no imaging verification [to check the treatment position] or anything like that…’ (Faith)

Overrides

With the Radiographers satisfied that the patient was positioned correctly for treatment, they would vacate the treatment room and enter the console area so that the radiotherapy could be delivered. The console area had a TV monitor for observing the patient, and a console screen which contained all the patients treatment information.

On the day of the error, Eva recalled the need to override one of the recorded treatment couch parameters[34] on the treatment console (photo 11).

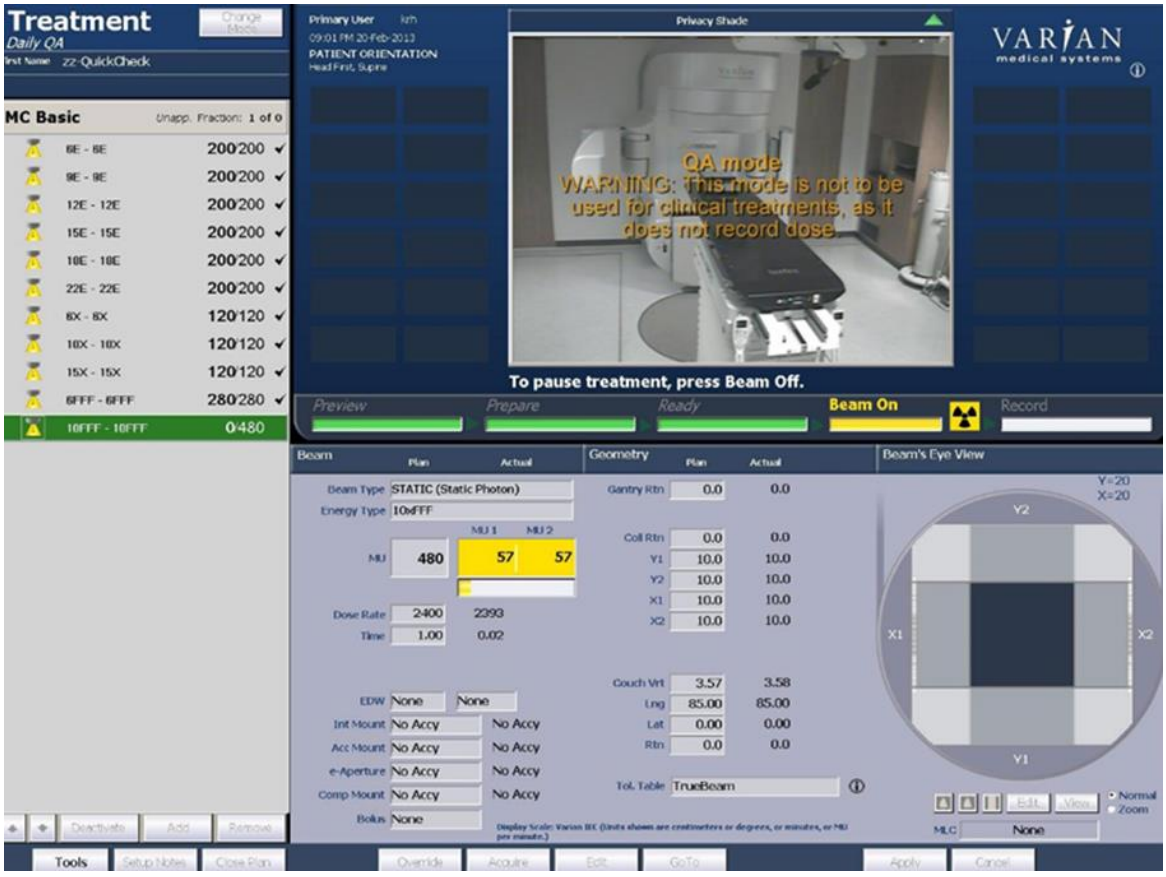


Photo 11. An example of a linac treatment console screen.

[34] The recorded treatment couch parameters are a safety mechanism on the treatment console that ensures that the treatment couch (and therefore the patients treatment position) is consistent each day throughout the course of treatment. If any of the treatment couch parameters flag up as significantly different to what is expected (that is, the 'actual' reading on the day is different to the 'plan' for any of the parameters, the parameter flags up in red - they are 'out of tolerance'), it tells the Radiographers that something was incorrect. This prompted the Radiographers to scrutinize the patient position more. Following this scrutiny, if the Radiographers can justify a reason for this difference, they must acknowledge this difference by overriding the original (plan) parameters before treatment can be delivered (Chinsky et al 2016).

On the day of the error, Eva described her thought process in justifying the need to override the couch parameters because of the removal of the shim from under the patients' headrest.

> '… when we're treating it, you've always got a justification [for every decision you make]. You've always got to justify your reasons for your overrides [overriding the recorded treatment couch parameters]. And in my head, yeah, you had justified it, when in hindsight… in hindsight, I really think it [the override] would be bigger… so I justified it in that I'd taken a few shims out because the man didn't like the mask … which drops his head back, then you raise the [couch] more. And so, I thought, yeah, that's why we were overriding, so that's fine….' (Eva)

In hindsight, Eva acknowledged that the scale of the override should not have been rationalized by the shim removal. Eva conceded that she should have spent more time scrutinizing the need to override, rather than quickly concluding that everything was OK.

> '… but then looking back at it, if the override was about a centimetre, so then that just shows it was too much. That's not justified by the shim [being removed]. So, looking back, you kind of think ohh God[!], maybe I should have picked that up more than just a very quick, yep, that's fine, without thinking more into it.' (Eva)

Faith also recalled the treatment couch being out of tolerance. Due to the flexibility and lack of clarity afforded when using this technique, she suggested that it was common to override the parameters.

> 'The tolerance was slightly out, and that's always an indication. However, this is the problem with electrons, is that a lot of it relies on the way the patient is lying and things like that, and it's not very clear. So, a lot of times you do end up overriding, but really, thinking back at it, it wasn't a massive override either. It was only very slightly out [of tolerance] so…'. (Faith)

<u>Error identification</u>

Eva recollected that the error was identified on the following day when the position of the fading skin marks was scrutinized by the Superintendent. On checking the recorded couch positions, it was discovered that the treatment had been delivered incorrectly on the previous day. An investigation into the cause of the error commenced; the findings of which are found in table 3.

5.4. Case study 3 – patient in pain.

It was a busy August day in Northtown radiotherapy department. One of the four linacs had been broken and out of clinical use for over a week due to delays in procuring the necessary replacement part from overseas. All the other three linacs were working extended 'shifts' to compensate for this loss of treatment capacity. Working in this way resulted in a reduced number of staff on each shift (three) compared to the usual four Radiographers on a normal working day. The Radiographers on the morning shift would attend at 7am and leave at 3.30pm. The Radiographers working the afternoon shift would arrive at 10.30am and leave when the last patient had been treated (at approximately 7pm). The teams of Radiographers would alternate between working early and late shifts each day. There were over fifty patients to be treated on Linac 3 that day. Due to the breakdown of the other linac, there was a mixture of patient types scheduled onto the linac that day including curative breast and prostate patients, as well as patients requiring palliative[35] radiotherapy.

This case will outline the events that led to the identification of an error on one of the patients receiving palliative treatment. This 75-year-old lady was having urgent radiotherapy to control a painful left posterior (back) chest wall lesion. The lesion was caused by a lung cancer that had spread to the posterior chest wall. Based on the diagnosis and treatment site, the patient was prescribed for 20Gy of X-Ray treatment to be delivered in five equal fractions.

The treatment was planned by a Consultant Oncologist who outlined the area to be treated on a Planning CT scan. The optimal set-up position would have offered a conundrum to the Planning Radiographers. A set-up position would be sought by the Planning Radiographers that could be replicated on each of the patients' five treatment appointments. As the patient had a painful lump on her back, an attempt would have been made to position the patient lying (prone) on her front. This would have allowed the Treatment Radiographers to visualise the lesion on her back. However, it is likely that a patient in this condition and considerable pain would not have been able to

[35] Palliative treatment involves using radiotherapy to treat patient's symptoms rather than dealing with the cause of the condition. The intention is to improve the patient's quality of life rather than aiming to cure (Wu et al 2019).

tolerate lying on their front on the hard carbon fibre treatment couch. Therefore, the patient was planned for treatment lying on her back.

The Consultant Oncologist requested that a piece of 'bolus' (photo 12) be placed under the lesion. The maximum dose of a radiotherapy X-ray beam occurs approximately a centimetre under the skin (the skin-sparing effect of radiotherapy). This bolus is a tissue-equivalent material used in radiotherapy to alter the treatment beam so that the maximum dose is at the skin surface. As this patient had a large visible lump on the surface of the skin, the Consultant Oncologist wanted the lesion in its entirety to be treated (including the skin); therefore, a piece of bolus would be used. As the patient was planned for treatment lying on her back, the bolus would be placed underneath the patient. The Planning Radiographers may have made the assumption that lying on this bolus would have also added to the patients' comfort.

Photo 12. Tissue-equivalent bolus used in radiotherapy.

On the second fraction of treatment, the patient was set up as per the setup information provided by the Planning Radiographers. The setup information instructed the Radiographers how the patient should be positioned to ensure accurate reproducibility of the treatment area each day. Accurate and reproducible patient setup is fundamental in radiotherapy; the aim of radiotherapy is to treat the exact same area during each treatment. However, the patient had great difficulty in lying flat due to the painful lesion on her back. A pre-treatment image was taken and assessed as requiring a couch correction shift of 0.8cm superior and 0.1cm to the right. The Radiographers had difficulty in matching the image as none of the anatomy aligned perfectly. As the superior displacement was similar to that seen on the first fraction the Radiographers

felt that the image match was appropriate. Further consideration for the displacement was that the patient was holding herself tense in discomfort. Also, as the couch position was similar to the previous fraction, no override of the couch longitudinal parameter was required. The Radiographers delivered the treatment.

As the displacement was consistent in magnitude and direction during both fractions one and two, the local work instructions dictated that a movement correction from the tattoo should be undertaken to account for this consistent displacement. As the correction was greater than 0.7cm it was referred to a specialist Radiographer with enhanced imaging skills. The pre-treatment images from fractions one and two were reviewed, where it was identified that the image matches were incorrect. According to the images, the patient had been treated approximately 2cm superior (towards the head) compared to the treatment field outlined by the Consultant Oncologist.

The patient was informed of the error in that the inferior (towards the feet) aspect of the treatment area had not been treated fully on the first two fractions. The patient was told that this error was discovered after the event, and that it had been reported to their Consultant Oncologist. The Consultant Oncologist advised that an extra fraction of treatment be added to compensate for the area that was not treated on the first two days. The patient completed this course of six fractions of treatment as requested.

Introducing Angela

Angela was a band six Radiographer in her late 20's. Whilst experienced as a senior member of staff at Northtown Hospital and another radiotherapy department prior to this, Angela was taking her first steps at leading the team.

Introducing Barbara

Barbara had recently been promoted internally into a temporary band six Radiographer position at Northtown Hospital, having graduated three years previously.

At the time of the research, the agency (temporary locum) Radiographer had left the organisation. The other Radiographers present on fraction one were not available for interview.

Shifts

The Radiographers were working shifts on Linac 3 because one of the other linacs in the department was broken.

> ‘We were working on [linac] 3 on the late shift with 3 members of staff as another machine in the department was broken’. (Witness statement extract (Appendix G)). (Angela)

> ‘On shift so smaller amount of staff than on a normal 8-6 today’. (Barbara)

Barbara recalled that the day of the error was quite stressful. One of the other treatment machines had broken down, meaning that the team had to work longer hours on the remaining functioning treatment machines. The breakdown meant splitting the team into two smaller ‘shifts’ with one team coming in earlier at 7am, and one team working later into the evening (the last patient scheduled at 7pm) so that all patients could be treated. It would have been unusual for a linac to be broken for so long. Barbara noted that the shifts caused her a feeling of stress on the day of the error.

> ‘It was quite a stressful day, as we were on a shift on that day. The machine had broken down in the week, so we were unexpectedly changing our plans, coming in at different times, and we're working with like a smaller amount of staff. So, it was a bit more of a stressful day, but I wouldn't say that would have impacted my mood that much, but it would have just you're more aware on a day that's a bit more stressful’. (Barbara)

Team leader absent.

The band seven Radiographer that should have led the linac was absent on the day of the error. This absence provided Angela with the opportunity to gain experience as a ‘team lead’ for the day.

> ‘We didn't have a band seven that day, so I was team leading…. I [had] team led a few times and like, I'm more than happy to do it…’. (Angela)

Angela revealed a fear of uncertainty and also a concern that she would not be in control (by encountering an issue that she was not able to deal with). Angela was leading the team for the day and didn’t want anything surprising to happen.

> '… but I think it was just, you do obviously want everything to be fine and you don't want any unexpected things that you can't answer but there's always that risk, even as a [band] seven'. (Angela)

Due to the Band 7 Radiographers' absence, Angela recalled that the team on the day of the error were relatively inexperienced. Despite feeling positive at the start of the shift, she remembered feeling stressed as the day progressed.

> 'At the start of the day, I think I was fairly positive, but it was a very busy day, and it was quite an [inexperienced] team. So, I think by the time the error happened, I was feeling quite stressed…'. (Angela)

The team's inexperience resulted in a lot of delegation, with Angela unable to think clearly in trying to manage the linacs workload whilst also concentrating on what she was doing. Angela found flicking between these conflicting requirements stressful.

> '…it was a case of having to sort of think for everybody, and so, it was like your mind's working in 10 different places trying to make sure everything's being done, and it's hard to then focus on that one task in front of you. So, then it gets quite stressful'. (Angela)

Due to the team's lack of experience, Angela was trying to remain a calm and positive influence for them. Angela was aware at the time that she was getting stressed, but her need to feel (and display) that she was in control resulted in increasing feelings of stress and frustration.

> 'And I personally take on quite a lot myself. I'm a bit of a control freak as well, and I like things to be done. So, then I internally stress. Even though I remain calm on the outside, internally I build myself up… […] … but I was trying to still be quite a positive influence because I don't like it to affect the day, but internally I would say I was more frustrated and stressed'. (Angela)

Angela remembered a feeling of continuous pressure throughout the day of the error. The Radiographers usually worked in teams of four with two Radiographers physically treating the patients in the treatment room whilst the other two Radiographers were undertaking the administrative tasks in the control area. However, on this day Angela and Barbara were working the shift with a locum agency Radiographer who was new to the department, as well as a new recruit (who was supernumerary) and a student. Due to the unusual makeup of the team, Angela was unable to get into 'the flow' of a normal working day.

> '… it had been more pressure throughout the day for pretty much every patient, there was a lot of like, you know, questions and things like that… when there's two of you, you kind of know what the other person's doing and you just get into a flow. Whereas when there's a lot of you, it feels like you're missing checking something because you're not sure what someone's done. And then you end up doing more. So, it just makes, I just find it makes it ten times harder because you're watching a student, you're watching [a new graduate], you're watching a new agency member, and you're making sure everyone has done every step as it should, and it makes it so much easier to miss a simple step because you're looking around the room continuously. And it's harder to get to the end of the bed to check paperwork if someone else is there, you don't want to appear rude and take it off them, but you need to have a look yourself as well'. (Angela)

Instead, she had to respond to the constant enquiries of her junior colleagues as well as checking their work. In compensating for her co-workers inadequacies, the day felt 'ten times harder'. Angela also inferred a sense of frustration in her inability to check each patients' paperwork easily because of the presence of these Radiographers.

Barbara was also aware that the team were not working cohesively on the day of the error. Her colleagues were not helping towards the efficient running of the day, leaving a feeling of hopelessness at their lack of effort.

> '… or when other staff members aren't being helpful in that situation. So, if you're running late, but then the next patients not ready to go in the treatment room, that can also mean that you just feel a bit demoralised because you're just you're trying your best but not everyone else is working with you to combat that, I think'. (Barbara)

Barbara recalled attempting to combat her frustrations by just getting on with the task at hand.

> 'It's very easy to feel that you're frustrated. And I think to combat that, I normally just try [to] tell someone else what needs to be done… So, I think I'm more of a person that's sort of…. tries to just get on with it. We've got this situation, you've just got to keep going with that frustration and just try our best and that's all we can really do, to be honest'. (Barbara)

However, Barbara singled out her good working relationship with Angela, the senior member of the team.

> '… me and the more senior member of staff, we worked really well together, so that was good'. (Barbara)

New band 5 graduate

Angela depicted the presence of a 'struggling' newly graduated (band five) Radiographer and a student. A challenging scene is illustrated by having lots of individuals present, with the student and new recruit unable to help towards the effective running of the workload.

> '… a new band five [Radiographer] that was struggling and wasn't signed off [as competent on the machine], and a student as well. So, I think the mix of [having] a lot of people, trying to explain everything to them, with only one other person who could do anything else to be helpful was quite a [pause]…'. (Angela)

Angela recalled the effort taken to bring the recent graduate to a point where they could work independently as a competent member of the team. Using language to portray that she couldn't take her eyes off the new recruit, Angela describes another distraction.

> 'Yeah, it's been quite a few months and it's been quite a long struggle to get them to the point of being signed off, so, it was a constant, like another thing in the room that you couldn't let your eyes go off. It was like a constant checking of someone else's work continually for every patient, so that was quite hard in itself…'. (Angela)

The length of time taken to train the new Radiographer was a source of exasperation for Angela.

> '…It was frustrating, and I think it was also a bit like annoyance that you're putting in all the work and you don't know how else to change how to help them anymore, sort of thing, so you feel bad as well that you're clearly not getting through, you are trying everything, you are trying your hardest, but something is not clicking, and you don't know how to change that'. (Angela)

Agency Radiographer

The agency Radiographer was revealed as an outlier within the team in that she was a figure of discord amongst the other team members.

> '… I was working with a new agency [Radiographer] who wasn't getting on very well with the rest of the team…'. (Angela)

Angela found the behaviour of the agency Radiographer difficult to deal with. In the week prior to the error, a tense working environment had intensified with the agency staff member seemingly at odds with the most senior members of the team. Continuous outbursts of impertinence led to a feeling of unease for Angela.

> 'It was just awkward, I think, because …[she was]… not getting on with the two bands seven [Radiographers] so it has caused a lot of tension on set, and you know, there was comments being made all the time and it's quite an uncomfortable situation to be in…'. (Angela)

Angela described a strong feeling of enmity towards the agency Radiographer.

> '…being around comments like that sort of thing because it just causes that animosity on set...'. (Angela)

Angela described the agency Radiographer as being dismissive towards both the patients and the rest of the team.

> 'She would just be quite, like dismissive, and what I found the hardest was that she was dismissive towards patients as well'. (Angela)

The impact on Angela of this dismissive behaviour was evident. Angela described how difficult she found the situation and attempted to compensate for the perceived inadequacies of the agency Radiographer.

> 'You'd be trying to get into the [treatment] room before them so you are trying to make up for a lot of things in a way. And it's difficult when you've got a student as well, and a new band 5 who's not signed off, and they're both in the room and people are getting frustrated that it's slow and things like that…'. (Angela)

Angela painted a picture of a challenging environment of frustration, and awkwardness that resulted in an uncomfortable working situation.

Barbara also recalled a difficult working relationship with the agency Radiographer. Considerately, Barbara attributed this to her lack of understanding at the hospitals' processes.

> 'And the other member staff was an agency member of staff, so they can sometimes be harder to work with because they don't know the hospitals ways of working more than, more like it as permanent staff do, so that can be quite difficult sometimes…'. (Barbara)

Barbara expressed her indifference towards the agency Radiographer.

> ‘Just indifferent [said with scrunched face and purse lips]. Just a member of staff. I wouldn't be friendly like, more friendly or less friendly to them. Just see them as a colleague sort of thing’. (Barbara)

It had been a demanding few weeks with the other linac being broken combined with working with the discord caused by the agency Radiographer and the struggles of the new graduate. Angela recalled a feeling of dread in having to deal with and think for *everybody* again.

> ‘But yeah, I think it was just a particularly hard time on [the linac], it had been a long few weeks as well, so, I think it, you just kind of had that little bit more dread dealing with everybody… it’s quite a difficult day when you're thinking for everybody’. (Angela)

<u>Tense and negative atmosphere</u>

The atmosphere in the treatment console area on the day of the error was described as tense and negative by Angela. The feeling of tension was palpable as it was a busy day amplified by the team lacking in cohesion.

> ‘It was potentially a little bit tense I guess you could say [said with a wry smile], because there was like a lot going on, it was really busy, and when everyone's not working together smoothly, it can cause that little bit of [being] disjointed. Then the atmosphere can be a little bit negative then, can't it?’. (Angela)

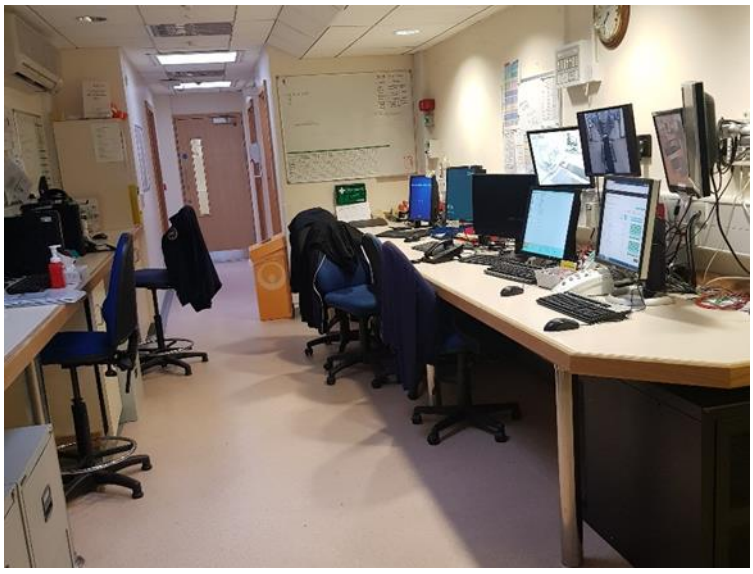


Photo 13. A radiotherapy treatment console area.

Barbara described a chaotic feeling on the day of the error.

> ‘I think it was just a little bit everywhere all over the place because the breakdowns and things, it always creates a bit more of a chaotic environment, I would say’. (Barbara)

Due to the breakdown, some patients were being treated on a linac that was unfamiliar to them. Also, the Radiographers were working in an area to which they were unacquainted with. These factors added to a feeling of chaos in the work area.

> ‘… it was just, yeah, just that bit more of a chaotic energy. Patients don't know where they're going. Staff don't… and people just… it creates that environment, doesn't it, of it's a not planned thing, it's not an everyday day’. (Barbara)

Angela recalled a noisy work area with several distractions adding to the tension. Telephones were ringing and patients were coming to the door of the control area to speak to the Radiographers.

> ‘Phone ringing, people dropping [treatment] sheets off, people with questions, patients popping around’. (Witness statement extract (Appendix G)). (Angela)

> ‘… the phone’s ringing, and patients come through. However much you put a barrier across, the patients just come straight on through the door, and up to the barriers to talk to you. You know, there's obviously always paperwork and stuff, so it's always quite noisy’. (Angela)

Photo 14. Entrance to a treatment console area with door and safety barrier.

Angela recalled ignoring some of the phone calls to the linac control area. Resorting to picking up the phone and putting it back down to provide respite from the ringing demonstrates a sense of tension.

> ‘A lot of the time of trying to just ignore, and sometimes you just pick up the phone and put it straight back down if you know its someone like reception who you know you can ring back in a minute just to stop the ringing from going on…’. (Angela)

Angela recalled a sign on the door to the treatment control area requesting that patients do not enter. Frustratingly for the Angela, the sign was mostly ignored by the patients and other individuals.

> ‘Probably just more frustrated, especially when it says [on the sign] please do not enter or please knock before entering, and they still just wander on through and start talking to you and you're like, I really can't… like ambulance staff will do it as well, and you're like, I really can't give you any attention right now’. (Angela)

<u>Fault on the preceding patient</u>

Angela recalled that the team were running behind schedule at the time of the error.

> ‘Working on a shift machine with reduced staff and running behind’ (Witness statement extract (Appendix G)) (Angela)

A fault on Linac 3 occurred during the patient prior to the error occurring. Barbara described a feeling of frustration as despite her greatest efforts, the queue of patients kept growing. This added to Barbara’s feeling of pressure, as she wanted all the patients to receive their treatment.

> ‘Felt rushed and under pressure. Machine had broken on the previous patient, and we were running behind’. (Witness statement extracts (Appendix G)). (Barbara)

> ‘I think the queue was getting bigger before the error occurred, so obviously you feel a bit more pressurised before that because you obviously want to treat the patients and get them treated and it just gets a bit frustrating when the queue keeps on getting bigger and you're working harder and harder’. (Barbara)

The fault on the linac made Barbara apprehensive; she feared that the machine would break down again on the next patient. The fault also meant that more than the usual number of individuals were present in the work area. Engineers were in attendance

attempting to clear the fault. Other Radiographers also attended the console area, attempting to offer their assistance. Some of the individuals present in the console area were displaying signs of stress.

> ‘It will that always makes you feel a bit apprehensive. You don't know what what's going to happen with the next patient if you're going to get through the next patient without another breakdown happening, it can also mean there's just a few more people around, different people react to things differently, so people can be more stressed’. (Barbara)

Barbara portrayed the picture of a scene spiralling out of control as a result of the linac running behind schedule. The machine faulting on the previous patient caused delays to the patients, some of whom required full bladders for treatment. The delay meant that these patients had to empty their bladders and start drinking again. A tense waiting area was portrayed, with some patients complaining at this inconvenience.

> ‘…so, the patients that are running late and then obviously the bladder fillers …so then they're emptying, and you just get in a spiral of everyone going in late, moaning that they're going in late, but then they go slow themselves, and then you just sort of end up in a situation…’. (Barbara)

As well as adding to her stress, running late made Angela feel flustered as she felt regret for the patients in having to wait longer than expected for their appointments.

> ‘I think we were a little bit behind. So again, probably a little bit stressed and a little bit, you know, flustered when you're feeling bad for the patients that they've been waiting for a while and you're trying to be as quick as possible, but obviously as accurate as possible as well’. (Angela)

Angela recalled worrying that the patients were being kept in the department longer than expected.

> ‘I only really worry about the patients… I just feel guilty making patients wait and be in the department any longer than possible’. (Angela)

Despite feeling stressed and flustered internally, Angela needed to show her work colleagues that she was in control.

> ‘I can recognize to myself that I'm getting flustered, but I really try not to let it show because I don't feel like it benefits anybody; with you being stressed sort of thing’. (Angela)

Patient in pain

The patient on which the error occurred arrived for treatment. Barbara recalled being surprised at revealing such an unexpected case.

> 'Yeah, definitely a bit of a surprise when I opened up the treatment sheet, umm, because it isn't something that we routinely see. You don't normally see tumours like that really'. (Barbara)

Barbara could vividly recall the size and shape of the patient's tumour on her back. She compared the tumour on the patients back rhetorically as 'like a golf ball'.

> 'The patient had a large golf ball sized tumour on her back'. (Witness statement extracts (Appendix G)). (Barbara)

> 'They had quite advanced disease, so the disease was visible on their back, but sort of in under the skin'. (Barbara)

Angela felt rushed to treat the patient as quickly as possible as she was in a lot of pain.

> 'Patient was rotated due to mass size and location and in pain... […] … Felt under pressure to rush as patient was in pain' (Witness statement extracts (Appendix G)) (Angela)

Angela emphasises how much pain the patient was in. The patient found the treatment position uncomfortable, and Angela commented on how slowly she was moving.

> *'*She was elderly, frail, in pain plus, plus, plus… There was a big lump on her back, which was quite movable when she lay down, and she couldn't lie down, she was holding herself sideways because she couldn't put pressure on it… and she was quite slow'. (Angela)

Angela felt unkind at attempting to reproduce the position in which they were planned in. The patient was recoiling in pain, and holding themselves in a tense posture which would have made positioning the patient difficult.

> 'I felt a bit mean when they are wincing in pain, and they are tense and holding themselves so you can't get them in the perfect position because they don't want to lie flat'. (Angela)

Barbara was sympathetic to the patient's needs and recognised that she was struggling to lie down flat and keep still in the treatment position.

> ‘Umm, you feel, you feel sorry for the patient…[…]… they just really struggled’. (Barbara)

Barbara implied a hint of annoyance towards the planning Radiographers for positioning the patient in this way. She states that the patient was lying uncomfortably because someone in the Planning department *deemed* this as the most appropriate position.

> ‘You know, it's such a shame that they had to be in that sort of situation to have the treatment sort of lying uncomfortably because that was what the planning department deemed was the most appropriate thing’. (Barbara)

Barbara remembered the effort of attempting to reproduce the position in which the patient was planned.

> ‘… we had to try and make sure that the patient was lying straight on the bed, but obviously because they couldn't lie down it was quite difficult to get them sort of in the right sort of position, not because they were being awkward, but just because of the nature of their disease really… they were just obviously in pain’. (Barbara)

<u>Bolus</u>

As this patient had a large visible lump on the surface of the skin, the Consultant Oncologist had requested that a piece of ‘bolus[36]’ be used. The Planning Radiographers had provided instructions as to the required positioning of this bolus. On inspection of these instructions, it became apparent that the annotation was recorded incorrectly. Angela recalled being confused by this.

> ‘…the bolus instruction were confusing as they stated to offset the bolus to the right – even though we were treating the left side’. (Witness statement extract (Appendix G)). (Angela)

Whilst being mindful that the patient was in pain, Angela came to the conclusion that the instructions had been recorded in the wrong direction.

[36] The maximum dose of a radiotherapy X-ray beam occurs approximately a centimetre under the skin. This bolus is a tissue-equivalent material used in radiotherapy to alter the treatment beam so that the maximum dose occurs at the skin surface (Wong et al 2020). If the patient had been lying on her front, the Radiographers would have been able to visualise the correct placement of the bolus over the patient’s tumour. However, as the patient was lying on her back (and lying on the lump), the Radiographers had to position the bolus underneath her back.

> ‘The instructions stated that the bolus was to be placed at the wrong side of the patient, so we made an executive decision that clearly the bolus needed to be over the lump that we were treating so we shifted it back as maybe she was more offset in Planning… but because of the pain and rotation [clearly it wasn’t right]… but you don't want to make a mistake, so you're processing it all as quickly as possible…’. (Angela)

Barbara again referenced that she was aware that the linac was running behind schedule because of the fault on the previous patient. This was a surprising type of treatment that Barbara was not expecting, coupled with a confusing bolus instruction.

> ‘We were running behind due to a machine fault on the previous patient so after discussing with [Angela] we decided that the bolus would be under the mass even if the bolus was offset to the right due to the size of the patient and the positioning of the mass’. (Witness statement extract (Appendix G)). (Barbara)

Angela provided a moment of sarcasm when recalling her feelings of latent annoyance towards the Planning Radiographer(s) that had transcribed the erroneous bolus instructions.

> ‘I feel like you're trying to just think, ohh this sounds awful, but sometimes you think, “ohh like typical” like you know, but they are busy down there as well, and they are writing stuff and it's easy to transcribe something wrong[!]’. (Angela)

<u>Imaging</u>

Barbara was unfamiliar with the type of imaging method used for this patient. Due to the palliative nature of this patient’s disease, it had been decided that a 2D image (similar to an X-Ray) would be used to verify the treatment. This 2D method of imaging would be suboptimal as it would typically be used to visualise bone rather than soft tissue.

> ‘… treating a visible mass that we were unable to see on the 2D scan. Hard to orientate myself with the image as was unable to see what I was treating… […]… This sort of [image] matching is not covered in the 2D [imaging] training and this is the first image of this sort that I have ever had to match where we are treating a posterior visible mass’. (Witness statement extract (Appendix G)). (Barbara)

This choice of imaging modality appeared to confuse Barbara; she did not have a clear impression of what was required to successfully complete the task.

> ‘No, no, I didn't have […] a mental picture of how I was going to do it. I didn't really have that in my head because it's nothing I’d done before, really’. (Barbara)

Unsurprisingly, the quality of the imaging was poor meaning that Barbara could not visualise what she was treating.

> ‘The image was hard to see and what we were treating wasn’t visible’. (Witness statement extract (Appendix G)). (Barbara)

Angela also found the image quality poor which made checking the position of the treatment field difficult.

> ‘The image was not of the best quality’ (Witness statement extract (Appendix G)). (Angela)

> ‘Yeah, I struggled to match the image. I wasn't 100% confident so I called [Barbara] to come and have a look with me, and we both agreed that [everything was correct]…’. (Angela)

Angela recalled feeling the need to check the image as quickly as possible as the patient was in pain. She was concerned about the consequences if she did not undertake this task as swiftly as possible. Angela was anxious that the patient would need to sit up and have a rest if she was left lying on her back for too long, potentially adding more time to the procedure. Giving the patient a rest before attempting again would have been time consuming – a worrying thought for Angela when the team were already running behind schedule.

> ‘And it's always that thing [when] you're trying to be as quick as you can, and especially when the patient is in pain, you're very conscious of how long you're leaving them lying there because you're worried they're going to, like, jump up and say, no, I can't do it anymore. I don't think it's stress as I don't know what the right word is where you're a bit more, like feeling like you're fast paced, having to like work more like 100 miles an hour because you know that they might not be able to tolerate it, so, you just want to get it done’. (Angela)

Prior to treatment on the previous day, the images had been ‘prepared’ where bony anatomy (such as the sternum) was highlighted. The purpose of this is to aid and speed up the matching process, where the image is compared against the Planning CT data prior to treatment. Barbara recalled making the assumption that this preparation must have been correct, instead of taking the time to adequately examine the image herself.

> '… I used that anatomy to try to match the image. This anatomy had been drawn by a band seven senior radiographer, so I trusted that they had drawn the most relevant and clearest anatomy. This is my mistake, and I will not do this in retrospect'. (Witness statement extract (Appendix G)). (Barbara)

Angela and Barbara reviewed the image and noted that the displacement was similar in size and direction to that recorded on the previous day. Instead of adequately checking the image, Barbara recalled making the assumption that it must have been appropriate as it was similar to that seen on the previous day.

> 'In the moment I believed that this was the correct place to put the image, but in hindsight I realise this was wrong. I saw that [the] shift was in the same direction as the previous day and of the same magnitude which seemed appropriate as it was a similar offset.' (Witness statement extract (Appendix G)). (Barbara)

Unbeknown to Angela and Barbara at this time, the image had been prepared and matched incorrectly on the previous day.

<u>Error identification</u>

The image was matched and assessed prior to treatment. The magnitude of the displacement meant that it was referred to an imaging specialist radiographer for review prior to the next treatment. On evaluation, it was found that the images from fraction one and two had been matched incorrectly. The patient had been treated approximately 2cm superior to the desired area.

The patient was informed of the error in that the inferior (towards the feet) aspect of the treatment area had not been treated fully on the first two fractions. The patient was told that this error was discovered after the event, and it had been reported to their Consultant Oncologist. The Consultant Oncologist advised that an extra fraction of treatment be added to compensate for what was not treated on the first two days. An investigation into the cause of the error commenced; the findings of which are presented in table 3.

5.5. Case study 4 – mismatched vertebrae.

The radiotherapy department in Southtown was one of the larger radiotherapy departments in the country with eight linacs, each treating between 40 and 50 patients a day between the hours of 8 am and 6.30 pm. The department was always busy, and this day in early May was no different on Linac 4 with a schedule full of patients. Despite the packed schedule, the team on Linac 4 were happy and working well.

This case will outline the events that led to an error being identified on one of the patients receiving palliative treatment to the abdomen. Based on the palliative intent of the treatment, the patient was prescribed for 15Gy of radiotherapy to be delivered evenly in 5 fractions over the course of a week. The error occurred on fraction 4 of the course of treatment. The first 3 treatments had all been delivered correctly.

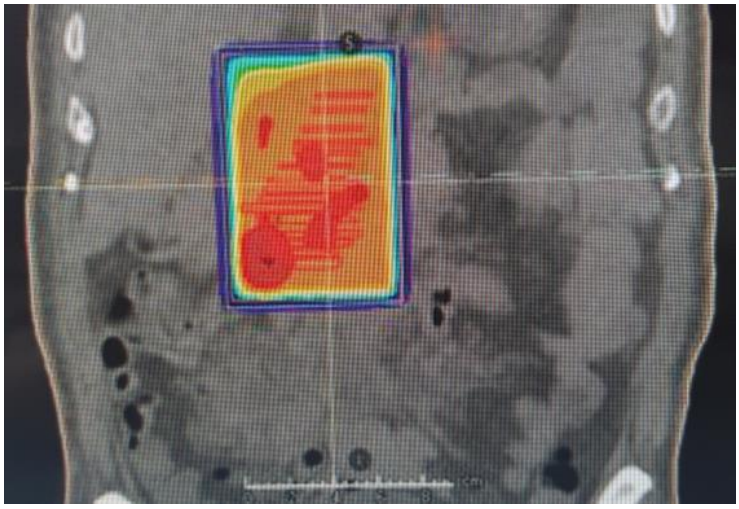


Photo 15. Planning CT scan of the patient with abdominal treatment field.

The treatment was planned by a Consultant Oncologist who outlined the area to be treated on a Planning CT scan (photo 15). It would be typical for the Radiographers in Southtown department to use MV imaging[37] (similar to an X-ray) to check the position of a palliative treatment field prior to delivering the radiotherapy treatment. However, the Consultant Oncologist requested that Cone-beam CT (CBCT) imaging[38] (similar to a CT

[37] In being similar to an X-ray, MV imaging produces a single 2D image prior to treatment. Bony structures are used to check for positional variations prior to treatment (Høyer et al 2011).
[38] CBCT mounted on the linac provides better 3D visualization of soft tissues. However, the image quality of CBCT in respiratory sites, such as in the chest or abdomen, is adversely affected by the body's motion when breathing as the boundaries between tumour and surrounding organs are blurred (Russell et al 2018).

scan) was used instead of the standard MV imaging on this patient. The request to use CBCT imaging was due to the patient also receiving concurrent[39] chemotherapy and concern for radiation dose to the patient's kidneys which were close to the treatment field. The Consultant Oncologist suggested that using CBCT imaging would allow the Radiographers to visualize the position of the kidneys prior to each treatment.

On day 3 of the treatment, it was noted that the patient had lost a significant amount of weight in comparison to when he had received a Planning CT scan a week earlier. This was evident to the Radiographers when comparing the patient's contour on the CBCT image (in green) which was superimposed onto the original planning CT scan (in purple) in the imaging software (photo 16). The large reduction in contour measured 4cm at the centre of the treatment field.

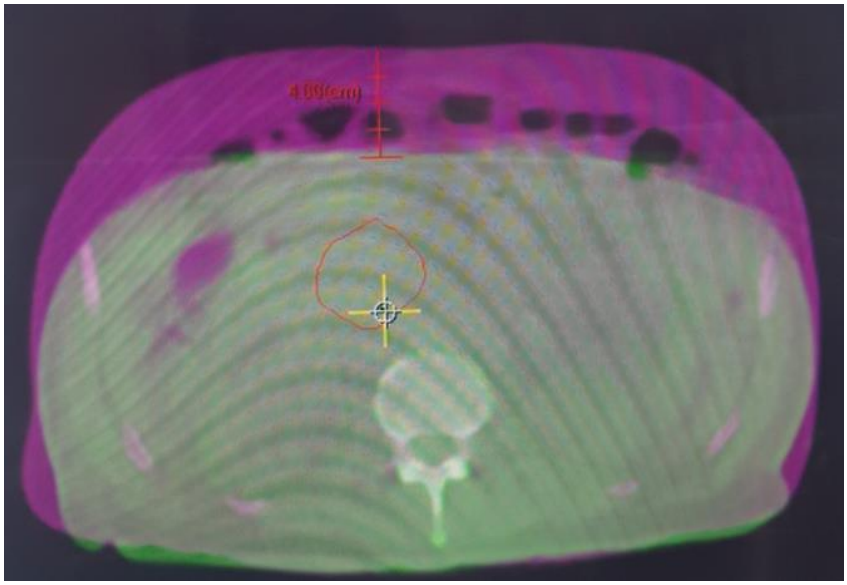


Photo 16. CBCT image (in green) compared to the original CT planning scan (in purple).

Subsequent review of the CBCT images taken on fraction 1 and 2 also acknowledged this contour change. Therefore, an adjustment was made to the amount of treatment (monitor unit correction) given on fraction 4 to compensate for this weight loss during the previous treatments.

During the Planning CT scan procedure, a small tattoo (~1mm) on the front of the patient's pelvis provided a permanent reference mark on the skin. Data from the

[39] Concurrent chemotherapy and radiotherapy is when chemotherapy is given during the same day during a course of radiotherapy (Tait 2009).

Planning scan was then used to direct the Radiographers to the treatment area in relation to the reference tattoo (that is, 2.1cm superior (longitudinal towards the head) and 3.5cm to the right of the tattoo). Following this 'movement' from the reference tattoo, a CBCT image was taken to confirm that the treatment would be delivered to the correct part of the body. Following review of the CBCT images prior to treatment during fractions 1 to 3, the Radiographers had needed to 'shift' the treatment field an additional 1.4cm superior to match the desired area to be treated. The need for this additional shift each day could possibly be accounted for by the patients' weight loss since the Planning scan was undertaken.

The CBCT imaging system uses automated matching software which uses 'greyscale' to compare the position of the treatment field with the original Planning CT scan. The local work instructions documented that the Radiographers should not trust the automatch and should carry out their own assessment before treating. Matching soft tissue in the abdomen was difficult using CBCT due to the low quality of the resulting image (as seen in photo 17). Due to the lack of visible structures available, the Radiographers chose to follow the automatch system which defaulted to comparing the position of the spinal vertebrae.

On fractions one to three, the system matched to the correct vertebrae and the treatment was delivered precisely. After three successful matches, it would be reasonable to expect the automatch to perform an adequate match on subsequent treatments. However, on fraction four, the CBCT system matched to an incorrect vertebrae leading to a shift of 1.8cm inferior (towards the feet) rather than (1.4cm superior) towards the head as on the previous days. The Radiographer's visual checks failed to detect this mismatch, and treatment was delivered 3.2cm in error.

An override of the couch parameters was required by the Radiographer at fraction 4 due to the couch position being 3.2cm different to those recorded on fraction one. The overriding Radiographer did not notice the mismatched vertebrae, and instead assumed the couch parameter override was required because of the consistent shift in the treatment position that had been required on the previous fractions.

The error was identified in a post-treatment review of the CBCT image. There was an underdose to the superior aspect of the tumour, and a corresponding overdose to healthy tissue inferior to the tumour. Due to the patients' deteriorating condition, the Clinical Oncologist confirmed that there was little clinical significance in this error and no compensation in dose (on fraction five) was required.

N.B. At Southtown radiotherapy department, the collection of witness statements from the individuals involved following the identification of an error did not form part of the local error investigation policy. Instead, the individuals were interviewed by the safety specialist as soon as possible after identification. Therefore, no witness statements were available for use in this case.

Introducing Ben

Ben was a Band 6 Therapy Radiographer. He had worked at Southtown radiotherapy department for seven years.

Introducing Sophie

Sophie was also a Band 6 Therapy Radiographer who had worked at Southtown radiotherapy department for seven years. Sophie and Ben were friends that had known each other since undertaking their undergraduate course together.

A good day

Ben was in good spirits on the day of the error.

> 'Funnily enough, that morning before work I had managed to get myself some tickets to go and see a gig in [Southtown]… So generally, I was feeling pretty good that morning… in good spirits'. (Ben)

Sophie recalled that the day had been going well; she was happy to be working with Ben who would be able to share the workload.

> '… the actual day had [been going] fine and the person I was working with was friends anyway, so working environment wise was fine, yeah, it was nice… my colleague was someone that you know I trained with him… we don't often work together, so it seems a bit of "ohh you're on here today, that's nice", you know, and you know and like I said, having someone who's working at another [band]

six, I think in your head, you are like the day's going to be easier because you've got somebody else you can share the workload…'. (Sophie)

Ben suggested that although staffing levels were poor recently, the team was working well on the day of the error.

'Staffing lately at work has not been great to be fair… but I think from memory, the members of staff we were expecting on our machine were the ones that we were treating with…'. (Ben)

Sophie commented that working with Ben meant that the day felt different to normal.

'…I think on this particular day, it was quite a one off on our little machine to have two [band] sixes working together... […] … Normally it is, you know, and like on our machine we've got quite a few new band fives that have only been qualified for a year or less, so it was a bit of it different day that day'. (Sophie)

'… So, I think on that day we saw it is a bit of a treat to have two people you know that had a bit more experience…[…]… so for me personally it was quite nice because beforehand a lot of responsibility had been on me to not only do all the imaging side, but also be sort of the band six with a lot of newly qualified band fives, so for me it was quite a nice bit of a day off from having all that responsibility [laughs]… Yeah, I saw it that way that it was a nice breather for the day to be like "ohh, it's not all on me, I can share it out with the person that I'm working with"… but yeah, this was kind of like a bit of a one off day like that'. (Sophie)

Sophie suggested that neither her nor Ben were in charge, so this added to the change from the norm on the day.

'… I think [how the day goes is] very dependent on who you're [working] with and the person I was with is somebody that I went to university with, we trained together, so I think maybe subconsciously we feel kind of very equal in that sense because we have kind of known each other since day one and qualified together and stuff, so I suppose that might feel a bit different to somebody who you didn't train with or had a few years more experience or something, so I think that might change things slightly…'. (Sophie)

Ben was used to being double-booked (that is, having more than one patient scheduled into each 15-minute appointment slot). However, Ben recalled that everything was going unusually well ('for a change') at the time of the error.

> ‘We weren’t overly double booked. It’s been busy lately and we've been double booked, but we were actually doing really well for a change this time’. (Ben)

Portering issues

The patient on which the error occurred was an inpatient on the ward in the hospital. Ben recalled that the porters were able to bring him down on time for his treatment, a situation that appeared to be unusual in the department.

> ‘They [the porters] brought him down in a timely manner... they can be quite terrible actually the porters… but yeah, on that particular day, I think he came down in a timely fashion, really’. (Ben)

Sophie recalled they were behind schedule when the patient came down. The uncertainty over the time that the porters would be able to bring the patient down from the ward, made it difficult to plan their day.

> ‘I think the day itself up until [the error] … I think we were a bit behind [pause] at the time, and I think … sort of with the way porters are… I think they either come down [from the ward] straight away or you're waiting forever for somebody to come down and you can't ever really time it right… Yeah, it's really like either the [porter’s] list is a mile long or it's only got two people on it...’ (Sophie)

Awkward introductions

Neither Sophie nor Ben had treated the patient previously.

> ‘So, it was a patient I hadn't seen before, and neither had the person [I was] working with…’. (Sophie)

When the patient arrived down from the ward, the team had other patients that they had to prioritise for treatment. Therefore, they were unable to treat the inpatient immediately. This annoyed the patient.

> ‘…And I think we'd ordered this [inpatient] down, but [at the time he arrived] we had lots of, you know, like people with full bladders ready, so we couldn't get [the inpatient] in straight away and I think they were a bit sort of annoyed that they've been sat outside for as long as they had been’. (Sophie)

Sophie justified the reasons for not treating him immediately.

> ‘I think they've been down, you know, probably less than an hour, but they have been outside [the treatment room] for quite a while, and I think obviously in their

> mind, they're thinking, well, why did you order me down if you're not ready? And whereas in our mind… the porters could take half an hour to bring [the inpatient] down, which would have worked out nicely, but they've actually only taken ten minutes, so actually the timing just didn't work out that well, but apart from that… I think you do kind of have the best intentions but sometimes, yeah, it just doesn't work out the way you planned…' (Sophie)

Sophie recalled taking the patients' annoyance personally.

> '…I don't like patients, being sort of annoyed, and I think that they're kind of being annoyed because I think he sort of took that being annoyed at me personally… and I think I don't like, you know, if a patient comes in and they're sort of annoyed, it kind of puts you on the back foot a little bit and then that makes me feel a bit kind of taken aback a bit… because again, you know, when it's a situation that you feel like it's your fault if you're being behind because of something and you're like, actually, yeah, that's kind of a feel quite bad because we should have done better or something… but I think it was a situation out of your control, you feel a bit like, "ohh, it wasn't me!"…'. (Sophie)
>
> 'I think in that sense it makes you feel a bit… [scrunches face] … because you don't want to feel like it's your fault, and I think it's just one of those situations, obviously where you've not meant to do it on purpose, and you think in your head that you've tried to do it with the best intentions but obviously it's not worked out'. (Sophie)

This uncomfortable opening exchange produced a negative atmosphere for Sophie.

> '… and I think because the opener was very [pause], you know when you first meet someone who's very much "I've been sat out there for ages!", so it was like before you get a chance to even introduce yourself really it was very much, you know [pause], and it kind of sets the tone a little bit…' (Sophie)

The negativity coming from the patient caused anxiety for Sophie.

> '…And you know, so I think, yeah, that kind of makes me feel a bit, a bit kind of like anxious or a bit nervous when someone comes in and they're like, you know, you haven't met before, and they already have a bit of negative feeling towards you…' (Sophie)

<u>The patient</u>

Ben recalled a lack of communication with the patient as he could not speak English and was visibly unwell.

> '… I don't think English was his first language either. So, he wasn't very interactive himself bless him, I mean, he didn't look very well either… yeah, he didn't really speak much at all to be honest'. (Ben)

Sophie recollected that on meeting the patient for the first time they were unable to bond.

> '…[the inpatient] looked quite… just quite like withdrawn, he was very quiet and I'd say not a kind of patient you'd have a lot of rapport with… Obviously, we hadn't met before, but my colleague that was working with hadn't met this patient before either, so we didn't have any previous meetings to kind of go off on… and he didn't speak much English either, so the language barrier was kind of another thing [that prevented us from] talking as much as you would [normally]…' (Sophie)

Whilst the patient was not in pain, Ben recalled being aware of the patient's ailing appearance and condition.

> '… he wasn't in any major pain or discomfort, anything like that. I just recall that he just didn't look very well, like I mean, he didn't look in the best of shapes, and he's obviously on the ward and yeah, he just didn't look the healthiest either…'. (Ben)

Sophie recalled trying to explain the situation with the porters to the patient.

> 'I think we kind of explained the portering system and just said, you know, we did want to get you down for this time… but they've brought you down a bit earlier… and we have tried to get you in as soon as we can sort of thing, and it's not that we've left you out there on purpose and got other [patients] in…' (Sophie)

Ben's previous good spirits had waned at the distressing sight in front of him.

> '… I guess I just probably felt bad for him really… just felt sorry that he was in that way really'. (Ben)

Due to the patients' condition, Sophie recalled wanting to get the patient treated and back up to the ward as quickly as possible[40].

> '…And I think also because he wasn't well and I think we wanted to get him back up [to the ward], you know, and you kind of do a bit less chat and more… we don't like rushing it through, but you kind of wanted to, to show you that we

[40] The patient appeared very ill so the Radiographers wanted him to be returned to the ward asap where nursing and medical staff would be present to deal with any issues that may occur.

were kind of getting on with things to try and get him back up, back up to the ward'. (Sophie)

Monitor unit correction due to patient weight loss.

The patient had lost a lot of weight since he had received his Planning CT scan a week earlier. As a result of the dramatic weight loss seen in the patient over the previous three days, the Radiographers needed to make an adjustment to the amount of radiation (monitor units) prior to treatment.

> 'And then he also had a lot of anterior contour change… it was a lot of loss. So, before we had treated him, we had to perform a monitor unit …'. (Ben)

The Radiographers had to wait for their colleagues in Radiotherapy Physics to correct the monitor units for the weight loss. Waiting for this correction meant the inpatient was brought from the ward later in the day.

> 'And I think the reason we ended up getting this guy down later was to give time for these checks to be done and come through so obviously if Physics work out what the new monitor units need to be…'. (Sophie)

If it wasn't for the need for the monitor unit change, the inpatient would have been treated earlier in the day.

> 'So, we try and get a lot of our inpatients down first thing as the porters are a lot quieter, and [the patient] can get back upstairs [to the ward] because obviously, otherwise you ring up [the ward] and X-ray want them, or someone else wants them, and they're never actually on the ward'. (Sophie)

Ben suggested that the nature of the monitor unit correction required were unfamiliar to him.

> 'It's not often I've treated anyone with an anterior [front of body contour] change, you know, that doesn't happen often, but I've seen plenty of patients with a lot of weight loss…'. (Ben)

Sophie commented that this was also uncommon.

> 'So, it's [the monitor unit change] something that I've seen before, it's just something that's less common now…'. (Sophie)

As there was a monitor unit change, Ben and Sophie had to check all the parameters before treating. This process involved Ben reading out the new monitor units and the other parameters with Sophie actively checking them.

> '…so, we've done a monitor unit correction, so… we'd have to check everything, check the monitor units, and everything and the parameters and stuff again'. (Sophie)

<u>CBCT prior to treatment</u>

Prior to treating the patient, the Radiographers needed to take a CBCT image to check the position of the treatment compared to the original Planning scan. Ben and Sophie discussed the patients' wellbeing as they prepared to perform the CBCT. However, Sophie's demeanor changed as she realised how much weight he had lost. In exclaiming the word 'Gosh', Sophie revealed her astonished surprise at the scale of the weight loss.

> '… normal comments you would say like he doesn't seem that well that chap… and then we saw the [CBCT] scan we could see how much weight he'd lost… we knew the time scale was quite short [since the Planning scan] and you know to get something like a three or four centimetres contour change is quite a lot… so I think we're a bit like "Gosh! he must have been quite unwell to lose this much [weight] in the space of a couple of weeks"…'. (Sophie)

Whilst Sophie had appeared restrained and almost unemotional up until this point, she was now suddenly deeply concerned for the patients' condition. Her heart would have been racing as her astonishment turned to anxiety. Sophie would have been regretting leaving him waiting for so long.

> '… I didn't know that much information about him, but yeah, it was kind of like it was a lot of sort of empathy and concern over it'. (Sophie)

The Radiographers were aware that the patient had lost a lot of weight. Ben suggested this focus on the amount of weight loss may have distracted them from adequately scrutinising the image.

> 'But I think the fact that we were, you know expecting the contour change, possibly just distracted us from the actual error itself…' (Ben)

Ben recalled that he may have been distracted by the scale of the contour change.

> ‘Yeah, I think it's a factor, definitely. I'm not saying it’s an excuse, but it's definitely a factor and because you know, large contour changes are what you'd call sort of red flags… you look at those and think something's not quite right’. (Ben)

Poor image quality

Ben recalled lamenting the poor quality of the CBCT[41] image produced.

> ‘I don't think that helped particularly because a lot of the soft tissue in the abdomen area just looks a lot like a lot of grey mush… At the time I think I remember seeing it and just thinking it's not the best of images to match to’. (Ben)

Lack of visible anatomical structures

Ben offered a hint of criticism towards the Planning Radiographers in providing inadequate anatomy to compare to. Ben suggested a longer field of view could have helped make an adequate assessment of the treatment position.

> ‘So, where we were treating was in the abdomen… basically you could only really see the mid-section of the abdomen, there was nothing really above or below. So, you couldn't see any sternum [breastbone] and no sacrum [bony pelvis] … so they would have been another giveaway that we've skipped [a vertebral level] because that would’ve been obvious at the time…. So yeah, those things would have helped as well ideally’. (Ben)

The lack of structures affected Sophie’s ability to make a correct judgement of the treatment area.

> ‘… the field of view that we got, we couldn't use the other sort of sense checks as reliably because we didn't have, you know, things like… lungs, [or] diaphragm…’. (Sophie)

Ben also explained that because of the palliative intent of the treatment, the Consultant Oncologist did not highlight relevant organs in the image.

[41] Whilst CBCT is a useful means of checking patient position and for identifying changes in anatomy prior to treatment, it does have some limitations. As the CBCT provides additional radiation dose, efforts would be made to minimize the dose to the patient (especially when used prior to every fraction). This reduction in dose diminishes the quality of images produced (in comparison to a conventional diagnostic CT scanner). Additionally, using CBCT to check the position of the tumour within the abdomen is difficult due to the organ motion as the patient breaths. This organ motion can produce a blurry image (Kincaid et al 2018).

> '…I think it's because of the nature of the treatment because it was a bit simpler… there was only the [basic visible tumour] which the [Consultant Oncologist] had highlighted'. (Ben)

Sophie suggested that this lack of highlighted organs caused confusion and needed greater effort to review.

> '… I think that sort of thing throws you off is because you've only got sort of one structure outlined, whereas I think we're used to seeing [CBCT] scans that have you know different [organs] outlined it gives you a better idea of what [you are looking at] … because of where it was and soft tissue within the abdomen was quite, you know, difficult to see compared to other parts of anatomy… So, you are having to trying to look at it a bit harder...'. (Sophie)

Ben regretted not spending more time trying to visualize the patient's kidneys. Again, if the Consultant Oncologist had highlighted the kidneys on the planning scan, this would have prompted the Radiographers to check for the position of these organs[42].

> 'I could have used the kidneys… again with hindsight, if I would have done a bit more of a thorough look I would probably have noticed the kidneys weren't quite level, but other than that the rest of the anatomy wasn't particularly great to match to be honest'. (Ben)

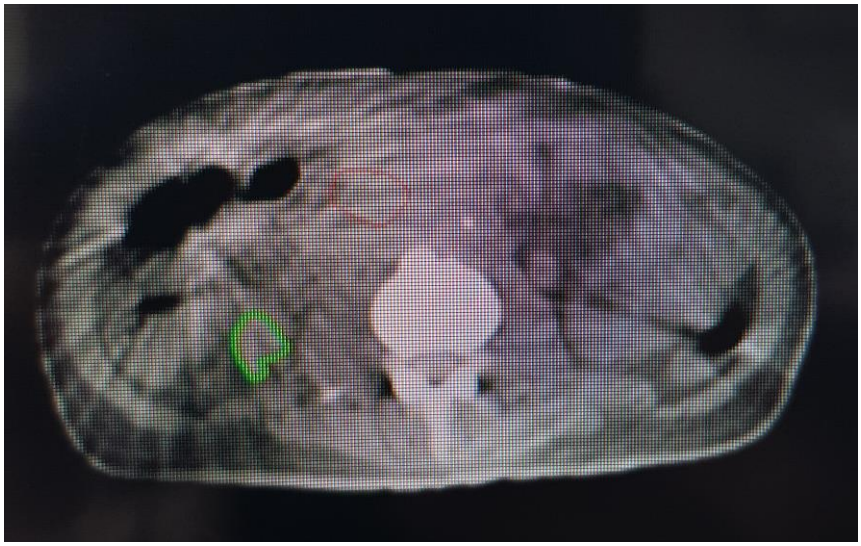


Photo 17. Image quality of the CBCT image produced (tumour in red, right kidney in green).

Sophie also suggested that the large contour change added to the confusion.

[42] Photo 17 illustrates the poor quality of the image. At the time of the treatment, only the tumour (in red) had been highlighted. Subsequently, the right kidney had been highlighted (in green) for inclusion in the investigation report.

> ‘It was just odd to look at because I think your brain’s very much because of the contour change, because things are jumping around so much, and obviously normally you'd be like, this is really off… and I think part of your brain’s kind of really focused on that… it does kind of distort your image quite a lot, and it distorts everything inside… […] … So, I think it's quite difficult to shut that bit off, and so I felt like you had to concentrate harder…’. (Sophie)

Ben bemoaned the poor-quality images and lack of organs to match to when reviewing the image. Ben decided to compare the position of the spinal vertebrae.

> ‘I think I did say to my colleague… there’s not a lot, it's just a lot of grey mush - there is not a great deal of you know, stuff to match to – it’s is only really the spine… so I guess at the time you just try and look at the spine and use that as a rough idea of where you are. And just unfortunately, you know, like all the vertebrae in that level are all very similar shapes and sizes’. (Ben)

<u>CBCT automatch</u>

Despite wanting the Radiographer’s to use CBCT imaging, the Consultant Oncologist had not provided them with many outlined structures to match to. This caused the Radiographers to rely on the automatch[43] function.

> ‘They've only provided us with the [basic visible tumour] structure, so there was no other sort of highlighted structures to match to particularly and yeah, just perform the auto matching…’. (Ben)

However, on fraction four the software matched the incorrect vertebrae.

> ‘[We] were [on fraction four of the course of] treatment and then basically what had happened is that the [CBCT] imaging software, when we performed the automatch, it had skipped a vertebral level’. (Ben)

Ben admitted putting too much trust in the automatch software.

> ‘But… when we perform the automatch we do probably put a lot of trust in it to a certain degree that it's going to, you know, perform a good match. I mean, obviously we always have to check… but I would say that you probably do put a bit more trust in the automatch than we probably should’. (Ben)

[43] The imaging software had an automatch function which automatically matched the position of the CBCT to the Planning scan (Grams et al 2014).

Sophie also confessed that the repeated use of the automatch resulted in an over-reliance in the function.

> '… but I think a lot of trust is put into it because we use it sort of for it almost every single patient really… so you are trusting it that many times, I think it gets in your head that "ohh you know it's been right for the other 39 patients I've treated today, so surely, it's going be right again", I think... […] … but yeah, we probably do trust it a bit too much'. (Sophie)

Ben was aware of the need to not rely solely on the automatch and check the images manually.

> '…even though I think in the protocol somewhere, it does say, you know, it is ultimately down to us to check because obviously the software will have limitations…'. (Ben)

The automatch had been accurate on the previous three occasions so Ben assumed that this match would also be correct.

> 'I guess one of the annoying things is on the previous fractions prior to that, the previous three [treatments] it had not skipped a vertebral level before that either… so, on this one occasion, it's [the CBCT software] just decided that you know it's just decided to skip a level because it probably thinks that you know one of the other [vertebrae] is probably … a better match'. (Ben)

<u>Consistent movements on previous fractions</u>

The software matching the incorrect vertebrae resulted in a large displacement. On reviewing the imaging records from the previous three treatments, the Radiographers could see that there had also been a large consistent displacement on each day.

> 'There was a very large [displacement] which was greater than a centimetre, which normally that would have been, you know, an eye raiser, but previously there had been a large [displacement] as well…'. (Ben)

However, on fraction four, the Radiographers had not noticed that the displacement was in the opposite direction to the previous days.

> 'So, it seemed like it was logical at the time, although at the time we didn't realize that that [the displacement] was actually in the opposite direction this time unfortunately'. (Ben)

Ben and Sophie had expected a displacement but did not pay attention to the detail of the direction.

> '…we knew [the patient] had a large [displacement] previously, so I kind of got blinded by that really…'. (Ben)

Typically, with such a large displacement, Ben and Sophie would have noticed the considerable difference in the patient's anatomy. However, because of the patients' weight loss, the difference in contour when comparing the images was not apparent.

> 'So again, when we saw that massive contour change [on the CBCT image on the day of the error], that didn't raise too many alarms because we were kind of expecting that to have happened'. (Ben)

Within the CBCT system, the sign of the number informs the Radiographer if the treatment field was inferior (positive e.g., +1.4cm) or superior (negative e.g., -1.4cm) to where it should be in comparison to the original planning scan. Ben's focus on the magnitude of the numbers prevented him from noticing their incorrect polarity.

> 'And so I think we just got blinded by the numbers, just we didn't notice that it was in the opposite direction, you see again with hindsight because the [displacements] when they come through on [CBCT] they kind of come through as a positive or a negative number, so you don't always necessarily at the time, translate that to whether it's sup or inf and you just know it's a [displacement] because it's in the [longitudinal] direction…'. (Ben)

Ben admitted not giving sufficient scrutiny to the number's sign provided by the CBCT system, which resulted in the Radiographers not noticing that the couch was being shifted in the opposite direction to that on the first three treatments.

> '….and you know with a bit more thought probably I could have probably worked it out. But just at the time when you are just looking at the numbers themselves, you don't necessarily translate it to a specific direction, if that makes sense'. (Ben)

<u>Movement correction</u>

As there had been a displacement that was consistent in magnitude and direction during treatments one to three, the local work instructions stated that a 'movement

correction[44]' from the tattoo *could* be made to account for this consistent displacement. As the Radiographers were taking an image each day, undertaking a movement correction was not mandated.

> 'So, if I'd have reviewed the image the day before, I probably would have done [a movement correction] just because it was consistent and it was a big [displacement] so I probably would have put one in, but then some people go, "but you're daily imaging, so why would we need to?"'. (Sophie)

Sophie suggested that undertaking a movement correction would have prevented the error.

> '…if the [movement correction] had been done, obviously we're expecting the [displacements] to be 0 or close to, and then that would have been a real thing to maybe stop that happening, so I don't know…' (Sophie)

Ben lamented that such a movement correction had not been undertaken prior to this treatment. Following such an amendment, Ben agrees with Sophie that the displacement in the wrong direction at fraction four would have been immediately noticeable.

> 'I mean, I think another thing as well that possibly would have avoided [the error] is in those prior three fractions because of the large [displacement] … so you know there was an argument that … a [movement correction] could have been implemented…'. (Ben)

A sense of annoyance towards the previous Radiographers was palpable as Sophie recalled that a movement correction wasn't carried out.

> '… I can only assume it's either distraction from them getting [Planning and Physics] around to look at [the weight loss] and getting the monitor unit change,

[44] The reference tattoo was located on the patients' abdomen. The Planning team had provided movements from this reference tattoo to direct the Radiographers to the area to be treated. However, as a result of the patient's extensive weight loss over the previous week, the movements from the tattoo no longer corresponded to the treatment area. Therefore, following the review of the CBCT image before treatment each day, the Radiographers needed to apply an additional movement to direct them to the area being treated. As this movement was consistent, it would be reasonable to suggest that a movement correction be undertaken. This correction would take account of the additional consistent movement and would supersede the original movements. Such a correction would have directed them straight to the treatment area and would have eliminated the time taken to check the previous images.

> and getting all that sorted, or whether they just didn't feel that one needed [to be done]'. (Sophie)

Ben and Sophie were not aware that a consistent displacement on the previous treatments hadn't been corrected on this patient. This only became apparent on review of the CBCT prior to treatment. The large displacement evident prompted them to subsequently review the previous images.

> '… I didn't really notice it hadn't been done [until we had taken the CBCT image prior to treatment] and until we had that big [displacement], and then we looked at, "has this been consistent or has this come up before?". I looked at it and was like "ohh it has been consistent" … so maybe if a [movement correction had been done], but at that point you're kind of at the when you've got the [CBCT] scan up so it's kind of too late to do anything about it [pause] and I think because unfortunately it was pretty much exactly the same number…'. (Sophie)

<u>Overriding the parameters</u>

Following the erroneous automatch and review of the CBCT image, and subsequent shift in the incorrect direction, the couch position was 3.2cm different to that recorded on the first fraction. Therefore, an override of the couch longitudinal parameter on the linac treatment console screen was required by the Radiographer prior to treatment. As this parameter was out of tolerance, the local procedure was for Ben and Sophie to get a third independent Radiographer to undertake the override for them.

> '… I personally feel it's down to the two people who are switching on to kind of persuade [the third independent Radiographer] into [overriding]. And obviously, if you think it's right, you're going to sit there and go, "Yeah, it's absolutely right!"'. (Sophie)

Sophie recalled the thought process in justifying the need for an override to the third Radiographer.

> '… and I think in our heads were like "ohh, it's a big [displacement]", because the [displacement] was like 1.8[cm], so that sort of makes sense… And because the [movement correction] hadn't been done we were just like "ohh yeah, that's sort of would make sense, wouldn't it?" … And we'd kind of spent a while looking at the image, so obviously in our head we're like, "yeah, everything's surely right"'. (Sophie)

Sophie recalled her frustration at having to get another independent Radiographer involved as they had already taken a long time to check the (poor quality) images whilst being mindful that they were running behind schedule.

> 'And we've sat here for ages looking at this, and so it was a bit like "ohh, we've got to read out [the change in monitor units and other parameters], and now we've got to get another person to look at this, and you know we're already a bit behind… And so yeah, it probably was seen as a bit of a "ohh, that's something else that we've got to do" … And I think this is always the problem with it is that obviously if you've spent ages looking at something, you don't really want someone else to come in and spend ages looking at it…'. (Sophie)

Sophie recounted the pressure that was put on the third Radiographer into overriding the parameters as quickly as possible.

> 'You know, obviously you just want to crack on and get on, and it's probably a bit of a problem with it, but… because then you kind of put a lot of pressure on the third person to be like, "Yep, yep, we've made the right decision, so if you could just put your password in [to override the parameters], that would be great!" …'. (Sophie)

Ben conceded that he was always mindful of the limited time that he could spend on each particular patient.

> '...I mean obviously we've all got time constraints to treat patients and we have only got allocated slots and you know we are a busy department, so you know, probably somewhere subconsciously in the back of my mind, I'm probably thinking, you know, we don't need to be too long on it…'. (Ben)

Sophie concluded that there was a lot of separate issues to contend with on this patient. These matters meant that the Radiographers were relieved to get the patient treated and back to the ward.

> '…it did feel like a lot, and you know, when you know with a patient and it's kind of one thing after another… so, I think the whole thing with the porters, and we're like "ohh we've got to read out [the monitor units and the other parameters]… ohh this image is taking a while to look at… ohh that [the movement correction]'s not been done… ohh, we've got to get a third [independent Radiographer to check the override]… it's kind of like, "how much more on this one [patient] can there be left to do?[!]"…[shakes head in exasperation]… And so, I think it was kind of one of those things where you are

like, the sooner you know this [patient]'s out, and like, the sooner we can move on, the better…' (Sophie)

Identification of the error

The local work instructions dictated that all images were checked by an independent Radiographer following treatment and away from the treatment console area. Free from the pressures experienced by Sophie and Ben, this Radiographer noted that the treatment had been centred on an incorrect vertebrae. An investigation into the cause of the error commenced the findings of which are presented in table 3.

5.6. Findings from local investigations.

Case	Findings from local investigations
1	'All staff were concerned with managing to get patient […] through the treatment with minimal distress, which also caused emotional pressures on the staff. The parents and play therapist were continually telling patient that treatment was going to be quicker than the scan –which is not the case- all staff involved felt that this added additional pressure. The error was not identified during set up as the image field was used rather than the treatment field therefore the overlap was not discovered (there is no protocol to identify that this should not be done). The error was deemed to be of no clinical significance, with no adverse outcome in relation to side effects or benefits expected by the patient'.
2	'It was confirmed during the investigation that as treatment progressed, the patient gradually lost his pen marks and not all staff took the set-up photo into the treatment room to verify the treatment site. This resulted in some staff setting up and treating the patient incorrectly.' '…a concession was raised to ensure all electron/skin treatments were overseen by Radiographers with sufficient experience of treating clinical mark-up patients. These Radiographers were identified based on their grade and competency'.
3	'All [linacs] had been working extended hours 7am to 7pm since **/*/20** due to La* breakdown. Reduced number of staff on 'shift' (3) compared to normal working day (4 staff). Patient unable to lie completely flat and in pain due to location of lesion. Therefore, staff felt under pressure to rush. Staff less familiar with taking 2DkV image of thorax bone lesion as not treated frequently. Skills mix'.
4	'The root cause of the error was a combination of [CBCT] skipping a vertebra and the Radiographers inaccurate imaging assessment. Repeated field placement [displacements], patient weight loss, trusting in accuracy of [CBCT] auto match, poor quality image and lack of additional structures outlined have contributed to the incident'.

Table 3. Findings from local investigations.

5.7. Conclusion to chapter.

Previous chapters have demonstrated the global health concern of patient safety. Historical attitudes towards patient safety have focused on systematic approaches and have disregarded the contribution of humans. However, this attention has not resulted in a reduction in harm; errors in healthcare still occur.

Preceding chapters have also highlighted how clinical environments are emotional spaces. Affect is concerned with how we are affected by others and how we are able to affect others in turn. Affect is important as it is central to our sociality, our relationships, and how we interact with the often-unpredictable environment around us. Patient safety will be affected by the behaviour of individuals, yet inadequate consideration is paid to these affective states. The literature called for greater attentiveness to the work of affect in clinical situations.

In presenting four case studies which describe how affect emerges and intensifies during the events that lead to human errors occurring, this chapter expands on this knowledge. The following chapter will comprehensively explore and analyse the factors and actions that led to each error taking place. Interpretations and analyses will be constructed from the data from each case study and presented in the themes that develop throughout the cases.

Chapter Six – Analysis and discussion

6.1. Introduction.

This research aimed to address the question of how affect plays a role in influencing human error. The findings demonstrated that the Radiographers contradicted what Croskerry et al (2010), Heyhoe et al (2016), Kozlowski et al (2017), and Isbell et al (2020) called the traditional view of health professionals employing cold, rational, cognitive processes when making clinical decisions. Instead, affect was found to drive human error in numerous subtle but very profound ways. The Radiographers were found to be entangled within the affectively charged worlds they share with intra-acting humans, objects, and technologies (Braidotti 2000; Barad 2003; Highmore 2010; Ronda 2020). The Radiographers were highly motivated to maintain control of their work (Furnham 2005; Leotti et al 2011) and remain on time (Szollos 2009). Threats to this control and running behind schedule resulted in various affective states accumulating (Ahmed 2004; 2010; 2014), recurring and spiralling (Pullen et al 2017). It was the movement between these different states that affected the Radiographers so much that a sense of overwhelm was apparent (Deleuze 2007). Actions and decisions were made by these affected Radiographers that resulted in different types of errors occurring (Reason 1990, 2000; Higham and Vincent 2021). In this chapter, I will discuss how these findings provide the basis for five main contributions (chapter 7.3) to our understanding of affect theory and the impact of affect on patient safety.

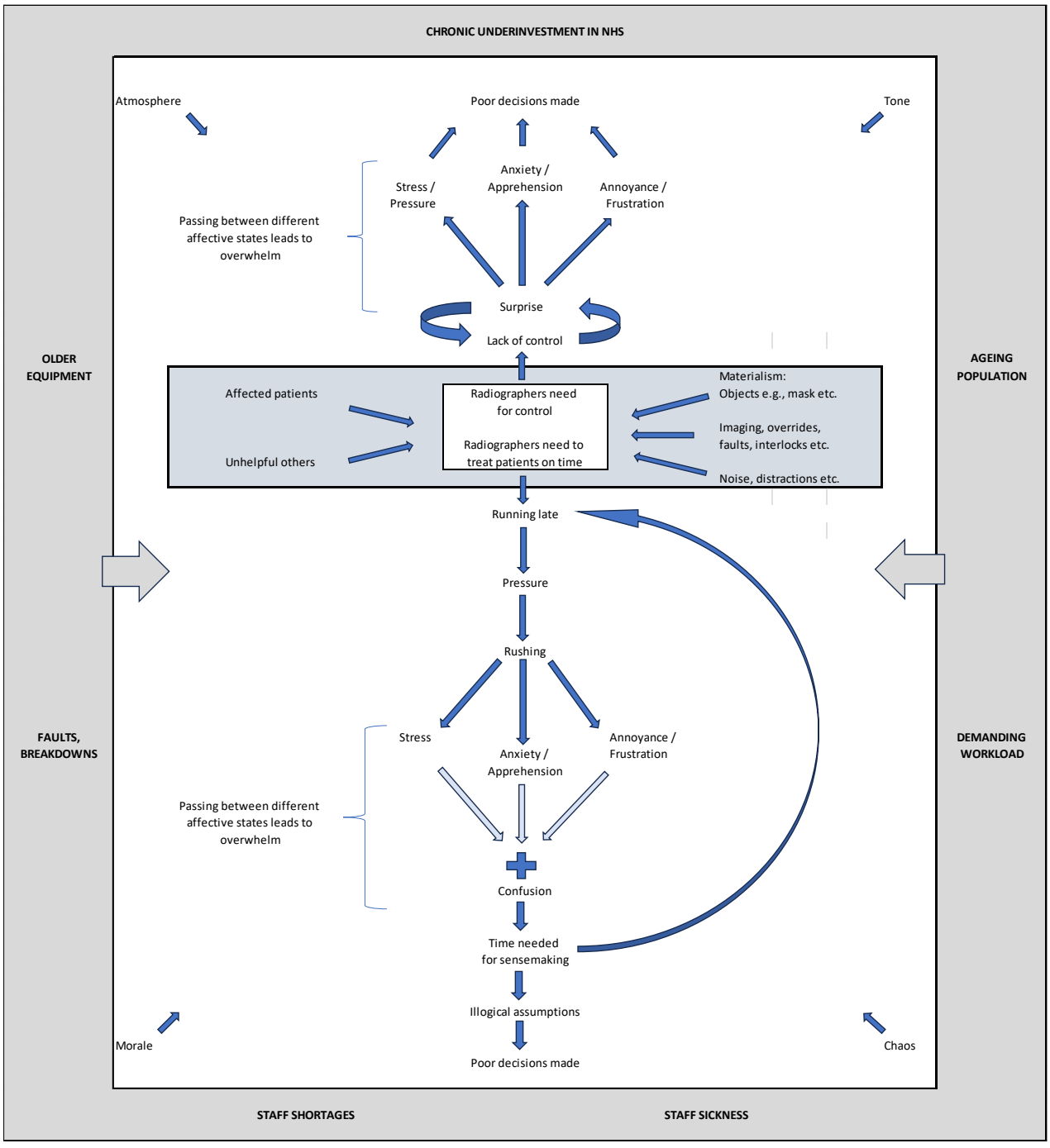
6.2. Themes.

This chapter will commence by presenting the common themes that were shared throughout the cases. The chapter will outline how affect is enmeshed within the complex inter-related macro (institutional / NHS), meso (departmental), and micro (individual) level factors that contributed towards the errors taking place. By the end of this chapter, the reader will have gained an understanding of the complex and varied shared experience of a group of Therapy Radiographers who have been involved in human errors. Below is a table of the key themes uncovered.

Sub-categories	Key themes
Macro factors	
Chronic underinvestment. Old linacs / faulting / breaking. Ageing population. Increased demand / very busy days. Staff shortages / sickness.	Institutional / NHS challenges.
Meso factors	
Objects. Technologies. Faults / Overrides / Imaging.	Materialism.
Micro factors	
Motivations	
Loss of control / uncontrollable events. Surprising / unexpected events. Others impacting on the ability to control.	Radiographer's need for control.
Running behind schedule. Rushing. Time pressures. Others impacting on efficiency.	Radiographer's need to treat patients on time.
Affective states	
Pressure. Stress.	Strain.
Annoyance. Frustration.	Anger.
Generalised worry. Specific worry.	Anxiety and apprehension.
Contagion. Tone. Atmosphere. Morale.	Collective affects.
Confusing set-up instructions. Confusing technologies. Blankness.	Confusion.
Changing affective states	
Overwhelm.	Shifting, spiraling, and intensifying affects.
Poor decision making	
Sub-optimal decision making. Decisions influenced by affective states.	Heuristics.

Table 4. Key shared themes or commonalities.

Examination of the overall themes throughout the four cases enabled the production of the following diagram which illustrates the similarities between the cases.



Macro level (institutional / NHS) factors

Meso level (departmental) factors

Micro level (individual) factors

Figure 7. Diagrammatical representation of overall themes.

6.2.1. Institutional (NHS) challenges.

The NHS is a complex healthcare system that faces various inter-related challenges emanating from an ageing population and the consequences of chronic underfunding (McKee et al 2021). To ensure high standards of quality and safety, systems should be designed to optimise wellbeing and performance (Reason 1995; Cafazzo and St-Cyr 2012; Carayon et al 2021). However, as demand for healthcare services continues to rise, the impact of inadequate funding adds stress and pressure on the incumbent workforce. The individuals' behaviour will be influenced and limited by their surroundings, and errors blamed on the human could be more accurately attributed to the environment or conditions inhabited (Leveson 2011). Examining the contributory factors and conditions which provided the foundation for the error to occur is crucial (Vincent 2001; Higham and Vincent 2021). Any investigation into errors should begin with an examination of the broader organisational context prior to attending to the individuals' proximal environment (Vincent 2010). Therefore, this analysis will commence with a discussion of the consequences of the pressures faced by NHS organisations.

Radiographers in each case declared they were running late because the day was so busy. With demand outstripping capacity, waiting times for cancer treatment have steadily increased throughout the UK in the last decade (Price et al 2022). Clearing the backlog of patients will require additional resources (e.g., more (experienced) staff) to increase capacity and provide efficient working. An ageing population has resulted in an increased incidence of cancer. Early-stage cancers are often curable, with the resulting drive for earlier diagnosis resulting in further demand for radiotherapy (Radiotherapy UK 2022). Despite workload being a known factor affecting safety (Karsh et al 2006; Vincent 2010), the pressures caused by this increased demand without the necessary infrastructure has resulted in stress, burnout, and low morale in the workforce (Thomsen 2023).

Significant staff shortages are being experienced in radiotherapy departments throughout the UK (Thomsen 2023) caused by a failure to recruit and retain a sufficient number of professionals (McKee et al 2021). This shortage was exacerbated during the covid pandemic (Thomsen 2023) and added to the exodus of healthcare professionals

following Brexit (McCarey 2023). Low staffing puts pressure on the existing workforce and leads to increased workloads, greater levels of sickness, and compromised care (McKee et al 2021). The cases demonstrated how poor staffing levels resulted in collective stress being felt. Therefore, the NHS is caught in a downward cycle with the stresses that can be partially attributed to staff shortages presenting a further threat to staff retention (Thomsen 2023).

Sickness absence related to anxiety, stress, and depression has increased greatly in NHS organisations (Palmer and Rolewicz 2023). Staff sickness was found to be very disruptive, with the present staff normalising some form of change or disruption to their teams each day due to sickness. However, the data illustrated how unexpected changes to routine caused by sickness can leave individuals feeling threatened (Murray and Nadelhofer 2023). Unexpected movement to cover for staff absence resulted in feelings of stress and pressure and therefore demonstrated the impact that sickness absence can have on the other staff. Such absence is disruptive and is also associated with a higher likelihood of the workforce leaving the service (Palmer and Rolewicz 2023). Staff absence also resulted in teams feeling the pressure of working in diminished teams. Working in reduced teams meant that the Radiographers were unable to focus on the patient that they were treating. Instead, their focus needed to continuously switch between the patient being treated, whilst also attempting to manage the contrasting needs of the upcoming patients. This was extremely challenging, especially when being busy and running behind schedule.

Attempts to address the chronic shortage of Radiographers has seen an increased number of graduate Radiographers entering the radiotherapy workforce (SoR 2021). However, the findings revealed that this has introduced novel challenges to the established workforce in the short-term. Radiotherapy is complex and it can take years of task repetition for the Radiographers to gain experience and skill (Renger 2019). Safety will be affected by how the team members supervise and support each other (Vincent 2001; 2010). Newly graduated staff require supervision which compounds the pressure of existing staff who must integrate this supervision into their own workload (van Dam et al 2023). Needing to repeatedly check their teammate's work was exhausting and made focusing difficult with the Radiographers unable to get into 'the

flow' of a normal day. Extreme feelings such as dread were expressed at having to contend with the inadequacies of their teams. Furthermore, inexperienced staff will feel anxiety and pressure if not sufficiently supported (van Dam et al 2023), and newly graduated Radiographers were found to be struggling during such challenging times. Adding to the flawed teams evident, inexperienced staff would be unable or unwilling to challenge senior colleagues (Donaldson 2021) or raise safety concerns if witnessed (Friary et al 2023). The data also offered an additional consequence of the pressures to existing staff of constantly supervising an increased number of graduates (SoR 2021) on top of their own workload (van Dam et al 2023). Respite from the responsibility of constantly supervising newly graduated Radiographers was enjoyed by the other experienced individuals on the day of error. However, the resulting parity of experienced Radiographers revelling in such relief resulted in unusual days with no Radiographer taking charge. Ultimately, as highlighted by Francis (2013), this lack of leadership would impact on safety.

Reason (1997) emphasised the importance of organisational decisions in the design of safe systems. A fundamental factor that impacted on the other individuals in the system was the use of agency staff (Vincent 2001; 2010). Agency staff are considered an ad hoc response to fluctuating demand and staff shortages. Whilst these locums can provide a critical role, their higher financial costs provide notable challenges. Higher agency costs can impact on funding to other areas such as equipment procurement. Also, a reliance on agency staff can lead to low morale amongst permanent staff who will be aware of the inequalities in pay. Permanent staff can feel pressurised by the need to constantly supervise agency staff, often without adjustment to their own workload. Frequent turnover of temporary staff can lead to a lack of continuity, with their unfamiliarity with local processes impacting on the quality of care provided. An increased likelihood of conflict between permanent and agency staff exists (Runge et al 2017; Dorney 2024); and the findings exposed agency staff being a source of considerable tension. Antagonistic comments and displays of annoyance had been witnessed by the permanent staff. The reactions and responses to such expressions of draining emotions spread and spiralled throughout the rest of the team (Hareli and Rafaeli 2008). Following repeated displays of enmity, the performativity of affect bound the team together and

against the agency Radiographer (Butler 1993; Ahmed 2014; Wetherell 2015). During this tension, strange behaviour such as dismissiveness towards the patients was witnessed. This resulted in Radiographers needing to exert greater effort in attempting to compensate for this behaviour. Such effort not being reciprocated by others in the team (Clarke and Kissane 2002) provided feelings of hopelessness. The data revealed how the subsequent incohesion and enmity within a team can cause feelings of demoralisation. As noted in Anderson (2010), they had been affected by the weakening from within (for example, the stress) and from without (that is, the animosity). When recalling the agency Radiographer's presence during such arduous times, verbal and non-verbal expressions were used to explicitly display intense feelings of dislike (Demos 1995).

The type and range of technologies present (and their propensity to breakdown) will impact on patient safety (Karsh et al 2006; Vincent 2010). However, chronic underinvestment in radiotherapy, combined with crippling bureaucracy has resulted in many departments in the UK using older inefficient equipment that reduces capacity despite the growing demand for this service (Radiotherapy UK 2022). Older equipment has a higher risk of fault and breakdown (Brkljačić et al 2014) as the many complex mechanical components in a linac undergo wear and tear from sustained (or over) use. The resulting repair of faults to these components can be disruptive (Agnew et al 2021) with such interruption being stressful for patients and staff (Wojtasik 2020).

The impact of machine faults and breakdowns on the Radiographers was profound throughout the cases. Use of idiomata, irony, and hyperbole signalled how these disruptions left the Radiographers affected (Kolvraa 2015; Berg et al 2019). Whilst inconvenient to the efficient working of the linacs, faults will often be promptly fixed. However, the data also highlighted the significant consequences of long term linac breakdowns. Prolonged linac unavailability resulted in significant disruption and stress for the Radiographers (Wojtasik 2020; Agnew et al 2021). Breakdowns resulted in a sense of chaos unfolding throughout the rest of the department. The resulting reorganisation caused a lack of familiarity and certainty for the staff and patients. The unusualness of the situation impacted on the efficiency in which the patients could be treated. Adding to the feeling of chaos, additional faults occurred on the functioning

linacs. Such further disruption impacted negatively on patient experience with discontent becoming evident. The Radiographers subsequently exhibited signs of emotional numbness caused by prolonged stress and anxiety (Friedman and Rosenman 1974). The findings portrayed scenes that quickly spiralled out of control during these interruptions.

To compensate for breakdowns at such busy times, the Radiographers would work 'shifts' in longer days to maximise the available capacity (Routsis et al 2006). However, the risks of shift working are well recognised. Changing work patterns upsets the body's natural circadian timing, is disruptive to sleep, and ultimately affects (instead of optimising) health and wellbeing. Sleep deprivation can impact on productivity and patient safety (Westwell et al 2021). Reorganisation into shifts provided a change from the normal composition of the team at a time when pressures were intensified. Working in shifts meant a constant change of plans so that the Radiographers could work either very early in the morning or later into the evening. This daily reorganisation added to the challenges of the day and provided an additional source of stress.

Therefore, radiotherapy departments have not escaped the challenges seen throughout the NHS. Each department was busy, with suboptimal staffing combined with the disruption caused by faulting equipment leading to stress (Wojtasik 2020). Knowledge, skills and experience of staff will affect safety (Vincent 2010). However, staff sickness and breakdowns, plus the recruitment of agency and graduate Radiographers resulted in the formation of inexperienced teams. As healthcare systems strain under the pressure of reduced staffing and increasing workloads, inexperienced staff will feel anxious, pressurised, and unsupported if not supervised sufficiently (Friary et al 2023). The unexpected absence of experienced colleagues left the Radiographers anxious and on edge. Patient care will require urgent responses to dynamic conditions. Therefore, previous experience with specific situations will aid decision making (Croskerry 2009) and provide confidence for less experienced staff members. The various broader challenges being faced resulted in sub-optimal teams being formed which inadvertently affected safety.

6.2.2. Materialism.

Materialism reveals the world as affectively charged with a liveliness that we participate in as bodily beings (Ronda 2020). Human and non-human bodies are complexly entangled within a world of 'lively and essentially interactive materials'. Through affect, we conceive ourselves as transversal rather than as bonded subjects, composed of mutual processes and forms. The cases portrayed the Radiographers as transcorporeal beings wholly enmeshed within their surroundings. Similar to the assemblage[45] described by Deleuze and Guattari (1987, 1994), Barad (2003) asserted a causal relationship of 'intra-acting' components. For Barad, reality is composed of things-in-phenomena. Phenomena are dynamic reconfigurations and entanglements; it is through intra-actions that the boundaries and properties of the components within phenomena (that is, what we conceive as 'subjects' and 'objects') are comprehended.

Healthcare settings are complex environments comprised of inter-dependent and inter-related components that contain permeable and shifting boundaries between them (Braithwaite et al 2021). The components of the system can interact in organised and expected ways, as well as unexpected ways; complex systems are fundamentally uncertain and unpredictable (Braithwaite et al 2021). The intra-actions of humans within these systems can intensify this unpredictability (Pomare et al 2018) and produce unexpected behaviours (Cohn et al 2013). Due to ever-evolving advancements in technology, humans are increasingly sharing work systems with complex automation. Complexity makes humans more prone to error (WHO 2019); with the greater proliferation of complex and automated systems leading to an increased prevalence of errors of omission (failure to do something) rather than commission (doing something wrong) (Leveson 2011; Balogh et al 2015). A reliance on affect is a quicker, easier way of navigating complex uncertain situations (Croskerry 2005; Croskerry et al 2008) and could account for omissions such as failures to adequately check digital images following automated matching.

Tomkins asserted that affect can combine and coassemble with memories, perceptions, ideas, relations, and institutions (Sedgwick 2003; Frank 2004; Houen 2020).

[45] An assemblage is a becoming; the fluid coming together of human and non-human phenomena (Deleuze and Guattari 1987, 1994).

Furthermore, affective forces 'intra-acted' and folded in-between the Radiographers, the patients, the technologies, the objects introduced to protect, the sensations of uneasiness, and the feelings such as annoyance and surprise. These elements were utterly entangled with the noises and distractions of the radiotherapy department; and led to stress and confusion and the uncanny relationships which developed 'in-between' (Braidotti 2000; Barad 2003; Highmore 2010; Ronda 2020).

> '…he was very calm most of the time… but then he saw the mask a little bit… I just remember that he didn't really like it…' [Eva]

Various intra-actions between Radiographers, patients, and objects were observed.

Photo 18. Photo recap of a plastic mask with hole cut out.

The findings revealed how patient's calmness can turn to stress as soon as they intra-act with objects such as the plastic mask worn for treatment (photo 18). On encountering these objects, the patient's body was changed, and the mind grasped that change; the patient was affected (Protevi 2020). The object prompted a chain of events that resulted in various affective states emerging in the Radiographers such as pressure and rushing. Subsequent objects, such as important photographs that provided detail of the treatment area were ignored by the affected Radiographers. Clouded by their feelings, the Radiographer's attention was drawn to the affected patient in his mask. However, this focus on the stressed individual resulted in other vital information being overlooked.

Photo 19. Photo recap of treatment console area.

Distraction can affect an individual's ability to function properly (Vincent 2010), and noisy working environments were portrayed with multiple interruptions taking place. Signs were present at the entrance to control areas asking for the Radiographers to not be disturbed whilst they were working. Also, safety barriers were in place at the door of the control room to prevent individuals from entering the area. However, frustration was displayed as these objects were ignored; affect surfaced and was felt between these various bodies. Also, the Radiographers recalled unusual interactions with objects such as the angry slamming down of a ringing telephone in the control area. The intra-actions between the noise, the excessive distractions, and the stressed individuals resulted in unexpected actions (Barad 2003; Ronda 2020).

Photo 20. Photo recap of safety barrier at console area entrance.

Affect emerged as a reaction to noise (Cunha and Silva 2015) and intensified the Radiographer's senses (Michels and Steyaert 2017). Anxious patients will often bring their favourite music to counteract the unfamiliarity of the clinical setting. However, music being played loudly in the treatment room was found to be a source of distraction. Music accumulated with affected patients and the presence of other

individuals in the treatment room and impacted on the Radiographers ability to communicate.

Faults[46] occurred on the linacs in the minutes preceding some of the errors. As noted, the linacs were all busy with the machines seemingly creaking under the pressure of the workloads. Using a metaphor of a complex organism, affect was amplified as the *stressed* linacs struggled to maintain control of its various parts and functions. Whilst the linacs were similar, the resulting faults affected the Radiographers in different ways. Murphie (2020) described the '(a)modal shimmering' at the junction of humans and digital technologies of all kinds. The performative intra-actions between the Radiographers and the technologies folded into and out of each other in unexpected ways. Affects were caused, even when the Radiographers were oblivious to the cause (Gatens 2014). For Murphie (2020), it was little wonder that 'strange feelings' arrived at these junctures. As noted in 6.2.1., the disruption caused by faults can be stressful (Wojtasik 2020; Agnew et al 2021). However, the faults also affected the Radiographers in other ways. Some found the faults annoying, and used ironic statements to communicate how these frequent occurrences made them feel. Others were already feeling aggrieved at their enforced change of plans, so the faults intensified the anger being felt. Guilt was felt as a result of delaying the patients longer than expected. Also, the faults made the Radiographers anxious about their reoccurrence during subsequent patient(s). With the teams already running behind schedule, the Radiographers feared the consequences of further faults that would result in them running further behind. To counter these concerns, the Radiographers would rush to work as quickly as possible.

In addition to the linacs cutting out when abnormalities (or faults) were sensed (Agnew et al 2021), various other safety mechanisms were in place to protect the patients. Since the 1990s, efforts have been made to design healthcare systems that enhance standards of safety and therefore reduce errors (Reason 1995; Vincent 2010; Cafazzo and St-Cyr

[46] The linacs are complex medical devices and they will 'fault' or cut-out if there is drift away from any pre-set calibrated parameters or failures due to mechanical, electrical, or cabling issues. These are safety mechanisms to ensure that the treatments are consistent (Agnew et al 2021).

2012; Carayon et al 2021). Door interlocks[47] were present to prevent unexpected individuals from entering the treatment rooms during an exposure. However, the intra-action of these interlocks with extraneous objects (such as a ribbon) impacted on the linac and was found to inadvertently affect the Radiographers. The presence of such 'foreign' objects in the system resulted in affect surfacing and being felt inbetween the various bodies (Barad 2003). The distraction caused by the object intra-acting with the safety mechanism resulted in the expression of affect.

Imaging provided a safety net for the Radiographers as it presented a verification that the treatment was being directed correctly. When an image is clear, a decision can be made quickly with the Radiographer assured that the treatment is positioned correctly (or not). Due to the production of poor-quality imaging, additional time was needed to scrutinise the images. All the Radiographers were hurrying due to running behind schedule. All were also trying to check the images as quickly as possible due to concerns over the patients, but the poor quality of the digital images left them unable to do so. Beleaguered by their spiralling thoughts and feelings, decisions were wrongly made by the Radiographers that the images (and therefore the treatment) were in the correct position. Also, whilst imaging verification was routinely used by the Radiographers, uncommon techniques that didn't have the benefit of imaging resulted in anxiety.

Couch overrides[48] are a final safety mechanism to ensure that the treatment couch is located in a consistent position each day of treatment. Any deviations from the norm should be investigated and justified before an override is actioned. However, in their haste to treat the patients, rushed decisions were made by the Radiographers. Flawed

[47] The purpose of a door interlock is to prevent entry to the treatment room during an exposure. Instead of a physical door at the entrance of the treatment room, a 'light curtain' interlock was present. Optical sensors on each wall provided a safety interlock which would interrupt the radiation beam when the curtain is 'broken'. To enable the interlock, a 'last person out' button is pressed within the treatment room and then the console area. The treatment beam cannot be enabled until both buttons are pressed. The parents and therapist had been directed to ensure that the ribbon remained underneath the light curtain at the entrance to the room (IAEA 2020).
[48] A couch parameter (height, lateral, or longitudinal) that is 'out of tolerance' indicates that it is positioned significantly different from when the couch parameters was initially 'captured' prior to the first treatment. The Radiographers will need to 'override' an out of tolerance couch parameter before treatment can be delivered (Chinsky et al 2016).

justification for overrides included the removal of a shim[49], the unpredictability of unfamiliar techniques, and a patient's significant weight loss. Therefore, despite efforts to assess equipment and environments against the capabilities and limitations of humans (CHFG 2021) and design errors out of healthcare systems (Vincent 2010; WHO 2019), the intra-actions of affected Radiographers with the technologies resulted in unexpected decisions and actions. Safety mechanisms put in place by the departments became ineffective due to the decisions made by affected individuals; and errors were still able to occur.

6.2.3. Radiographer's need for control.

In following Tomkins' concern for understanding the motivations of individuals (Alexander 1992; Demos 1995; Smith 1995), the Radiographer's were found to be driven by maintaining control. Level of control is a latent factor that will influence safety (Vincent 2010), and the fundamental psychological and biological necessity for individuals to perceive they have control was evident. A loss of control was exposed as having a significant impact on the Radiographers as they recounted their experiences.

> '… [the] parents and play therapist came in as well. I was not expecting them all to come in but felt unable to approach them … as a result of the previous day's events'. (Emma).

A Radiographer in control of a 'normal' day would be working with one other Radiographer, to treat a list of scheduled patients safely, efficiently, and without distraction. The patient would be called from the waiting area, his or her wellbeing ascertained, prior to the Radiographers reproducing the patient's treatment against clear set-up instructions that had been provided by the Planning department. It was interesting to note that none of the cases involved such straightforward interactions.

The treatment room and adjacent console area are the Radiographer's domain and there was an evident need for them to feel in control of this area. Affect refers to the bodily changes that surface from encounters with other bodies, with each body having the capacity to affect and be affected by others (Spinoza 2001 (1677); Gregg and Seigworth 2010; Leys 2011; Fox 2012; Massumi 2015). The presence and intra-actions

[49] A shim is only a couple of millimetres thick and therefore the scale of the override (>1cm) should not have been justified by the shim removal alone.

with various other individuals in this area impeded the Radiographer's work and left them affected. The data revealed how an inability to exert control due to these distractions resulted in the Radiographer's power of acting to be diminished (Protevi 2020).

> 'I'm a bit of a control freak as well, and I like things to be done. So, then I internally stress…'. (Angela)

Furthermore, the Radiographers obsessed over getting things done in a certain way (Furnham 2005). There were endless variables to manage, and during challenging situations, the participants struggled to maintain control. Exercising control was necessary to the lead Radiographer's sense of self-efficacy; they needed to prove their self-worth by exerting control over their teams and by providing effective leadership (Leotti et al 2011). In applying Tomkins' theory, maintaining control allowed these individuals to maximise positive affect (for example, satisfaction) out of their day whilst minimising negative feelings (McIlwain 2007). Threats to this control resulted in the expression of 'negative' feelings such as stress or anxiety.

Surprise describes the sense of wonder that an individual feels towards the unexpected (Mellers et al 2013). The intertwining nature of surprise and the individual's need for control became evident within the cases. Unexpected events left the Radiographers surprised and impacted on their ability to maintain control. Surprising surroundings and tasks were found to be a source of uncertainty. Repetition of tasks is important to improving knowledge, insight, experience, and skill (Renger 2019) and the unfamiliarity of certain treatment techniques elicited unusual reactions. The Radiographers required the adherence to clear guidelines to ensure safety (Carayon 2009; Vincent 2010); a lack of which resulted in excessive displays of negativity such as anger and hatred. That simple treatment techniques could provoke such a powerful response as hate was surprising (Hemmings 2005; Fox 2012). However, in directing hate at an unfamiliar form of treatment (Ahmed 2014) demonstrated the uncertainty and precariousness of affect's autonomic responses (Clough 2008).

6.2.4. Radiographer's need to treat patients on time.

As a means of maintaining control, the need for the Radiographers to remain on time became evident. Time pressure is a latent condition noted by Vincent (2010) as

impacting safety. However, as a consequence of the challenges noted in 6.2.1., all the departments were busy, and various inefficiencies meant that the Radiographers in all four cases were running behind schedule at the time of the error.

> 'Felt rushed and under pressure. Machine had broken on the previous patient, and we were running behind'. (Barbara)

Running behind schedule affected the Radiographers and subsequently resulted in a need to rush. Feeling rushed is related to the subjective experience of being short of time, being worried, and feeling a sense of pressure (Szollos 2009). Rushing provided insufficient time for planning and decision-making and meant that the Radiographers were always needing to react and adapt quickly to issues as they developed. It was also notable that none of the cases involved a typical interaction involving just two 'treating' Radiographers. Other individuals entered the cases and were able to affect the treating Radiographers. Affects are becomings (Uhlmann 2020); they are always in process, changing, and transforming (Coleman and Ringrose 2013). The participants became affected if the inadequacies of their colleagues resulted in inefficiencies in their work (Pruitt et al 1997). Consequentially, pressure was placed on other Radiographers to undertake tasks as quickly as possible.

The significance of the planning Radiographers in being able to affect their treatment colleagues became evident. Again, any delays caused by the inadequate actions of the planning team provoked the elicitation of affect. The data showed how poorly positioned patients were time consuming to replicate. Similarly, the provision of insufficient anatomical structures and incorrectly annotated set up instructions resulted in the treatment Radiographers needing extra time to make sense of the information provided. Sarcasm was expressed at the planning Radiographers, with such provocative language interpreted as a 'playful' means of signalling the participant's affective investment (Kolvraa 2015). Lack of clarity and completeness of instructions will impact on quality of care (Carayon 2009; Vincent 2010), yet there was no evidence in the error reports to explain if the (in)actions (or the wellbeing) of the planning staff had been investigated.

Also, other individuals, from consultant oncologists to porters, were able to enter the scenes and affected their unfolding (Seyfert 2012; Michels and Steyaert 2017). Reliance

on other work groups added an uncertain uncontrollable factor to the day. For example, the unexpected promptness of the porters provided the foundation for an uncomfortable exchange. Similarly, unusual actions from consultant oncologists to move away from standard practice provided the Radiographers with uncertainty and confusion (Craig et al 2004) and resulted in extra time needed for sense making.

Each patient had an allocated time slot, with the Radiographers constrained by the amount of time they could dedicate to each. Affording too much time on one patient would impact on the next. However, every patient portrayed was evidently in a form of affected state (that is, anxious or distressed, in pain, or annoyed), which resulted in additional time being afforded to each. On examination of the data, it became observable that each of the affected patients were able to profoundly affect the behaviour and decisions of the Radiographers. The interactions intensified the pressures that the Radiographers were already feeling and caused them to further rush. Other patients, such as those that required the specific preparation of a full bladder for treatment, were also able to enter the cases and affect the Radiographers. The practice of maintaining a full bladder can be distressing for patients (Cramp et al 2016; Smith et al 2022). These findings demonstrated how this distress can circulate (Ahmed 2014; Muhlhoff 2019) and add to the Radiographer's stress. Organising this patient group to ensure that their bladders were sufficiently full at their treatment time meant that the Radiographer had to plan ahead and also prioritise these patients when their bladders were full. Running behind schedule added stress for these patients as feelings of urgency developed. Such stress affected the Radiographers; and when bladder-filling patients became unexpectedly delayed (for example, due to faults), events were seen to quickly spiral out of control.

6.2.5. Strain: pressure and stress.

The following sections will examine the terms used by the Radiographers to give affect shape and meaning (Massumi 1995); the affective states or emotions that refer to the nameable dimensions of feeling that individuals can consciously identify (Damasio 2003). The term strain in this context is used to express the feeling of being subjected to stress or pressure.

Pressure

> 'The parents and play therapist were continually telling patient that treatment was going to be quicker than [the Planning] scan – which is not the case - this added additional pressure'. (Emma).

In addition to time pressures, other 'pressures' were expressed. Massumi (1988) defined affect as 'a pre-personal intensity corresponding to the passage from one experiential state of the body to another'. The intensities of affect are increased through the pressures we experience and will therefore influence how we live and work (Pullen et al 2017). Pressure describes the subjective experience of 'any factor or combination of factors that increase the importance of performing well'. That is, we feel pressure to attain desirable outcomes and avoid negative consequences (Baumeister 1984; Mitchell et al 2019).

The Radiographers wanted to get into the 'flow' of the day. They wanted to be immersed in their skilled work as efficiently as possible without any unnecessary distractions. Challenges experienced throughout the day presented barriers to these needs, which resulted in a sense of pressure developing. The pressures had amplified the intensity of affect which reduced what the body could do (Pullen et al 2017). The feelings of pressure were experienced in feelings of tiredness and impacted on the Radiographers' ability to focus their attention.

Other sources of pressure for the Radiographers included the unhelpful presence of other individuals. The data revealed how affect manifested in a feeling of intensifying pressure as a patient's expression of distress increased at every attempt of the Radiographers to undertake a necessary routine task (Colebrook 2002). The Radiographer's goal was to position the patient safely and accurately. However, each reaction of the patient caused a similar response from these others and compounded the Radiographer's pressure (Hickey-Moody 2013). Affect had placed the individuals in a circuit of feeling and response, with each reaction of pressure seemingly increasing in intensity (Hemmings 2005).

Each error occurred during a busy time in the departments. A collective feeling of pressure was sensed due to the challenging workloads. As noted by Houen (2020), such

pressures can become embodied and can influence working life. The pressures had challenged the Radiographers ability to perform their roles and had provided a significant source of stress (Mitchell et al 2019).

Stress

As noted in 6.2.1, institutional challenges caused by chronic underfunding had provided a foundation for collective feelings of stress to develop. The increased demand for the service without the necessary resources had resulted in a depleted and stressed workforce (Thomsen 2023) with frequently faulty equipment adding to this stress (Wojtasik 2020).

> '… we were short staffed … everybody's stressed… it's very stressful[!]'. (Faith)

A feeling of stress refers to a state of worry or mental tension that is caused by a challenging situation. Stress is a bodily response that stimulates us to confront this challenge (WHO 2023). Perceived control is located in parts of the brain responsible for modulating affect. Therefore, the situations perceived as lacking control (as noted in 6.2.3) were found to intensify the feelings of stress (Kemeny 2003; Furnham 2005; Leotti et al 2011; Mitchell et al 2019) on the days in which the errors occurred.

The Radiographers felt under pressure to perform well and threats to their self-esteem resulted in a feeling of stress (Mitchell et al 2019). An inability to maintain control over the many uncertainties developing throughout the day added to this stress (Kemeny 2003). Changes in their bodily composition had left them affected; their power of acting was diminished (Protevi 2020) and resulted in a powerless to act safely and efficiently. Also, changes to routine and powerlessness over their own autonomy affected the Radiographers feelings of self-efficacy. Such a lack of control elicited significant stress which provoked unusual reactions. For example, the data revealed how an entirely appropriate request for a Radiographer to cover a staff sickness was met with fervent anger at this perceived unfairness.

6.2.6. Anger: annoyance and frustration.

Feelings of annoyance and frustration are similar to each other, and their use was often confused by the participants. Annoyance is commonly used to describe mild states of anger. Being annoyed occurs when something disturbs you or is against your wishes

(Wierzbicka 1994). Annoyance always requires an object; you are annoyed at someone or something (Pruitt et al 1997), whereas frustration relates to a goal that an individual is trying to achieve.

Annoyance

> '… [the inpatient was] a bit sort of annoyed that they've been sat outside for as long as they had been'. (Sophie)

A passive affect occurs when an encounter with another causes a change in our body. Affect enables someone to act (Spinoza 2001 (1677)). As noted previously, perceived loss of control provoked stress responses in the Radiographers (Kemeny 2003). The findings also demonstrated how this stress could accumulate and spiral into intense displays of annoyance. Perceived threats provoked imitated reactions from the participants. Such annoyance was able to circulate and affect entire encounters. Affected Radiographers were found to become annoyed by the actions (and inactions) of various others. Provocative language was used to unequivocally accentuate annoyance (Kolvraa 2015). Also, tone was used to signal such affect (Riley 2005; Willink and Shukri 2018; Houen 2020). On recalling annoying memories, the Radiographer scrunched their faces to display intense emotion. Such excessive responses were interpreted as being unusual. However, as noted by Sedgwick (2003) and Hemmings (2005), affect is interesting because it is unpredictable.

Frustration

> 'Probably just more frustrated, especially when it says [on the sign] please do not enter or please knock before entering…'. (Angela)

As illustrated, a means of maintaining control was to treat the patients on time. A sense of frustration emerged if the Radiographer's efficiency was impeded (Pruitt et al 1997) and resulted in a need to rush (Szollos 2009). The distractive and disruptive presence of various others who hindered the Radiographer's work were significant sources of frustration. Likewise, frustration was felt at the perceived incohesion and ineffectiveness of the teams. Lastly, frustration was felt towards the faults on the linacs which caused disruption to the workflow.

6.2.7. Anxiety and apprehension.

Anxiety refers to a generalised feeling of nervousness or worry about something that may happen in the future; there is an uneasiness of mind about some form of contingency. Conversely, apprehension relates to a more specific fear or concern (Griffin 1990). The words anxious and apprehension also appeared to be confused by the participants and used interchangeably with other terms such as concern and worry.

> Electron treatments can be quite fiddly… […] … I find it apprehensive'. (Faith)

In adding to the elicitation of stress noted previously, unexpected situations developed into anxiety (Murray and Nadelhofer 2023). Infrequently used treatment techniques made the Radiographers feel 'on edge'. Repetition of tasks is important to develop the necessary skills (Renger 2019), and an unfamiliarity caused a concern that something unpleasant was going to happen. This function of affect in eliciting an uneasiness was experienced as a 'gut feeling' that something wasn't quite right (Hickey-Moody 2013); and revealed an autonomic response that was in excess of consciousness (Hemmings 2006; Clough 2008).

The Radiographers in each case were running behind schedule at the time of the error, with feeling rushed giving rise to anxiety (Szollos 2009). The Radiographers worried about the consequences of various concerns that had the potential to impact on their efficiency. Anxiety over the repeat of faults, and the occurrence of unexpected situations distracted the Radiographers' thoughts. The importance of effective handovers became evident as surprising or unexpected patient complications added to this anxiety. Patient wellbeing issues prompted concern in the Radiographers. Time was needed to make sense of these issues, and the uncertainty over their management allowed anxiety to intensify.

The data also illustrated how the memories of the previous day's concerns were found to affect the Radiographers on the subsequent day of the error (Wetherell 2015). Anxiety was able to circle and enveloped the Radiographers in the hours prior to challenging treatments. The Radiographers had been affected and previous feelings of anxiety resurfaced (Hickey-Moody 2013; Pullen et al 2017); the viscerality of affect had left a residue (Michels and Steyaert 2017). To manage these concerns, the

Radiographers needed to take control of the situation. However, as control receded and anxiety grew, the Radiographers felt powerless to act.

6.2.8. Collectives formed.

> '[Eva] was a bit flappy that day… but to be honest, I was as well … We were like, oh, we need to do this, we need to do that… we used expressions [to each other] and I joined in because [Eva]'s very similar to me…'. (Faith)

Affect is contagious and can be experienced collectively (Colebrook 2002; Ahmed 2014; Wetherell 2015; Pullen et al 2017; Lehmann et al 2019). The contagious quality of affect was evident throughout all four cases, with collectives formed in each.

Individuals with shared affect were drawn together with strong bonds existing between some of the Radiographers. The Radiographers would treat patients in pairs, and they recognised how they would copy each other's behaviour (Knight and Barsade 2015). In mimicking each other, affect was elicited and passed between each (Gibbs 2010). Affect was recognised as emotion and the Radiographers were sensitive to the 'emotions' being expressed around them (Wetherell 2015). Anxious individuals were able to sense the shared apprehension of their colleagues. Also, feelings of stress and a need to rush brought the Radiographers together. They would exert additional effort to compensate for the inadequacies in their teams. The Radiographers used facial expressions to communicate with each other (Gibbs 2010; Knight and Barsade 2015); they worked 'in sync', as the contagious quality of affect was sensed. Pairs of Radiographers in the flow of working could almost read each other's minds. Affected Radiographers were also attuned to the emotional attachment taking place in others (Muhlhoff 2019). Individuals with shared affect will act against the various other bodies (Ahmed 2004), and the Radiographers' connections meant that displays such as annoyance towards one would affect them both. Such exchanges would 'set the tone', in that affect was able to circulate and linger. Affect had a rippling effect where collectives were formed, and feelings were remembered on subsequent days. Feeling such as anxiety from previous challenging situations were found to influence perceptions and behaviours on subsequent days (Brennan 2004; Ahmed 2010; Anderson 2014; Muhlhoff 2019).

The cases revealed the draining effect of shared affect on the Radiographers. The term 'atmosphere' concerns the formation of a field of heterogenous elements and forces

(Muhlhoff 2019). Anderson (2014) describes atmospheres as 'vaguely and interchangeably with mood, feeling, ambience, tone and other ways of naming collective affects'. Negative atmospheres were able to develop due to the tensions in poorly formed teams. Such atmospheres of negativity described the swirl of affect that emanated from and subjugated the bodies present (Brennan 2004; Thrift 2006; Anderson 2009; Wetherell 2012, 2013; Anderson 2014). The days were busy and demanded efficient working, with exhausting tensions developing in incohesive teams. Morale describes the moods and state of minds of the collective; a group temper or mentality (Anderson 2010). The stress of being busy when also short-staffed resulted in collective feelings of low morale. Weary groups of Radiographers were portrayed, and mirrored Deakin (2022) in highlighting the impact on morale of workforce shortages and overstretched healthcare teams working under sustained pressure. Peer support within a close-knit team will have a strong positive influence on morale (Totman et al 2011) and ultimately safety (Vincent 2001; 2010). However, during such challenging times, collective tensions resulted in conflict and interactions which ultimately affected the patients.

The data also revealed how affect manifested in different ways in pairs of Radiographers in response to faults occurring. A fault caused anxiety about the consequences of it reoccurring. Also, a same fault affected a colleague differently in that guilt was felt for delaying the patients. Kolvraa (2015) described how the signification of affect can alter as it circulates across a space. Thus, affective contagion can be understood as a phenomenon where the 'charge' or the intensity of the various bodies within a collective space are raised, even if this is felt in different ways. Therefore, these feelings of worry and guilt as a result of the fault can be interpreted as being part of the same re-signified affective circuit.

6.2.9. Confusion.

> '… it makes you spend more time trying to figure it out… but that's why it was confusing just because … it wasn't normal… it wasn't normal[!].' (Eva)

The Radiographers were all affected when they subsequently encountered confusing information caused by the actions (or inactions) of various others. Confusion developed when judging something as new or unusual (Prineas et al 2021) and affected the

Radiographer's ability to think clearly. The state of confusion indicated an uncertainty about what to do next (Craig et al 2004; Silvia 2010). Decisions made by others to move away from standard procedures caused confusion. Also, simple situations were able to confuse the Radiographers if they were not actioned in a way that was expected. The Radiographers would recall their previous experiences, yet if this contradicted with what could be seen, confusion occurred. Such situations elicited hunches that something wasn't right; the Radiographers felt anxious and unsure about what to do. Time was needed to make sense of the confusing information that was presented (Prineas et al 2021), yet every Radiographer was conflicted with a pressure to rush. Anxiety swirled with this confusion and made concentrating difficult (Barraclough 1997; Folk 2020). The Radiographers minds were seemingly overfull with sensation and content (Massumi 2002). They were affected and their power to act (think and make sense) was diminished (Spinoza (2001 (1677)).

The important requirement of the planning Radiographers to provide clear instructions became evident. Their inability to do so impacted on safety (Carayon 2009; Vincent 2010) with confusion being attributed to a lack of explicit instructions concerning routine requirements (such as bolus position, location of treatment area, and treatment technique). Similarly, unusual decisions by others to use particular imaging modalities[50] provided confusion for the Radiographers. Previous decisions to use 2D imaging for viewing soft tissue disease caused uncertainty for the Radiographers who did not have a mental picture of what needed to be done. Conversely, the use of CBCT imaging to verify the position of spinal vertebrae caused similar confusion. A blankness was sensed as the performative presence of the human and digital technology folded into each other (Barad 2003; Murphie 2020). Extreme patient weight loss witnessed on the imaging was distracting and made focusing difficult. Also, failures to provide expected digital information resulted in a need for the Radiographers to concentrate harder. As highlighted in Silvia (2010), such confusing situations should signal the appeal for support from a senior expert (for example, a Superintendent). However, there was no evidence that such support was requested throughout the cases.

[50] Different types of imaging exist, which enable the Radiographers to check the position of organs / soft tissue (CBCT) or nearby bony structures (2D imaging) (Høyer, M. et al. 2011).

6.2.10. Shifting and intensifying affects leading to overwhelm.

> '…how much more on this one [patient] can there be left to do? [!]'… [shakes head in exasperation] … (Sophie)

The '…power of being affected is really an intensity or threshold of intensity' (Deleuze 2007). In the moments (and hours) prior to the errors, events and experiences occurred that registered in a shift of affects. Affect accumulated (Ahmed 2004; 2010; 2014), recurred, and spiralled with intensity; they built momentum (Pullen et al 2017). In all four cases, the reader can understand how the passing between different affective states (for example, from varying feelings of anxiety to annoyance and stress) affected the Radiographers so much that they become overwhelmed (Deleuze 2007).

All of the cases described busy radiotherapy departments, struggling with the consequences of an insufficiently funded service. The intertwining lack of control and surprise at unexpected situations was noted and resulted in Radiographers that were stressed and anxious. All of the cases involved Radiographers rushing to remain on time due to the various issues encountered, such as linac faults, breakdowns, and the inefficiencies of inadequate teams. None of the patients were straightforward. All were affected and their needs and issues intensified the Radiographers' affective states. Also, the presence of and actions of various others affected the Radiographers and impeded their work. A folding-in of external influences (e.g., technologies, noise, and objects) and a simultaneous folding out of affects (e.g., anxiety and annoyance) was described (Braidotti 2000). A swirl of affect shifted and intensified and was felt by the Radiographers in terms of chaos, tension, and negative atmospheres. The 'utter entanglement of all these elements' (Highmore 2010) left the Radiographers affected to such a degree that a sense of exhaustion and overwhelm was witnessed towards the culmination of the cases. On encountering confusing information during such challenging times, each affected Radiographer needed additional time to focus attention and make sense of their surroundings.

6.2.11. Decisions made using the affect heuristic.

> '… the treatment area only covered half of the skin graft (which is unusual practice, as usually for these patients the entire graft site is covered by the treatment field) …'. (Eva)

Efficient and accurate decision making is critical to patient safety (Prineas et al 2021), and poor decisions will contribute towards the occurrence of human errors (Higham and Vincent 2021). Individuals will rely on heuristics (mental shortcuts) or biases when making decisions, and when examining flawed clinical decision-making, the use of 'shortcuts' are often evident (Alti and Mereu 2021). When using heuristics, we rely on prior knowledge rather than an active thought process (Minda 2015). The affect heuristic allows us to rely on emotions or 'gut feelings' to arrive at the easiest most intuitively pleasing decision (Croskerry et al 2008; Minda 2015). Relying on our affective state can distort our thinking and led to unusual assumptions being made by each affected Radiographer. Poor decisions were arrived at in each case; the body's power of acting (decision making) was diminished because of these affects (Spinoza 2001 (1677); Protevi 2020).

As noted previously, the Radiographers were all stressed because of a perceived loss of control and were rushing due to efficiency concerns (for example, the repeat of faults or the wellbeing of affected patients). The Radiographers were affected and when they subsequently encountered confusing information, they were disorientated and unable to focus (Silvia 2010). Time was needed to process the information, work out how it fitted with previous experiences, and decide upon an action. However, an ability to make effortful well-reasoned decisions was impacted by stress (Soares et al 2012) and anxiety (Hartley and Phelps 2012). The Radiographers relied on heuristics as they didn't have the time or sufficient mental resources to make cognitively effortful, well-reasoned decisions (Alti and Mereu 2021; Higham and Vincent 2021).

Illogical assumptions were made by the affected Radiographers. Instead of gathering detailed information that would have revealed that these assumptions were incorrect, time and effort was saved by consulting the affective impression of the situation (Finucane et al 2000). Inadequate attention was paid to the detail of the information presented, with important details overlooked or ignored (Silvia 2010). Each Radiographer's attention was seemingly focused elsewhere. Finally, safety mechanisms were in place (for example, couch overrides and review by an independent Radiographer) to alert the Radiographers that something was incorrect and to protect the patient. However, overcome by their overflowing feelings, insufficient time and

attention was paid to these safety mechanisms. Evaluation of the risk of overriding the couch parameters was also influenced by the affect heuristic (Slovic and Peters 2006; Skagerlund et al 2020). Without adequate thought, the parameters were quickly overridden, and the erroneous treatments delivered.

6.2.12. Review of local investigation findings.

Sedgwick embraced Tomkins (1963) in recognising the vulnerability of humans to err; we are motivated to learn by making mistakes (Sedgwick and Frank 1995). Reason (2004, 2008) described the importance of learning from errors to enhance safety within complex systems. Embracing an 'ethic of learning' (Berwick 2013) from errors is important in preventing them from happening again. However, a review of the local error investigations found that the findings were incomplete, with affect largely undetected despite its prominence in each.

Case 1: Using the taxonomy of errors developed by Reason (1990) and subsequently referenced by Higham and Vincent (2021), this error was defined as a 'slip'. That is, it was a skill-based failure to complete an action as intended. Related to a failure of attention, this act occurred during the automatic performance of a routine task. The pressures that the Radiographers described in their witness statements were referred to in the local investigation report. However, there was no evidence that these pressures had been further investigated during the subsequent interviews. This suggests that the investigators were unaware of the significance of these pressures to the findings and no other expressions of affect were identified. As the purpose of the investigation was to highlight the cause(s) and prevent similar errors from reoccurring, this case suggests that a knowledge of affect would have been valuable.

Case 2: This error was caused by a 'rules-based mistake' (Reason 1990). That is the Radiographers applied an incorrect rule or procedure despite being trained what to do. Mistakes are caused by unprepared or unanticipated situations. They cause an action to go entirely as planned, but the plan itself was wrong. Therefore, a mistake could be described as a 'conscious' failure, which contrasts explicitly with the almost 'unconscious' automatic performance of the slip described in case 1. An investigation was completed, yet there were no findings pertaining to affect in the local investigation report. Similar to the first case, as the purpose of the investigation was to identify the

cause(s) with a view to preventing similar errors from occurring, recognition of affect would have been beneficial.

Case 3: Similar to case 2, this was caused by a 'knowledge-based mistake'. That is, it developed from an unusual or unanticipated situation where a solution needed to be worked out immediately. This caused an action to go entirely as planned, but the plan itself was wrong. The Radiographers did not have an adequate mental model to base their decision on. In encountering an unrecognisable situation, the Radiographers would need to rely on the 'cognitively effortful and error prone processes of reasoning' (Higham and Vincent 2021). However, easier and quicker decisions based on their feelings were made instead. The Radiographer's pressure to rush as extracted directly from the witness statements was referred to in the investigation report. However, there was no evidence that this had been further investigated during the subsequent interviews. This suggests that the investigators had only a superficial understanding of the significance of the pressure to the findings. There was no other reference to affect in the investigation report. As noted with the previous cases, if the purpose of the investigation was to prevent the reoccurrence of similar errors, the case suggested that a knowledge of affect would have been useful.

Case 4: Similar to case 1, this error was also caused by a 'slip' in that it was a skills-based failure that was associated with either distraction or preoccupation (Reason 2000; Higham and Vincent 2021). This case was noteworthy in that the patient provoked an unusual, intensified reaction from the Radiographer. Heuristics can provoke negative affective responses towards individuals that have been labelled as difficult (Croskerry et al 2008) and this could have influenced the Radiographer's behaviour. Furthermore, the patient spoke little English, with the Radiographers recalling minimal interaction throughout the remainder of the encounter. As noted by Vincent (2001; 2010) any factors that impact on communication will influence the risk of harm. Unfortunately for this inpatient, his safety may have been compromised following the angry initial exchange. Despite the profuse annoyance and confusion evident, there were no findings pertaining to affect in the local investigation report. Comparable to the previous three events, this case suggested that a knowledge of affect would have been useful to maximising learning with the aim of preventing similar errors from being repeated.

Therefore, the cases uncovered different types of errors as originally defined by Reason (1999), with these definitions remaining in current practice (Higham and Vincent 2021). However, a necessary amendment to this taxonomy was identified. Slips were described as 'associated with either distraction or preoccupation' (Reason 1990). That is, they occur either from 'the person's surroundings or their own preoccupation with something in mind' (Higham and Vincent 2021), their environment *or* from their thoughts. However, the Radiographers were overwhelmed because of the utter entanglement of their thoughts intra-acting with digital technology, the presence and actions of various others, and a swirl of affective states that originated from the consequences of the broader institutional challenges. Therefore, in developing the definition by Higham and Vincent (2021), the slips in these cases were caused by:

> 'the thoughts of the individual *because* of their intra-action with the surrounding environment'.

The key debate of whether affect is autonomous from cognitive appraisal has been central since the affective turn (Gregg and Seigworth 2010; Knudsen and Stage 2015). Arguments concerning affect's position in preparing human judgement and decision making without scope for consciousness to intervene (Kristensen 2016) had important implications for this research. However, the errors that emerged in these cases suggested that affect operated at *both* above and below conscious awareness, and had various influences on thought, perception, and behaviour. Affect was found to intrude into slips, the failure of automatic 'unconscious' performances of routine tasks. Also, affect was present in the conscious mistakes that developed from unexpected situations. Some Radiographers recognised affect as pressures when providing their witness statements immediately following the identification of error, whilst others were evidently oblivious. Furthermore, literature from both sides of the debate was found to be applicable when used to support this discussion of the errors.

These cases have demonstrated how the underlying latent conditions caused by organisation decisions (that is, decisions that resulted in the use of old frequently breaking equipment, shift work, agency staff, inexperienced teams etc.) were able to lay dormant for days or weeks (Cafazzo and St-Cyr 2012; Donaldson 2021). It wasn't until these weaknesses combined with the flawed decisions of affected Radiographers that all

the ‘holes in the defences’ (WHO 2019; Donaldson 2021) aligned and an error occurred. If the purpose of error investigations is to examine why the error happened, with the aim of redesigning work to prevent it from happening again (Buerhaus 1999; Donaldson 2021), it follows that the recognition of affect when investigating a wide range of errors would have been important. Consequentially, knowledge of affect should be applied to future error investigations and also the retrospective examination of past investigations to maximise the learning from these events.

6.2.13. Diagrammatical representation of discussion chapter.

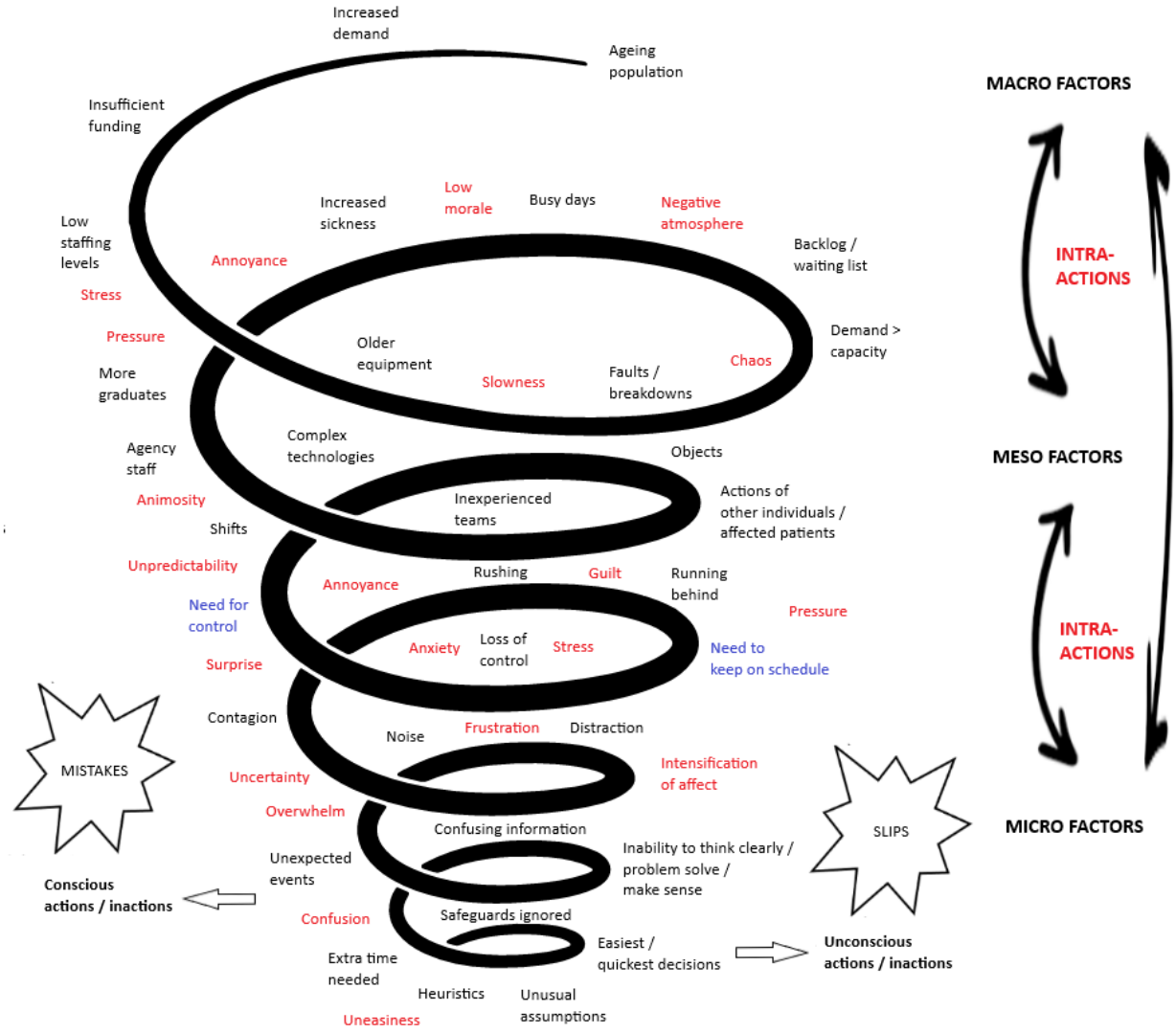


Figure 8. Diagrammatical representation of analysis and discussion chapter.

Figure 8 demonstrates how affect intra-acts, accumulates, intensifies, and spirals prior to error. Affect emerged as a consequence of the institutional challenges faced by NHS organisations. The diagram demonstrates how affect from these macro factors is tightly interwoven and intra-acting with the meso and micro factors that combined to result in errors occurring.

6.3. Conclusion.

In examining the distinctions and themes that developed throughout the cases, the reader would have gained an understanding of the experiences of a group of Radiographers involved in human error. Whilst each case had its discrete uniquities, several complex and overlapping themes were uncovered. The cases highlighted the consequences on patient safety of various inter-related challenges facing NHS organisations such as insufficient funding, staff shortages, a backlog of patients, and an ageing population (McKee et al 2021). These chronic issues resulted in affected Radiographers utterly enmeshed within institutional contexts which made the occurrence of errors more likely. Radiographers were found to be intra-acting within a lively world where affect was folded in-between themselves, the technologies, distractions, and objects. Despite considerable efforts being made to design healthcare systems that are safe (Cafazzo and St-Cyr 2012; Carayon et al 2021), the intra-actions of affected Radiographers within these lively technological worlds resulted in unexpected actions occurring.

None of the cases involved a straightforward interaction between two *treating* Radiographers and a patient. Each patient arrived in a form of affected state, and in addition to various other individuals who entered the scenes, were able to affect the Radiographers and hinder the efficiency of their work. The Radiographers held a fundamental need to maintain control of their workload, and threats to this control left them affected. An important means of keeping control was the motivation to remain on schedule; with the consequences of 'running behind' a source of affect. All of the erroneous cases were found to contain elements of control ebbing away and all involved the Radiographers rushing to catch up. This rushing and lack of control resulted in varying bodily expressions of stress, pressure, anger, and anxiety being conveyed by the Radiographers as they recalled the moments prior to the errors occurring. The

Radiographers were affected, and when each encountered distraction or confusing information, extra time was needed for sense-making. Compounded by the accumulating, shifting, and intensifying affective states that enveloped them, a sense of overwhelm was palpable in each. Unusual assumptions were made, and the safety mechanisms installed by the organisations to prevent harm became ineffective due to the uncanny decisions made by these affected individuals.

Examination of the local error investigations found that the findings were incomplete, with affect largely undetected despite its prevalence throughout the cases. Different types of errors were uncovered with affect significant in each. Affect was identified in both rules- and knowledge-based mistakes. Also, affect was recognisable in slips that were found to be caused by the thoughts of the individual *because* of their intra-action with their surrounding environment. Decisions were made that suggested that affect operated at both above and below consciousness. Affect was consciously felt and named by some as pressures when providing witness statements following the identification of an error. Others were evidently unconscious of affect, with its presence mostly ignored. Also, both sides of the debate were found to be applicable to the discussion that has taken place within this chapter. If the purpose of an error investigations is to examine its causes with the aim of preventing it from happening again, knowledge of affect would be valuable to those investigating, so that an ethic of learning can be maximised.

Chapter Seven – Conclusion

7.1. Introduction.

I have experienced working in the Radiotherapy domain for over twenty-five years, with part of my current role being to investigate errors that have occurred within the Radiotherapy department. In recent years, this has developed into an interest in the role of affect and its influence on patient safety. This followed the recognition of emotion and traces of affect being elicited when investigating errors that had been identified within my own workplace. Undertaking this research has provided a huge amount of personal and professional growth. In sharing an awareness of affect through interactions with colleagues, it has enabled me to stimulate reflection in others' own practice as well as in my own. Through publication, I am also optimistic that this research will inspire other healthcare professionals to engage in research on affect.

The aim of this research was to examine the role of affect when a human error occurred within a radiotherapy department. This was accomplished by undertaking case studies following the identification of human errors in four UK radiotherapy departments. This concluding chapter refers back to this aim. Having completed the research, I will consider the data that supports the answering of the following research questions:

> What role does affect play in influencing human error?
>
> In what ways can we identify the influence of affect as a precursor to human error within radiotherapy?
>
> How does enhancing our understanding of affect contribute to reducing the recurrence of human errors?
>
> What are the benefits of sharing rich experiential qualitative data on affect after human errors?

Firstly, I will outline how the aim has been achieved by responding to each of the research questions sequentially. Next, I will consider the contributions and implications of this research for patient safety policy and for the professional practice of Radiography and error investigating in radiotherapy. Following this, I will highlight the limitations of

the research prior to closing the chapter by offering directions for future research which have developed from these limitations.

In order to successfully achieve the aim of this research, the study has followed an established framework for undertaking a doctoral thesis within the social sciences. Primarily, the introductory chapter explained the significance and purpose of the research and how this would be addressed in the remainder of the thesis. Secondly, the theoretical chapter began by reviewing the literature related to key concepts within patient safety. An understanding of why individuals are harmed in healthcare organisations was developed, prior to discovering the importance of learning from error events. A thorough understanding of what is known about affect was established by uncovering the limited research on affect in the healthcare literature. This knowledge was expanded by exploring the key proponents of affect theory, before exposing affect within discourse and materialism, and recognising the contagious nature of affect. Lastly, details of the intertwining affective states revealed by the participants was presented, in advance of unveiling contemporary research on affect within organisational studies.

The third chapter introduced the methodological framework which enabled the role of affect to be examined when a human error occurred within a radiotherapy department. A relativist ontology was adopted to understand that multiple realities can exist, with separate individual's appraisals of the same event being different. A subjectivist epistemology uncovered how an individual's experience shapes their knowledge of the world. I reflected on how my own values and experience (as a Radiographer and an error investigator) could never be truly detached from the research process. These elements were found to be entwined with the field of phenomenology, which studies the structures of experience. The chapter substantiated the reasons for choosing qualitative data and a case study approach to answer the research questions. In concluding the chapter, I set the scene of the radiotherapy departments and challenging NHS landscape in which the research was situated.

Fourthly, the methodological foundations of chapter three were used to guide the methods applied for generating data. A detailed discussion of the use of document analysis, memory work, and interviews was provided, prior to considering the ethical

concerns of undertaking research in healthcare settings. The sensitive nature of discussing errors was highlighted, along with the mechanisms employed to prevent harm in those participating. Practical aspects relating to the research sites were presented, prior to discussing the rationale for selecting IPA as a means of analysis. IPA was found to support the need to capture the participants experience of being involved in an error. The approaches' idiographic, interpretive, and reflective nature appealed, whilst I also considered the practice's potential limitations.

Chapter five followed the proposals of Smith and Osborn (2003) in uncovering the emergent findings within a results section. The chapter presented four case studies which described how affect surfaced and intensified during the moments preceding the human errors occurring. Lastly, the sixth chapter linked an analysis of the findings revealed in the previous chapter to the existing literature. Interpretations from each case study were analysed and presented in the assemblage of themes that had emerged across all the cases.

This research has been successful in examining the role of affect when a human error occurred within a radiotherapy department. In outlining four case studies that revealed the rich experiences of eight individuals directly involved in the errors, the significance of affect was evident. Achieving the research aim has enabled the following research questions to be answered.

7.2. Addressing the research questions.

Research question 1: What role does affect play in influencing human error?

In the four cases presented, affect contributed as a precursor to human error in manifold ways by influencing the Radiographer's attention, behaviour, and decision-making. The cases revealed that the various challenges facing NHS organisations originating from chronic underfunding and an ageing population have provided the foundations for environments that significantly affect the Radiographers. In recalling the errors, the Radiographers portrayed the lively affectively charged worlds in which they inhabit; a world where humans, objects, technology, and the environment were entangled and dynamically intra-acting. The cases demonstrated examples of the

Radiographers being aware of affective influences that situated the scenes; of 'negative' atmospheres, tense 'tones', chaotic energies, and feelings of low morale.

A need of the Radiographers to maintain control was evident in all four cases. A key means of keeping control was to remain on schedule, with falling behind schedule a source of anxiety for the Radiographers and resulted in them rushing to catch up. Perceived control and the modulation of affect are intrinsically linked (Leotti et al 2011), and threats to this control by running behind schedule affected the Radiographers. Each patient was affected by feelings of anxiety, pain, or annoyance, and these states subsequently impacted on the Radiographer's efficiency. Every Radiographer was concerned for the patients and the consequence was to want to treat the patients quickly. Also, various other individuals were able to enter the scenes and affect the 'treating' Radiographers; be that by distraction or by the inadequacies of their work hindering the Radiographers.

Varying degrees of stress, anxiety, and annoyance were described in the moments preceding the errors. Such emotions can influence where individuals focus their attention; with heuristics leading individuals to interpret information in ways that are influenced by these affective states. In attending to information that confirms their emotions or preconceived beliefs, important details were overlooked in favour of the quickest easiest decisions. When the Radiographers subsequently encountered confusing information, additional time was needed to make sense of this material. Even further behind schedule, it was these changing and intensifying affective states that resulted in a sense of overwhelm in each (Deleuze (2007). The power to act was diminished because of affect; uncanny decisions were made by each affected Radiographer that resulted in errors.

Research question 2: In what ways can we identify the influence of affect as a precursor to human error within radiotherapy?

Identifying the influence of affect as a precursor to human error requires attentiveness to affective states and their potential impact on behaviour and decision making. The influence of affect as an antecedent to human error was recognised in each of the methods applied in this research. The written statements were a valuable method of

identifying affect as they were taken in the moments following the error being identified. These statements provided an important recorded glimpse in time about the perspective of the Radiographers in the rawness of realising that an error had occurred (Stake 1995; Bowen 2009). The cases described in chapter five incorporated written affect taken from these statements.

As this study used errors that had happened in the past, each participant was asked to recall their memory of the error in the days prior to the interview. Each participant was informed that the interview would be enacted in two stages: with the Radiographer firstly recounting their memories of the error, and then subsequently answering predetermined questions covering various aspects of affect found in the literature. Firstly, using memory work in this way allowed the participant to tap into the past and reflect on previously overlooked details of their experience (Stephenson 2005; Haug 2008). When supplementing this memory work with answers to specific questions pertaining to affect, rich descriptions of their experiences were provided (Brinkmann 2013). This presented an additional layer of information that was not evident in the local investigation reports. Audio-visual recordings of these interviews were taken so that this data could be comprehensively examined. The cases portrayed in chapter five blended verbal descriptions of affect whilst providing glimpses into the non-verbal aspects of affect as the recollection of the errors elicited memories that lived on in the participants. Combining the data from these three methods enabled the lived experience of the Radiographers to be shared, and the influence of affect as a precursor to error to be recognised.

Research question 3: How does enhancing our understanding of affect contribute to reducing the recurrence of human errors?

Following the discovery of an error in a radiotherapy department, a safety investigation commences. For errors judged to be significant (see section 4.6) a comprehensive investigation is followed. Witness statements are collected from those involved immediately after the incident is identified and supplemented with interviews (Taylor-Adams and Vincent 2004; Forsyth 2016). A record is made of the investigation and the subsequent findings (the local investigation findings of the four cases were presented in

table 4). The aim of this process is to identify the cause(s) of the error, with the purpose of preventing similar errors from reoccurring (CQC 2020).

Whilst the pressures that the Radiographers were experiencing were referred to in the investigation reports from cases one and three, there was no evidence that these aspects were further investigated. There were no findings at all pertaining to affect in the investigation reports following cases two and four. If the purpose of these investigations was to identify the cause(s) with the aim of preventing similar errors from being repeated, it follows that the respective error investigators would have benefitted from a knowledge of affect. This knowledge would ensure that a comprehensive understanding of errors occurs which allows departments to conduct thorough analyses and implement focused actions. By analysing the affective influences of errors, organisations can identify trends, evaluate the effectiveness of safety mechanisms, and refine their approaches over time. This ethic of continuous learning (Berwick 2013) and improvement reduces the likelihood of errors within complex systems (Reason 2004, 2008) from reoccurring.

Whilst error investigations are reactive, an enhanced understanding of affect in influencing behaviour and decision-making could also enable organisations to develop proactive approaches to error reduction. Whilst knowledge of affect will be valuable for investigating future errors, safety specialists should also employ the methods used in this research to retrospectively examine past error events. An understanding of affect should inform the design of work environments that promote safety by minimising stressors or distractions. Additionally, this understanding could enable departments to develop relevant effective training and education programs. By integrating awareness of affect as a precursor to human error into training, individuals could learn about the early warning signs and consequences (of for example, feeling out of control, rushing, pressure etc.) in themselves and others. Furthermore, an understanding of affect enables departments to develop specific support for individuals at key points in the pathway (e.g., the Planning Radiographers) as well as individuals at risk of making errors. For example, if certain tasks consistently evoke anxiety, stress or frustration, education or workload adjustments could be implemented. Therefore, by enhancing our understanding of affect, errors can be designed out of the system.

Research question 4: What are the benefits of sharing rich experiential qualitative data on affect after human errors?

The establishment of a national reporting system for radiotherapy has enabled errors to be categorised, with quantitative error data analysed and generalised learning shared (Donaldson 2008). However, there is limited evidence that safety is improving in radiotherapy (Graveling 2020). Graveling (2020) highlights a lack of qualitative data as limiting the potential for learning from similar events. This thesis has highlighted the complex nature of radiotherapy practice and demonstrates that qualitative methods should be used to understand its intricacies. In placing value on the significance on the participants lived experience, the complex social dynamics stirring in the moments prior to the errors were unearthed. Asking participants to recall their memory of the error and supplementing this with questions on affect yielded responses that were in excess of the original investigation findings.

This thesis has demonstrated that the sharing of an individual's experience of affect following the occurrence of human error would be valuable. The intra-actions between the Radiographers, the unhelpful others, the patients, and the objects and technology were all revealed. The significant consequences to the cases of losing control and rushing was also exposed. Notably, the importance of the swirling, intensifying, and accumulating feelings of confusion, stress, anger, and concern were all uncovered. Affect was prominent in all the cases but was undetected by the original investigators. Sharing of such qualitative cases provided rich context and detail about each individuals' affective experiences. This depth of understanding would help error investigators gain insights into the complex intra-actions that occurred in the moments prior to the errors. By exploring affective experiences in depth, qualitative data revealed the underlying causes or contributing factors to human errors that would not be apparent through quantitative analysis alone. This insight would have provided greater learning than that gained from the original investigation findings and would have provided organisations with evidence to help tackle systemic issues.

Qualitative data emphasises the human aspect of errors. By focusing solutions on the experiences of individuals, organisations can develop more effective approaches to error prevention. Such experiential cases should be used to provoke discussion and debate as

part of the error investigation. Implementing error reporting that encourages individuals to reflect on and share the affective context should promote more open and honest communication amongst the Radiographers. When individuals feel safe to discuss their affective experiences about errors, it promotes collaboration and collective problem-solving. This way, the potential for learning from these errors could be maximised and improvements in safety will follow.

7.3. Contributions and implications.

Traditional views of healthcare professionals as employing cold, rational, cognitive processes when making clinical decisions has provoked criticism in contemporary literature (Croskerry et al 2010; Heyhoe et al 2016; Kozlowski et al 2017; Isbell et al 2020). Croskerry et al (2008) asserted that affect influenced decision making, patient interactions, and therefore patient safety. For Croskerry et al (2008) it was imperative to integrate such understanding into the clinical domain. Croskerry et al (2010) further emphasised 'how [healthcare professionals] feel, their emotional or affective state, may exert a significant, unintended influence on their patients, and may compromise safety'. It follows that knowledge of the work of affect would be of value to healthcare professionals in ensuring that patients are not harmed. Despite this, there is little evidence that the issue has been addressed; research on affect in healthcare remains overlooked (Heyhoe et al 2016; Kozlowski et al 2017; Isbell et al 2020). In identifying this neglected field, this research contributes to filling this gap in knowledge.

The research recognised the multitude of ways in which affect profoundly influenced a group of Radiographers in the moments prior to a human error occurring. Therefore, the thesis adds to knowledge on affect theory in that it imparts the potential of affect to cause harm. The findings and subsequent discussion enabled the formulation of five key contributions of this research:

<u>Contribution 1</u>

The existing literature revealed the world as affectively charged with a liveliness that humans participate in as transcorporeal beings (Ronda 2020). That is, through affect, we conceive ourselves as transversal rather than as bonded subjects, composed of mutual processes and forms (Braidotti 2000; Highmore 2010). Human and non-human bodies

are complexly entangled within a lively world of intra-acting and endlessly reconfiguring components (Barad 2003). Furthermore, healthcare settings are becoming increasingly complex environments. The components within these systems can interact in organised and expected ways, as well as in unexpected ways (Braithwaite et al 2021). The intra-actions of humans within these systems can intensify this unpredictability (Pomare et al 2018); a reliance on affect being a quicker, easier way of navigating complex uncertain situations (Croskerry 2005; Croskerry et al 2008). Therefore, complexity makes humans more prone to error (WHO 2019). **This research contributes to theories of materialism by highlighting the significance of the intra-actions of affected Radiographers within their lively, affectively charged technological environments. The intra-actions of the healthcare professionals within these worlds resulted in unusual actions which undermined the safety mechanisms that had been instated by the organisation to protect the patient. Therefore, this research also adds to the patient safety literature in highlighting the risks to patient safety of these strange intra-actions.**

As complex technologies continue to evolve, with automation and artificial intelligence proliferating throughout healthcare systems, these risks should be factored into designing safety systems. Otherwise, despite efforts to design errors out of healthcare systems, poor decisions will be made by affected Radiographers that invalidate safety mechanisms. Also, healthcare professionals should be made aware of these intra-actions through training and education. Affective forces 'intra-acted' and folded in-between the Radiographers, the patients, the complex digital technologies, and the objects. These elements were utterly entangled with the noises and distractions of the affectively charged worlds that situated the cases. The strange relationships which developed 'in-between' manifested in feelings such as stress and the 'blankness' of confusion which ultimately impacted on patient safety. Awareness should be raised of our innate likelihood to make quick easy decisions (and subsequently fail to do something) when affected during these complex uncertain situations.

<u>Contribution 2</u>

The existing literature revealed two broad types of errors that remained relevant to modern clinical practice: mistakes; and slips and lapses (Reason 1990; Higham and Vincent 2021). Mistakes refer to actions that go entirely as planned, but the plan itself

was wrong. Slips and lapses are errors of action, in that they occur when an action does not turn out as intended. They are skill-based failures that occur predominantly during automatic performance of a routine task. Lapses are skill-based events that are associated with failures of memory. Whereas a slip of action is 'associated with either distraction or preoccupation' (Reason 1990); they occur either from 'the person's surroundings *or* their own preoccupation with something in mind' (Higham and Vincent 2021). **This research identified that an amendment to the definition for a slip of action was necessary. Whilst the definitions in the literature were used to differentiate between the occurrence of slips and mistakes, the taxonomy was taken and developed further to account for the findings. In offering a development to the description, the slips in these cases were caused by:**

> **'the thoughts of the individual *because* of their intra-action with the surrounding environment'.**

This contribution is important as it helps develop our understanding of the significant role that health professionals play within increasingly complex healthcare systems. Accurate definition is important to correctly categorise the different types of errors, so that the maximum can be learnt from such occurrences. As healthcare systems evolve with complexity, it follows that types of errors will evolve due to the human intra-actions within these complex systems. As noted in contribution 1, the intra-actions of humans within increasingly complex systems means that the borders between our thoughts and surroundings are becoming increasingly entangled and blurred. The affected Radiographers were overwhelmed because of the utter entanglement of their thoughts and concerns for the patients intra-acting with the digital technology, their settings, and the distracting presence and inadequate actions of various others. Therefore, this amended definition contributes towards theories of human error and helps develop our understanding of why slips of action are still able to occur in modern, complex, healthcare organisations.

<u>Contribution 3</u>

The existing literature described the important debate within affect theory concerning arguments of whether affect is autonomous from cognitive appraisal or not. Whether or not affect prepares human judgement and decision making without scope for the

intellect to intervene is pivotal to this debate. Affect theorists such as Massumi, Thrift, Brennan, and Clough focus on affect as an outside stimulus that hits the body before hitting the cognitive apparatus. Others, such as Ahmed, Leys, Wetherell, Butler, and Blackman criticise this dichotomy of mind and matter (Gregg and Seigworth 2010; Knudsen and Stage 2015; Kristensen 2016). **This research identified errors that asserted that affect operated at *both* above and below conscious awareness. Affect was found to intrude into the failure of the automatic 'unconscious' performance of routine tasks. Also, affect was present in the conscious mistakes that developed from unexpected situations. Also, some Radiographers were aware of affect (as pressures) when providing witness statements immediately following the identification of error, whereas others were evidently unaware of its significance until the subject was directly examined. Lastly, literature from both sides of the debate was found to be applicable to the detailed analysis of these cases.**

Therefore, this research is important in that it contradicts both sides of the debate and adds a third argument. In arguing that affect operates at above and below consciousness, this thesis provides a contribution to affect theory. Furthermore, this is a first study to differentiate between conscious and unconscious affect and its impact on patient safety. In providing a single profession addition to the broader affect theory and patient safety literature, this research contributes a first application of affect theory to patient safety within the Radiotherapy domain. Researchers interested in affect theory should be convinced to employ the methods described in this thesis to explore other organisational settings.

Whilst some Radiographers and error investigators were evidently oblivious to affect, others were consciously aware of affective states such as annoyance, as well as strange feelings of uneasiness, negative atmospheres, and low morale. If we are conscious of affect, healthcare professionals and error investigators would benefit from awareness of its consequences through training and education. In particular, the impact of affective influences on decision making would be valuable to healthcare professionals. Likewise, knowledge of affect will ensure that investigators extract the maximum learning from error events.

Contribution 4

The existing literature described how affect can accumulate (Ahmed 2004; 2010; 2014), recur, and spiral with intensity (Pullen et al 2017). It is the passing between these affective states which affect us so much that we become overwhelmed (Deleuze 2007). **This research identified the significance of these changing and intensifying affective states to patient safety. In each case, the changing affective states accumulated and spiralled and resulted in the Radiographers becoming overwhelmed in the moments prior to errors occurring. The participants were highly motivated to remain in control, alongside the associated need to treat patients on time. Threats to this control and running behind schedule significantly affected the Radiographers, with subsequent expressions of stress, annoyance, and anxiety evident. In the moments prior to the errors, events and experiences occurred that registered in a shift of affects. Poor decisions were made by these overwhelmed Radiographers that resulted in different types of errors occurring.**

Identification of this contribution (and how it *intra-acts* with the previous contributions) enabled the production of a visual representation of the analysis (figure 8). This diagram represents how affect emerged as a consequence of institutional challenges and then subsequently intra-acted, accumulated, intensified, and spiralled prior to the occurrence of various types of error. Therefore, this research is important in presenting evidence for policy makers to argue that the institutional challenges facing NHS organisations has provided the foundations for environments that significantly affect the individuals within its workforce and subsequently impacts on patient safety.

This research has revealed the potential for affect to accumulate, intensify, and spiral in the moments prior to human errors occurring. The interpretation of information is influenced by affect, with important details overlooked by affected Radiographers. Therefore, healthcare professionals should be educated about the risks and consequences of losing control and rushing. Also, individuals should be educated about the risks of accumulating, intensifying, and spiralling affective states on patient safety. Healthcare professionals should be informed to recognise these behaviours in themselves and others so that proactive measures can be introduced (such as seeking support from experienced colleagues) to help prevent errors from occurring.

Contribution 5

The existing literature asserts that developing methodologies for the identification and study of affect provides unique challenges (Kenny 2012; Coleman and Ringrose 2013; Knudsen and Stage 2015; Michels and Steyaert 2017). Significant debate exists as to the potential of discourse as a medium for analysing affective phenomena (Kolvraa 2015; Knudsen and Stage 2015; Ayata et al 2019; Berg 2019; Houen 2020; Burnett and Merchant 2020). Followers of Massumi, believe that affect describes dimensions of the body that are beyond the scope of language categorization (Kolvraa 2015; Berg et al 2019). For critics of Massumi, language would be considered capable of expressing affect (Knudsen and Stage 2015). Butler (2015) suggested that affect and discourse are closely connected, with affect being crucial for the origination of discursive subjects. Whilst others such as Houen (2020) and Riley (2000) holding a more centrist belief in theorising affect as thoroughly conjoined and open to interaction with language and cognition. **This research demonstrated that the significant influence of affect on the Radiographer's decision making was recognisable within the written statements as well as verbally and non-verbally when recalling their experience of the error event. Consequentially, safety specialists should apply knowledge of affect to future error investigations and also to retrospectively investigate past errors that have occurred within their departments with the use of memory work. This will ensure that the maximum learning is extracted and shared from error events; and proactive focused measures can be implemented to prevent them from reoccurring.**

This research is important as it contradicts followers of Massumi who suggest that language is incapable of expressing affect. Our ability to recognise affect is significant as it means that it can be identified within the methods traditionally used to investigate errors. Acknowledgement that affect can be identified (as opposed to mysteriously occurring in the background) means that Radiographers and error investigators can be educated to be aware of its various forms. We know that dependence on our affective state can distort our thinking and lead to unusual assumptions and poor decisions being made. Therefore, recognising affect within the written statements provided in the moments following the identification of an error is important; and should guide the

direction of the subsequent error investigation interviews. This will ensure that affect is not overlooked, and the maximum is learnt from these events.

Implications

Significantly, the influence of affect was not recognised in each of the local investigations that followed the identification of these errors. If the reason for undertaking these investigations was to identify the causes(s) of the error to prevent them from reoccurring (CQC 2020), neglecting affect would be detrimental to future patient safety. Therefore, this research has implications for improvements in professional radiotherapy practice and error investigation in that it raises awareness of the affective consequences of losing control and rushing to treat patients on time. Increasing understanding of the risks of stress, anxiety, anger, and confusion (and the shifting and intensifying thereof) would be of value to Radiographers. Sharing qualitative cases that illustrate the Radiographers' experience of affect should be used to provoke discussion following the error investigation. This will allow the potential for learning from these events to be maximised and continuous improvement in radiotherapy safety will result.

This research should inform improvements in patient safety policy by mandating the requirement to examine for traces of affect as part of an error investigation. In particular, the recent advances in technology call for a greater understanding of materialism and post-humanism. As technologies continue to develop and further proliferate, safety policy will need to account for the intra-actions of affected individuals within these increasingly complex systems. Beyond the confined field of radiotherapy, this research offers implications for enhancing patient safety in wider healthcare. This study should inspire researchers to replicate these methods in other healthcare settings. In being transferrable to other domains, the research acts as a piece of public value research which could have learning implications for wider society (Toft and Reynolds 2005). When things go wrong (that is, an error occurs) in healthcare, there can be an adverse effect on the patient and the staff involved. Investigating and reporting the cause of the error is time consuming, and therefore also has a cost to those undertaking the investigation. A greater understanding of affect as an antecedent to human error could help reduce the repeat of similar errors in the future. This will improve the life of

patients and staff involved, and ultimately the healthcare organisation in which they are situated.

7.4. Limitations.

Although considerable effort was made to ensure that the research was as reliable as possible, it is important to consider the factors that may have limited the interpretation of the study's findings. Limitations are acknowledged on the practical level on which the research was conducted, and also firstly on a personal level pertaining to any bias that may have been introduced. I was acutely aware of my proximity to the research. I was conscious that my background as both a Therapy Radiographer and an error investigator could introduce an undesirable bias to the study. However, I quickly reflected and became aware that my closeness to the subject should be seen as an asset, rather than a weakness (Stake 1995). As noted, people are reluctant to talk about their involvement in errors, and it became clear that departmental managers were sceptical about me discussing such events with their Radiographers. Without my significant history within the profession, it would have been challenging to persuade these individuals to allow me to undertake such sensitive research within their organisations. Several meetings took place with each manager where I shared awareness of my ethical responsibilities and the reasons for the research. Providing a video recording that outlined my background and experiences further augmented a feeling of trust to develop and facilitated my access to the participants. This trust enabled the openness from the Radiographers that followed. Finally, my understanding of the interminable jargon and technical phrases used by the participants was beneficial.

To counter any bias that could be introduced, I used the witness statements taken from the Radiographers in the moments following the identification of the error (Bowen 2009). These statements provided access to a valuable recorded moment in time which portrayed how the participants were feeling on the day of error. In supplementing these statements with interviews, I was determined to allow the participants to share their memories of the errors prior to my asking any questions that could prejudice the responses. The Radiographers were asked to recall their memories of the day prior to the interviews, and this was key to my accessing their experiential worlds (Haug; Brinkmann 2013). Relevant extracts from the witness statements and verbatim

quotations from the interviews have been included in the results chapter to ensure robustness. Aligned with a relativist ontology, this will allow the reader to make alternative interpretations from the data or draw their own conclusions from the interpretations formed in this research, the existing literature, and their own experiences.

A practical limitation of the study is that only four case studies were presented. Limitations are inherent in any research with a small amount of participants, with the richness of data obtained being at the detriment of scope and generalisation. Although I am thankful to the participants that were willing to give up their time to contribute towards this study, I am aware that further cases would have provided additional and different experiences. The justification for including only four cases is that healthcare professionals are averse to talk about their involvement in errors. Securing participants that were willing to discuss the errors was an extremely challenging process. Even after the various hurdles of the ethics approval processes had been negotiated, it was an unfortunate consequence of qualitative research that some individuals did not wish to participate. A related limitation is that only two Radiographers in each case agreed to take part. The Radiographers would have routinely worked in teams of three or four, so the voices of these other Radiographers could have added views that were distinct from those that participated. I recall the precarious balancing act of being grateful for those that did wish to be involved, whilst tentatively enquiring about the potential of the hesitant others. However, the research was successful in gaining a detailed analysis of the experiences of those individuals who did choose to participate.

A limitation of IPA research is that I was reliant on the participants being able to communicate their experience (Tuffour 2017). I was aware of the delicate nature of the subject matter so considerable effort was taken to ensure that participants felt comfortable. All of the interviews were carried out remotely (over Microsoft Teams). The post-pandemic world meant that each individual was at ease with communicating in this way and each chose this method in preference to a face-to-face interview. I was concerned that by not undertaking the interview in-person, I was going to forfeit the discrete feelings that would unfold between myself and the interviewee (Willink and Shukri 2018). I was aware that the responses could be different if done remotely.

However, it was notable that the participants appeared relaxed in their own environments without the awkwardness of a researcher being present in the room. This 'remoteness' may have accounted for the open and forthright responses that were offered by each Radiographer. The method also allowed various non-verbal expressions to be captured from the participants when recounting their memories of the errors.

The original plan for the research was to be part of a 'live' investigation following the identification of an error. It was envisaged that following receipt of the witness statements, the local investigation would be observed prior to asking interview questions pertaining to affect. It was proposed that a reflexive group discussion would take place following the interview to produce a further layer of data (De Dreu 2007; Moon Joung et al 2016). The team members involved in the error would engage in a group discussion, where reflection would be encouraged, prior to the assimilation of improved behaviours for practice (Kessler et al 2015). Unfortunately, initial notifications from the departmental managers that errors had occurred within their departments were not followed up by participants willing to engage in the study. I was aware that involvement in a focus group setting may not be embraced easily or enthusiastically by the Radiographers, especially in the rawness of an error being identified. Therefore, following reflection, a change of approach was adopted where past errors would be examined, and the focus group disregarded. However, this provided the limitation that neither data from observation nor focus group were attained during the research. It is possible that these methods could have provided different findings to those uncovered via document review, memory work, and interview alone.

Finally, I was aware of the struggle between IPA's commitment towards idiography and its averseness at making general claims (Smith and Osborn 2003; Noon 2018). In recognising this conflict, it was possible to make reference to the connections that became visible during the analyses, whilst recognising the uniquities of each participants' experience. It will be through the continued accrual of related studies that universal claims can be made. This point leads me on to the final section where recommendations for future research will be provided.

7.5. Recommendations for future research.

This research has shared the experiences of eight Radiographers from four radiotherapy departments in the UK. Whilst the study has been successful in understanding the lived experience of these individuals, more research is required before theoretical proposals could be presented.

The research provided an interest in the affective intensities that developed amongst the various human and non-human entities of the radiotherapy department. The lively nature of matter was uncovered and the intra-actions that emerged in-between the junctions of humans, (what we perceive as) objects, and technologies offer an exciting possibility for future research (Barad 2003; Murphie 2020). As complex technologies continue to develop, and systems become increasingly automated and dependent on artificial intelligence, more research will be needed to examine the intra-actions of humans within these systems. Alternatively, a researcher could focus on the specific nature of the 'blankness' felt when attempting to make sense of confusing digital information.

Whilst Vincent (2010) indicated control and time pressures as factors that can impact on patient safety, this research highlighted the significance of these elements in the four cases outlined. This study's identification of the Radiographer's need for control (and the associated need to rush as a means to remaining in control) revealed an opportunity for future exploration. Future studies could focus on the affective processes that surfaced and developed out of this perceived loss of control. Furthermore, the mechanisms that enabled affect to accumulate and spiral, and resulted in Radiographers that were overwhelmed offers an important avenue for safety research. Such research could have implications for professional practice in other healthcare professions that are time pressured. Whereas this research was undertaken within the specificity of the radiotherapy department, it could also be replicated in other healthcare domains.

Analysis of the findings alongside the literature engendered claims that affect occurred both above and below consciousness in driving error. Debates concerning the relationship of affect with cognition have been prominent since the affective turn. Therefore, these findings add to this debate and provides an important opportunity for further investigation. Similarly, an amendment to the long-standing definition for a slip

of action was identified from the data. In taking and developing the work of prominent safety specialists such as Reason, Higham, and Vincent, further research will be needed to determine if the amended definition holds up to wider scrutiny.

Also, the aforementioned limitations of this research provide notable opportunities for future study. Researchers interested specifically in affective processes following the occurrence of error in radiotherapy could further develop my findings by adding supplemental cases. Whilst a modest cohort of eight participants was sufficient for this IPA study, a comparative analysis of a larger group of participants could further explore the similarities and differences between the cases. As an alternative, future researchers could focus on a smaller number of cases that also captures the experiences of all the other individuals that will enter each case and affect its unfolding. Including the experience of the patient would offer an imitable perspective of an error in its evolving.

A smaller focused approach could also provide the opportunity to include a collective discussion through a reflexive focus group. Such group discussions have been used previously in complex healthcare settings to encourage reflection and assimilate improved behaviours into clinical practice (Kessler et al 2015; Schmutz and Eppich 2017). Group reflexivity has also been used to promote collective awareness of communication and decision making and adapt them to future situations (West 2000). It is with significant regret that the opportunity to undertake a group discussion with the participants following a 'live' investigation did not arise. Due to the contagious nature of affect uncovered within the cases, this collective reflection would have yielded an interesting layer of data. Without the time constraints of the PhD schedule, this is a method that I will pursue in the future.

I would also advocate the future researcher's use of a video recording to describe their background and experiences from the outset of the study. Discussing the involvement in error events is a sensitive subject that many potential participants will evade. Providing a brief recording will present the human element of the researcher, offer a window into the researcher's motivations, and help inspire trust in potential participants. Whilst this study employed solely 'remote' interviews, the future researcher could supplement this method with face-to-face interviews as used by Graziotin et al (2015) in uncovering affect experienced in a group of participants. Being present with the interviewee could

offer access to the affective and relational dimensions of the interview process (Willink and Shukri 2018; Ayata et al 2019) that may be overlooked during the remote interview.

Each year, millions of people suffer injuries or die from unsafe healthcare practices globally (WHO 2019). Significant healthcare expenditure is spent directly as a consequence of patient harm (Panagioti et al 2019) and therefore, a significant burden of harm has developed (Jha et al 2013). The improvement of patient safety globally should represent a moral, professional, and public health priority (Balogh et al 2015). Despite calls to examine the poorly understood role of affect and emotion in patient safety, such research remains ignored (Heyhoe et al 2016; Isbell et al 2020). The reluctance to relinquish the traditional view of healthcare professionals as rational, thoughtful, 'emotionless' decision-makers remains. This thesis adds to the evidence of others (Croskerry et al 2008; Iedema et al 2009; Croskerry et al 2010; Heyhoe et al 2016; Kozlowski et al 2017; Isbell et al 2020) in revealing the study of affect as an important avenue for future research on patient safety. It is clear that healthcare research on affect, and the uncanny feelings that develop in-between the intra-acting bodies, should no longer remain overlooked.

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Appendices

Appendix A. Literature review summary of key points.

Author(s)	Year of publication	Key points
Healthcare literature		
Long et al	2011	* Role of humans in patient safety has been neglected. * Little attention is paid to the affective states of individuals and how they interact with teams members, situations, and patients.
Heyhoe et al	2016	* Healthcare professionals do emotional work.
Croskerry et al	2010	* The emotional or affective state of individuals may compromise safety.
Croskerry et al	2008	* Affect intrudes into almost all decision making. * Decision making occurs via a combination of two separate systems: fast affective and slow deliberative systems. * Reliance on affect is a quicker, easier, and efficient way of navigating complex uncertain situations. * Errors of judgement occur in system where affect is dominant. * Heuristics (shortcuts) and biases occur when making decisions in affective system. Prior experience is used rather than active thought. * Heuristics can provoke negative reactions towards others (patients) that compromise safety. * Affective state may be influenced by the environment or work conditions. * Internal affective states can be reliant on own thoughts or memories.
Slovic and Peters	2006	* Decision making is entangled with affect in risk perception and judgement. * A dual process approach to risk is enacted: immediate intuitive reaction to danger, and a slower reasoned judgement.
Spinoza		
Robinson and Kutner	2019	* No split between mind and body. They are always correlated and fused together. * Mind and body are the only aspects of an infinite substance that a human can comprehend. * Mind is the active comprehension of the processes within the body. * Affects are the changes in bodily composition from encounters with other bodies (being affected) by which our

		power of acting is increased or decreased, alongside the awareness of that change. * When our power is increased, we are affected with joy. This leads us to true knowledge. * When our power is diminished, we are affected with sadness. This leads us away from true knowledge.
Uhlmann	2020	* There are only three basic affects: joy, sadness, and desire, from which all emotions are derived. * Desire is related to conatus. Conatus is the endeavour to remain in existence, seek pleasurable things, and avoid painful ones.
Spinoza	2001(1677)	* Affect defined in terms as of power and capacity as the body's desire, and the ability to affect and be affected by other bodies. * Affects can be active or passive. * Active – we are the cause of an event, our power of acting, and our understanding of the event. * Passive – an encounter with others causes a change in our body.
Gatens	2014	* Affects are associationist because they are caused even when we are oblivious to the cause.
Deleuze and Guattari		
Colebrook	2002	* Affect is what happens to us when we feel an event, e.g., fear, laughter etc. * Affect is the response to an experience.
Hickey-Moody	2013	* Affect refers to changes in bodily capacity. * Bodies (and minds) are continuously reshaping themselves through their ideas and actions - the relations, interests, and environments by which they live.
Fox	2012	* The body does what it does because of the interaction of two factors: * The body's relation with its physical and social context; the link between body, subjectivity and culture. Our capacity to affect and be affected by these relations results in our subjectivity. * The second factor is the active, engaged body, with its ability to form new relations and its motivation to do so. * Body-without-organs - the body that emerges from the union of relations and creative potential - the limit of what a body can do. A body is distinguished by its organs / functions and not by the affects of which it is capable of. The more an individual is capable of being affected, the more powerful that individual is - with humans capable of being affected in many ways. * We respond in complex / unpredictable ways that implies an ability to make choices and actions based on the world around us.

Deleuze	2003, 2007	* Assemblages form out of bodily relations and interactions. * An assemblage is a collection of ideas, powers of acting, and a relation to others - the effect of the genetic, social, and historical. * A group is an assemblage of bodies; the makeup of any assemblage is created by its connections. * It is the changing and intensifying affective states that results in a sense of overwhelm.
Uhlmann	2020	* Affects are becomings - worlds are always in process, changing, and transforming. * Each of us, as modes (individual entities), have an intensity (or measurable degree of power) that makes us what we are and distinguishes us from all other things. * The intensities that affect an individual then, are other modes (other individuals). * Affects are defined as that which registers a shift in power.
Pullen et al	2017	* Becoming affects our capacity to act upon and be acted upon others - life can be different, no matter how sad things may seem, and such difference can be joyous. * It is the passing between sad and joyful affects, which affects us so much that we are overwhelmed, so little that we are under-stimulated, or so much that our capacity to affect others is enhanced. * The body remembers affective experiences; there are times when individuals or experiences take you back to a previous encounter.
Massumi		
Clough	2008	* For Massumi, the turn to affect was about 'opening the body to its indeterminacy', the uncertainty and precariousness of its autonomic responses. * Affect and politics overlap. Change is what is central to affect, and this is what makes it immediately political. * Affect is defined in terms of bodily responses - autonomic responses which are in excess of consciousness. * Affect is described as virtual and unliveable.
Kristensen	2016	* A distinct dichotomy between cognitive judgement and affect.
Kluitenberg	2015	* Affect is a non-conscious registered experience of energy/intensity in response to a stimulus on the body. * Affect is a bodily response before it is cognitively processed. * Affective processing occurs twice as fast as consciousness.
Massumi	2002	* Libet's lag – cognitive processing is 0.5 secs after stimulus.

		* Affect as distinct from emotion. Affect is 'unformed and unstructured' with emotion being the verbal / written register of the experience through its supposed 'function and meaning'.
Clough	2010	* Affect takes place below and before human cognition, and thus escapes the 'speaking subject'. * Affect attends to the organisation of bodies through the transmission of forces or intensities that move across them.
Massumi	1988	* Like Spinoza, affect is an intensity corresponding to the passing from one state of body to another. * It is through changes in what we experience that we are affected. * Affects are infused with forces of desire and power to the extent that they shape and are shaped by social processes.
Uhlmann	2020	* Affect is distinct from emotion. Affect is raw intensity – emotion is affect given meaning.
Tomkins		
Demos	1995	* Affect is critical to motivation and is central to cultural meanings and values. * We endure a need to maximise positive affect and minimise negative affect. * Affect as one of the five basic systems of human function with homeostasis, drive, cognition, and motor. They all interact with each other. * The dynamic joining and separating of affect and cognition etc. is fluid, and dependent upon stimuli, and the state one happens to be in. * Accounts for emotions changing rapidly or feeling an emotion for no reason.
McIlwain	2007	* Nine basic affects, and not the drives, are the primary motivators of human behaviour. * These affects are six basic affects: interest–excitement, enjoyment–joy, surprise–startle, fear–terror, distress–anguish and anger–rage; one affect-auxiliary: shame; and two drive-auxiliaries: disgust and 'dissmell'. * Each affect is named within an affective range at both moderate and high intensity. * A hyphenated format emphasised the qualitative aspect of an affect at different intensities.
Carlson	1995	* Script theory - the ways in which affect is involved with our responses to the stimuli of the world.
McManus	2018	* Script theory is employed in fields as diverse as restorative justice, clinical psychology, coping with shame, and helping victims of abuse. * Understanding the triggers of affect can help us manage emotions and tensions in life.

		* Being able to identify emotions and adjust behaviour can be beneficial.
Sedgwick and Frank		
Hemmings	2005	* Affect is considered key to sensory mixing of individuality and community because of its ability to link us to others. * Affect attaches itself to anything. * Affect is of interest because it is unusual, unexpected, and unforeseeable. * Affective attachments must be unpredictable. We create associations with feelings and contexts that are often surprising. * Our character becomes a record of the histories in which emotion has prompted changes to the self and our relationships; affect's freedom, in combination with its contagious quality, results in its capacity to transform the self in relation to others. * An example of freedom being shame which can attach itself to many objects and can surface unexpectedly in relation to an object that was previously in favour.
Wetherell	2015	* Affect is social / cultural – able to link us together.
Borchers	2016	* Shame is a good example of affect as it is felt by the individual, it is expressed bodily, and it is perceived by others.
Houen	2020	* Shame is the incomplete reduction of interest or joy. Shame blocks a potential interest or enjoyment in the world.
Leys	2011	* Sedgwick endorsed the work of Tomkins and Ekman, not least because of its emphasis on the role of contingency (what may happen) and error in emotional life. We learn by making mistakes. * Affect can be triggered by any object or "stimulus" without the cognitive systems knowledge. * This disjunction between emotion and cognition (and drives) is attractive as the experience of shame is not our conscious or unconscious wishes towards an object, but our own subjective feelings.
Ahmed		
Ahmed	2014	* How we make a judgement of something depends on how we are affected by that thing. * It does not make sense to separate affect from emotion; both terms are used interchangeably. * Ahmed is interested in the sociality of emotion. * No dichotomy of mind / matter - affective episodes integrated with memory and cognition. * Intentionality - how emotions are directed towards objects. * Emotions are not within people – they shape people.

		* Affect resides inbetween objects and subjects - emotions construct them in such way that makes an emotional reaction certain.
Wetherell	2015	* Emotion shapes an object and provides a performative identity. Emotions can also be shaped by contact with objects. * Objects are anything that triggers an emotional response e.g., people's actions, texts, memories, situations, or material objects. * Emotions shape the surfaces of bodies -they take shape through repetition of an action over time. * An impression – the contact of one body with another. * Stickiness is repeated impressions over time.
Ahmed	2004	* The sociality of emotion – they connect us. * Emotions do things and align individuals through attachments. * Affective economies – increase in affect due to circulation between subjects and objects. * Objects become saturated in affect. * Affective economies also used to describe the creation of collective identities through affective attachments. * Emotions align some subjects with some and against others. * Emotional words in rhetoric align groups with or against each other.
Affect in discourse and materialism		
Houen	2020	* Affect, language, and cognition are thoroughly conjoined and open to interaction, co-assembly, and fusion. * The structure of language is at the heart of the affects we form. Punctuation, vocabulary, grammar, and syntax all form and inform our affective life.
Butler	2015	* Affect and discourse are closely connected, with affect being crucial for the origination of discursive subjects. * Performativity challenges the representationalist belief in the power of words to represent preexisting things.
Berg et al	2019	* The materiality of the text should be considered; how written language could be formed and structured to express affect. * Figures of speech, such as metaphor, metonymy, and onomatopoeia are covert forms in which affectivity becomes tangible in discourse. * Forms of hyperbole and linguistic excess being explicit.
Kolvraa	2015	* The signification of affect can alter as it circulates. * Provocative challenges or ironic statements are 'playful' means of signaling the subjects' affective investment. Also, witticisms, insincerities, or light-hearted humour may be witnessed.

Barad	2003	* Proposes a posthumanist account of performativity that incorporates material and discursive, human and nonhuman; and examines how their boundaries are fluid. * A causal relationship of 'intra-action' between material configurations of the world and specific material phenomena is proposed. * Discourse is not a synonym for language. * The primary unit of knowledge is phenomena; not 'things' or objects with boundaries and properties.
Affect as contagious		
Muhlhoff	2019	* Emotional contagion - the primitive subconscious transfer of emotions from person to person. * A process where the affective state of the sender is copied or synchronised by the receiver. * Active and passive – the affective state of one is copied in the other.
Hemmings	2005	* Affect places the individual in a circuit of feeling and response. Tomkins – the contagious nature of a yawn or smile (yawn increases in intensity). * Facial expressions activate a mimetic response that communicates / motivates.
Barsade and Knight	2015	* Mimicry leads a perceiver to feel the emotion of another - catching the emotion from the other person.
Ahmed	2010	* Contingency - becoming affected is contingent on how we feel, or as an effect of how objects are given. * Bodies do not arrive in neutral - what we receive as an 'impression' will depend on affect. How we enter a space, a room, a situation, will affect the impressions we receive. * Inside-out – I have feelings that move out towards an object. * Outside-in – emotion comes from outside. Absorbed by the individual. * Circulation, accumulation, stickiness.
Anderson	2014	* Atmosphere - mood, feeling, ambience, tone - collective affects. How affects bring a specific feel to episodes, encounters, and events.
Brennan	2004	* Entrainment - a process where a person's / group's nervous and hormonal systems are brought into alignment with another's. * Chemical – hormonal, pheromones. * Electrical – touch, sight, or sound.
Group affect		
Barsade and Knight	2015	* Group affect as an integration of affect, moods, and emotions within a purposive group. * Collective positive / negative affect emerges as group members converge in their affective experiences.

		* The more interconnected the group members are, the greater likelihood of affective experiences being shared. * Diversity of positive affect was negatively related to group cooperation.
Walter and Bruch	2008	* Complex and dynamic processes of collective affect. Cyclical / spiral. * High-performing groups enable contagion /convergence in positive affect which further enhanced the interpersonal relationships in the group.
Knight and Eisenkraft	2015	* Convergence in positive affect - greater social integration – groups are more cohesive / perform better.
George	1996	* Long-term work groups -characterised by unique homogenous collective affect.
Totterdell	2000	* Group member interdependence as a key mechanism in emotional contagion.
Tee	2015	* Emotional contagion is essential for effective leadership.
Kaplan et al	2013	* Diversity in positive affect had a disruptive influence that impedes group effectiveness. * Groups diverse in positive affect made inferior decisions.
Affective states		
Leotti et al	2011	* The ability to exert control over our environment and produce desirable results are fundamental psychological needs.
Kemeny	2003	* Circumstances perceived as uncontrollable are more likely to cause stress than those deemed as under control. * Threats to our social status or self-esteem can result in stress.
Murray and Nadelhofer	2023	* We feel safer in familiar settings. Uncertainty or unexpected changes to our routine can leave us feeling threatened and the resulting anxiety can become intertwined with stress.
Szollos	2009	* Feeling rushed is related to being short of time, being worried, and feeling pressure. * Feeling rushed can give rise to anxiety and frustration.
Mitchell et al	2019	* Pressure to perform can stimulate psychological, emotional, and physiological reactions such as anxiety. Pressure can represent a significant source of stress.
Griffin	1990	* Anxiety may be defined as a general feeling of nervousness, tension or uneasiness of mind about some form of contingency. * Apprehension is a fear about a specific future concern. When apprehensive, there is a hesitancy or reluctance to act.
Pruitt et al	1997	* Annoyance always requires an object; you are annoyed at someone or something. * Frustration relates to a goal that an individual is trying to achieve.

Craig et al	2004	* Confusion indicates an uncertainty about what to do next or how to act. * Individuals feel confused when they receive information that cannot be aligned with that which they believe to be true. * Confusion entails individuals trying to figure out information presented and how it aligns with their existing knowledge.
Affect in Organisational studies		
Pullen et al	2017	* Need to examine how real people / bodies experience work, their lived expressions and visceral experience. * Organisations affect us / is affected by us, across the corporeal / political registers of social and organisational life. * Affect is central to the sociality (embodied interactions) that founds organisations. * An individual's potential depends on the interaction with others and the possibilities that develop. * We are constrained by organisational attempts to regulate and protocolise us - we are capable of change and innovation. * Organisations are enabled and subverted by a complex interplay of affects.
Dashtipour and Vidaillet	2017	* Affect has a central role in organisational life – affect is associated with leadership, power, learning, and change. * Work is fundamental to human life - individuals can derive pleasure from it. Suffering at work can be turned into pleasure, subjective expansion, and freedom at work. * Negative affects envelope organisations: they can drag us down, take our energy, and sap the joy out of our lives. * Individuals learn how to endure organisational life and allow joyful affect to punctuate it.
Beyes and De Cock	2017	* Affect is central to the politics of organisations. * Shame and anger can provide a platform for disrupting the status quo and creating possibilities for change. * Such affect is contagious; it turns into a collective that joins individuals with similar experiences. * Organisations are saturated in colour and affect. Such colours and affects do something to the settings / bodies that inhabit and pass through them.
Hemmings	2005	* Affect is of interest because it is unusual, unexpected and unforeseeable; it has affective freedom.
Michels and Steyaert	2017	* Organisational spaces are in process, alive, and unstable and provoke unfamiliar and uncanny affects. * These spaces are enacted through an ongoing social process of being together and joint interdependence.

		* Each body (human or non-human) is capable to affect and be affected - it has the potential to alter. * Affect is at work in all corners of the organisation. * Something emerges as affect that is unstable and unpredictable that intensifies the senses.
Prineas et al	2021	* Affect can stimulate comfort or discomfort. * If unfamiliar, affect provokes responses such as feelings of unease. * Unease should prompt the individual to gather more information or engage in more extensive sense-making. * This function of affect is like the role of hunches in instant decision-making.

Appendix B. Participant information Sheet.

PARTICIPANT INFORMATION SHEET

Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy.

You are being invited to take part in a PhD research project. Before you decide whether or not to take part, it is important for you to understand why the research is being undertaken and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish.

Thank you for reading this.

1. What is the purpose of this research project?

Human errors occur in healthcare settings. The aim of this research project is to contribute towards the enhancement of patient safety, by recognising the role of affect (feelings, interactions, atmospheres etc. that are similar to emotion) as a cause of human error. Recognition of the contribution of affect when things go wrong within the radiotherapy department could provide evidence for the need to increase awareness of the role of affect as a cause of human error.

2. Why have I been invited to take part?

You have been invited because a human error has occurred within your team in your place of work. A greater understanding of the work of affect in contributing towards human errors could help reduce the occurrence of such errors in the future.

3. Do I have to take part?

No, your participation in this research project is entirely voluntary and it is up to you to decide whether or not to take part. If you decide to take part, we will discuss the research project with you and ask you to sign a consent form. If you decide not to take part, you do not have to explain your reasons and it will not affect your legal rights.

You are free to withdraw your consent to participate in the research project at any time, without giving a reason, even after signing the consent form.

4. **What will taking part involve?**

When an error occurs in the workplace, a safety investigation takes place. The investigation looks at the whole process with the purpose of recognising the factors that contributed to the error. Common practice is that statements are collected from each team member directly involved in the error as soon as possible after the incident has occurred. This information is supplemented with interviews by the departmental safety specialist(s) to allow each radiographer involved in the error to effectively collaborate in the process of investigation.

From your perspective, the only additional time resulting from participation in this study will be in answering interview questions on the subject of affect and being involved in a follow-up (reflexive focus group) debrief discussion. Both of these could potentially take up to one hour each.
With your consent, you (and each individual team member involved in the error) will be asked to participate in **four** elements of the research. That is,

Document review – The researcher will review the statements that you submitted to the departmental safety specialist(s) following the identification of an error.

Observation – The researcher will observe you being questioned by the departmental safety specialist(s) when investigating the root causes of the error event. This will be recorded by the researcher for analysis purposes.

Interview questions – The researcher will ask you questions relating to the error and focusing on the subject of affect (feelings, interactions, atmospheres etc. that are similar to emotion). This could potentially take up to **one hour**. This will be recorded for analysis purposes.

Reflexive focus group – At a later date, the researcher will re-contact you to invite you to engage in a focus group / debrief session. This follow-up reflexive discussion will be used to review the findings and to confirm and reassess the information you provided. To allow sufficient analysis of the findings, this session may take place up to one month after the other parts of the study. This discussion could potentially take up to **one hour**. This will be recorded for analysis purposes. You'll be asked for your consent to join the focus group and you can decline to take part if you don't want to.
Please note that the focus group will also include other participants (e.g., the safety specialist(s) engaged in the error investigation, and potentially other members of the radiographer team involved in the error). As such, full confidentiality cannot be assured.

Audio-visual / audio recordings will be made of the interview observations, researcher questioning on affect, and the follow-up (reflexive focus group) debrief discussion.

During consent, you will be asked if you agree to being recorded by audio or audio-visual means. Whilst audio recordings would provide valuable data, it would be advantageous to this research if audio-visual recordings are made. Communication is a dynamic process with many interacting components (e.g., verbal, eye contact, body language, and gestures etc.). Capturing such subtle moments of behaviour using audio-visual recordings would be greatly beneficial to the nature of this research.

Due to the covid 19 pandemic, the interviews and focus groups may be conducted remotely (i.e., via Cardiff University licensed Zoom or Microsoft Teams). It's important to note that the researcher will anonymise any data which could identify you, or your place of work prior to writing up and publishing the research data.

The presence of the researcher in person will be subject to stringent risk assessment and prior approval by Cardiff University.

5. Will I be paid for taking part?

No. You should understand that any data you give will be as a gift and you will not benefit financially in the future should this research project lead to the development of a new method.

6. What are the possible benefits of taking part?

There will be no direct advantages or benefits to you from taking part, but your involvement will help us to contribute towards the enhancement of knowledge of patient safety, and the role of affect when human errors occur.

7. What are the possible risks of taking part?

Involvement in human errors can be a difficult subject to talk about. However, all occurrences of human errors provide learning opportunities that could prevent them reoccurring in the future. The researcher has 10 years' experience in error investigation in radiotherapy and will approach the interview process in a sensitive manner. If at any point you wish to stop taking part in the interview or focus group, then please let the researcher know. You do not have to give a reason. The researcher may need to keep any data you have provided up until that point.

8. Will my taking part in this research project be kept confidential?

All information collected from (or about) you during the research project will be kept confidential and any personal information you provide will be managed in accordance with data protection legislation. Please see 'What will happen to my Personal Data?' (below) for further information.

Please be aware that the focus group will involve other members of staff and therefore confidentiality cannot be assured. All participants in the focus groups will be reminded of their responsibility to treat information shared during the focus groups in strictest confidence.

If during the interviews or focus groups, it becomes apparent that an unreported incident of clinical negligence or malpractice has occurred, then the researcher has a duty to report this through the standard reporting procedures in place within your place of work.

9. How will we use information about you?

The researcher will need to use information from you for this research project.

This information will include your name, initials, contact details, job title and your place of work. People will use this information to do the research or to check your records to make sure that the research is being done properly.

People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

The researcher will keep all information about you safe and secure.

Once we have finished the study, the researcher will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

10. What are your choices about how your information is used?

- You can stop being part of the study at any time, without giving a reason, but the researcher will need to keep information about you that we already have.
- The researcher will need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

11. Where can you find out more about how your information is used?

You can find out more about how Cardiff University will use and safeguard your information

- by asking the researcher.
- by viewing the Cardiff University Data Protection Policy: https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection
- by contacting the Cardiff University Data Protection Officer by email: inforequest@cardiff.ac.uk or in writing to Data Protection Officer, Compliance and Risk, University Secretary's Office, Cardiff University, McKenzie House, 30-36 Newport Road, Cardiff CF24 0DE.

As soon as possible, the research team will anonymise all the personal data it has collected from, or about, you in connection with this research project, with the exception of your consent form. Your consent form will be retained for 15 years and may be accessed by members of the research team and, where necessary, by members of the University's governance and audit teams or by regulatory authorities. Anonymised information will be kept for 15 years but may be published in support of the research project and/or retained indefinitely, where it is likely to have continuing value for research purposes.

Participants can be assured that the data will not be used for any purpose other than this PhD research and future related paper publications. Data will be stored securely and confidentially. University protocol is to upload documents and audio files as quickly as possible to a university password protected computer and store these on a secure drive such as Cardiff University One drive. A personal One drive account will not be used. The student researcher will assign a code or pseudonym to the interviewee as soon as possible to anonymise the data and store any personal details separately.

12. What happens to the data at the end of the research project?

The data will not be used for any purpose other than this PhD research and future related paper publications.

13. What will happen to the results of the research project?

It is our intention to publish the results of this research project in academic journals and present findings at conferences. Participants will not be identified in any report, publication or presentation. There is an intention to use direct (verbatim) quotes from participants. No one will be able to identify you or your place of work in any publications or presentations.

14. What if there is a problem?

If you wish to complain or have grounds for concerns about any aspect of the manner in which you have been approached or treated during the course of this research, please contact the researcher's supervisor, Dr Robin Burrow (burrowr1@cardiff.ac.uk). If your complaint is not managed to your satisfaction, please contact the Research Integrity, Governance and Ethics department at resgov@cardiff.ac.uk

If you are harmed by taking part in this research project, there are no special compensation arrangements. If you are harmed due to someone's negligence, you may have grounds for legal action, but you may have to pay for it.

15. Who is organising and funding this research project?

The research is organised by the researcher's supervisor, Dr Robin Burrow (burrowr1@cardiff.ac.uk) at Cardiff Business School in Cardiff University and student researcher Paul Jenkins jenkinsp7@cardiff.ac.uk. The research is not funded.

16. Who has reviewed this research project?

This research project has been reviewed and given a favourable opinion by the Cardiff Business School Research Ethics Committee, Cardiff University, the Health Research Authority (HRA) and **[insert the name of the relevant NHS Trust/Health Board when known]**. The Sponsor is Cardiff University.

17. Further information and contact details

Should you have any questions relating to this research project, you may contact us during normal working hours:

Dr Robin Burrow (burrowr1@cardiff.ac.uk),
Cardiff Business School,
Aberconway Building,
Colum Drive,
CF10 3EU.
02920 874674.

Thank you for considering taking part in this research project. If you decide to participate, you will be given a copy of the Participant Information Sheet and a signed consent form to keep for your records.

Appendix C. Consent forms.

Consent Form – Document review

Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy.

SREC reference: 2122006

Name of Chief Investigator: Dr Robin Burrow burrowr1@cardiff.ac.uk

Name of Principal Investigator: Paul Jenkins jenkinsp7@cardiff.ac.uk

	Please initial box
I confirm that I have read the participant information sheet (PIS) version 1_1 dated 30/4/22 for the above research project.	
I confirm that I have understood the participant information sheet version 1_1 dated 30/4/22 for the above research project and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
I understand that my participation is voluntary, and I am free to withdraw at any time without giving any reason and without my legal rights being affected.	
I understand that data collected during the research project may be looked at by individuals from Cardiff University or from regulatory authorities, where it is relevant to my taking part in the research project. I give permission for these individuals to have access to my data.	
I understand that the information provided by me will be held confidentially and securely, such that only the researcher can trace this information back to me individually. The information will be retained for up to 15 years after the end of the research project, and will then be anonymised, deleted or destroyed. I understand that if I withdraw my consent, I can ask for the information I have provided to be anonymised/deleted/destroyed in accordance with the Data Protection Act 2018.	
I understand who will have access to the personal information provided, how the data will be stored, and what will happen to the data at the end of the research project.	

I understand that anonymised excerpts and/or verbatim (direct) quotes from the document may be used as part of the research publication.	
I understand how the findings and results of the research project will be written up and published.	
I agree to participate in this research project conducted by Paul Jenkins (jenkinsp7@cardiff.ac.uk), PhD student of Cardiff Business School, Cardiff University, under the supervision of Dr Robin Burrow (burrowr1@cardiff.ac.uk).	

Name of participant (print)	Date	Signature
Name of researcher (print)	Date	Signature

THANK YOU FOR PARTICIPATING IN OUR RESEARCH

YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP

Consent Form - Interview

Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy.

SREC reference: 2122006

Name of Chief Investigator: Dr Robin Burrow burrowr1@cardiff.ac.uk

Name of Principal Investigator: Paul Jenkins jenkinsp7@cardiff.ac.uk

	Please initial box
I confirm that I have read the participant information sheet (PIS) version 1_1 dated 30/4/22 for the above research project.	
I confirm that I have understood the participant information sheet version 1_1 dated 30/4/22 for the above research project and that I have had the opportunity to ask questions and that these have been answered satisfactorily.	
I understand that my participation is voluntary, and I am free to withdraw at any time without giving any reason and without my legal rights being affected.	
I understand that data collected during the research project may be looked at by individuals from Cardiff University or from regulatory authorities, where it is relevant to my taking part in the research project. I give permission for these individuals to have access to my data.	
I understand that the information provided by me will be held confidentially and securely, such that only the researcher can trace this information back to me individually. The information will be retained for up to 15 years after the end of the research project, and will then be anonymised, deleted or destroyed. I understand that if I withdraw my consent, I can ask for the information I have provided to be anonymised/deleted/destroyed in accordance with the Data Protection Act 2018.	
I understand who will have access to the personal information provided, how the data will be stored, and what will happen to the data at the end of the research project.	

I consent to being audio recorded for the purposes of the research project and I understand how it will be used in the research.		
In addition to being audio recorded, I also consent to being visually recorded for the purposes of the research project and I understand how it will be used in the research.	yes	no
I understand that anonymised excerpts and/or verbatim (direct) quotes from my interview / discussion may be used as part of the research publication.		
I understand how the findings and results of the research project will be written up and published.		
I agree to participate in this research project conducted by Paul Jenkins (jenkinsp7@cardiff.ac.uk), PhD student of Cardiff Business School, Cardiff University, under the supervision of Dr Robin Burrow (burrowr1@cardiff.ac.uk).		

Name of participant (print)	Date	Signature
Name of researcher (print)	Date	Signature

THANK YOU FOR PARTICIPATING IN OUR RESEARCH

YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP

Appendix D. Confirmation of Capacity and Capability from each hospital.

Approval email from Hospital 1

Dear Paul,

Re: Confirmation of Capacity and Capability at [redacted]

Study Title	Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy.
R&D Local Reference	2023VCC0005
IRAS Reference	302972

This email confirms that [redacted] has the capacity and capability to deliver the above referenced study. You may start your project when you are ready.

Please ensure that any future correspondence including amendments are sent to the following email address [redacted]

If you have any questions, please do not hesitate to contact me.

Kind regards

[redacted]
Head of Research and Development

[redacted]
Research Facilitator
Research & Development Department, [redacted]

We constantly strive to improve our services and value your feedback. We'd really like to hear from you and your responses will, of course, remain confidential and you won't be identified in any results. Please click on this link to leave your feedback: [redacted]

Approval email from Hospital 2

Dear Sponsor Representative,

RE: IRAS 302972. Confirmation of Capacity and Capability at [redacted]
Full Study Title: Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy.

This email confirms that [redacted] has the capacity and capability to deliver the above referenced study. Please find attached our agreed Organisation Information Document as confirmation.

We agree to commence research activities on a date which is to be agreed, upon receipt of 'green light' notification from you the sponsor.

As sponsor, you are required to keep the local research team and the R&D office ([redacted]) up to date with any changes/amendments to this study.

As sponsor you are also required to provide the End of Study Submission Date or Local Close-Down Date (whichever happens first) to the R&D office ([redacted]) to ensure HTA and REC regulations are adhered to at this site.

We may also contact you to provide other data relating to your study as and when required.

[redacted] will continue to support this study providing service impacts relating to Urgent Public Health research demands, and services in relation to COVID-19 allow (e.g. introduction of a UPH vaccine study or increased COVID-19 positive cases leading to service support deprivation). We will contact you regarding any changes to capacity, should the need arise.

If you wish to discuss further, please do not hesitate to contact me.

Kind regards

[redacted]
Research Facilitator [redacted]

[redacted]

[redacted]

Approval email from Department 3

Sent on Behalf of the [redacted] Study Set Up Team

Dear [redacted],

Study Title:	Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy
[redacted] Study Reference:	[redacted]/2023/016
IRAS ID:	302972
Chief Investigator:	Dr Robin Burrow
Sponsor:	Cardiff University
Funder:	Not applicable

Further to the above study being issued with HRA/REC approval, this email confirms that [redacted] has the capacity and capability to deliver the above study at the following site(s):

[redacted]

Please note that the Sponsor may issue their own 'green light' prior to [redacted] being able to start recruitment – please do confirm with them prior to any recruitment activities.

At [redacted] we aim to recruit the first patient into trials within 30 days of confirmation of participation being issued. For your study this date is 10-March-2023. Should you envisage any difficulties please get in contact.

- The agreed recruitment target for this study: 15
- Recruitment end date**: 29-Dec-2023**
- The clinical trial agreement: **OID is attached**

Please supply the following information at the appropriate time points to [redacted]:

- Notification of any changes to the local study team, SUSARs, urgent safety measures or if the study is abandoned.
- Notification of the actual end of recruitment date, end of participant follow up date (if applicable), end of study date and a copy of the end of study report.
- Details of any publications arising from this research project.
- Please send notification of any amendments to [redacted].
- Recruitment should be uploaded to EDGE to ensure that recruitment at [redacted] is counted towards our overall recruitment target. Failure to do this could result in confirmation of participation being withdrawn. Information on how to upload data and a user account can be accessed by emailing [redacted].

Please note that confirmation of this study is dependent on full compliance with all of the above conditions.

Also, please find below the list of HRA/REC, and R&D approved documents, for this study:

Document	Version	Date
Interview schedules or topic guides for participants	v1_0	30 November 2021
Interview schedules or topic guides for participants	v1_0	17 March 2022
Participant consent form - Document review	v1_0	17 March 2022
Participant consent form - Interview	v1_1	30 April 2022
Participant consent form – Observation	v1_1	30 April 2022
Participant consent form – Reflexive focus group	v1_1	30 April 2022
Participant information sheet (PIS) - Radiotherapy Team	v1_1	30 April 2022

Participant information sheet (PIS) - Safety Specialists	v1_1	30 April 2022
Research protocol or project proposal	v1_0	17 March 2022

Please contact us via the details below if you require any further information.

Yours sincerely,

[redacted]

[redacted]
Sponsor Trial Manager
Research and Development
[redacted]

[redacted]

Approval email from Department 4

Dear Sponsor Representative and [redacted],

RE: R&D Ref 156481– IRAS 302972. Confirmation of Capacity and Capability at [redacted]

Full Study Title: Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy.

Project R&D Ref: 156481
IRAS ID: 302972
REC Ref: 22/PR/0511

This email confirms that [redacted] Hospitals NHS Foundation Trust has the capacity and capability to deliver the above referenced study. Please find attached our signed agreement as confirmation.

We agree to start this study on **12/April/2023**, as previously discussed.

Please note [redacted] study teams are now required to populate EDGE (www.edge.nhs.uk) with the following information for each study that falls within their remit:

- Planned recruitment start date at [redacted]
- SIV dates
- Status updates at [redacted]
- Open to Recruitment dates
- Planned Recruitment end date
- Actual recruitment end date at [redacted]
- Planned UCLH closing date
- Actual study closure date at [redacted]

I attach a user guide which provides information around how to complete the above. If anything is unclear a member of the JRO Research Data and Information team will be happy to help. Please make contact via [redacted]

Kind regards,

[redacted]

[redacted]
Portfolio and Database Administrator
[redacted] **Joint Research Office, part of the Research Directorate**
[redacted]

Approval email from Department 5

Dear [redacted],

Re. Affect and human error. **R&I No: RT23/156481**

Affect and error: A qualitative study of affective processes when things go wrong in Radiotherapy

This email confirms that the [redacted] Hospitals NHS Trust has the Capacity and Capability to deliver the above research study, based upon Protocol version 1.0 (17/03/2022).
If applicable, please now liaise with the Study Sponsor and acquire Greenlight confirmation.
Please ensure R&I is notified once the trial is Open.

Please find attached:

- Agreed Organisation Information Document,
- Agreed Schedule of Events.

It is the responsibility of the principal investigator to ensure that the study is conducted in accordance with the terms of the Health Research Authority approval and [redacted] Hospitals NHS Trust policies and procedures including the requirements for research governance and clinical trials performance management. These are available at https://www.[redacted].nhs.uk/assets/Research/636ce652fc/PI-responsibilities-v2.0-27072018.pdf.

If you have any queries, please do not hesitate to contact the R&I team at [redacted]-tr.researchfacilitation@nhs.net.

Kind regards,

[redacted]

[redacted]
Senior R&I Coordinator,
RAAFt | Research Assurances & Approvals Facilitation team
[redacted]

Appendix E. Statements from Westtown Hospital (Terri and Emma).

Statement re incident: **/**/20** WEB427212

Statement
** Band 7 Therapy Radiographer
01 *** 20**

Incident Details:
Day one
I was called to La* to see the patient as they had queries about the patients' tattoos, and positioning. The patient was on the treatment bed, they were obviously distressed, and his father did not seem to have much control of him. The decision was made not to treat the patient, but to take him to the mould room so we could check the fit of the "mask". Whilst in the mould room the patient was still distressed and exhausted, however we were able to confirm the fit of the "mask".

I contacted the consultant and the anaesthetic department regarding the possibility of the need to anaesthetise for future treatments.

On day two, I received a phone call from the Paediatric specialist Oncology Nurse to discuss how we were planning to overcome the issues of the previous day. She informed me that the patient did not respond well to men, I then went to LA* to discuss this with ** (the band 7 on set) and **, and it was decided to ask ** to step in to treat the patient instead of **. We also discussed how to speed up the process by not using the tattoos for alignment as this caused the patient to become more distressed. We also discussed the possibility of anaesthetising the patient in future if he was too upset by the treatment and not fully compliant.

I was aware that everyone was getting drawn into the emotion of the situation as we were all concerned about him receiving treatment.
I went to the set during the treatment. We had planned who was going to do which role, and that I was going to lead the patient care and liaise with the parents.
The play therapist did not seem to be very helpful, as she seemed to be emotionally attached to the patient –she was saying things to the patient to make it seem better rather than fact (i.e. how long the treatment would take).
I spoke to the patient's father in relation to him taking control of the situation if the patient became upset.

There was loud music playing in the room (as per usual in these treatments- and on patients request), the patient was screaming and his father and the play therapist were talking to him, trying to encourage him to comply, however this did mean that they were often in the way, and close to the treatment bed. I spoke to the patient firmly to get him to keep still, and during the treatment I conveyed instructions to the

parents to pass on to the patient to maintain the treatment position. During this time the parents kept "breaking" the interlock with the ribbon that is used to link the patient and their parents (as is standard in paediatric treatment). There were a lot of distractions during the set up and treatment.

Following treatment I discussed how it went with ** and **, and what we should do for the next treatment.

On my return to the mould room, I contacted the consultant and the anaesthetic department and stated that we potentially wouldn't need to anaesthetise, but this was dependant on the results of the image review.

This is a true account of the events as I recall them:

Statement typed, after discussion with **. Senior Radiographer.

Statement re incident: **/**/20** WEB*****

Statement
** Band 6 Therapy Radiographer
30 *** 20**

Incident Details:
Patient was not treated on day one as they were too distressed and unable to comply with treatment position.

His parents and the play therapist informed the staff that the patient did not respond well to male staff therefore we considered and decided to change team lead.

The patient attended at 2pm for treatment, it was very busy on that day, and the machine was running late which put the team under pressure. I felt anxious to treat the patient on time, and was also apprehensive at the level of distress the patient had experienced the previous day, and was concerned how the team were going to be able to manage to treat the patient.

The patient attended with their parents and a play therapist. When patient was taken into treatment room, parents and play therapist came in as well. I was not expecting them all to come in, but felt unable to approach them with regards to keeping the individuals in the room to a minimum, as a result of the previous day's events.

At this point ** (Paediatric group) attended as liaison, and ** (**) attended to assist with the shell. No discussion had been taken at this point as to defined roles for everyone.

The patient got onto the bed, and began to cry, getting a little upset, but not to the level of the previous day. We were unable to use pelvic tattoos as patient became more upset as we tried to use them. This increased the pressure.

It became difficult to communicate and hear the team lead as the play therapist and the parents were shouting encouragement loudly trying to engage with the patient to maintain their compliance with the treatment. It became difficult to align the patient as the additional individuals in the room were often in the way, and moving around the patient. This made it difficult to access the patient and the equipment. This was due to the individuals not realising they were in the way and their enthusiasm to get the patient through the treatment.

The parents and play therapist were continually telling patient that treatment was going to be quicker than scan –which is not the case- this added additional pressure.

Fiducial couch values were noted and checked by both treating radiographers.

Cranial fields were treated with difficulty as parents and play therapist kept inadvertently breaking the interlock –several times- whilst trying to communicate with the patient. All parameters were checked and ok. Cranial field images were taken. Next we set up the spine fields – we decided to do the images first –we moved the couch long to what was thought to be the spine isocentre using the movements for reference (cranial reference used in error rather than fiducials). ** and I checked all other parameters and ** communicated with the parents so that they knew if the patient was moving and what instructions to give them. FSD under-couch checked and ok. Field visualised on the patients ant looked ok- however we now realise that as this was an image this was not representative of the treatment.

The quality of images poor, therefore the sheet was given to imaging specialist for image review, the error was detected on revision of images.

I was informed of error by the imaging specialist.

** informed consultant and physics.

This is a true account of the events as I recall them:

Statement typed, after discussion with **. Senior Radiographer.

Appendix F. Statements from Midtown Hospital (Eva and Faith).

Incident Investigation – factual account

Dear Colleague

There has been a recently reported incident and we would welcome your input into our investigation. What you can recall helps us to build up a detailed understanding of exactly what happened, allows us to learn lessons and put changes in place to ensure such an incident does not happen again and allows us to improve patient safety whilst they are in our care.

It is important that you complete this paperwork as quickly as possible to ensure your recollection of events is fresh in your mind. It is your duty to be open and honest.

Incident reference (IR1 number):

Brief description of the incident:

Questions	**Things for you to consider.**	**Comments/ thoughts.** (Write or type in the boxes)
What happened **i.e. what exactly did you see, hear and do?**	Be specific; do not assume the investigator has an in-depth knowledge of the task you were performing. Use names and job title of any other staff members involved (it may be useful for us to involve them in gaining their account of events) Try to recall dates and times and the order things happened in.	I treated the patient in question on his 9th fraction of treatment then 2 other times in his first week. The first 3 times marks were clearly visible, myself and the 2nd operator I worked with used the photograph with the marks clearly drawn, used the acquired parameters of the couch, the gantry and the collimators to align the patient to an approximate position, then as protocol adjusted accordingly with skin apposition, on some days I recall the patient wanting shims removing from under his headrest, which altered his position very slightly. Some days the gantry or the floor rotation needed to be moved away from the acquired parameter to achieve a flatter, better skin apposition therefore requiring the bed height, longitudinal and lateral position to also be adjusted. Therefore justifying the difference in bed parameters to myself, as the FSD was always set at 100cm, we had used the photograph to guide us and the position of the light field was always checked and deemed appropriate coverage of the lesion I was always confident with the treatment.

Where and when did it happen?		When I came to treat the patient after a gap of approximately 13 treatments, the marks had faded slightly, neither myself or the 2nd operator I worked with were confident in our position so we asked an experienced senior radiographer who had previously treated the patient on many occasions for assistance. After scrutinising the photograph in detail and with assistance from our colleague we were all confident with the position achieved. The bed parameters again were not too greatly different from the acquired parameters giving us further confidence in position, overrides may have been needed for some parameters but again this was justified by the need to achieve a better skin apposition for treatment, and backed up by our visual checks. Additionally the fact the patient had been mainly treated on a different machine (TrueBeam 1) was another justification for the bed parameters being slightly different to those acquired. Due to these justifications, we re marked the marks which were visible to us and we had set up too, we did not draw any new marks on the patient, only made clearer the ones already there. I never treated on a day where no marks were visible at all, there was always a reference mark visible.
Why did it happen?	You can give opinions as to why the incident it happened or what you think contributed to the incident. Was there anything else going on around you that may have distracted you?	The photograph provided wasn't the clearest, and could have been interpreted differently by each radiographer, there were no measurements, or orientation indicating which direction was superior inferior or laterality and as the treatment area was relatively circular again this was made more difficult. Additionally the treatment area only covered half of the skin graft (which is unusual practice, as usually for these patients the entire graft site is covered by the treatment field) this was not made clear or highlighted. We weren't provided with measurements or any additional set up information making this clear. The patient's thermoplastic mask was also misleading as the hole cut out was much larger than the area needed to be

	What were staffing levels like at the time?	treated, again not usual practice, and may have caused confusion. The patient also did not like the mask therefore additional pressure to work swiftly but ensuring the position was correct. I treated the patient on fraction 9 and created an electron treatment form as one had not already been created and put into the patients' documents. This would have been the perfect place to highlight the fact the field was not centred on the graft and indicate when and if shims had been removed daily.
What action(s) were taken as a consequence of the incident?	Think about your or colleagues actions immediately after the incident.	
What was the outcome?	What are the long terms outcomes for yourself and the individual patient?	
Do you think there were any gaps in policy, procedures or training?	You can evaluate systems and process. Think about what training or process deficiencies which might have led to the incident.	I don't think enough information is always provided for our electron patients, we rely on the patient themselves keeping drawn marks on but I feel there should be a contingency in place as the doctor or radiographer who marked the patient up may not always be available to come and re-mark the patient. An acetate sheet overlay drawn on at mark up once the doctor has marked the area they want treated, indicating measurements, orientation, and other defining features (any

		distinctive freckles or birth marks, frown lines, lip or nose outlines and clearly marked margins) and signed by the doctor and mark up radiographer on the day of the mark up to be used daily by treatment staff even when marks are clearly visible to give additional confidence in treatment area. Additionally, a treatment superintendent, experienced senior radiographer, physics staff or both could be present on the first day of treatment, see the set up and approve it (ideally the radiographer who marked the patient up with the doctor would be present, but may not always be possible due to staffing logistics). On day 1 any additional measurements (stand off or stand in measurements) could be taken and recorded for future reference included in the daily set up checks protocol for electron patients. Even on day 1 another photo could be taken in the event of any changes which may have been made to the treatment area by the doctor between the mark up and day 1.

Any other information you think could assist the investigation?		I have provided to the best of my ability as much information as I can recall.

Name……. Role……

Date……

Incident Investigation – factual account

Dear Colleague

There has been a recently reported incident and we would welcome your input into our investigation. What you can recall helps us to build up a detailed understanding of exactly what happened, allows us to learn lessons and put changes in place to ensure such an incident does not happen again and allows us to improve patient safety whilst they are in our care.

It is important that you complete this paperwork as quickly as possible to ensure your recollection of events is fresh in your mind. It is your duty to be open and honest.

Incident reference (IR1 number):

Brief description of the incident:

Questions	Things for you to consider.	Comments/ thoughts. (Write or type in the boxes)
What happened **i.e. what exactly did you see, hear and do?**	Be specific; do not assume the investigator has an in-depth knowledge of the task you were performing. Use names and job title of any other staff members involved (it may be useful for us to involve them in gaining their account of events) Try to recall dates and times and the order things happened in.	Me and my colleague were setting up for an electron treatment we put the patient in the orfit and did the appropriate set up with height/position/gantry/ coll angles, checked the coverage was good and the FSD was at 100. Although I cannot remember this is much detail there was a parameter slightly out however the decision was to override as we were in the optimum position the treatment area was well and evenly covered. It has later transpired that the patient has been given the incorrect treatment from a number of staff. The patient had a distinguished skin graft, however me and my colleague who I have worked with a number of occasions are very cautious and take our time in the treatment room. I cannot remember if the treatment area was fully marked out but there would have been a substantial indicator as me and my colleague would not just guess where it was despite the graph. In addition there was a photo which I will have looked at outside the room as I do with any electron treatment before bringing the patient in (I am unsure if we brought the photo into the room with us. I treated this patient on one occasion on **/**/** on **2

Where and when did it happen?		
Why did it happen?	You can give opinions as to why the incident it happened or what you think contributed to the incident. Was there anything else going on around you that may have distracted you? What were staffing levels like at the time?	Electron treatments can be quite fiddly and there is no imaging which is what many of us are used to. From my observations of the documentation this patient has had many members of staff treating on different occasions there doesn't seem to be a consistent person from the beginning to the end of treatment. In hind sight although we do this for photon treatments- it should have been documented about the inconsistencies in shifts. **Without any speculation and my honest opinion only as far as I am aware there is no proof that this happened-** it could be possible that the patient may have been remarked once or numerous times but for whatever reason something may have gone wrong.

What action(s) were taken as a consequence of the incident?	Think about your or colleagues actions immediately after the incident.	
What was the outcome?	What are the long terms outcomes for yourself and the individual patient?	Low morale amongst the treatment staff and possibly a lot of confidence in treating electrons knocked.
Do you think there were any gaps in policy, procedures or training?	You can evaluate systems and process. Think about what training or process deficiencies which might have led to the incident.	I think it could have been related to experience as electron treatments do not come up often making it harder for staff recently qualified to gain anything close to the experience of them, compared to some of the staff that have been here a long time. Even whilst training at a different department as a student, electron patients would only come up once or twice a placement year if that.

Any other information you think could assist the investigation?		Sometimes if the person you are working with has seen the patient before and confident with the setup you can find yourself following their lead. They get the same 15min slot even though the treatment is very quick it takes time to put the heavy equipment on and off the gantry and to get the patient into an optimum position. Electron treatments are quite few and far between, we do not get many come through and can be planned or unplanned which can confuse things.

Name……. Role……

Date……

Appendix G. Statements from Northtown Hospital (Angela and Barbara).

Statement re incident: Datix ****
Statement from: Radiographer- **
Date: **/*/22

Incident Details:

Situation

Incorrect match on an Online 2DkV image, therefore identified as a partial miss.

Background

- We were working on LA* on the late shift with 3 members of staff as another machine in the department was broken.
- I was working with **, a band 6 agency (**), a supernumerary band 5 (**) and a student. We set up the bed as instructed – the bolus instruction were confusing as they stated to offset the bolus to the right – even though we were treating the left side – we ensured that the bolus was covering the mass before the patient lay down.
- The patient had a large tumour on her back causing pain ++ and an anterior reference tattoo. The patient struggled to lie down flat on their back and was rotated. We got the patient to relax as much as possible and continued with our set up.
- ** was switching on and I loaded up the image in XVI. Once this was acquired we swapped seats for me to match. The image was not of the best quality and you could not visually see what we were treating
- The anatomy had been drawn on in the image prep – this included the clavicle, ribs, chest wall, spine and humorous [humerus] joint.
- Once the image was acquired I changed the filter to 'CLAHE'.
- When matching the image, the clavicle did not look in the correct position but as it is a movable structure we accepted the position would be slightly off.
- Nothing fitted perfectly and I assumed that was due to the patient not being able to lie flat. The Ribs looked at the right level; the inferior aspect of the shoulder joint looked acceptable, the inferior aspect of the pedicles looked correct. The most superior and inferior aspect of the spine looked at the appropriate level. The left/right was off but I accounted that to patient rotation.
- I used the image fusion control and flicked back and forth between the images. We had the image zoomed in to the isocentre point – this took away being able to see the apex of the lung – in retrospect we should have zoomed back out to look at the bigger picture.
- From my IGRT training, it states we should use the vertebral bodies, ribs, pedicles, spinal processes and the intervertebral space for spine and the chest wall can also be used.
- In the moment of matching I believed where I placed the match was the best fit of the rotation of the patient using all the main structures suggested.

- As I was struggling to match I asked for a second opinion. ** happened to be in the edit room and came out to second check. She agreed the image was difficult to see and that where I had placed it look reasonable to where we were treating.
- ** asked if we could visually see where we were treating, we explained that unfortunately even though it is a large mass the patient was lying supine and a post field had been planned.
- All three of us agreed we were happy and we accepted the imaged, moved it online and treated the patient.

Specific questions. If you answer YES or MAYBE please elaborate your answer

Team Factors: Was there any failure in team function? E.g. Conflicting team goals, poor delegation, lack of respect for colleagues, absence of feedback?

YES ☐ NO ☐ MAYBE ☐

Individual Factors: Were there any reasons this incident was more likely to occur with staff involved? E.g. Fatigue, stress, rushed, distracted, inexperienced?

YES ☐ NO ☐ MAYBE ☐

Felt under pressure to rush as patient was in pain. Working on a shift machine with reduced staff and running behind.

Team leading the shift (not a full team lead) with a fairly new agency, another band 6, supernumerary band 5 and a student to manage.

Task Factors: Did the task feature make the incident more likely? E.g. Unfamiliar task, monotonous task, difficult task?

YES ☐ NO ☐ MAYBE ☐

Usually when it is such a visible mass we ensure field over area. Could not so this as patient was lying on mass. Do not KV image very often.

Patient Factors: Were there any reasons this incident was more likely to occur to this particular patient? E.g. language barrier, unusual physiology, uncooperative, intoxicated, complex medical history?

YES ☐ NO ☐ MAYBE ☐

Patient was rotated due to mass size and location and in pain.

Workload & staffing Factors: Was there a mismatch between workload and staff provision around the time of the incident? E.g. High workload, staff sickness, insufficient staff?

YES ☐ NO ☐ MAYBE ☐

On a shift – less staff, more people in the room (band 5 & student).

Working with member of staff who is not trained in imaging so no support when matching until calling upon another member of staff.

Leadership, supervision, & Role Factors: Was there any failure in team function? E.g. Inappropriate delegation, remote supervision, unclear responsibilities?

YES ☐ NO ☐ MAYBE ☐

Physical environment: Did the environment hinder our work in any way? E.g. Poor layout, poor visibility, lack of space, poor lighting, excessive noise/heat/cold, poor access to patient?
YES ☐ NO ☐ MAYBE ☐
Phone ringing, people dropping sheets off, people with questions, patients popping around.

Staff training & education: Were there any issues with staff knowledge or skill? E.g. Inadequate training, training not standardised, no protected time for teaching, no regular updates?
YES ☐ NO ☐ MAYBE ☐
Agency staff not trained to image match.

Reflection
What can you do to reduce the risk of this happening again?

I will take more care in looking at the larger picture of the image required rather than focusing on the isocentre alone. Once matched the image where I think is appropriate I need to zoom back out and look at the overall image. I will take more time to check my image offline, sets are busy and if the image is written up there and then, you don't always get a chance to sit down properly and spend time re assessing it. If it is a new patient, don't have as many people in the room.

This is a true account of the events as I recall them: **

Statement reviewed by **, RT Clinical Governance Manager.

Statement re incident: Datix ****
Statement from: ** Temporary Band 6 Treatment Radiographer
Date: */*/22

Incident Details:
Situation
Incorrect match on an Online 2DkV image, therefore identified as a partial miss.

Background

- When setting up the bed we thought it was confusing that the bolus had been requested to be offset to the right when the patients mass was on the left. A machine had been broken down so there was a reduced number of staff members around and more patients than usual. We were running behind due to a machine fault on the previous patient so after discussing with ** we decided

that the bolus would be under the mass even if the bolus was offset to the right due to the size of the patient and the positioning of the mass.

- The patient had a large golf ball sized tumour on her back and only one ant tattoo. This meant that it was hard to get the patient lying flat on the bed due to the tumour causing her to be rotated.
- All other set up was ok and we left the room.
- I was switching on and logged in as myself. I took the image and started to match it. I did as I normally do adjust the filter first. The image was hard to see and what we were treating wasn't visible. I asked for peer support from ** who helped to look at the image with me. I was aware that the mass was soft tissue and not able to be seen on the scan. The anatomy drawn on the scan was more sup than the isocentre so I used that anatomy to try to match the image. This anatomy had been drawn by a band 7 senior radiographer so I trusted that they had drawn the most relevant and clearest anatomy. This is my mistake and I will not do this in retrospect. I used the chest wall and ribs on the superior part of the image that had been outlined in the anatomy on the scan. I felt that due to the rotation and the best fit that the image was appropriately matched to the superior ribs and chest wall. I cannot really remember any more of the match process so cannot elaborate anymore apart from concentrating on matching the area that had anatomy drawn on it. This sort of matching is not covered in the 2D IGRT training and this is the first image of this sort that I have ever had to match where we are treating a posterior visible mass. ** was also present outside the room and as she had seen it the day before I asked where she had concentrated her match. Using her guidance as a three we all looked at the image and matched it to where we treated. In the moment I believed that this was the correct place to put the image but in hindsight I realise this was wrong. I saw that my shift was in the same direction as the previous day and of the same magnitude which seemed appropriate as it was a similar offset. We checked the maths for the bed move and auto moved the bed into the corrected position. Treated the patient and she left.
- I then applied a Systematic error corrective shift based on the previous 2 fractions of 0.8 sup. Because of the magnitude of this shift I had to refer it to the imaging specialists where the error was picked up.
- I am very disappointed in myself for making this error and am frustrated that I did so. It was completely my fault as it was me taking the image and I fully take responsibility for my mistake.
-

<u>Specific questions. If you answer YES or MAYBE please elaborate your answer</u>

Team Factors: Was there any failure in team function? E.g. Conflicting team goals, poor delegation, lack of respect for colleagues, absence of feedback?

YES ☐ NO ☐ MAYBE ☐

Individual Factors: Were there any reasons this incident was more likely to occur with staff involved? E.g. Fatigue, stress, rushed, distracted, inexperienced?

YES ☐ NO ☐ MAYBE ☐

Felt rushed and under pressure. Machine had broken on the previous patient and we were running behind. On a shift with no gaps.

Task Factors: Did the task feature make the incident more likely? E.g. Unfamiliar task, monotonous task, difficult task?
YES ☐ NO ☐ MAYBE ☐
Different sort of treatment. Treating a visible mass that we were unable to see on the 2D scan. Hard to orientate myself with the image as was unable to see what I was treating,

Patient Factors: Were there any reasons this incident was more likely to occur to this particular patient? E.g. language barrier, unusual physiology, uncooperative, intoxicated, complex medical history?
YES ☐ NO ☐ MAYBE ☐
Due to the nature of the patients tumour the mass meant the patient was unable to lie flat on the bed causing the patient to be rotated.

Workload & staffing Factors: Was there a mismatch between workload and staff provision around the time of the incident? E.g. High workload, staff sickness, insufficient staff?
YES ☐ NO ☐ MAYBE ☐
On shift so smaller amount of staff than on a normal 8-6 today

Leadership, supervision, & Role Factors: Was there any failure in team function? E.g. Inappropriate delegation, remote supervision, unclear responsibilities?
YES ☐ NO ☐ MAYBE ☐

Physical environment: Did the environment hinder our work in any way? E.g. Poor layout, poor visibility, lack of space, poor lighting, excessive noise/heat/cold, poor access to patient?
YES ☐ NO ☐ MAYBE ☐

Staff training & education: Were there any issues with staff knowledge or skill? E.g. Inadequate training, training not standardised, no protected time for teaching, no regular updates?
YES ☐ NO ☐ MAYBE ☐

Reflection
What can you do to reduce the risk of this happening again?

I will be more mindful when looking at an image in relation to the anatomy drawn and the position of where we are treating. Take time to match the 2D images when they are rotated.

This is a true account of the events as I recall them: **
Statement reviewed by**, RT Clinical Governance manager

Appendix H. Affect and error presentation

Affect and error presentation-20230312_123509-Meeting Recording.mp4

Appendix I. Interview questions.

Individual

Could you describe how were you feeling on the day of the error? Were you feeling positive? Were you feeling negative? Would you say that this is a normal mood for yourself?

Do you recall any changes in how you were feeling throughout the day? Were you sad then happy? Do you recall feeling positive earlier in the day, then negative?

Were there any changes to how you were feeling immediately prior to the error?

Do you recall recognising how you were feeling and were you able to adjust this mood?

Had there been any occurrence during the day that had triggered an emotional response in yourself? Do you remember feeling sad, fearful, angry, shameful etc.? For example, on the drive in to work, were there any phone calls or texts, on the radio, any memories or situations?

Was there anything unusual or unexpected about the day?

Did anything unusual or unexpected occur immediately prior to the error?

Team

How was the team performing on the day of the error?

Was there any change in the make-up of the team on the day of the error? Why was there a change in the team? How did these changes make you feel?

How did the performance of the team differ on the day compared to other days?

Would you say that the team is able to work interdependently? Or did there need to be a certain level of management / delegation / motivation etc.? How did this make you feel?

How would you describe your relationship with the other members of the team? Was it comfortable / uncomfortable / uneasy?

Could you describe any negative experiences that you may have had with members of the team in the past? How did it make you feel having to work with them on the day of the error?

Would you describe the team as cohesive? Would you say that there are any outliers in the group? Is there anyone that doesn't fit in to the team? Did anyone affect the mood of the team on the day?

Had there been any occurrence on the day of the error that had triggered an emotional response in any member of the team? How did they express themselves emotionally? Would you describe them as verbally expressive? Or do they use facial expressions and/or body language?

How did this affect you or other members of the team? How did it make you (or your team) feel?

Was there any conflict between the team members on the day of the error? Why did this conflict take place? How did this affect you or the rest of the team? How did it make you (or your team) feel?

Atmosphere

How would you describe the atmosphere (mood or tone) in the work area on the day? Did the atmosphere change as the day progressed? Would you describe the workspace as usually serious / professional but upbeat or jovial on the day of the error (etc.)?

Describe the work area on the day of the error? Was it particularly noisy or quiet? Were there any issues or disruptions? How did these issues or disruptions make you (or your team) feel?

Can you remember if there were any faults with any of the equipment? Did these faults occur often? Were these faults dealt with promptly? If not, how did this make you (or your team) feel?

Leaders

How would you describe the leader of the team? Charismatic / relaxed / authoritative (etc.)? Do they usually make good decisions?

Have you ever had any negative interactions with the team leader in the past? If so, how did it make you feel to work with them on the day of the error?

Describe the mood of the team leader on the day of error? Did the mood of the team leader change throughout the day or prior to the error?

Had you had any interactions with departmental managers / superintendents on the day of the error? Were these interactions positive or negative? How had they made you feel?

Patient

How would you describe the patient that was directly involved in the error? How did the patient make you feel?

Were there any interactions between you and the patient?

How would you describe the interactions that had taken place with the patient?

Were there any interactions between other members of the team and the patient?

Was there anything unusual about the patients' behaviour / conversations had with the patient prior to treating / scanning on the day of the error?

Task

Leading up to the error, did you have a good ‘mental model’ of what you needed to do to carry out the task successfully? Was there anything unusual about this task on the day?

Had you been in this situation previously? Had you treated this patient type previously?

Do you recall having any hunches that something was not right?

Do you feel that you did not have the time to process the issue in front of you? Were you feeling rushed or pressurised?

Appendix J. Glossary of Radiotherapy terminology[51].

Band 5 Therapy Radiographer	A newly graduated Radiographer who works as part of a team that provides radiotherapy treatment for patients who have cancer.
Band 6 Therapy Radiographer	Senior Radiographer who deputises for the team leader in the management of the radiotherapy team.
Band 7 Therapy Radiographer Radiographers.	Senior Radiographer who leads a team of Therapy
Cancer	A condition where cells in a specific part of the body grow and reproduce uncontrollably.
Consultant Oncologist	A doctor who is an expert in radiotherapy and other anti-cancer treatments. They specialise in planning and overseeing a course of treatment.
Electron treatments	Radiotherapy treatment using a radiation beam of electron particles. It is effective at treating tumours near to the skin's surface as well as avoiding any deeper sensitive structures.
Fractions	The total radiation dose is usually divided into several treatments or fractions. This technique allows the cancerous cells to be treated effectively, whilst reducing the amount of damage the treatment causes to the normal surrounding tissue. The healthy cells within the treatment area recover between the treatments.
Gray (Gy)	The unit used to measure the total amount of radiation that the patient is exposed to.
Linac	A linear accelerator (or linac) is a device commonly used to provide radiotherapy treatment for patients with cancer. It delivers high-energy x-rays or electrons that destroy cancer cells whilst sparing the surrounding normal tissue.
Planning CT scanner	Dedicated CT scanner designed solely for radiotherapy. The position of the tumour and surrounding organs are accurately identified and provides a mock-up of the treatment position.
Radiotherapy	Radiotherapy is a treatment used to destroy cancer cells, using radiation delivered by a machine called a linear accelerator (linac). Common types of radiotherapy use high energy x-ray beams, but other particles can be used, e.g., electrons. High-energy x-ray (or photon) beams can reach tumours deep within the patient's body.
Superintendent Radiographer radiotherapy staff.	Provide operational management and supervision of all

[51] Glossary developed with reference to Radiotherapy UK (2024).

Appendix K. Extract from transcription taken from interview with Barbara.

Colour coding:

Yellow: Areas of interest following initial readings.

Purple: Facial / Non-verbal expression.

Blue: Affective states.

Green: Figures of speech.

Red: Emergent themes.

PJ: There was a breakdown on the previous patient. Can you remember how that made you feel?

B: That always makes you feel a bit apprehensive. You don't know what what's going to happen with the next patient if you're gonna get through the next patient without another breakdown happening, it can also mean there's just a few more people around. Different people react to things differently, so people can be more stressed.

PJ: What causes the most stress when you're running a bit behind? Is it other patients being late? Is it what are the other Radiographers would say to you?

B: Yeah. It's so it's probably more the patient. So, the patients that are running late and then obviously the bladder fillers there then running in so then they're emptying, and you just get in a spiral of everyone going in late, moaning that they're going in late, but then they go slow themselves and then you just sort of end up in a situation or I suppose like when other staff members aren't being helpful in that situation. So, if you're running late. But then the next patients not ready to go in the treatment room, that can also mean that you just feel a bit demoralised because you're just you're trying your best but not everyone else is working with you to combat that, I think.

PJ: Can you remember anything about how it felt on the machine on the day?

B: Not really, no. I think it was just a little bit everywhere all over the place because the breakdowns and things, it always creates a bit more of a chaotic environment, I would say.

PJ: Did it feel noisy as well or anything like that?

B: It wasn't noisy, but it was just. Yeah, just that bit more of a chaotic energy. Patients don't know where they're going. Staff don't. Yeah. And people just. It creates that environment, doesn't it of it's a not planned thing. It's not an everyday day.

PJ: Did you recognise how you were feeling at the time and were you able to adjust this mood?

B: 'It's very easy to feel that you're frustrated. And I think to combat that, I normally just try [to] tell someone else what needs to be done [pause]… So, I think I'm more of a person that's sort of [pause]…. tries to just get on with it. We've got this situation, you've just got to keep going with that frustration and just try our best and that's all we can really do, to be honest'.

PJ: So, as you, as you pointed out, it was a smaller team, you were working on a shifts because another machine was breaking down. How did you feel that the team was performing on the day of the error?

B: Yeah, we were performing well. We were quite a good team to work with me and the more senior member of staff, we work really well together, so that was good [pause]… And the other member staff was an agency member of staff, so they can sometimes be harder to work with because they don't know the hospitals ways of working more than, more like it as permanent staff do so that can be quite difficult sometimes, especially if they bring in experience from other hospitals. It can be sometimes it can be good experience, but other times it can be just different to how we do things and then that can make it hard.

PJ: How would you describe your relationship with that at the agency member of staff? Was it comfortable or uncomfortable?

B: Just indifferent. Just a member of staff. I wouldn't be friendly like, more friendly or less friendly to them. Just see them as a colleague sort of thing. [scrunches face]

PJ: Was there any change in the makeup of the team on the day?

B: It was consistent members of the team, but we were we didn't have a band 7, so we just had a band six team lead and then two band sixes, one of which was the agency. So, I suppose we were missing that overall Band 7, but yeah.

PJ: OK, so there was a team leader on the day. How would you describe how they led the team? Would you say the charismatic or authoritative?

B: I'd say quite like a laid-back approach to leadership, more of a friendly approach. Like they get you do your jobs and if you need some advice, I'm here, sort of thing. I wouldn't. I'm not sure how to describe that leadership style. But you know, the sort of thing I'm trying to say is like they wouldn't is actually tell you what to do all the time. But if you need them, or if you feel you want to be told what to do, they would sort of do whatever suits you really.

PJ: And can you remember the mood of the team leader on the day? Were they in the same sort of mood all day?

I think they were quite stressed because they weren't given that much support. They were quite new to that role. So, they'd sort of just been, I think someone may have been off and they had to step up into that role. So, it's obviously quite stressful for them, but yeah [pause]…