



**Evaluation of Wales Postgraduate Medical and Dental  
Education Deanery outcomes at core and higher general  
surgery before and after national reconfiguration, enhanced  
selection, and Joint Committee on Surgical Training defined  
curricular standards.**

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**M.D. 2017**

**DECLARATION**

This work has not previously been accepted in substance for any degree and is not currently submitted in candidature for any degree.

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**For Kathleen, my parents and Khalid**

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## SUMMARY

This thesis examines contemporary outcomes of surgical training in Wales and the UK. The hypotheses tested were: Core Surgical Training (CST) outcome is related to specific curricular defined goals, and themed focused CST rotations improve success at Higher Surgical Training (HST) National Training Number (NTN) appointment; CST rotations including rural placements provide training comparable with non-rural placements; General Surgery (GS) Certificate of Completion of Training (CCT) curricular guidelines require focused appraisal and rotation planning; GS HST indicative procedure targets are not in keeping with competence achievement determined by Procedural Based Assessment (PBA); Dedicated Emergency General Surgery (EGS) modules enhance HST training experience; H-Indices are a valid measure of GS consultant academic productivity and identify training research opportunity.

Successful NTN appointment improved from 5.3 to 33.3% ( $p=0.005$ ) following CST [OR 4.789 (1.666 - 13.763),  $p=0.004$ ] and is independently associated with success. ST3 appointment was similar irrespective of rural or non-rural CST rotational placement (18.1 vs. 22.1%,  $p=0.695$ ). Of the 155 UK GS HST CCTs awarded in 2013, global operative log book and academic achievements varied widely, with two-thirds of trainees achieving elective operative targets, but only half the requisite experience in EGS, and 5% non-operative targets. Wales' HSTs level 4 GS operative competencies varied 4-fold, ranging from 0.76 to 3.4 times national targets. EGS modular training introduction delivered a high volume of index EGS procedures and higher rates of PBA completion when compared with controls. H-indices were a robust measure of surgeons' academic activity ( $p<0.001$ ).

## **GLOSSARY**

- AAA – Abdominal Aortic Aneurysm
- ANC – Axillary Node Clearance
- AV – Aorto-Venous
- AES – Assigned Educational Supervisor
- APX – Appendicectomy
- ARCP – Annual Review of Competence Progression
- BMA – British Medical Association
- CBD – Cased Based Discussion
- CCT – Certification of Completion of Training
- CS – Clinical Supervisor
- CST – Core Surgical Training/Trainee
- CT... – Core Trainee Year ...
- CTS – Cardiothoracic Surgery
- DGH – District General Hospital
- DOPS – Direct Observation of Procedural Skills
- EGS – Emergency General Surgery
- EL – Emergency Laparotomy
- ENT – Ear Nose and Throat
- EWTR/D – European Working Time Regulations/Directive
- FRCS – Fellowship of the Royal College of Surgeons (examination)
- GI – Gastro-Intestinal
- GMC – General Medical Council
- GS – General surgery
- HI / h-index – Hirsch Index

HMN – Hartmann’s Procedure

HPB – Hepato-Pancreato-Biliary

HST – Higher Surgical Training/Trainee

IH – Inguinal Hernia

ISCP – Intercollegiate Surgical Curriculum Programme

JCST – Joint Committee on Surgical Training

LAT – Locum Appointment for Training

LC – Laparoscopic Cholecystectomy

MD – Doctor of Medicine

Mini-CEX – Mini Clinical Examination

Mini-Pat – Mini Peer Assessment Tool

MMC – Modernising Medical Careers

MRCS – Membership of the Royal College of Surgeons (examination)

MSc – Master of Science

NTN – National Training Number

OCAP – Orthopaedic Competence Assessment Project

OGD – Oesophagogastroduodenoscopy

OMFS – Oral Maxillofacial Surgery

PBA – Procedure Based Assessment;

PD – Peritoneal Dialysis

PhD – Doctor of Philosophy

PRHO – Pre-Registration House Officer

rDGH – Rural District General Hospital

SAC – Specialist Advisory Committee

SC – Segmental Colectomy

SHO – Senior House Officer

SLNB – Sentinel Lymph Node Biopsy

SpR – Specialist Registrar

ST .. – Specialty Trainee Year..

ST3 – Specialty Trainee Year 3 (1<sup>st</sup> year registrar)

T&O – Orthopaedic Surgery

TPD – Training Programme Director

WBA – Workplace Based Assessment

WoS – Web of Science

## **Chapter 1**

### **Introduction and review of the literature**



## 1.1 HISTORICAL PERSPECTIVE

“It would take me one year to teach a trainee how to do an operation, five years to teach them when to do the operation, but a lifetime to teach them when not to do an operation”, former President of The Royal College of Surgeons of England (1973-77) Lord Edwin Rodney Smith (Thomas 2006).

The role of a doctor demands a broad range of skills and personal qualities, however it is the craft of operating that distinguishes a surgeon from other clinicians and remains fundamental to their professional identity. The training of a surgeon is a challenging and multifaceted process. Unlike a technician with an expertise in only the technical details of a subject, the surgeon must be trained to possess the skills and temperament necessary to deal with the unexpected, operatively and non-operatively.

Surgical education is a career-long process that begins at undergraduate level, but is predominantly focused at the postgraduate training of surgeons. William Thomas, former head of surgical education and consultant surgeon from Sheffield, described four basic aims and objectives of surgical education: (i) a sound knowledge base; (ii) good communication skills; (iii) proficient technical skills; and (iv) excellent clinical judgment (Thomas 2006).

Education per se, derived from the Latin; *educō* (comprising *e*; out of, and *duco*; I lead) has long been cherished as the key to improved opportunity, well-being and quality of life. Almost two millennia ago Emperor Marcus Aurelius, in *Meditations* (Book 1, AD 115 to 180) wrote; “Not to have frequented public schools and to have had good teachers at home, and to realise that on such things man should spend lavishly”.

Although the roots of Surgery can be traced back to ancient times, it was not until the time of the great Roman Empire that the most notable contributions in surgical education were made. Physician to the famously philosophical Emperor Marcus Aurelius - Claudius Galenius (AD 131 to 201) a prominent Greek Physician, surgeon and philosopher, first sought to demonstrate the workings of the human body through dissection. Galen travelled extensively, exposing himself to numerous discoveries and medical theories, before settling in Rome. His work emphasised the importance of physical practice and experimentation, with theories that were the mainstay of medieval university curricula for over 1500 years. Despite being an extremely influential writer and educator, many of his theories that dominated Medicine for over a century were later proven wrong.

Through the Middle Ages, the most common and well-established method of surgical training was through apprenticeships. In its most basic form every learner would imitate the actions of a skilled mentor. At this time surgery was predominantly undertaken by Barber Surgeons, non-academics entrusted with duties that ranged from cutting hair to performing surgery. Over time, barber surgeons developed a poor reputation, with resulting disquiet amongst the academic physicians. In 1505 the surgeons and barbers of Edinburgh were formally incorporated as a Craft of the Burgh. This formed the foundation of the Royal College of Surgeons of Edinburgh, one of the oldest surgical corporations in the world. A charter of privileges granted to them by the town council imposed certain duties, the most important of which required the master to have full knowledge of anatomy and surgical procedures; that all apprentices be literate, and that this knowledge be thoroughly tested at the apprenticeship end. All clauses remain relevant to contemporary surgical practice. Surgeons were

thenceforth to become academic doctors who performed surgery (MacLaren 2014).

“We need a system and we will surely have it - which will produce not only surgeons, but surgeons of the highest type, men who will stimulate the first youths of our country to study surgery, and to devote their energies and their lives to raising the standards of surgical science”, a quote by William Stewart Halsted (1852-1922), John Hopkins Hospital’s first Professor of Surgery and the man credited with having developed the first surgical residency programme. Halsted formalised and pioneered the widely-adopted apprenticeship model of modern postgraduate surgical training and advocated a steep pyramid programme where only the most capable progressed. Although time was not a limiting factor, the average length of training was 8 years with no guarantee of progression. The programme was constructed on a triad of educational principles: basic science, research, and graduated clinical responsibility. Halsted’s aim was to train mentors, not merely competent surgeons, with 11 of his 17 chief residents going on to form their own Halstedian residency programmes elsewhere (Kerr and O’Leary 1999).

## **1.2 DEVELOPMENT OF SURGICAL TRAINING**

### **1.2.1 Surgical Training in the 20th Century**

For the most part, the delivery of surgical education remained relatively unchanged in the last century. It was not uncommon for surgeons to have spent in excess of 15 years in training, prior to becoming a consultant. The structure of the surgical team and the frequency of on-call duties exposed the trainee to a high volume of work, with education being part of the process of providing care. High levels of clinical responsibility entrusted to relatively inexperienced trainees early on in their career meant that the job was at times demanding. The end product of training however was a surgeon with an extensive operative repertoire and a vast breadth of clinical experience. Although no specific assessment of technical ability existed, it was widely acknowledged that experience and time spent in training was an acceptable surrogate marker of competence.

The beginning of the 21<sup>st</sup> century witnessed changes in postgraduate medical and surgical training. Up until that point, newly qualified doctors undertook a Pre-Registration House Officer year (PRHO), a role largely split between medical and surgical specialties, in which the trainee acquired the generic skills necessary for a hospital doctor. After registration, those seeking a career in surgery would embark on a surgical training pathway, rotating through a variety of surgical specialties as a surgical Senior House Officer. The trainee would remain in this role until they had successfully completed surgical membership exams and developed a career specialty interest in which to pursue higher training. The trainee could then apply for competitive entry onto a specialty registrar Higher Surgical Training post.

Until the early 1990's registrars would then progress onto the 'Senior Registrar' grade, as a bridging to Consultancy. At this point however many would remain at this grade until a consultant position became available. The distinct lack of career pathway and structure in the system meant significant bottlenecks ensued between the registrar and senior registrar grades, leaving many demoralised at the failure of progression and seeking alternative career paths. The Chief Medical Officer was tasked with the redesign of surgical training to overcome this.

### **1.2.2 The Calman Report**

In 1993 Sir Kenneth Calman, Chief Medical Officer of England led a nationwide review of postgraduate medical training, in which important recommendations were made, most importantly:

- A reduction in time spent in training with more intensive training programmes (5-6 year Higher Surgical Training),
- Two training grades within the period of specialist training: Senior House Officer (SHO) in which basic specialist training is provided; and development of the Specialist Registrar (SpR) grade in which higher specialist training is provided. The registrar and senior registrar grades were abolished,
- The new Specialist Registrar grade would have explicit educational and service competitive entry requirements, and progression based on annual assessment of educational attainment,
- Introduction of a defined end point of Surgical training Certification of Completion of Specialist Training (CCST) (Department of Health 1993).

Registrar training was to become structured with an emphasis on dedicated high quality education delivered under direct consultant supervision, and a reduced contribution to service provision. Progression was to be based on educational attainment assessed at regionally organised annual in-training assessment exercises. A Postgraduate Dean was made responsible for all Higher Surgical Trainees within a region. The development of a more structured time-limited system allowed for better workforce planning, and recruitment into Higher Surgical Training (Specialist Registrar). However, in reality what ensued after implementation was a new bottleneck between the still unstructured SHO grade and this new SPR grade.

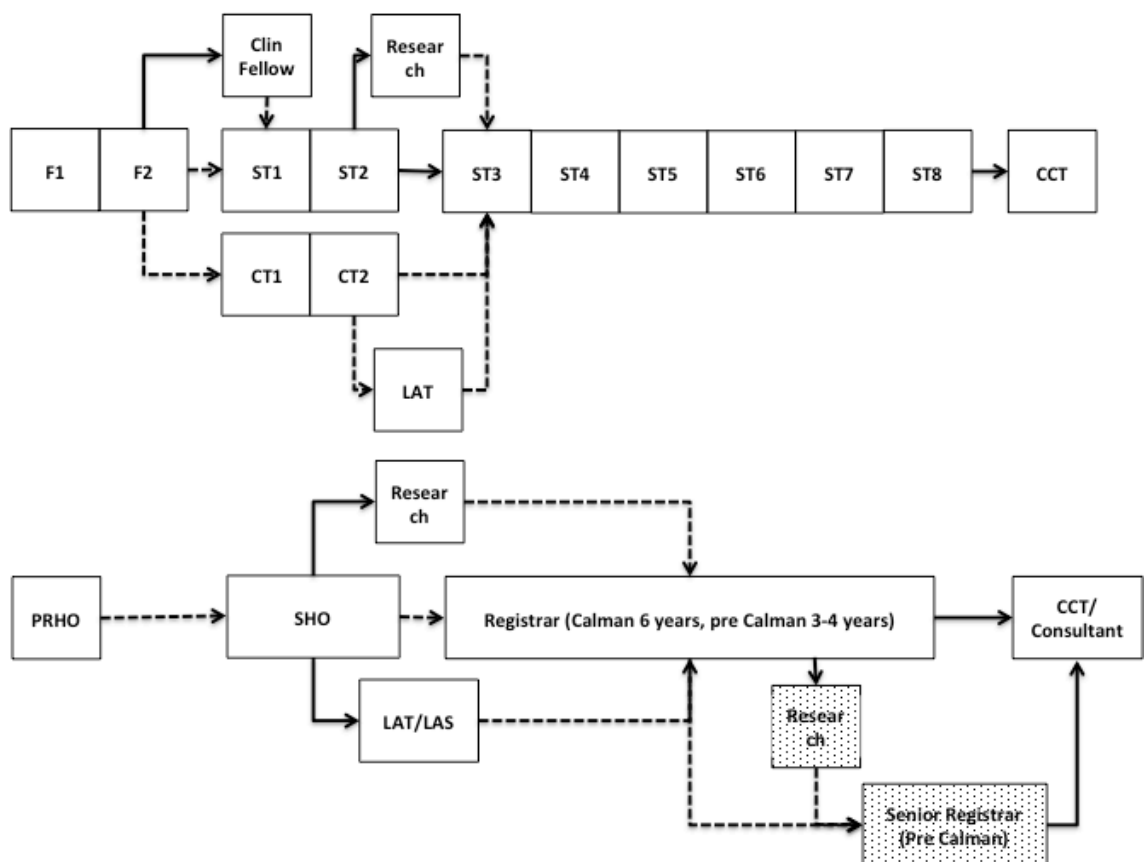
### **1.2.3 Unfinished Business – Modernising Medical Careers**

In 2002 yet another government commissioned report was published.

“Unfinished business: reform of the SHO grade” by the new Chief Medical Officer Sir Liam Donaldson, identified that basic surgical training at SHO level was disparate and unstructured, with up to 50% of posts taken in isolation and not forming part of a planned rotation (Donaldson and Britain 2002). Time spent in this grade varied with no defined educational supervision, appraisal or endpoints to training. Increasing service requirements as a result of legislations relating to working hours resulted in bottlenecks, which progressively worsened as the SHO workforce increased to occupy rotas. Many SHOs unsuccessful at Higher Surgical Training interview went on to complete a postgraduate research degree, often in subjects of no interest to them, in the hope of improving future chances of securing a training job.

A radical overhaul in postgraduate medical education followed in the shape of “Modernising Medical Careers”. This initiative aimed to rationalise early years of training, providing a structured programme for the SHO grade. A 2-year Foundation Programme was also introduced with the F1 year (Foundation Year 1) being equivalent to the previous PRHO. The main objective of this programme was to develop and enhance the core and generic skills required of all doctors (eg. team working, communication skills, clinical governance, patient safety, research skills and an introduction to management roles). After this, through competitive entry, a trainee would commence basic specialist training equivalent to SHO training, in the case of surgery, Core Surgical Training lasting 2 years.

**Figure 1.1 Structure of UK postgraduate surgical training, pre and post MMC.**



PRHO – Pre Registration House Officer, SHO – Senior House Officer, F.. - Foundation year..., ST..- Specialty Training year..., CCT – Certificate of Completion of Training, LAT/LAS – Locum Appointment for Training/Service

A formalised system of workplace-based assessment was introduced as part of MMC with the intention of providing formative feedback and allowing documentation of clinical progression. This changed the emphasis of assessment away from the membership exams alone and replaced the time-based curriculum with that of a competency-based one. Postgraduate Deans were now responsible for the management of all postgraduate trainees within a designated region (Deanery), and an Annual Review of Competence Progression (ARCP) introduced for all grades to assess evidence for progression onto the next level of training.

### **1.3 DRIVERS FOR CHANGE**

#### **1.3.1 Government led reports and initiatives**

A number of schemes were introduced to improve yet shorten training on the background of damning government-led public enquiries demonstrating shortfalls in clinical practice. In the last two decades, the medical profession within the UK witnessed an upsurge in clinicians being held accountable in a court of law for adverse patient healthcare outcomes. This increasingly litigious culture has driven the need for increasing transparency and governance structures (Kelly and Canter 2007) (Lanier et al. 2003). In 2006, for the first time a Hospital Trust was prosecuted by law for failing to provide adequate supervision of trainees leading to a death of a patient, with the trainees deemed to be acting outside the realm of their competence (Dyer 2006; Kelly and Canter 2007). It was no longer considered acceptable to rely on unstructured judgments of trainees to assure the general public that doctors could provide safe care. The introduction of MMC looked to address one of the Department of Health's major concerns, patient safety, through the provision of a framework of



accountability.

The Report of the Public Inquiry into Children's Heart Surgery at the Bristol Royal Infirmary 1984-1995 revealed an inexplicably high patient mortality and morbidity. Amongst the 198 recommendations resulting from the report was the need to develop regular appraisal and revalidation of doctors, with a need for postgraduate medical education to become a competency rather than time-based system. Within the proposed training framework, assessment would encompass not only technical skills, but skills in communication, team working, leadership, clinical governance and reflection (Hilton et al. 2005).

Subsequent to the Bristol enquiry, publication of surgeon- and unit- specific operative outcomes were made available to the UK public in the hope that such transparency would drive improvements in clinical standards and patient safety. A study from Southampton's Department of Cardiothoracic Surgery revealed that surgeon specific data reporting was deemed to have made a significant impact on training, with a reduction in the overall proportion of operative cases undertaken by trainees (Khan et al. 2007; Radford et al. 2015). This was inevitable as consultant surgeons sought to protect their individual outcomes that were audited irrespective of whether a trainee was involved. Although resulting in fewer opportunities for trainees to perform major procedures independently, higher consultant supervision in theatre can be viewed positively as a development in surgical education.

As part of earlier UK Government reforms in the late 1990's, quality assurance surveillance of clinical services was introduced, with hospital trusts given a star rating based on their performance. This also had far reaching implications on surgical training. Medical education did not feature in these assessments and therefore became a low priority for hospital managers when planning service

reconfigurations. Speed, productivity and patient throughput took precedence with an increasing demand on hospital consultants to deliver this at the expense of training. In surgery, such demands put pressure on the training of junior surgeons who inevitably take longer to perform procedures than their consultant colleagues (Crofts et al. 1997; Canter and Kelly 2007; Kelly and Canter 2007). It seemed there was very little incentive to provide training, with one recent UK study estimating a cost of £1.3 million and 270 extra theatre days per year required to increase trainee operative theatre time in one specialty within a region (Crofts et al. 1997).

### **1.3.2 European Working Time Directive**

It was Anders Ericsson, Professor of Psychology at Florida state university, who first claimed that to become an expert in almost anything requires 10,000 hours of deliberate practice (Ericsson et al. 1993). Prior to the Calman reforms in 1995, on average a surgeon could be expected to have worked a total of 30,000 hours before being appointed as a consultant. This number has now fallen to an estimated 6,000 hours (Donaldson and Britain 2002; Chikwe et al. 2004). In a craft specialty such as surgery, there has been a growing concern that as a result of recent implementation of working hour restrictions, the hands-on operative experience which has formed the backbone of surgical training would be insufficient, and an increase in service provision over dedicated training would ensue.

Young doctors have traditionally had to endure long working hours in often stressful and unforgiving environments. The issue of trainee working hours, fatigue and poor patient outcomes came to fruition in New York after the tragic death of 18-year-old Libby Zion at a teaching hospital in 1984. Long hours

undertaken by unsupervised and inexperienced residents were deemed to be contributory factors to her death (Asch and Parker 1988). Consequently in 1987, nationwide regulations were implemented in the US to improve both the supervision and reduce the working hours of the junior doctors (New York Department of Health 1987)(New York Department of Health 1987). A number of studies have since shown the detrimental effects in surgical performance associated with fatigue (Taffinder et al. 1998; Eastridge et al. 2003; Leff et al. 2008; Fitzgerald and Caesar 2012).

In the UK, a progressive reduction in hours worked by junior doctors resulted from the New Deal negotiated by the British Medical Association (BMA) and subsequently by the introduction of the European Working Time Directive (EWTD). This restricted working hours to an average of 48hrs per week over a 6-month period and was finally fully implemented in August 2011 (European Parliament 2003; British Medical Association 2011).

The implications of EWTD on surgical training have been reported in the literature, with the majority of studies using trainee operative caseload as an objective comparative measure. Within the UK, data has suggested that implementation of the EWTD has led to significant reduction in the operative experience of surgical trainees (Stephens et al. 2004; Marron et al. 2005; Bates et al. 2007; Kairys et al. 2008; Kara et al. 2008; Maxwell et al. 2010; Blencowe et al. 2011; Breen et al. 2013). A systematic review from the US in 2011 similarly reported a global reduction in operative numbers achieved in the majority of studies following duty hour restrictions (Sadaba and Urso 2011). Despite clearly demonstrating a difference in trainee surgical exposure, the quality of training cannot be inferred from such studies, as surgical practice and education have also evolved during this time. Sub-specialisation and an

increasing evidence base for minimally invasive management of surgical conditions has resulted in a differing case-mix being operated on by surgeons (Martin 2004; Eckert et al. 2010). Coupled with the political drive towards a greater consultant-led NHS service, consultant surgeons now perform or supervise more operations that would traditionally have been undertaken independently by the trainee (Blencowe et al. 2011). It is therefore reasonable to assume that the reduction in trainee operative caseload is multifactorial (Emmanuel et al. 2015). The educational value of 20 unsupervised emergency laparotomies performed 20 years ago is therefore very different from the equivalent consultant-supervised operations performed today.

A large study performed by Dutch group Hopmans et al. revealed that EWTD did not confer a reduced trainee operative caseload within their contemporary training programme. The authors claimed that a more efficient use of available training was possible through improvements in theatre efficiency, day case surgery, simulation and the introduction of physician assistants freeing up more opportunities for trainee operative exposure (Hopmans et al. 2015). Although this operative experience may have come at the expense of other non-operative aspects of surgical training, this study proves that through workforce planning, and a conscious effort to maximise all potential training opportunities, operative exposure can be maintained within the current working time restrictions.

Perceptions of training have also changed over time. Parsons et al. demonstrated a significant reduction in self-reported operative ability between current surgical UK Core Trainees (SHO) working in an EWTD compliant rota when compared with past SHOs (current registrars). The majority of trainees felt that operative training opportunities had drastically declined whilst communication and provision of teaching skills had improved (Parsons et al.

2011). Results from Mehmood et al. echoed the sentiment amongst UK trainers and trainees that training quality had declined (Mehmood et al.). In the US, a systematic review similarly demonstrated increasing dissatisfaction with the perceived quality of surgical education (Ahmed et al. 2014).

## **1.4 COMPETENCY BASED TRAINING**

### **1.4.1 Defining Competence and Competency Based Training**

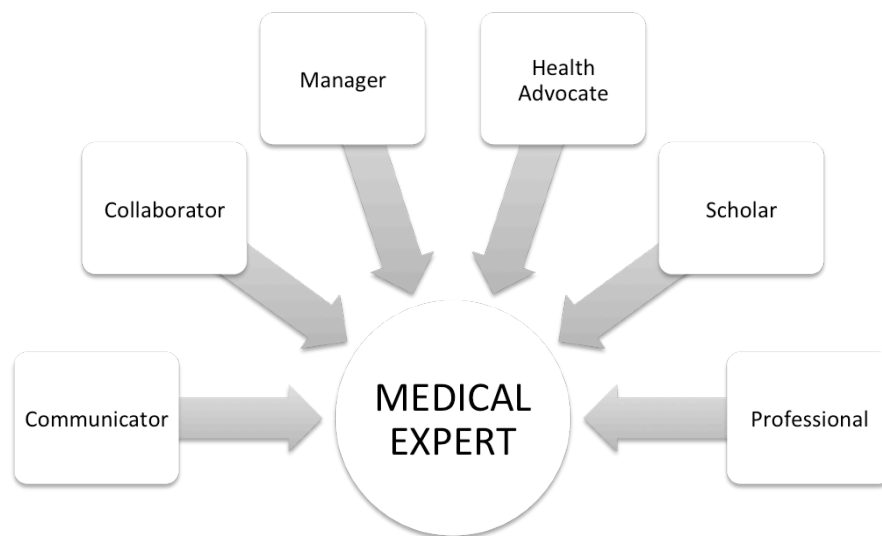
Experience is vital in the acquisition of competence however as Charles Mayo, renowned surgeon and one of the founder members of the Mayo Clinic, once famously stated “Experience can mean making the same mistake over and over again” (Ellis 1984). In the past career progression in surgery focused on time and experience and although extremely successful in producing consultant surgeons of the past, this model is now considered flawed. Competence is achieved when experience (practice) is combined with positive feedback (Reznick 1993).

The time limitations associated with introduction of the EWTD has necessitated a contemporary training system that is proactive, whilst recognising that education must be self-directed, reflective and experiential. The development of a curriculum that encourages this, and facilitates more structured and validated assessment has been developed in the UK under the umbrella of MMC, and has been implemented into surgical practice through the Intercollegiate Surgical Curriculum Project (ISCP).

The term “surgical competence” does not have a unified definition within educational literature, and has been described as a collection of skill, knowledge, and judgment required to complete new or familiar tasks

incorporating both technical and nontechnical components (Szasz et al. 2015). Most definitions within the literature have embedded within, a minimum standard needed to be safe and/or the ability to perform an operation independently (Szasz et al. 2015). The ultimate goal of any surgical training programme is to produce competent surgeons that are able to meet the needs of the society in which they work. It is therefore essential that one can define competence within the context of surgery in relation to addressing a clinician's fitness to practice, but also providing constructive feedback in training. A competency is an observable ability or job related task of a health professional integrating multiple components such as knowledge, skills, values and attitudes (Frank et al. 2010; Beard et al. 2011). In the UK, the competencies for postgraduate surgical training have been derived from the Royal College of Physicians and Surgeons of Canada CanMEDS model (Figure 1.2), in which the surgical expert has 6 components to their role as a professional, skills that closely correspond to the principles of Good Medical Practice as stated by the UK General Medical Council (Intercollegiate Surgical Curriculum Programme ; Frank et al. 1996).

**Figure 1.2 The CanMEDS key roles of a clinician**



A competency-based system, although not new to medical education, has only recently been introduced into postgraduate medical training (McGaghie et al. 1978). It describes an outcomes-based approach to training, assessment and evaluation of education programmes, using a framework of defined competencies (Frank et al. 2010). Using this model, trainees progress through predefined competency milestones instead of traditional time based rotations. This outcome based approach to surgical curricula differs from that of the past in which the focus was very much content based (Table 1.1), and consequently is heavily reliant on a comprehensive system of clinical workplace assessments, which are considered to accelerate educational attainment through learning curve theory (Collins et al. 2007; Grantcharov and Reznick 2009).

Learning curves are often referred to in surgical education, however it was an aeronautical engineer, TP Wright, in 1936 who was one of the first people to describe this theory in the context of airplane component production, showing that performance improved with experience (Wright 1936). In surgery surrogate

markers of performance are used, either measures of surgical process (clinical skills assessment) or measures of patient outcomes, to plot a curve against experience. The gradient of ascent indicates how quickly one's performance improves (Hopper et al. 2007). The ALMANAC trial in axillary sentinel node biopsy is an example of a large multicentre study which amongst a number of outcomes, reported a learning curve based on the level of operations required to achieve acceptable localisation and false negative rates (Clarke et al. 2004).



**Table 1.1 Comparison of Traditional and Competency based medical education**

<b>Variable</b>	<b>Traditional</b>	<b>Competency Based</b>
Focus of curriculum	Content (“knows”)	Outcomes (“does”)
Goal of learning activities	Knowledge acquisition	Knowledge application
Educational process	Teacher driven	Learner driver
Responsibility for content	Teacher	Learner and teacher
Assessment emphasis	Summative (high-stakes final examination)	Formative (smaller, more frequent examinations)
Assessment tools	Indirect or proxy, subjective measures	Direct observation, objective measures
Evaluation standards	Norm referenced (compared with peers)	Criterion referenced (compared with objective standard)
Completion time	Fixed	Variable

(Knox et al. 2014)

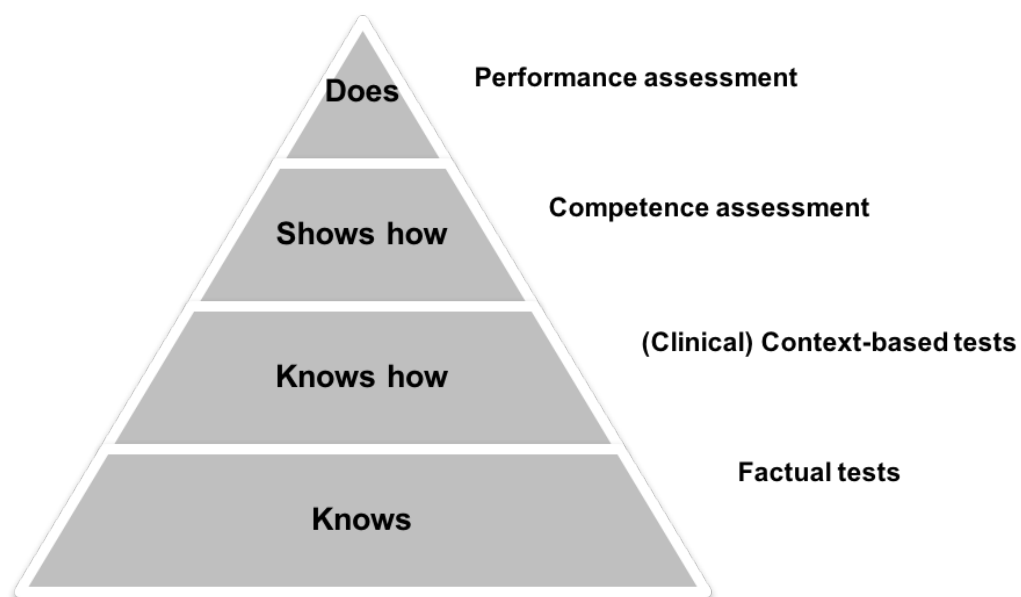
### **1.4.2 Assessment of competence**

The late George E Miller, eminent Professor of Medical Education at the University of Illinois, once stated that “no single assessment method can provide all the data required for judgment of anything so complex”, referring to the difficulties associated with competency assessment in medicine (Miller 1990). Assessment of competency provides assurances that healthcare professionals are performing their job to an acceptable level. There has been growing political and legal interest in surgical competency in particular, as a growing body of evidence has reported surgeon training to be predictive of operative morbidity and mortality (Prystowsky et al. 2002; McKay et al. 2008).

Assessment has two main purposes: to provide a trainee with feedback to aid the learning process (formative); and to measure the level of achievement of knowledge, skills and professional behaviours necessary for certification in training (summative). Miller went on to suggest a framework for assessment,

which has since guided the design of contemporary medical curricula and development of assessment tools. Miller's triangle states a hierarchy of assessment methods comprising of four levels. The bottom two levels, 'Knows' and 'Knows how', represent the cognitive domains and application of knowledge, and are mostly examined through written examinations. The top two levels, 'Shows how' and 'Does' describe behavioral domains with performance (does) relating to what a surgeon does in his/her normal professional practice, and competence (shows how) relating to assessment in a controlled representation of professional independent practice (Norcini 2003; Beard et al. 2011).

**Figure 1.3 Miller's pyramid of assessment of clinical competence**



(Beard et al. 2011)

### **1.4.3 Intercollegiate Surgical Curriculum Project (ISCP)**

In 2007, collaboration between the Government's Department of Health and an alliance of the 4 UK surgical colleges produced a unified surgical curriculum in the form of the internet-based Intercollegiate Surgical Curriculum Project (ISCP). The aim was to provide a framework for surgical training from

foundation years through to consultant level. Curriculums for the nine surgical specialties were developed providing specialty-specific standards of generic professional skills, specialty-based knowledge, clinical judgment and operative and technical skills, integrating both formative and summative assessments, the key concepts illustrated in the figure below (Canter and Kelly 2005; Canter and Kelly 2007; Kelly and Canter 2007).

Four key concepts were identified:

- (1) Focused training programmes underpinned by clear standards with defined levels of progression;
- (2) Support to consultants to promote high-quality teaching and learning and reliable assessment;
- (3) Rigorous and fully integrated regulatory systems, informed by curriculum standards;
- (4) Adequate staff, resources, and reward systems to support trainees in attaining competence to Certificate of Completion of Training (CCT) level (Intercollegiate Surgical Curriculum Programme ; Phillips and Madhavan 2013).

Each trainee has an Assigned Educational Supervisor (AES) and Clinical Supervisor (CS), responsible for overseeing educational progress through each training post. At the Deanery level, a Training Programme Director (TPD), who as part of their responsibilities specifies compulsory generic Global Objectives from the curriculum and oversees the supervision provided by the AES. Guided by these Global Objectives, it is the responsibility of the AES and trainee to develop a tailored educational agreement detailing specific curricular topics and competencies to be achieved from the placement. This includes the resources needed for learning, workplace based assessments, clinical skills, courses,

exams and scholarly activity to be undertaken. Documentation of this through initial, interim and end-of-placement appraisal is performed electronically with all evidence of curricular activity uploaded for summative assessment purposes at annual review (ARCP). The AES can then make an overall assessment of the trainee's progress and achievement of set competencies with regards to topics set at the initial meeting.

The ARCP is a formal process that is undertaken annually, and reviews the evidence of trainee curricular achievement submitted via the ISCP portfolio. Assessing performance requires triangulation of all available assessment modalities to facilitate an overall judgment (Schuwirth et al. 2002; Beard et al. 2011). It is this approach that is used in the ARCP, and has also been adopted by the GMC when assessing poorly performing doctors (Southgate et al. 2001). A recommendation is made as to whether a trainee may progress onto the next stage of training by a panel consisting of senior trainers, deanery officers, a consultant representative from outside of the deanery (SAC Liaison member), and a lay person. Consideration is then given to the future training needs of the trainee in addition to an optional appraisal regarding long-term career planning. The ARCP outcomes are defined in Figure 1.4.

## Figure 1.4 ARCP outcomes

### Satisfactory Progress

- 1 Achieving progress and competences at the expected rate

### Unsatisfactory or insufficient evidence (trainee must meet with panel)

- 2 Development of specific competences required – additional training not required
- 3 Inadequate progress by the trainee – additional training time required
- 4 Released from training programme with or without specified competences
- 5 Incomplete evidence presented – additional training time may be required

### Recommendation for completion of training

- 6 Gained all required competences

### Outcomes for trainees out of programme or not in run-through training

- 7 Fixed-term specialty outcome – competences achieved identified above
- 8 Out of programme experience - clinical experience, research or career break
- 9 Top-up training (outcome should be indicated in one of the areas above)

Summative assessment of career progression through ARCP has been shown to be effective. The only recent study reporting trainee satisfaction was amongst UK paediatric specialty trainees, which revealed that three-quarters of those questioned, viewed the ARCP process positively (Goodyear et al. 2013).

#### 1.4.4 Workplace based assessments (WBA)

Fundamental to the successful implementation of competency-based training has been the development of formalised assessment tools, which have also addressed key issues of training and competence in the interest of public,

political and professional accountability. Essential surgical qualities including history taking, clinical examination, leadership and specialty related expert knowledge have traditionally been assessed at board examinations and interviews. However, in the arena of arguably the most important attributes of manual dexterity and technical skill, objective assessment has lagged behind. Workplace based assessments were introduced to bridge this apparent gap and to improve the efficiency of learning by informing more focused educational activity (Beard et al. 2011). Direct trainer feedback of observed clinical interactions and technical skills has been shown to be beneficial to learning (Hattie and Timperley 2007; Beard 2008).

Essential to the introduction of new assessment tools however is the need to ensure that it is reliable, valid, feasible, and has educational impact. There has been some resistance to the uptake of such tools, with a number of educationalists and clinicians stating that the justification for their implementation has been based on weak evidence (Pereira and Dean 2013). Early in their introduction into UK surgical training, WBAs were singled out amongst trainees as being a source of dissatisfaction with one of the earliest surveys reporting up to half of the 539 respondents describing WBAs as 'poor' (Pereira and Dean 2009). A concerted nationwide effort ensued, to educate trainees about the intentional formative use and value of WBAs, which resulted in a significant improvement in satisfaction rates (Marriott et al. 2011; Pereira and Dean 2013; Hawkins et al. 2014; Hunter et al. 2015; Phillips et al. 2015).

A description of the assessment tools in practice and their evidence base is given below:

### Case Based Discussions (CBD)

The Case Based Discussion was first designed to assess clinical judgment, professionalism knowledge and decision making in relation to a case in which a trainee has been directly involved. The basic premise involves an in depth two-way discussion with a clinical supervisor exploring the trainee's reasoning around the management of a patient. The CBD encourages trainees to reflect on learning and identify any potential development needs (Phillips et al. 2015). A recent study by Phillips et al. demonstrated that surgical trainees valued CBDs, their use encouraging higher thinking and reflection however concerns existed about their potential use as a tick box exercise (Phillips et al. 2015). There is little research on the validity of CBD in the surgical workplace setting, however research in medicine has shown its positive educational impact (Johnson et al. 2011). Within Otolaryngology trainees, CBD was shown to be reliable with good construct validity (Awad et al. 2015a).

### Mini Clinical Evaluation Exercise (Mini-CEX)

The Mini-CEX mainly assesses clinical and professional skills in a work setting, with the trainer observing a trainee's interaction with a patient. The area of emphasis may include history, examination, diagnosis, investigation or management, with communication being assessed throughout.

A meta-analysis of studies looking at the use of the Mini-CEX within postgraduate medical training revealed evidence to support good construct validity and hence its use within medical training (Al Ansari et al. 2013). Within surgery, the Mini-CEX has been found to be of more use in earlier years of training with poor discriminatory value amongst trainees in their later years of training, a recent study reporting trainees achieving relatively high levels in their

assessments early in their training (Awad et al. 2015a).

#### Direct Observation of Procedural Skills (DOPS)

The DOPS is the direct observation of a basic diagnostic or interventional skill performed by a trainee, and is used to assess technical, operative and professional skills. This tends to be reserved for use for trainees in their early core years, with Procedural Based Assessments (PBA) used for Higher Surgical Trainees in more complex procedures and operations.

DOPs, although shown to accurately differentiate between junior and senior trainees, does not clearly demonstrate progress above ST3 level, due to the simplicity of the procedures (Awad et al. 2014). It is for this reason that they are restricted for use in foundation and core surgical training. A systematic review of the use of DOPs in medical education revealed generally good reliability and acceptability, however research on validity and educational impact was lacking (Naeem 2013).

#### Procedure Based Assessment (PBA)

As with the DOPS tool, Procedural Based Assessments examine a trainee's technical, operative and professional skills in a range of routine surgical procedures. Derived from the Orthopaedic Competence Assessment Project (OCAP), it was developed to assess orthopaedic surgeons; the PBA is procedure specific and involves direct observation of an index operation. Assessment is broken down into two components (i) overall ability to perform the procedure, and (ii) a series of competencies specific and necessary to undertake the operation (Pitts et al. 2005). The highest rating is commensurate with the ability to be able to undertake the operation at a level equivalent to that



of a consultant surgeon. This form of assessment is often used instead of the DOPS for Higher Surgical Trainees.

A number of studies have shown PBA to be a well-validated tool (Beard et al. 2005; Pitts and Rowley 2009; Beard et al. 2011; Marriott et al. 2011; Awad et al. 2015b). A large study performed in 6 surgical specialties within Sheffield teaching hospitals demonstrated clear construct and content validity, as well as excellent reliability and positive overall satisfaction amongst users (Beard et al. 2011; Marriott et al. 2011). Importantly this study demonstrated that achieving PBA reliability did not require rigorous clinical supervisor training due to the intuitive binary scoring system and descriptive anchor statements provided for overall assessment of competence. Another more recent large UK study of over 3000 ENT PBAs similarly demonstrated excellent reliability and validity (Awad et al. 2015b).

#### Mini Peer Assessment Tool (Mini-Pat)

This is a 360-degree multisource feedback that largely covers a trainee's professionalism within the multidisciplinary team. The Mini-PAT requires a trainee to nominate a minimum of 8 raters from allied professionals within the MDT. Assessment forms are mapped against the GMC's standards of Good Medical Practice, with feedback anonymised. This is normally undertaken annually and has been found to be a feasible, reliable and valid tool in assessing non-technical competencies in surgery. A meta-analysis revealed that professionalism, communication and interpersonal skills could be reliably assessed using this tool (Al Khalifa et al. 2013).

## **1.5 CURRENT STRUCTURE OF UK SURGICAL TRAINING**

### **1.5.1 The Deanery, CST and HST**

Within the UK, appointment to a surgical training programme is currently undertaken at a national level. If successful, a trainee is appointed to a Deanery, covering a range of hospitals within a geographical region. Hospital training posts range from small rural district general hospitals providing more generic services, to larger university teaching hospitals in which tertiary subspecialty services are offered. The Deanery, often referred to as the Local Education Training Board (LETB), has the responsibility of ensuring the quality of training delivered by these local training providers (hospitals) is satisfactory. Rotation through different units provides trainees with a range of operative experiences, academic opportunities and subspecialty training necessary for individual educational development.

Core Surgical Training is the commencement of surgical training after foundation years, and provides a common stem for all surgical specialties excluding trainees entering Cardiothoracic surgery and Neurosurgery for whom run-through training is provided from year 1 through to consultancy. During a 2-year CST programme (CT1 and CT2) a trainee can expect to rotate through anywhere between 4 and 6 posts in a number of surgical specialties which can include Cardiothoracic surgery and Neurosurgery. This affords the trainee opportunity to develop the basic and fundamental surgical skills common to most specialties, together with some specialty-specific skills.

The primary outcome of Core Surgical Training is to achieve all the necessary competencies, obtain the postgraduate membership exam (MRCS) and successfully be appointed to a Higher Surgical Training post / National Training Number (NTN) in the surgical specialty of choice through competitive selection.

Higher Surgical Training ranges between 5 to 6 years (from ST3 to ST7/8) with the aim of training a surgeon who will be able to work independently at a standard commensurate with Consultant status. Through structured supervised training and graduated clinical responsibility a trainee will first develop the generic skills needed of a generalist; and in the later years of training, develop a subspecialist interest in which they will be examined via the Fellowship of the Royal College of Surgeons (FRCS) exit examination. The Joint Committee on Surgical Training (JCST), which represents the four UK Royal Colleges of Surgery, monitors all postgraduate surgical training, and is divided into Specialty Advisory Committees (SAC) for each surgical specialty.

### **1.5.2 Career progression**

Halsted demonstrated in his first residency programme, a competitive pyramidal structure in which only the most accomplished, dedicated and hardworking trainees progressed, and was successful in producing accomplished surgeons. The competitiveness that was instilled into trainees remains to this day, with progression demanding resilience and determination from an early stage in a surgeon's career. A recently published nationwide survey of UK surgical trainees over a 30-year period reported that 90% of those that had progressed in surgery had made their career choice by their first year of postgraduate training. An early commitment to a career in surgery was deemed an important indicator of success (Goldacre et al. 2010). This may be even more apparent today, with recent restructuring resulting in a further reduction in years spent in training.

Robust systems for appointment to training posts are imperative to allow early identification of trainees with the prerequisite skills and attributes of an independently practicing consultant surgeon. However, Professor Bulstrode, formerly Professor of surgery at Oxford, stated “to have a truly unbiased understanding of these attributes requires a true appreciation of the future role of a surgeon, which remains unknown” (Bulstrode 2005). Generic qualities of a practicing surgeon today include: an expert clinical knowledge and skills; an aptitude for mastering practical skills; excellent communication, organisational, team working and leadership skills; the ability to confidently cope with pressure and uncertainty whilst possessing excellent judgment and decision making skills; and a strong commitment to their career (Patterson et al. 2008; Grantcharov and Reznick 2009; Lamont et al. 2011). It is these skills that are currently used to identify those best suited to a training programme in surgery.

### **1.5.3 Appointment to HST**

Until only recently, appointment to HST was neither objective nor structured, with selection criteria based on a number of potentially unreliable measures used as surrogate markers of future performance. Since Calman training was introduced, the critical juncture in career progression has been the transition from Senior House Officer (Core Surgical Training) to Registrar (Higher Surgical Training).

Prior to MMC, to be eligible for a registrar post, a trainee was expected to have completed a minimum of 2 years in approved SHO training posts, often much longer. Within these posts a logbook served as evidence of operative experience, with no discriminatory thresholds or evidence of assessment of competence set (Bulstrode and Hunt 2003). Completion of the Membership of

the Royal College of Surgeons (MRCS) examination ensured a baseline factual knowledge in basic sciences and its clinical application (Bulstrode and Hunt 2003). The next hurdle, and possibly the most challenging was shortlisting by means of the Curriculum Vitae (CV), in which trainees with the strongest CVs related to evidence of scholarly productivity, leadership and management roles, were more likely to be successful. Once shortlisted, a relatively unstructured interview was undertaken, with those successful, appointed to a National Training Number HST post.

This system of recruitment came under a lot of criticism in a nationwide inquiry into postgraduate training undertaken by Professor John Tooke in 2007 (Tooke 2008). It was deemed to be a subjective and ineffective method of selection with potential for bias and nepotism. At interview, attributes most consistently selected were based on an interviewer's perception of likeness to themselves, often experienced surgeons (Bulstrode et al. 1998). It has also been shown to be of low validity and to be a poor predictor of subsequent career performance (Holdsworth et al. 1988; Papp et al. 1997). Recommendations from the Tooke report resulted in the introduction of interview assessment centres. The structure, resembling that of an examination, using stations to assess attributes and skills deemed relevant for the job. The use of assessment centres has already been shown to be valid and reliable in the recruitment of General Practitioners (Patterson et al. 2000; Patterson et al. 2005). A ranking system based on a trainee's global performance at interview ensured that the best trainees were successfully appointed, with a study by the Specialty Advisory Committee in General Surgery demonstrating scores amongst interviewers to be highly reliable (Lamont et al. 2011). This selection process became

nationally coordinated for general surgery HST interviews in 2011 in an attempt to improve robustness.

Trainee involvement in research has remained an important discriminator in surgical career progression. Through research, several skills are acquired including the ability to collect, analyse and interpret data in a systematic way, providing translational skills that develop a trainee's critical and analytical skills. It is important not only that a surgeon can understand future advances within the specialty, but also has the ability to contribute to future developments in surgical science (Kmiot et al. 1993; Dawson et al. 1996). Patients require surgeons that can operate, as well as make sophisticated decisions based on the best up-to-date evidence. In the shortlisting of trainees for registrar and consultant jobs, evidence of academic activity can be assessed and quantified through the academic activities of, communications to learned societies, publication in peer reviewed journals, and the attainment of postgraduate degrees examined by thesis (MD or PhD).

#### **1.5.4 Completion of training**

In 2013, the JCST comprising of the Specialty Advisory Committees (SAC) for the major surgical specialties in the UK, came together to formulate a set of certification guidelines identifying achievements and competencies expected of a trainee about to embark on independent consultant practice. The guidelines published specific criteria related to operative experience, demonstration of clinical and operative competence, scholarly achievements, evidence of quality improvement and management roles, and leadership engagement and set out in a ST8 Check List. These CCT guidelines have set a precedent for postgraduate surgical training with board certification guidelines in the US, and

Australia, only stating global operative numbers and examinations as a prerequisite for completion of training. It is known that some trainees require limited exposure to new challenges before being able to retain the skills to perform the duty competently, whilst others require more time. Through the use of recently developed and validated workplace based assessment tools, trainees in the UK must now demonstrate competence in both the operative and non-operative management of diseases relevant to their specialty. By stipulating minimum requirements, quality assurances can be made that a minimum level of competence is being met, however further research is required to ensure that the operative targets set are achievable and reflect a level in which competence is attained.

## **1.6 AIMS AND HYPOTHESES**

The definitive outcomes of current surgical education programmes remain relatively unknown. Up until now the paucity of research linking current surgical practice with training has predominantly been a result of difficulties obtaining high volume, good quality data. Through the ISCP, both longitudinal and cross-sectional evaluation of surgical training is now feasible through access to a wealth of validated data. The ability to quantify educational outcomes as a result of nationwide reconfigurations will help inform the structure of future training programmes and allow the development of evidence-based guidelines reflecting the achievement of clinical and academic competencies.

## **Aims**

1. To establish the definitive outcomes of Core Surgical Training (CST) reconfiguration (2013) on CST outcome in terms of ST3 progression in Wales;
2. To determine if there are any specific factors in terms of Work Based Assessments (WBA), operative log book numbers, and academic achievements which directly predict successful ST3 national training number (NTN) appointment for all surgical specialties (excluding ophthalmology) and to evaluate whether subspecialty differences exist;
3. To determine whether the outcomes of CST rotations utilising rural district general hospitals differ from those achieved from enhanced local district and teaching hospitals in Wales;
4. To perform a 2013 SAC curriculum concordance analysis of all 2013 UK CCT (Certification of Completion of Training) applicants and also assess how Wales PGMDE higher surgical trainees compare;
5. To examine the relationship between experience in key general surgical procedures and the level of competence achieved within the Wales Higher Surgical Training (HST) programme;
6. To evaluate the impact of a novel one-month emergency general surgery (EGS) module for higher surgical trainees over a one-year period;
7. To assess the research productivity of General Surgery consultants from different hospitals in the Wales Deanery and to assess the value, variability and validity of the Hirsh index (h-index) as a marker of research training potential for trainees.



## Hypotheses

1. CST reconfiguration in Wales will improve ST3 NTN success significantly;
2. Trainee specific, academic-related factors (number of communications to learned societies and peer reviewed publications) and educational outcomes exist that predict National UK ST3 National Training Number (NTN) selection appointment success;
3. CST rotations encompassing 6-month attachments in rural district general hospitals are as effective as those training programmes which only involve enhanced district and teaching hospitals in terms of success at ST3 national selection;
4. The UK SAC/JCST 2013 curriculum standards are only achievable by a focused ARCP and reconfiguration of HST;
5. Variability exists in individual higher surgical trainee's operative competences as determined by procedural-based assessments and learning curves related to index operations in General Surgery;
6. A dedicated month of Emergency General Surgery exposure will enhance trainee's experience and educational outcomes;
7. The research productivity of academic and teaching hospital consultant surgeons are higher than that of district general hospital surgeons, with the Hirsch Index providing a valid measure of a consultant's research impact to facilitate the identification of trainee research opportunities.

## **Chapter 2**

### **Materials and Methods**

A narrative review of the literature was undertaken as part of the introduction with relevant articles identified using the Thompson Reuters Web of Science database, Pubmed and Google Scholar. Search terms “surgery” and also (“learning” or “skills” or “competence” or “assessment” or “training” or “workplace-based assessments”) or (“procedure-based assessments” or “performance” or “technical skills” or “curriculum” or “education” or “mentoring”) were used. Reference lists of articles were also used to identify articles of relevance.

Ethical approval for this research project was granted by the University of Cardiff.

## **2.1 SUBJECTS**

### **2.1.1 Core Surgical Trainees**

All Core Surgical Trainees were appointed to national approved training rotations within Wales. Training posts were 2-year run-through rotations (CT1 through to CT2 or CT2+ / CT3) commencing between 2009 and 2013 (finishing in 2015). Recruitment to Core Training became nationally coordinated in 2012. Only trainees in approved core training posts could progress to National Training Number (NTN) Higher Surgical Training jobs, an important outcome measure of CST. To minimise bias in measured educational outcomes, doctors appointed to non-training posts were excluded.

### **2.1.2 Higher Surgical Trainees**

All Higher Surgical Trainees were in possession of an NTN in General Surgery. All non-training registrars were excluded for the same reasons as those

excluded at Core. Wales trainees were identified through the Postgraduate School of Surgery records.

In Chapter 5 a study of all successful CCT applicants in the UK between November 2012 and December 2013 was undertaken, with trainees identified through administrative records of the UK's Joint Committee on Surgical Training.

### **2.1.3 Consultant Surgeons**

For the purpose of assessing scholarly activity amongst trainers, all Consultant General Surgeons involved in training within the Wales Deanery were identified through trainee ISCP portfolios, hospital department websites and the Wales Postgraduate Deanery records. Surgeons that had retired before 2013 were excluded from analyses. Consultants were classified into: Academic (professor, reader, and senior lecturer, including honorary titles), University Hospital (all non-academic National Health Service general surgeons working at either Cardiff or Swansea University Hospitals), or District General Hospital (all non-academic National Health Service DGH GS) groups.

## **2.2 DATA EXTRACTION**

### **2.2.1 ISCP**

Since 2007, the Intercollegiate Surgical Curriculum Project online portfolio system (v9) has been the platform for assessing trainee progress. Trainee engagement with the system was compulsory over the study period, with an expectation that all achievements and mandatory Workplace Based Assessments (WBAs) were uploaded via the website. Any achievements that

had not been uploaded were not considered as evidence towards curricular progression at ARCP. CVs were updated and uploaded onto the website annually.

Data extraction from ISCP was undertaken with reference to the below:

- Training post demographics
  - Placement Hospital
  - Placement dates and length
  - Specialty and subspecialty
  - Consultant Team/ Educational Supervisor
- Training outcomes
  - Workplace Based Assessment numbers and levels achieved
  - Evidence of Scholarly Activity
    - Presentations to national and international meetings (oral or poster)
    - Peer reviewed publications (excluding case reports and letters)
  - Audits
  - Postgraduate Examinations
  - Postgraduate Degrees
  - Operative logbook
  - Course and conference attendance
  - Career intentions and progression

All data were anonymised and extracted at least 2 months after the end of the clinical rotations to allow time for all curricular evidence to be uploaded and validated. Individual trainee data was accessed through the Head of School and

Programme Director pages on the ISCP. Portfolios of current trainees, and trainees that had left within the past year were available through the 'My Trainees/School Of Surgery' option. Trainees that had left the rotation before this time were accessed through the past ARCP function. Individual trainee reports for each 4 – 6 month post were created using the 'Generate Report' function ensuring accurate recording of all educational activity undertaken during the specified timeframe. For Core Trainees this process also included logbook data automatically uploaded from the eLogbook website as a consolidated report.

Only consultant validated workplace based assessments were included to ensure that the training being assessed was consultant-led. Comparative analysis of scholarly activity in individual training posts was undertaken by linking trainee research projects with the clinical placement in which the work was conceived. This was achieved by examining the authorship of the work, the subject content and the trainee's documentation in the evidence section of the ISCP portfolio. Because of delays between the completion of work and its presentation, which often extends past the duration of a clinical placement, it was important to ensure representation of a unit's scholarly output was accurate.

CVs that were uploaded onto ISCP were used for triangulation of the data extracted through the ISCP.

Career progression of trainees after CST was obtained through ISCP documentation, ARCP outcomes, and the Wales Postgraduate Deanery records.

## 2.2.2 eLogbook

The eLogbook is a pan-surgical operative database used by all UK trainees to log operative experience. Data entered is confidential with each user's logbook being password-protected. The trainee is responsible for accurately entering the operation, date, time and urgency of the operation. For training purposes the trainee is also responsible for providing information on the level of supervision and thus opportunities provided by specific training post.

The definitions of trainee involvement are as below.

### Assisting (A):

- The trainer completes the procedure from start to finish
- The trainee performs the approach and closure of the wound
- The trainer performs the key components of the procedure

### Supervised - trainer scrubbed (S-TS):

- The trainee performs key components of the procedure (as defined in the relevant PBA) with the trainer scrubbed

### Supervised - trainer unscrubbed (S-TU):

- The trainee completes the procedure from start to finish
- The trainer is unscrubbed and is:
  - in the operating theatre throughout
  - in the operating theatre suite and regularly enters the operating theatre during the procedure (70% of the duration of the procedure)

### Performed (P):

- The trainee completes the procedure from start to finish
- The trainer is present for <70% of the duration of the procedure
- The trainer is not in the operating theatre and is:
  - scrubbed in the adjacent operating theatre
  - not in the operating suite but is in the hospital

### Training more junior trainee (T):

Trainee logbooks were examined via the Head of School / Director's access on

the eLogbooks website. Individual reports were created using the dates corresponding to the training posts.

All operations were included in overall trainee operative numbers. Trainees were deemed to have performed the procedure if any classification other than assisting was used (S-TS, S-TU, P, T), relevant when examining operative competence and experience.

### **2.2.3 Operations examined**

All operations undertaken in Core Surgical Training were analysed as global operative experience. Further analysis of a number of core procedures per specialty was performed to compare focused operative experience between subspecialties within different hospitals (see Chapter 4).

Regarding Higher Surgical Training as well as overall operative exposure, specialty specific operations were examined further. The general surgery JCST indicative operations, in which prescribed operative numbers and competence levels have been set, were: Emergency Laparotomy (EL), Hartmann's Procedure (HMN), Appendicectomy (APX), Cholecystectomy (LC), Inguinal Hernia (IH), and Segmental Colectomy (SC). Further General Surgery subspecialty indicative procedures were analysed according to trainee subspecialisation.



Emergency laparotomy was defined as:

All patients undergoing immediate / urgent abdominal surgery via

- An abdominal incision or
- A laparoscopic approach or
- A combined approach

to treat:

- The first presentation of abdominal pathology or trauma
- A post-operative complication

Exclusions include: appendectomy; cholecystectomy; diagnostic laparoscopy; relook laparotomy; implantation of organ transplants.

The operations classified as 'Emergency Laparotomy' are listed in Appendix 1.

Specific methodology and statistical analyses relevant to each individual study are described in further detail in subsequent chapters.

## **Chapter 3**

### **Core surgical training outcome in Wales: reconfiguration, reflection, and the rise of educational contracts**

### **3.1 SUMMARY:**

The aim of this study was to determine factors associated with success at UK National Higher Surgical Training (HST) selection and to assess the impact of a reconfigured, enhanced, focused, and themed 2-year training program.

Consecutive 142 trainees appointed to CST between 2010 and 2013 (112 before and 30 after reconfiguration) were included. Intercollegiate Surgical Curriculum Programme (ISCP) online portfolios were examined and individual CVs used for triangulation, with the primary outcome measure success at National HST selection.

Overall MRCS examination pass rate was 66%, and 34 Core Surgical Trainees (CSTs) left surgical training (24%). The proportion of CSTs successful at National HST selection (global National Training Number success 24/142, 16.9%) improved from 3 of 58 (5.3%, 2010 entry) to 10 of 30 (33.3%, 2013 entry,  $p=0.005$ ). HST progression was associated with higher logbook operative numbers (median 479 vs. 338,  $p<0.001$ ), validated work based assessments (107 vs. 79,  $p<0.001$ ), communications to learned societies (4.5 vs. 1,  $p<0.001$ ), scientific publications (1 vs. 0,  $p<0.001$ ), and CST reconfiguration ( $p=0.007$ ). Binary logistic regression revealed 2 factors to be associated with HST progression; scientific publication number [Odds Ratio 1.687 (95% CI 1.274 - 2.232),  $p<0.001$ ], and full CST programme reconfiguration [OR 4.789 (1.666 – 13.763),  $p=0.004$ ].

CST reconfiguration was associated with a six-fold higher success rate at National HST selection, and focus on ARCP driven ISCP competencies allied to themed training was pivotal to this improvement.

### 3.2 INTRODUCTION

Core surgical training (CST) and its optimal modern form are under scrutiny and review. Despite national recruitment and standardised assessments, no inter Deanery consensus exists regarding the best CST programme structure (Glancz 2013). Appointment to Higher Surgical Training (HST) by a National Selection panel, after completion of a 2-year CST program has traditionally been associated with competition ratios amongst the highest of any medical specialty, and other than by the Certificate of Eligibility for Specialty Registration (CESR) route, remains the only pathway for trainees to obtain a Certificate of Completion of Training (CCT).

The UK Joint Committee on Surgical Training (JCST) has now published curriculum guidance which demands that CST constituent posts must provide, on average, three operative sessions, two outpatient clinics, and one didactic teaching session per week, as part of a focused job plan (JCST 2015).

However, despite this positive development and national agreed competencies and attributes, no universal CST format has emerged, and unlike higher surgical training, target levels of competence and experience based on educational outcomes of previous cohorts have not been set. Inconsistencies in hospital post durations, formal teaching, and face-to-face or not appraisal and Annual Review of Competence Progression (ARCP) processes, have given rise to variable trainee outcomes and General Medical Council (GMC) satisfaction ratings throughout the UK (GMC 2014). Increasingly, specialty-themed CST programs in which at least 1 year of the rotation is spent in the trainee's specialty of choice, have proven popular, rather than more generic rotations, because of the perception that focused clinical training may enhance Core

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Surgical Trainee's probability of success at UK National Specialist HST Selection (Glancz 2013).

Reconfiguration of postgraduate surgical education and the adoption of a competency-based system, in which curricular achievements are evidenced, is now an integral part of the assessment of trainee progression. And the use of quantifiable markers such as operative logbook numbers and Workplace Based Assessments (WBA) have been facilitated by the Intercollegiate Surgical Curriculum Programme (ISCP) online portfolio system providing access to both individual trainee and composite Unit data previously not recorded. Arguably therefore, Local Education Providers or Deanery's are now in a position to request Educational Contracts between Health Boards or Trusts, Deaneries, and individual trainees. The aim of this study was to establish whether there are measurable factors that predict success at National Selection to Higher Surgical Training directly from Core Surgical Training, and to determine the impact of a 2013 major reconfiguration that introduced enhanced, focused, and themed 2-year training posts with bi-annual face-to-face ARCP in a single UK Deanery. The primary outcome measure was success at national selection into a substantive Higher Surgical Training post.

### **3.3 MATERIALS AND METHODS**

One hundred and forty-two Core Trainees (105 male and 37 female) were appointed to CST within the Wales Deanery between August 2010 and August 2013, in 4 cohorts. Full reconfiguration of the training program was undertaken in August 2013. Table 3.1 illustrates the salient features and differences before and after reconfiguration. The 2013 entry cohort, were the first to complete the

new program in July 2015. Comparative analysis of pre- and post-reconfiguration cohorts in terms of training outcomes was undertaken.

**Table 3.1 Salient features of CST programme pre and post reconfiguration**

	Pre Reconfiguration (n=112)	Post Reconfiguration (n=30)
<b>ARCP</b>	Annual (electronic)	Bi-annual (face to face)
<b>Operative logbook targets</b>	200 CT1 per annum 250 CT2 per annum	200 CT1 per annum 250 CT2 per annum
<b>WBA target</b>	18 – 36 per annum	36 CT1 45 CT2
<b>Post structure</b>	2 x 6/12 posts CT1 2 x 6/12 posts CT2	3 x 4/12 posts CT1 2 x 6/12 posts CT2
<b>Themed rotation</b>	No	Yes 8 GS 9 T&O 3 OMFS 4 ENT 3 PLASTICS 2 UROLOGY
<b>Deanery teaching</b>	N/A	Monthly (70% attendance)

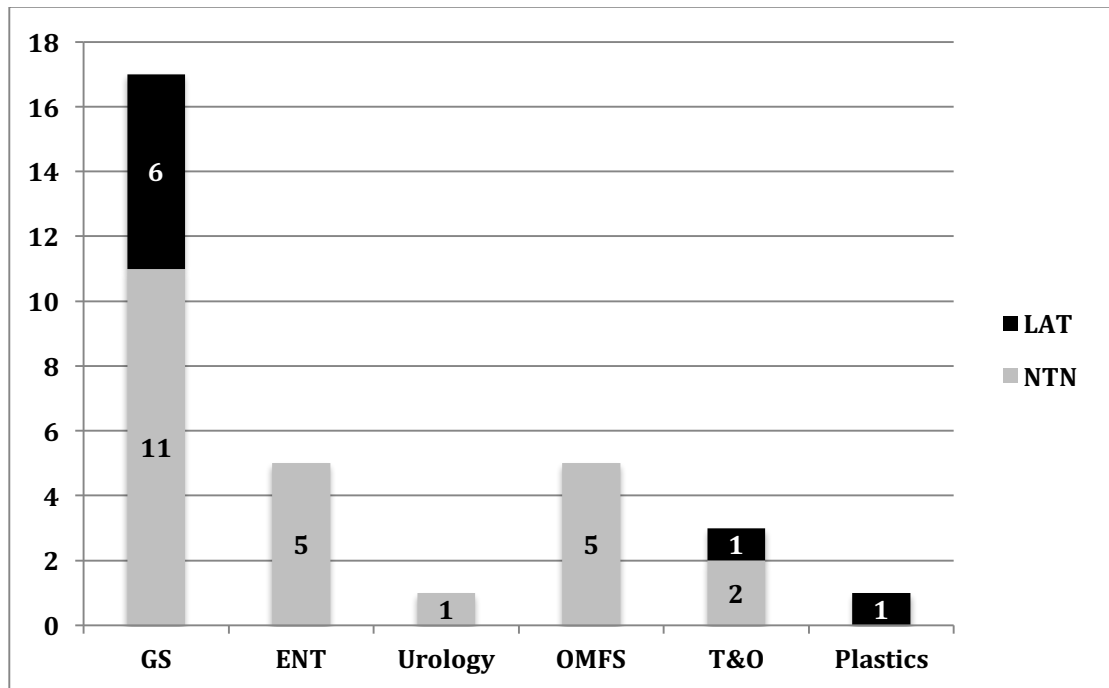
ARCP – Annual Review of Competence Progression; CT..- Core Trainee Yr ...; ENT – Ear Nose and Throat; GS – General Surgery; OMFS – Oral Maxillofacial Surgery; T&O – Trauma and Orthopaedics

The online portfolios (via the ISCP) and Curriculum Vitae of these Core Trainees were assessed for the following two years for training outcomes (see above) within each placement. The career progression of trainees performing a third CST year was also followed. The ISCP and ARCP defined competencies and outcomes of those trainees successful at HST National Training Number selection were compared with the trainees who were unsuccessful at national selection. Data extracted was then entered into a bespoke SPSS 20 (IBM, Chicago, Illinois). database. Statistical analysis was performed with non-parametric data expressed as median (range). Proportions were compared with Chi-squared or Fisher’s exact tests ( $p < 0.050$  was considered significant) and Mann-Whitney U test used to compare medians. Binary logistic regression was used to determine the effect of each co-variable on overall outcomes. Primary outcome measure was success at HST national selection.

### 3.4 RESULTS

The overall MRCS pass rate was 66% (94 trainees). Thirty-four trainees left surgical training (24%, 29 during and 5 after CST). A total of 32 trainees were successful at HST selection (24 NTN and 8 LATs). Figure 3.1 illustrates a breakdown of the specialties to which trainees were appointed.

**Figure 3.1 Details of HST specialty appointment**



GS – General Surgery, ENT – Ear Nose and Throat, OMFS – Oral Maxillofacial Surgery, T&O – Orthopaedic Surgery, HST – Higher Surgical Training

Table 3.2 shows a univariable analysis of the factors associated with successful HST selection.

**Table 3.2 Univariable analysis of factors associated with successful HST selection**

	NTN success			
	No (n=118)	Yes (n=24)	p value	
<b>Ethnicity / no. (%) *</b>	British white	78 (80.4)	19 (19.6)	0.38
	Other	33 (86.8)	5 (13.2)	
<b>Gender / no. (%)</b>	Male	88 (83.8)	17 (16.2)	0.703
	Female	30 (81.1)	7 (18.9)	
<b>Operative Cases</b>	338 (0-1020)	479 (108-920)	<0.001	
<b>WBAs</b>	79 (0-228)	107 (44-176)	0.002	
<b>Presentations</b>	1 (0-26)	4.5 (1-31)	<0.001	
<b>Audits</b>	3 (0-14)	4 (0-7)	0.328	
<b>Publications</b>	0 (0-8)	1 (0-11)	<0.001	
<b>Cohort Year / no.</b>	2010	55	3	0.007
	2011	20	6	
	2012	23	5	
	2013	20	10	
<b>Post Reconfig / no.</b>	20	10	0.007	
<b>National Selection 2011</b>	Pre	55	3	0.002
	Post	63	21	

\* ethnicity not stated in 7 trainees; Values medians unless stated; Ranges in parentheses unless stated; NTN – National Training Number, HST – Higher Surgical Training, WBA – Workplace based assessment, Reconfig – 2013 Reconfiguration.

There was no sex-dependent difference in the HST NTN appointment rate of trainees (16% male vs 19% female;  $\text{Chi}^2=0.145$ ,  $\text{df}=1$ ,  $p=0.703$ ). Despite a 7% difference in NTN appointment according to ethnicity, this did not reach statistical significance (20% White British vs 13% Other;  $\text{X}^2=0.772$ ,  $\text{df}=1$ ,



p=0.380).

The HST National Training Number (NTN) appointment rate improved significantly after full reconfiguration of the CST program from 12.5% to 33.3% (p=0.007). There was a commensurate improvement in CST educational outcomes as shown in Table 3.3.

**Table 3.3 CST educational outcomes related to reconfiguration**

	<b>Pre Reconfiguration (n=112)</b>	<b>Post Reconfiguration (n=30)</b>	<b>p value</b>
<b>Operative Cases</b>	335 (64-1020)	472 (0-699)	0.002
<b>WBAs</b>	79 (11-189)	110 (0-228)	0.004
<b>Presentations</b>	2 (0-31)	2.5 (0-21)	0.358
<b>Audits</b>	3 (0-14)	3 (0-9)	0.996
<b>Publications</b>	0 (0-11)	0 (0-4)	0.928
<b>HST NTN / no. (%)</b>	14 (12.5)	10 (33.3)	0.007

Values medians unless stated; Ranges in parentheses unless stated; NTN – National Training Number, HST – Higher Surgical Training, WBA – Workplace Based Assessment.

The attrition rate reduced from 27% to 13% after CST reconfiguration (Chi<sup>2</sup>=2.351, df 1, p=0.125). After completion of two years of CST, 4 trainees took up full-time research posts, and 10 were appointed to non-training clinical surgical posts. Sixty-two trainees undertook an extra CST year, with 9 yet to complete. The career progression of the 53 trainees who had completed their third CST year (trainee cohorts 2010 to 2012) revealed that 10 trainees (18.9%) were successful at ST3 NTN selection, and 8 (15%) obtained Locum Appointments for Training (LAT).

Of the 10 trainees that were successful at HST selection after CST reconfiguration, appointment rates related to the themed rotations were as follows: OMFS 2 (67%), GS 5 (63%), ENT 1 (25%), T&O 2 (22%).

### *Multivariable analysis*

On binary logistic regression analysis, 2 factors were found to be independently associated with HST progression: number of scientific publications [Odds Ratio 1.687 (95% CI 1.274 - 2.232),  $p < 0.001$ ], and completion of the fully reconfigured CST program [OR 4.789 (1.666 - 13.763),  $p = 0.004$ ] (Table 3.4).

**Table 3.4 Factors independently associated with HST NTN appointment on two Multivariate Analyses**

a. Model including 2013 reconfiguration as a variable

	Odds Ratio	95% Confidence Intervals	p value
<b>Publications</b>	1.675	1.266 – 2.215	0.001
<b>Reconfiguration</b>	4.649	1.616 – 13.378	0.004

b. Model excluding 2013 reconfiguration

	Odds Ratio	95% Confidence Intervals	p value
<b>Publications</b>	1.731	1.276 – 2.349	0.001
<b>Cohort year</b>			
<b>2010</b>	0.094	0.019-0.472	0.04
<b>2012</b>	0.195	0.045-0.844	0.029

NTN – National Training Number, HST – Higher Surgical Training

### **3.5 DISCUSSION**

Yet again, this study has demonstrated a positive correlation between individual curricular and academic productivity and successful career progression, suggesting that meritocracy still holds sway in British Surgery. Success at Higher Surgical Training NTN selection was associated with fuller operative logbooks (>450 procedures), more Work Based Assessments (>100), and academic scholarly achievement both in terms of communications to learned societies (>4), and scientific publications. On logistic regression however, only a solitary scientific publication was deemed independently predictive of progression, as was CST programme reconfiguration. The improved outcomes in those successful at NTN appointment were consistent with the impact of the reconfigured CST programme that included the introduction of enhanced, focused, and themed 2-year training posts with bi-annual face-to-face ARCP, and suggests that the development of Educational Contracts between Doctors, Local Educational Provider and the regional Postgraduate Deanery may hold the key to the future successful delivery of the modern surgical curriculum, by embedding the above targets within learning agreements. Observed improvement in career progression may substantiate the theory that trainee opportunities to focus CV building and clinical exposure in their chosen career path are enhanced in themed rotations.

Scholarly activity in the form of peer reviewed publications have traditionally been used to differentiate trainees at shortlisting, largely due to the lack of quantifiable evidence available to assess trainees. As well as providing a surrogate marker of a commitment to the specialty, peer reviewed publications demonstrate an understanding of the principles of evidence based practice. However with the introduction of workplace based assessments, quantifiable

assessment of competence is now possible which may arguably be a better way of identifying the best trainees at NTN selection in the future.

Selection into Higher Surgical Training is very competitive, though information on the definitive applicant pool and relative competition ratios has until the advent of national selection been thin. Consequently, sharing evidence based career advice to aspiring surgeons presents significant challenges. Carr et al. in 2011, on behalf of the Department of Health's Medical Education and Training Programme England, reported on CST and progression into the 2010 specialty training programs (Carr et al. 2011). Selection data was available on 2,178 applicants for 341 HST NTN surgical posts and revealed an overall competition ratio for all posts to be 6.1, ranging from 4 (ENT & Urology) to 15 (Plastic Surgery). Of the applicants likely to have applied directly from CST, only 116/475 (24%) were successful in gaining a HST post, compared with 193/1,433 (13%) doctors with more experience. Nearly half (46%) of applicants were UK trained, but others had medical degrees from no fewer than 65 countries (Carr et al. 2011). Binary logistic regression analysis suggested that the applicants most likely deemed appointable and offered training posts were recently qualified and UK trained, and this effect varied between Deaneries for general surgery and trauma and orthopaedic surgery.

A follow up publication related to the 2011 selection process reported that 1760 applicants for 325 substantive HST posts with an overall competition ratio of 5.5:1. Competition again varied between specialties and ranged from 5 (General Surgery, ENT, Urology), 6 (T&O), 8 (Plastic Surgery), to 10 (Paediatric Surgery). Doctors likely to have applied directly from CST were on this occasion more probable to be appointed with 43% successful. This percentage varied by specialty from 11% in plastic surgery to 62% in ENT (Carr AS 2011).

An extra year in core training (CT3) demonstrated a higher conversion rate to NTN than the traditional 2-year programme (18.9% vs 12.5%, 2010-12 cohorts); however, the difference did not reach statistical significance. With many NHS trusts and local health boards struggling to fill rotas, and operative experience proving increasingly difficult to obtain, partly as a result of a reduction in duty hours, an additional experiential year of core training may arguably benefit both trainees and hospital trusts (Thomas et al. 2014).

Surgical Colleges have a responsibility of ensuring equality within an increasingly diverse workforce with recent strategies introduced to promote equal opportunities. Encouragingly, as per Carr's report, no apparent differences in gender or ethnicity were observed in those appointed to ST3 posts from Wales (Carr et al. 2011). On the other hand, poorer nationwide pan-specialty ARCP related outcomes amongst overseas trainees have previously been reported in the literature (Carr et al. 2011; Tiffin et al. 2014). Unfortunately it was not possible to ascertain whether trainees had undertaken their undergraduate training abroad, and hence quantify this within the cohort of trainees studied.

Clearly, this study has several potential limitations as it represents data from a single UK Deanery and it is therefore uncertain whether this is representative of the UK in general. Moreover, the improved outcomes relate to a single entry cohort (2013), and further data will be required to corroborate the findings. The paucity of published data regarding overall competition ratios over the years meant that it was not possible to truly quantify the effect, if any, that this may have had on HST National Training Number success within the cohort of trainees. In contrast, the strength of the study relates to a full data set obtained

from ARCP review allied to the ISCP, with no Core Trainees lost to follow up. This was only possible due to the universal national uptake of the ISCP, which provided instant access to data previously unrecorded centrally. Moreover, it demonstrates how reverse analysis of ISCP data can facilitate progressive change and inform positive reconfiguration by information driven negotiation with local health care education providers.

Wales has its own set of challenges arising from low recruitment rates and low Royal College examination pass rates in certain specialties, retention issues, high rates of Less Than Full Time working, impact of changes to immigration legislation, and a large number of training locations. In order to address these issues, there is a need to improve the quality of training on offer to trainees by investing in the educational environment i.e. protected teaching time, opportunities to attend outpatient clinics and operating theatre time, in order to be able to recruit and retain high quality trainees. This should lead to a culture across NHS Wales, which supports learning, education and training, a recommendation of the recently published Health Professional Education Investment Review (Evans et al. 2015). To facilitate such change, an Educational Contract between the trainee, the local education provider (LEP), and the deanery should be considered. The aim of this Education Contract would be to articulate the roles and responsibilities of all parties in order to ensure the delivery of a high quality training experience and to meet the standards set by the UK regulator. These contracts should be specialty specific and must be focused on not only on professional examination curricula, contain prescriptive indicative numbers, and also deliver the wider competencies required to train a surgeon capable of independent consultant practice.

### **3.6 CONCLUSION**

Finally, this study raises important questions related to the quality of Core Surgical Training, and why the majority of trainees leaving core training are deemed unready for progression to Higher Surgical Training without further training or experience. The JCST considers CST to be an arena of tangible concern and is focused on confronting the prevalent educational challenges therein. An educational contract, mapped against GMC approved curricula, Royal College training standards, and the GMC standards for education and training, subject to revision and properly administered should be considered and developed.

## **Chapter 4**

**Rural rotations at core: Rarefied exposure or real experience?**



## 4.1 SUMMARY

Surgical rotations involving rural District General Hospitals (rDGH) are often associated with recruitment challenges partly because of adverse perceptions regarding distances from social support networks allied with a fear of suboptimal training. The aim of this study was determine the outcomes of core surgical training (CST) rotations involving rDGHs with respect to the JCST curriculum.

Online portfolios (ISCP) from 99 Wales CSTs were reviewed related to operative experience, workplace based assessments (WBA), and academic output. Of the 99 CSTs, 22 had completed at least 2 rDGH posts within 2-year rotations and were compared with 77 control CSTs. Primary outcome measure was success at Higher Surgical Training (HST) national training selection.

Median logbook operative experience was 335 (93-611) operations in the rDGH rotations vs. 335 (64-1020) in controls ( $p=0.708$ ). Median WBA numbers and audits performed were similar at 79 vs. 79 ( $p=0.733$ ), and 3 vs. 3 ( $p=0.724$ ) respectively. Median presentations to national learned societies were fewer from rotations involving rDGHs 1 (0-5) vs. 2 (0-20,  $p=0.03$ ), but publication numbers were similar, 0 (0-3) vs. 0 (0-11,  $p=0.217$ ). Success at national HST appointment was also similar (18.1% vs. 22.1%,  $p=0.695$ ).

Rural DGH rotations did not adversely influence CST outcomes.

## 4.2 INTRODUCTION

In the UK, the Rural General Hospital, a concept pioneered by the Scottish NHS, is defined as a Consultant-led secondary care unit that provides around the clock emergency care in addition to elective diagnostic and therapeutic services to sparsely populated remote communities (Buckley 2003; Government 2008). Up to a third of the population in Wales and Scotland and a fifth in England live in areas classed as rural, related to the settlement type and its geographic context (sparsity) (Scottish Executive 2000; Gartner et al. 2007). One-fifth of all surgical postgraduate training posts in Wales are in rural hospitals, and recruitment to rotations involving these hospitals remains challenging. This is arguably due to the perceptions of long distances from individuals social support networks allied with a fear of suboptimal training environments, and professional isolation when compared with rotations involving larger urban centres (Scottish Executive 2000; McCabe 2002; Sim et al. 2009).

Recent reconfiguration of postgraduate surgical training coupled with the reduction in global working hours, has demanded close scrutiny of individual hospital posts to ensure curricular targets can be met (European Parliament 2003; Temple 2010). There has been a recent movement towards quantifiable measures of trainee outcome with the development of the ISCP online portfolio system and the publication of JCST curricular targets for CCT (Intercollegiate Surgical Curriculum Programme ; JCST 2013). As a result, benchmarking of hospital posts can now be accurately undertaken. The aim of this study was to determine the outcome of core surgical training (CST) rotations involving training in Rural District General Hospitals in terms of specific JCST defined curriculum requirements in a single UK deanery.

### 4.3 MATERIALS AND METHODS

One hundred and twelve core surgical trainees (CSTs) commenced Wales deanery training posts between 2010 and 2012. 13 trainees left the rotation within a few weeks of appointment for which no data was available. Data was obtained from the remaining 99 CSTs (74 male, 25 female). Trainees were allocated four 6-month placements within a 2-year core surgical training programme prior to the post structure changing to 4 month rotations at CT1 in 2013. For comparative analysis, 2013 trainees were excluded for this reason. Online ISCP portfolios and CVs were analysed, with reference to logbooks, workplace based assessments (WBA), audits, presentations and publications. Each hospital was categorised into either a rural District General Hospital (rDGH), or non-rural District General Hospital (non-rDGH). The rural hospital was defined at deanery level: a district general hospital which serves a largely rural population. The ONS (Office for National Statistics) uses settlement size of <10,000 to delineate rural and urban areas.

Educational outcomes were compared and analysis performed according to the proportion of time spent at a rDGH. The primary outcome measure was trainee progression to National Higher Surgical Training (National Training Number or Locum Appointment in Training). Statistical analysis was performed with non-parametric data expressed as median (range) using SPSS 20 (IBM, Chicago, Illinois). Proportions were compared with Chi-squared or Fisher's exact tests ( $p < 0.050$  was considered significant) and Mann-Whitney U test used to compare medians.

## 4.4 RESULTS

The 12 training hospitals within Wales (3 in North Wales, 9 in South) were categorised as shown in Table 4.1.

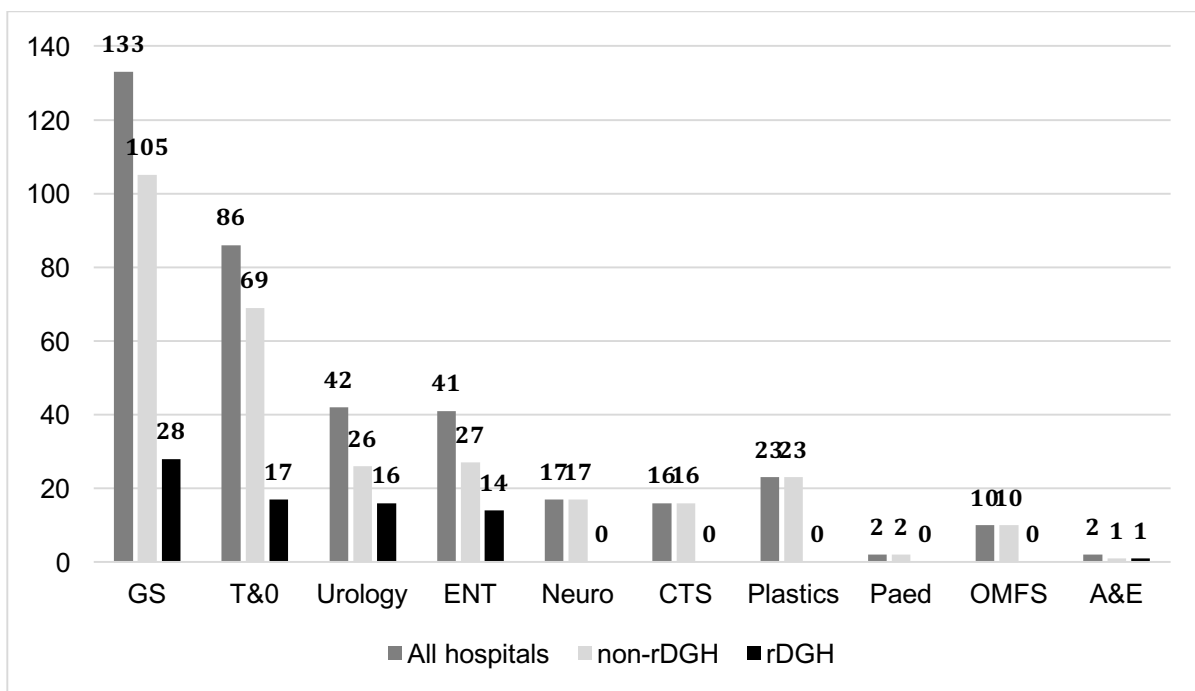
**Table 4.1 Hospital post classification**

Hospital	Classification	Region
UHW & Llandough / Cardiff	non-rDGH	South
Morrison & Singleton / Swansea	non-rDGH	South
Royal Gwent / Newport	non-rDGH	South
Nevill Hall / Abergavenny	rDGH	South
Prince Charles / Merthyr	non-rDGH	South
Princess of Wales / Bridgend	non-rDGH	South
Royal Glamorgan / Llantrisant	non-rDGH	South
Glangwilli / Carmarthen	rDGH	South
Withybush / Haverford West	rDGH	South
Ysbyty Gwynedd / Bangor	rDGH	North
Glan Clwyd / Rhyl	rDGH	North
Wrexham	non-rDGH	North

rDGH – Rural District General Hospital

Of the 99 trainees, 93 completed the full 2 years, however all data was analysed, and proportion of time spent in rural posts were calculated accordingly. Data was available for 375 placements (76 rDGH, 299 non rDGH). A breakdown of the placement numbers per specialty is shown in Figure 4.1.

**Figure 4.1 Specialty post breakdown**



GS – General Surgery, CTS – Cardiothoracic Surgery, ENT – Ear Nose and Throat, OMFS – Oral Maxillofacial Surgery, Paed – Paediatric Surgery, A&E – Accident and Emergency, Neuro – Neurosurgery T&O – Orthopaedic Surgery

Table 4.2 shows a comparative analysis of the 2-year outcomes of trainees that have  $\geq 50\%$  of their rotations in rural hospitals (2 or more in a 2-year rotation), with those that have  $< 50\%$  rural posts. HST appointment rates in the two groups were equivalent however academic productivity in the form of national presentations were significantly lower in the rDGH rotations.

**Table 4.2 Comparative trainee outcomes of 2-year rotations involving rural posts**

	All rotations	Rotations with <50% rural posts	Rotations with ≥50% rural posts	P Value
<b>Trainee numbers</b>	99	77	22	
<b>Operations</b>	335 (64-1020)	335 (64-1020)	335 (93-611)	0.708
<b>WBAs</b>	79 (11-189)	79 (11-176)	79 (20 -189)	0.733
<b>Audits</b>	3 (0-14)	3 (0-14)	3 (0-8)	0.724
<b>Total presentations</b>	2 (0-31)	2 (0-31)	1 (0-8)	0.144
<b>Nat. Presentations</b>	1 (0-20)	2 (0-20)	1 (0-5)	0.030
<b>Intern. Presentations</b>	0 (0-13)	0 (0-13)	0 (0-4)	0.776
<b>Publications</b>	0 (0-11)	0 (0-11)	0 (0-3)	0.159
<b>MRCS pass (rate%)</b>	71 (71.7)	55 (71.4)	16 (72.7)	0.906
<b>HST appts (rate%)</b>	21 (21.2)	17 (22.1)	4 (18.1)	0.695

All values medians unless stated. Ranges in parentheses unless stated. Int – International; Nat – National; MRCS – Membership of Royal College of Surgeons exam; HST – Higher Surgical Training post.

Training outcomes for 6-month posts in the rural and non-rural hospitals are shown in Table 4.3. Similar outcomes were observed in terms of overall operative experience, audits and workplace-based assessments however there were significantly lower presentations to learned societies and publications in the rDGH placements despite both groups having a median of 0.

**Table 4.3 Comparative trainee outcomes of non-rural and rural 6-month posts**

	<b>Non - rural</b>	<b>Rural</b>	<b>P value</b>
<b>TotalOps</b>	82 (0-371)	91(0-173)	0.997
<b>Non Assisting</b>	25(0-296)	32(0-151)	0.141
<b>TotalWBA</b>	17(0-78)	16(0-57)	0.618
<b>Audits</b>	1(0-6)	1(0-4)	0.764
<b>Cycles</b>	0(0-2)	0(0-1)	0.868
<b>Presentations</b>	0(0-9)	0(0-4)	0.024
<b>Publications</b>	0(0-2)	0(0-1)	0.070

All values medians unless stated. Ranges in parentheses. Ops – Operations; WBA – Workplace Based Assessment

Table 4.4 shows core procedure involvement in relation to speciality.

**Table 4.4 Core operative exposure per speciality**

	<b>Non – rural</b>	<b>Rural</b>	<b>p value</b>
<b>General n = 133</b>			
Appendix	9 (0-25)	10 (2-19)	0.498
Hernia	7 (0-67)	12 (3-29)	0.005
<b>T&amp;O n = 86</b>			
DHS	3 (0-12)	5 (0-16)	0.003
Ankle ORIF	2 (0-9)	4 (0-13)	0.121
Metal Removal	1 (0-13)	3 (0-6)	0.223
<b>ENT n = 41</b>			
Tonsillectomy	9 (0-42)	8 (0-34)	0.28
<b>Urology n = 42</b>			
Cystoscopy	23 (0-140)	33 (7-135)	0.273

All values medians unless stated. Ranges in parentheses. DHS – Dynamic Hip Screw; ORIF – Open Reduction and Internal Fixation; T&O – Trauma and Orthopaedics

## 4.5 DISCUSSION

This is the first UK study to report the definitive Core Surgical Training outcomes in rural hospital rotations. The principal finding was that educational outcomes from rotations in which considerable time was spent in rural hospitals, were comparable to those from non-rural rotations. The primary outcome measure of training – National Higher Surgical Training (HST) appointment rates, were equivalent and reassuringly 6-month post analyses further demonstrated equivalence in quantifiable training outcomes such as operative experience, workplace based assessment completion and audit activity. There was however a trend toward lower academic productivity in rural rotations.

The appointment to Higher Surgical Training has always been highly competitive. A recent nationwide study by Carr et al. in England revealed that in 2010, just under a quarter of trainees were successful at HST NTN appointment interviews (Carr AS 2011). Results from this current study of Welsh trainees has reported the outcomes of all trainees completing CST, regardless of whether application to Higher Surgical Training was pursued. Exclusion of trainees that had not applied for HST (changed specialties, failed exams, pursued research interests or taken career breaks) revealed an HST appointment rate of 25% from rural rotations.

Advances in UK surgical practice accompanied by strong evidence reporting improved outcomes in high volume specialist units has resulted in subspecialisation and centralisation of major elective services within Wales (Archampong et al. 2012; RCSEng 2013; Ch'ng et al. 2015; RCSEd 2016). The provision of elective and emergency surgery to rural areas of Wales has subsequently undergone significant reconfiguration over the past decade with the aim of improving overall standards of care, whilst ensuring adequate and



safe provision of essential local surgical services. As a result, when compared to the larger teaching centres, the rural hospitals undertake a lower number of complex major operative procedures. This is reflected in the results of the current study, with trainees in rural general surgical placements involved in a higher number of hernia procedures, a core intermediate procedure for surgical trainees. On the other hand, the higher scholarly activity achieved in the non-rural rotations reflects the higher academic profile of consultants working at the teaching centres, the access to more developed university research facilities fostering an environment suited to academic productivity, and the centralisation of surgical services.

This study has a number of strengths, it relates to a full data set of all core surgical trainees over a 3-year period, with no loss to follow up. This is the first study to look at the role of rural hospitals in the training of core surgical trainees, with results that will directly influence the further reconfiguration of CST in Wales. The limitations of this study are that the data is representative of a single deanery only with results that will only be relevant to UK deaneries that include Rural General Hospitals on their training rotations. An assessment of training quality would be strengthened by qualitative research that assessed trainee and trainer attitudes.

#### **4.6 CONCLUSION**

With the introduction of both the European Working Time Directive and Modernising Medical Careers reducing the global hours spent in training, deaneries must ensure that individual hospital posts provide adequate training opportunities. Recent development of quantifiable markers of curricular achievement that are evidenced on the ISCP portfolio system has meant that trainee outcomes can now be robustly measured. This study has demonstrated that rural district general hospitals can deliver high volume consultant-led subspecialty training within a contemporary core surgical training programme. The results of this study should help inform surgical rotation planning and reassure both trainers and trainees that placements in rural hospitals provide a level of training akin to that of a large district general or tertiary teaching centre.

## **Chapter 5**

**Does UK surgical training provide enough experience to meet today's training requirements?**

## 5.1 SUMMARY

In 2013, the JCST published guidelines for the award of a CCT in General Surgery citing global operative experience together with other professional credentials. The aim of this study was to determine whether these guidelines were achievable within contemporary MMC UK surgical training.

The CVs and online portfolios of 155 consecutive CCT applicants with certification dates between 1 November 2012 and 12 December 2013 (119 male, 36 female) were analysed with specific reference to curricular guidelines.

No inter-deanery differences emerged related to global guidelines. The median total operative caseload was 1802 (range 783-3764), with 104 applicants (67%) achieving the defined guideline of 1600, which was unrelated to subspecialty preference ( $p=0.133$ ). Median emergency laparotomy caseload was 102 (1-335) with 85 applicants (55%) achieving the guideline of 100 (data excluding segmental colectomy and Hartmann's). This was related to subspecialty preference, with GI trainees more likely to exceed the guideline than non-GI counterparts (median 111 vs. 92,  $p<0.001$ ). Allowing for this, first quartiles for all indicative procedures matched the guideline numbers with the exception of infra-inguinal bypass. The median number of publications achieved was 7 [0-100, median 4 (0-30) as first author], and median national or international presentations 10 (0-67). The academic guidelines of 3 peer reviewed publications and 3 presentations were achieved by 136 (88%), and 146 (94%) respectively, and requisite courses by 28%.

Global operative and academic achievements varied widely with two thirds of applicants achieving elective operative guidelines, and over half achieving the requisite experience in emergency laparotomy. A total of 5% of trainees achieved all the non-operative guidelines. Measures to identify trainees in the lower quartile early within training coupled with enhanced simulation resource should be considered to rectify this apparent surgical training experience shortfall.

## 5.2 INTRODUCTION

Surgical education and postgraduate training is under scrutiny, not least because of its craft specialty status, but also because of a progressive onslaught of initiatives aimed at improving yet shortening training time (Greenaway 2013). The traditional British surgical apprenticeship, once the envy of the world, has undergone considerable reconfiguration culminating in Modernising Medical Careers (MMC) which, allied to a competency based approach, demands that educational outcomes are quantifiable allowing unequivocal measured proof of ability (Temple 2010; Moonesinghe et al. 2011).

GMC approved curricula have contained required levels of competence since their inception, but until recently no specific quantitative guidelines existed for the award of a Certificate of Completion of Training (CCT) in General Surgery. However, in 2013, with the first cohort of post-MMC trainees approaching the end of their training, the Joint Committee on Surgical Training (JCST) published specific guidance for the award of CCT in all surgical specialties, citing clinical competence, operative experience, operative competence, evidence of research, quality improvement, medical education and training, management and leadership, additional courses and qualifications, and attendance at educational conferences (Table 5.1). The caseload component of the above were calculated and set by the SAC in General Surgery by taking the first quartile level from a modest cohort of contemporary successful CCT applications (Allum et al. 2013). This guidance is applied flexibly for trainees gaining certification under the 2010 (or earlier) curriculum, but will be used more strictly for those following the 2013 curriculum. The numbers set within this curriculum have caused a degree of trainee angst because of fears that the

levels set may be unrealistic and not achievable in certain surgical specialties and hospital training posts (Thomas et al. 2015).

ISCP with its electronic portfolio is mandatory for all general surgical trainees and provides the *prima facie* evidence necessary for the Annual Review of Competence Progression (ARCP) and final certification (CCT) (Intercollegiate Surgical Curriculum Programme ; Canter and Kelly 2007; Allum 2013). This process now approaches a critical juncture with the first MMC surgical cohort completing their standard six years of structured training (2013), and it is appropriate that educational achievements are measured against the JCST curriculum guidance for the award of a CCT (JCST 2013). The aim of this study was to examine the CCT application documentation provided to the UK General Surgery SAC with reference to the guidelines for CCT, to assess trainees' achievements and determine which domains were not being met. Such analysis is particularly opportune in light of the imminent developments associated with the Shape of Training review (Greenaway 2013).

### **5.3 MATERIALS AND METHODS**

All successful applicants for a Certificate of Completion of Training (CCT) in General Surgery in the UK between November 2012 and December 2013 were identified from the administrative records of the Joint Committee on Surgical Training (JCST). Information provided by each trainee when making their application for CCT was confidentially examined and amalgamated with operative logbook and Workplace Based Assessment (WBA) data provided by the JCST from ISCP.

Data gathered for each applicant included the training outcomes, length of training, ATLS status, evidence of completing Training the Trainers (TtT) course, a management course, attendance at other relevant courses and conferences, and evidence of having undertaken a managerial role. Applicants publications were assessed in the form of full paper and peer-reviewed publication numbers, with case reports and letters excluded. First author presentations, both poster and oral, at national or international level were included.

Logbook data collected as “emergency laparotomy” had to exclude emergency segmental colectomy and Hartmann’s due to the logbook’s design at time of data collection, even though the guideline number of 100 emergency laparotomies includes these two procedures. This data was then compared with the guidelines set by the JCST for the award of CCT

**Table 5.1 JCST Curriculum Guidance**

Domain	JCST guideline
Total operative cases performed	1600
Number of index procedures performed	Varies by special interest
Peer reviewed publications	3
First author national/international presentations	3
Audits	3 (at least one cycle completed)
Courses	TtT, ATLS, special interest course and Management course
Conferences (National/International)	4
Management	Evidence of engagement

ATLS – Advanced Trauma and Life Support; TtT – Training the Trainers.

All data were anonymised with non-parametric data expressed as median (IQR). Proportions were compared with Chi-squared or Fisher’s exact tests ( $p < 0.050$  was considered significant). Statistical analysis was performed using

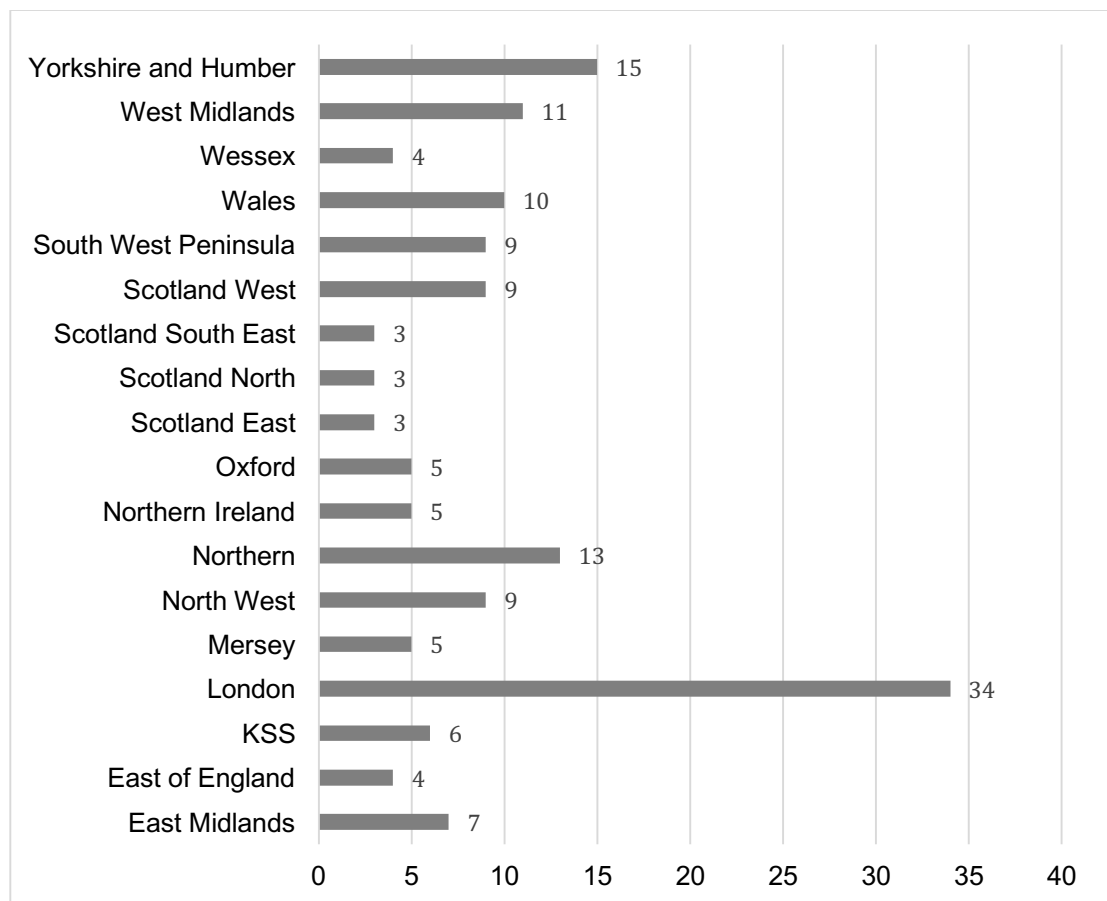


SPSS 20 (IBM, Chicago, Illinois). Ethical approval for the study was provided by the Cardiff University research ethics committee.

## 5.4 RESULTS

Applicants were spread across all 18 UK Deaneries (Figure 5.1) and 6 special interests: Colorectal 45 (29%), Breast 34 (21.9%), Upper GI 28 (18.1%), Vascular 27 (17.4%), HPB 14 (9%), Transplant 5 (3.2%). Two trainees (1.3%) did not have a special interest.

**Figure 5.1 Number of trainees related to Deanery**



KSS – Kent Surrey and Sussex

Median length of time spent in training at ST3 level and above was 72 (range 63-141) months. Female trainees spent significantly longer in training than males (median 85, range 71-141 vs. 72, range 63-108 months,  $p=0.003$ ).

Higher degrees in the form of an MD or PhD had been achieved by 82 trainees (53%) with a further 34 trainees (22%) in possession of a Masters degree. The median number of publications achieved by all applicants was 7 (range 0-100), with a median of 4 (0-30) first author publications. The median number of presentations was 10 (0-67). The CCT requirement of 3 peer reviewed publications and 3 presentations were met by 136 (88%), and 146 (94%) of applicants respectively. For each applicant, the highest journal impact factor (2013 report) in which they had published was noted, irrespective of year of publication, with a median of 3.43 (range 0-38.6). The median number of audits completed was 6 (range 0-25), and 124 (80%) had performed at least 3, but only 28 (18%) had completed an audit cycle.

The influence of gender on scholarly activity was studied, with male gender being associated with a higher number of total publications (8 vs. 5.5,  $p=0.004$ ), first author publications (4 vs. 3,  $p=0.002$ ) and presentations (11 vs. 9,  $p=0.013$ )

The relative influence of having a higher degree on academic output was also considered. Applicants with a higher degree (MD or PhD) were in possession of higher numbers of total publications (10 vs. 5,  $p<0.001$ ), first author publications (4 vs. 3,  $p=0.003$ ) and were more likely to publish in higher impact journals (3.92 vs. 2.82,  $p=0.002$ ) than applicants without higher degrees. The former applicants also presented more widely (14 vs. 9,  $p<0.001$ ) and attended more conferences (11 vs. 8,  $p<0.001$ ), but there were no statistically significant differences in scholarly activity between special interests or Deaneries.

Seventy-seven applicants (50%) were ATLS providers/instructors at the time of CCT application, 88 (57%) had completed TtT, 111 (72%) had attended a recognised management course, and 119 (77%) described a managerial role during training. However, only 36 applicants (23%) fulfilled all four of the above

criteria. Other courses and conferences were in general well attended, with median numbers of courses (19, range 0-47) and conferences (9, range 0-44) well above CCT guidelines. One hundred and fifty-one (97%) attended at least one special interest course and 141 (91%) had attended four or more national/international conferences.

Examination of online logbooks revealed a wide range of total operative experience and case numbers during ST3 to ST8 registrar-level training, with a median involvement (including assisting) in 1802 cases (range 783-3764).

Overall, 104 applicants (67%) reached the JCST guideline of 1600 cases. Table 5.2 shows the proportion of applicants achieving JCST guidelines for indicative procedures, with Table 5.3 showing the results by special interest for the 6 generic index procedures, including emergency laparotomy. There were no statistically significant differences when considering the effects of gender ( $p=0.803$ ), special interest ( $p=0.133$ ) or deanery ( $p=0.104$ ) on total operative experience. Emergency caseload however, was related to special interest with GI trainees more likely to exceed the guideline than their non-GI counterparts (median 111 vs. 92,  $p<0.001$ ).

**Table 5.2 Number of applicants achieving JCST operative guidelines**

Sub specialty	Index procedure	Median	IQR	Range	JCST guideline	% reaching JCST guideline
<b>All trainees</b> (n=155)	Emergency laparotomy*	102	76-150	1-335	100	55
	Hartmann's	12	7-17	0-76	5	85
	Segmental Colectomy	42	29-84	3-225	20	86
	Appendicectomy	121	93-171	21-316	80	84
	Cholecystectomy	103	59-176	0-376	50	81
<b>Upper GI</b> (n=35)	Inguinal hernia	92	67-118	0-392	60	83
	Cholecystectomy	207	171-250	106-376	110	96
	Major UGI	66.5	36-111	9-209	35	75
<b>Colorectal</b> (n=47)	Anterior resection	34	29-49	12-116	30	73
	Fistula surgery	37	23-48	0-95	20	78
	Segmental colectomy	96	85-115	41-225	50	96
	Haemorrhoidectomy	33	22-44	6-96	15	89
<b>Breast</b> (n=34)	Prolapse surgery	9	4-15	0-27	4	82
	Breast lump	72.5	54-103	38-160	40	97
	Mastectomy	96	77-122	50-250	50	100
	SLNB	121	100-149	56-198	70	97
<b>Vascular</b> (n=27)	Axillary clearance	55	43-75	9-112	45	74
	AAA (total)	66	41-95	6-246	15	96
	AAA (open)	31	22-50	4-70	10	89
	Carotid Endarterectomy	55	45-85	7-138	30	93
	Infra-inguinal bypass	69	48-86	24-101	60	56
	Varicose vein surgery	163	113-207	50-312	60	96

\*see caveat in text. AAA – Abdominal Aortic Aneurysm; JCST – Joint Committee on Surgical Training; SLNB – Sentinel Lymph Node Biopsy; UGI – Upper Gastrointestinal;

**Table 5.3 Operative experience in General Surgery related to special interest**

Procedure (JCST guideline)	Number (%) reaching JCST guideline by special interest						TOTAL	TOTAL (%)
	Breast	Vascular	UGI/HPB	Colorectal	Transplant	General		
Emergency Laparotomy* (100)	16 (34)	8 (30)	26 (62)	33 (73)	1 (20)	2 (100)	86	55*
Hartmann's (5)	25 (74)	21 (78)	36 (86)	42 (93)	5 (100)	2 (100)	131	85
Appendix (80)	28 (82)	17 (63)	38 (90)	42 (93)	3 (60)	2 (100)	130	84
Cholecystectomy (50)	22 (65)	16 (59)	42 (100)	40 (89)	4 (80)	2 (100)	126	81
Inguinal hernia (60)	23 (66)	19 (70)	39 (93)	42 (93)	3 (60)	2 (100)	128	83
Segmental colectomy (20)	28 (82)	20 (74)	36 (86)	45 (100)	3 (60)	2 (100)	134	86

\*see caveat in text: 75% met the modified indicative number of 75 emergency laparotomies. HPB – HepatoPancreaticoBiliary Surgery; UGI – Upper Gastrointestinal

WBAs for 66 of the trainees applying for CCT were available for review. These included procedural based assessments (PBA) and case-based discussions (CBD) for which the JCST have set guideline numbers for CCT. At least 3 PBAs need to be completed for each specialty specific index procedure, at varying levels depending on complexity of the procedure. Analysis revealed that just 2 (3%) trainees had completed the necessary number of assessments for the 6 core procedures in general surgery. Table 5.4 shows a breakdown related to special interest. No trainee achieved the set criteria for both general surgery and their special interest. With regard to CBDs, JCST guidelines are for 'satisfactory' CBDs as follows: 10 in different conditions from the range of emergency general surgery, 10 in different aspects of the trainee's special interest and 10 in different conditions from other areas of general surgery. Slightly more encouragingly, 33% of trainees met the JCST CBD guidelines.

**Table 5.4 Number of PBAs related to special interest**

	Median no. of PBAs at CCT level	Range
<b>PBA (GENERAL/ALL)</b>		
Laparotomy	3	0-18
Hernia	2	0-20
Cholecystectomy	3	0-11
Hartmann's	1	0-5
Segmental Colectomy	1	0-24
Appendicectomy	1	0-9
<b>PBA (UGI/HPB)</b>		
OGD	2	0-8
Liver Resection	0	0-8
Cholecystectomy	7	1-11
Pancreatectomy	0	0-8
Antireflux	0	0-3
Oesophagectomy	0.5	0-14
Gastrectomy	1	0-7
<b>PBA (COLORECTAL)</b>		
Anterior resection	2.5	0-13
Segmental Colectomy	5	0-11
Fistula	2	0-5
Haemorrhoids	2	0-6
Colonoscopy	2	0-6
Prolapse Surgery	0	0
<b>PBA (BREAST)</b>		
Breast Lump Excision	3	1-8
Image Guided Excision	3	0-8
Mastectomy	5	2-10
SLNB	4	1-12
ANC	3.5	1-6
Duct/Nipple Surgery	1	0-9
Implant Reconstruction	0	0-5
Pedicled Flap	2.5	0-7
Mammoplasty/ augmentation	1.5	0-7
<b>PBA (VASCULAR)</b>		
AAA	2	0-6
Carotid	4	1-7
Bypass	4	0-12
Varicose Veins	4	1-6
AV Fistula	1	0-3
<b>PBA (TRANSPLANT)</b>		
Cadaveric retrieval	0	0
Kidney Transplant	5	3-7
PD Catheter insertion	2.5	1-4
AV Fistula	4	3-5

AAA – Abdominal Aortic Aneurysm; ANC – Axillary Node Clearance; AV – ArterioVenous; OGD – Oesophagogastroduodenoscopy; PBA – Procedure Based Assessment; PD – Peritoneal Dialysis; SLNB - Sentinel Lymph Node Biopsy;

## 5.5 DISCUSSION

**“Not everything that counts can be counted and not everything that can be counted counts”**

**(William Bruce Cameron 1963 and often attributed to Albert Einstein 1879 to 1955)**

This is the first national study to examine the achievements of the initial cohort exiting MMC-type surgical training in the UK as measured against the JCST guidelines for CCT. The principal findings were that large variances exist in the curricular achievements of trainees at the time of the award of a certificate of completion of training; two thirds of applicants successfully awarded CCT had achieved the minimum advisory total operative experience of 1600 cases, and over half achieved the emergency laparotomy guideline number. In broad terms however, across the spectrum of general surgical special interests, index procedures matched curricular guidelines at the first quartile level, confirming the numbers set from an earlier cohort and academic guideline credentials were mainly achieved.

The emergency laparotomy data are misleading. Because of logbook design, it was not possible to identify which segmental colectomies or Hartmann's procedures were carried out as emergencies. Our emergency laparotomy data therefore exclude both of these procedures. The guideline number of 100 emergency laparotomies includes 20 segmental colectomies and 5 Hartmann's. This would leave 75 as a modified guideline number of emergency laparotomies, excluding, as this study did, emergency segmental colectomy and

Hartmann's. We found the first quartile of emergency laparotomy in this data set to be 76, so matching this modified guideline.

Nevertheless when all of the global guideline credentials were taken into consideration only one candidate had achieved them all. It must be emphasised at this juncture that the guidelines for CCT were introduced in late 2012, after the first trainees in this cohort had achieved their CCT and within a year of CCT for the remainder. The earliest in the cohort were Calman trainees and the remainder were on the 2010 curriculum which did not contain the guidelines.

The guidelines were therefore flexibly applied to this whole cohort. It is nevertheless encouraging to see that the first quartile logbook numbers for experience match those of the earlier cohort used to set the numbers and that all the criteria are achievable even though very few trainees met them all.

Considerable emphasis is placed on training now being competence based.

This is clearly important but, in a craft specialty, experience is also an essential component of training. It is one thing to be judged as being competent in a small number of straightforward cases, but it takes a volume of experience to have seen strategies for managing unusual or more complex surgical pathology at operation. For this reason, the JCST included indicative numbers in its guidelines for CCT and these have now been incorporated into the 2013 general surgery curriculum. It is better to describe surgical training as being competence and experience based.

Female trainees spent longer in training, yet published less than their male counterparts. The reasons for this are unclear, but arguably because for most, registrar-level training occurs during childbearing years, female trainees choose this time and the option of less than full time training to start their families. A little over half of trainees had pursued and been awarded a higher degree (MD



or PhD), and a further one fifth a Masters degree, and unsurprisingly these additional qualifications were associated with stronger academic portfolios. Irrespective of higher degree status, the vast majority of trainees met or surpassed JCST academic guidelines. Taking time Out of Programme for Research (OOPR) is not a requirement of the general surgery curriculum, but achieving research skills is. These results confirm that achieving the guidelines for research within clinical training is achievable. Taking time out of training for research is not therefore imperative, but may be advisable for competitive reasons related to Consultant selection.

Only one in four applicants achieved management and teaching guidelines, but as these are relatively easily achievable, mandating their attainment, they in theory, should not be a significant concern. Similarly, attendance at the requisite number of conferences and specialty specific courses should simply require highlighting and benchmarking at an early stage in registrar training to enable efficient planning of study leave.

Operative guideline numbers related to key index operations are therefore the salient concern raised by the results of this study. These numbers were originally set using the first quartile of a cohort of successful CCT applicants and so were certainly achievable in the relatively recent past(Allum et al. 2013) The majority of the guideline levels continue to be met by upwards of 80% of trainees, as would be expected given the first quartile results. Exceptions to this included in order of frequency: anal fistula surgery (78% of trainees met the guideline), major upper GI procedures (75%), axillary clearance (74% - first quartile was 2 cases below the indicative number), anterior resection (73% - first quartile was 1 case below the indicative number), infra-inguinal bypass (56% - first quartile was 12 cases below the indicative number), and emergency

laparotomy (55% - caveat with the data discussed above). Infra-inguinal bypass is a special case (and may be joined by axillary clearance in the future) due to changes in surgical practice reducing the number of procedures performed. This emphasises the need to keep these guideline numbers under review. Knowing this data allows trainees, supervisors and TPDs to focus training as required from an early stage to ensure experience as well as competence is sufficient by CCT. The introduction of simulation may help, but there is no suggestion that simulated procedures could take the place of actual operative numbers. For upper GI trainees, following the centralisation of upper GI cancer services, exposure to major procedures can be largely dependent on geography, with some Deaneries having only one or two centres performing these major cases; planned training programmes are necessary. More generally, trainees in the lower quartile of these numbers need to be identified early on within the framework of a training program and offered targeted training to ensure they gain the experience needed for independent practice and meet the guidelines. The newly introduced ST4 and ST6 ARCP checklists should help provide early warning in this regard.

This study and evidence from previous literature show that PBAs, tools designed to be used for formative assessment, risk use in a summative way (Shalhoub et al. 2014). This may be seen as an inevitable result of the introduction of formal curricula that include competence levels to be met by CCT for each surgical procedure. It is impossible to complete a PBA for every procedure in the general surgery curriculum, but seeing PBA evidence for the key procedures is a surrogate marker for broader experience and allows the SAC to demonstrate to the GMC that the trainee has met the competency required of the curriculum.

General surgery has many components, most of which form special interests for consultants in independent practice (e.g. colorectal surgery). The unifying force in general surgery is the ability of all with a CCT in the specialty to be able to manage an unselected emergency general surgery take, treating the majority of cases (and all common and straightforward cases) through to completion. It is recognised that uncommon or complex cases may require referral to more specialised units. This has always been the case and is in keeping with the themes of the Shape of Training report. Whether those with a non-GI special interest will remain in general surgery or, if they do, whether they will still be required to undertake emergency general surgery awaits the final outcome of the implementation of the report. Until then, however, having every trainee in general surgery, regardless of special interest, meet specific guidelines ensures that each will gain CCT with sufficient competence and experience to work as a general surgeon.

The level at which to set competencies for the more complex procedures with special interests will continue to be a point for discussion. The 2013 curriculum reduced the competencies expected for such procedures (e.g. oesophagectomy reduced from level 4 to level 3). The extent to which the Shape of Training report is implemented will dictate whether and what further change is required in the future. These data demonstrate that reduced levels of expected competency and experience would be required if training time were reduced. The JCST figures seem high when compared with the requirements of the American Board of Surgery, which mandate just 750 operations performed during the 5 year residency programme (American Board of Surgery). Further development and refining of surgical training in the UK is required. If training time were to be used more efficiently, it may be possible to shorten overall

training at the expense of trainee and consultant delivered service provision (Alman et al. 2013).

There are several potential weaknesses of this study. Logbook data as supplied may have been inaccurate. Some trainees included no experience of procedures that they would almost certainly have gained exposure to (e.g. inguinal hernia repair). The data were not corrected for cases such as this and so represent the “worst” view. If logbooks had included data on such procedures the results would show greater experience than is presented here. When considering the data on emergency laparotomies (55% of trainees reaching JCST guideline numbers) it must be re-emphasised that earlier versions of the commonly used e-logbooks did not enforce the coding of operations as emergency or elective. It is therefore likely that some trainees had performed more emergency laparotomies than their logbook may suggest, particularly as the data recorded as emergency laparotomy excluded emergency segmental colectomy and Hartmann’s (as discussed above). Improvements to the e-logbook mean that this is no longer a concern and the recording of trainees’ emergency operative caseload should now be entirely accurate. The data on PBAs is incomplete, due to the fact that some of this cohort were Calman trainees and did not require WBAs, nonetheless the poor uptake of WBAs in this cohort is an indication of the early attitudes towards the use of these tools, and the challenges faced with its implementation. Much of the other data was extracted from CVs and is therefore dependent on the accuracy of the submitted paperwork from individual trainees.

In contrast the study has several strengths, and has provided a valuable snapshot of the current situation and has clearly shown that development work

is required to ensure the next cohort of trainees are on target. The indicative numbers and other non-operative criteria are viewed as representing appropriate levels of experience and achievement, regardless of the method of their calculation. There is already anecdotal evidence of trainees gaining additional experience in order to meet the guidelines, experience they would not otherwise have achieved. In this way, the guidelines may drive improvements in training.

## **5.6 CONCLUSION**

The findings of this study, performed across all UK Deaneries, has flagged issues to be addressed to enable surgical specialty training in its current iteration to meet the guidelines set by the JCST. The European Working Time Directive (EWTD) has already led to a marked reduction in surgical training hours; with the recent Shape of Training Report suggesting that the total duration of core and higher surgical training should be reduced to just 6 years, the attainment of these competencies and experience as currently defined may be challenging. Contemporary UK surgical training risks providing inadequate operative experience for up to a quarter of trainees, with only one successful applicant for CCT in 2013 achieving all the newly published guidelines set by the JCST. That large variances exist in the achievements of UK surgical trainees is perhaps unsurprising given the traditional UK surgical apprenticeship training methods that remain in common use and in the way that MMC has reportedly been implemented. It is hoped that the guidelines will help drive improvements in training at programme and individual trainee level.

Experience is important, rather than simple competence as defined by isolated problem based assessments. Moreover, guideline numbers are defined for explicit patient safety reasons to ensure that new consultants have the requisite breadth of experience of a spectrum of operative pathologies to draw upon. The ISCP must be considered a significant and positive step forward with regard to UK surgical training and the JCST guidelines have been set for good reasons to produce a quality assured safe consultant general surgeon with the skills required for the increasingly demanding arena of NHS clinical practice. If training and clinical experience are to be optimised and made consistent with the aspirations of the Shape of Training report, then further detailed programme profiling will be required so that surgical rotations can be configured to be fit for purpose.

## **Chapter 6**

### **Operative experience versus competence: a curriculum concordance and learning curve analysis**

## 6.1 SUMMARY

Certification of Completion of Training (CCT) in General Surgery requires proof of competence of index operations by means of 3, level 4 consultant validated Procedural Based Assessments (PBAs). The aim of this study was to examine the relationship between index operative experience and competence.

Consecutive 69 National Training Number Higher surgical trainees appointed to a single UK Deanery between 2007 and 2014 were included. PBAs were compared with e-logbooks to determine the relationship between index operative experience and achievement of a third level 4 competence (L4C) related to the indicative procedures of: Emergency Laparotomy (EL, target 100), Hartmann's procedure (HMN, 5), Appendicectomy (APX, 80), Segmental Colectomy (SC, 20), Laparoscopic Cholecystectomy (LC, 50) and Inguinal Hernia (IH, 80).

EL L4C was achieved at a median of 76 (15-136) cases, HMN L4C at 17 (7-27) cases ( $p=0.009$  vs. EL), APX L4C at 107 (20-206) cases, SC L4C at 52 (15-131) cases, LC L4C at 72 (40-197) cases, and IH L4C at 64 (17-132) cases.

The learning curve and caseload required to demonstrate L4C related to specific procedure varied over 4-fold, from 0.76 to 3.4 times the national indicative target number guidance. CCT operative logbook number targets should be re-considered to better reflect the competencies demanded by the curriculum.



## 6.2 INTRODUCTION

Good medical practice and proof of surgical competence have long been considered important. Indeed, the Royal College of Surgeons of Edinburgh original charter of 1505 stated "No manner of person [shall] employ our said crafts of surgery unless he be worthy and expert in all the subjects belonging to the said crafts, [and be] diligently and advisedly examined" (Lowenfels 2005).

Public concern over quality control in surgical practice and operative risk, allied with initiatives to improve standards of training, have driven development of more robust training methods and competence assessment. With the introduction of the 2013 UK General Surgery Curriculum, evidence of competence in technical ability has become mandatory for certification of completion of training (CCT), and Joint Committee on Surgical Training (JCST) guidance cites indicative numbers for key operative procedures with targets set at a level that corresponds to the first quartile of previously successful CCT applicants (Allum et al. 2013). The caseload components of the above include key procedures, chosen because of their clinical importance and because they can be used as a marker of experience across the breadth of the curriculum. Evidence of competence must then be achieved for each procedure by completion of validated Workplace Based Assessment tools in the form of the Procedural Based Assessment (PBA).

PBAs allow objective assessment of technical skills, with each procedure associated with a generic descriptor based grading (see Fig 6.1) (Pitts et al. 2005). Evidence of competence for each procedure is defined as the completion of 3 Consultant validated PBAs at level 4 (competent to perform independently and deal with complications, Figure 6.1). The aim of this study was to examine the relationship between the volume of operative experience in

the key indicative procedures required of all general surgery trainees and the level of competence achieved within a Higher Surgical Training programme in a single UK Deanery.

**Figure 6.1 Procedure Based Assessment Level Descriptors**

<b>Levels of Procedure-Based Assessment (Global Summary)</b>	
<b>0</b>	Insufficient evidence observed to support a summary judgement
<b>1</b>	Unable to perform the procedure, or perform the procedure part observed, under supervision
<b>2</b>	Able to perform the procedure, or perform the procedure part observed, under supervision
<b>3</b>	Able to perform the procedure with minimum supervision (needed occasional help)
<b>4</b>	Competent to perform the procedure unsupervised (could deal with complications that arose)

### **6.3 MATERIALS AND METHODS**

All National Training Number Higher Surgical Trainees within the Wales deanery that had commenced Higher Surgical Training between August 2007 and August 2014 were identified and the relevant Intercollegiate Surgical Curriculum Programme (ISCP) online portfolios were interrogated. Individual HST reports were created with particular reference to PBA dates and competence levels achieved for the 6 indicative procedures required of all general surgery HSTs. PBA dates and levels were cross-referenced with e-logbooks to ascertain the relationship between competence level achievement and the operative volume performed. Assessors for PBAs were all Consultant Clinical Trainers in General Surgery, who were competent to perform the procedure under assessment. As well as written guidance and web-based training via the ISCP, all Consultant trainers had attended a Deanery training

workshop. Only the PBAs that were Consultant trainer validated and undertaken in approved Higher Surgical Training posts were included.

Operative experience obtained in posts prior to commencement of Higher Surgical Training was also included, as this represented global operative experience. Competence commensurate with the award of a Certificate of Completion of Training was defined as 3, level 4 PBAs (L4C).

All data were anonymised and descriptive statistics were used where appropriate, with non-parametric data expressed as median (range).

Proportions were compared with Chi-squared or Fisher's exact tests ( $p < 0.050$  was considered significant). Statistical analysis was performed using SPSS 20 (IBM, Chicago, Illinois). Ethical approval for the study was provided by the Cardiff University research ethics committee.

## **6.4 RESULTS**

Sixty-nine consecutive trainees were included in the analysis, and details regarding training grade and the median number of key indicative procedures performed are shown in Table 6.1.

	n	Median operative cases					
		EL	LC	HMN	IH	APX	SC
ST3	9	22	21	2	16	55	5
ST4	15	41	47	4	48	61	13
ST5	11	63	50	8	52	96	29
ST6	9	78	66	6	65	117	30
ST7	9	111	88	12	86	118	48
ST8/CCT	16	136	87	22	102	144	60
<b>Total</b>	69	67	59	7	64	100	23

**Table 6.1 Median Number of Indicative Operations Performed Related to HST Level**

n (number of trainees) EL (Emergency Laparotomy), LC (Laparoscopic Cholecystectomy), HMN (Hartmann's Procedure), IH (Inguinal Hernia), APX (Appendectomy), SC (Segmental Colectomy) ST.. (Specialty Trainee year ..)

A total of 8 trainees had achieved all of the PBA operative competences required for CCT [7 Specialty Trainee Year 8 (ST8), 1 Specialty Trainee Year 7 (ST7) grade], and 7 HSTs had achieved CCT PBA competences in 5 of the 6 procedures (1 ST8, 2 ST7, 3 ST6, 1 ST5). Eighteen trainees met the indicative operative target numbers for all 6 procedures (10 ST8, 5 ST7, 2 ST6, 1 ST5).

Table 6.2 shows the median number of procedures at which the first and third level 4 PBA competencies were achieved. The ratio of the median number of operations at L4C achievement to CCT operative target (L4C/CCT) was defined as the Competence Ratio (Table 6.2). A ratio of <1 meant that competence was achieved within the JCST target set, and was only apparent in Emergency Laparotomy (EL). In the case of Hartmann's (HMN) procedure the operative experience required to achieve CCT competence was more than three times the set target [L4C EL (achieved by 41%) vs. HMN (achieved by 19%), Chi<sup>2</sup> 6.8,

df 1, p=0.009, and vs. all other indicative procedures p not significant, APX (35%) p=0.597, LC (32%) p=0.377, SC (27%) p=0.151, IH (35%) p=0.597].

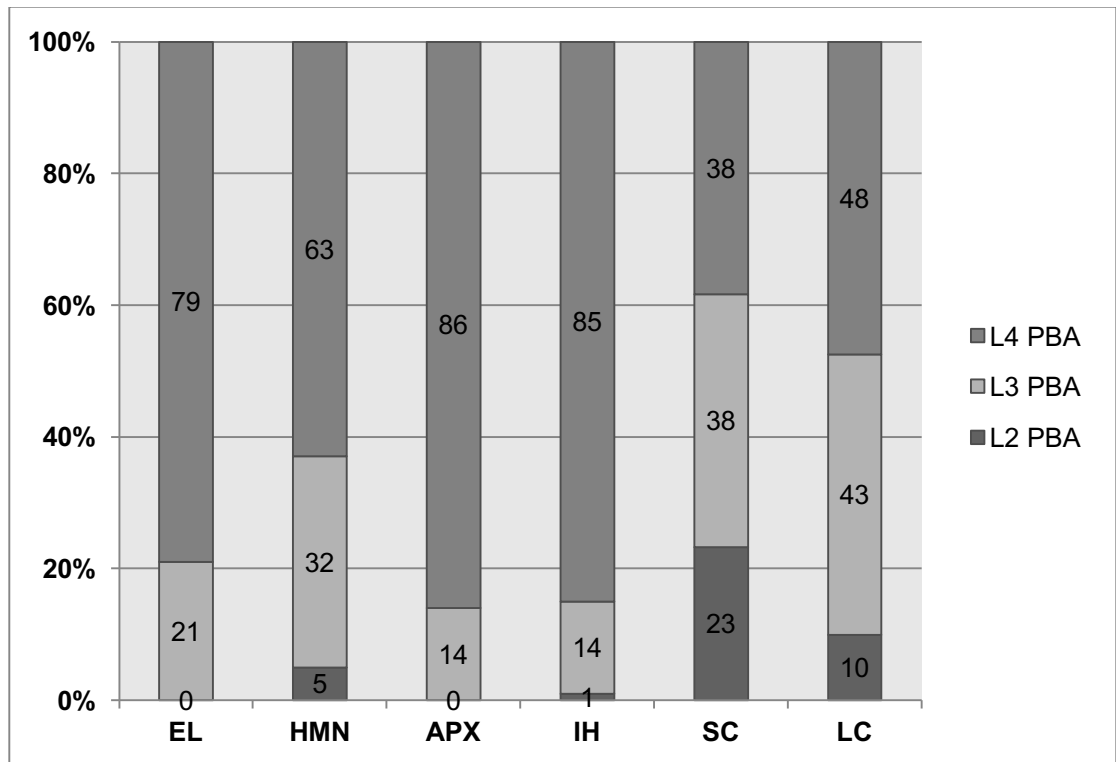
**Table 6.2 Number of Procedures Performed at First and Third Level Four Competence Related to Index Procedures**

	CCT Target	1 <sup>st</sup> Level 4 PBA		3 <sup>rd</sup> Level 4 PBA		Competence Ratio
		n	Median Cases	n	Median Cases	
<b>EL</b>	100	43	40 (4-116)	28	76 (15-136)	0.76
<b>HMN</b>	5	21	8 (2-24)	13	17 (7-27)	3.40
<b>APX</b>	80	49	61 (7-163)	24	107 (20-206)	1.34
<b>IH</b>	60	50	41 (11-108)	24	64 (17-132)	1.07
<b>SC</b>	20	30	32 (1-89)	19	52 (15-131)	2.60
<b>LC</b>	50	35	55 (10-179)	22	72 (40-197)	1.44

Ranges in parentheses; Competence ratio = ratio of 3<sup>rd</sup> level 4 PBA to CCT target number; n (number of trainees) EL (Emergency Laparotomy), LC (Laparoscopic Cholecystectomy), HMN (Hartmann's Procedure), IH (Inguinal Hernia), APX (Appendicectomy), SC (Segmental Colectomy)

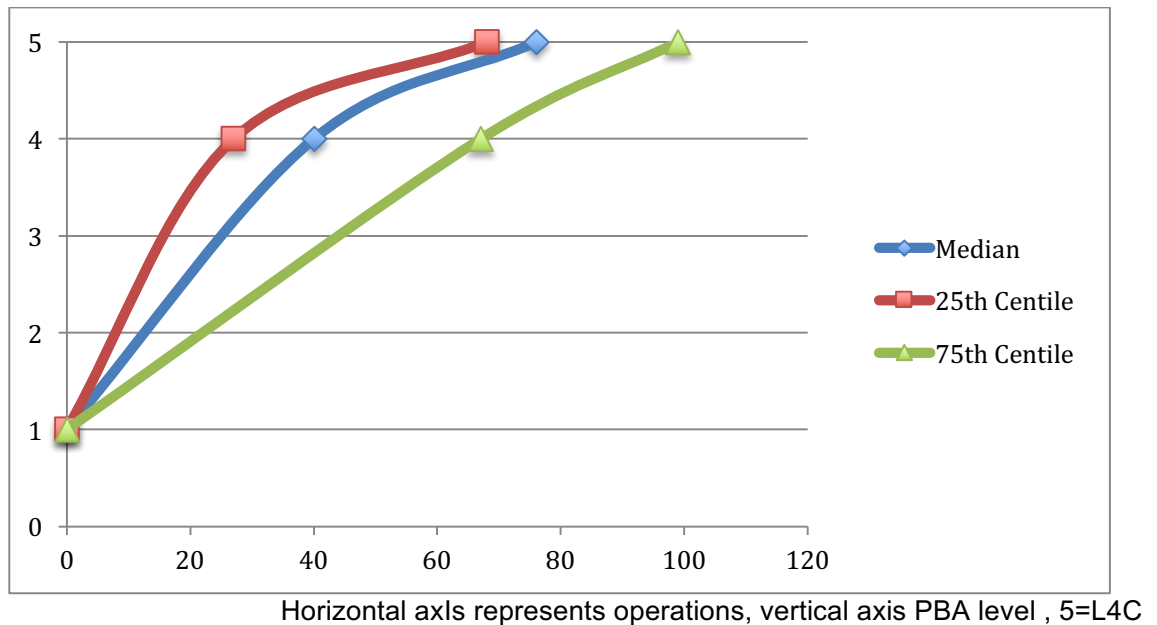
Once the CCT operatives targets were met, an evaluation of all assessments undertaken after this point revealed wide variation related to the proportion of PBAs at level 4, ranging from 38.2% related to Segmental Colectomy, to 86.4% related to Appendicectomy (Figure 6.2).

**Figure 6.2 PBA level achieved after CCT operative targets met**



All numbers percentages. EL (Emergency Laparotomy), LC (Laparoscopic Cholecystectomy), HMN (Hartmann's Procedure), IH (Inguinal Hernia), APX (Appendicectomy), SC (Segmental Colectomy)

**Figure 6.3 Learning Curve for Emergency Laparotomy**



## 6.5 DISCUSSION

This is the first study to examine the relationship between operative experience and competence within a contemporary UK surgical training programme, and the principal finding was that CCT defined competence was achieved within the set operative target window in only 1 of 6 key indicative procedures, with competence ratios ranging over four fold, from a minimum of 0.76 (Emergency Laparotomy) up to a maximum of 3.4 (Hartmann's procedure). Arguably therefore, current CCT guidance targets of 60 inguinal hernia and 100 emergency laparotomy operations are set at the correct level because the median operative experience needed to reach competence was comparable. All of the other indicative operations have their target numbers set too low with competence ratios of 1.3 to 3.4, and these levels require re-consideration. Certainly, anxiety has been expressed regarding whether modern training is fit for the purpose of producing surgeons capable of independent practice (Thomas et al. 2015), and of particular concern is emergency surgery training, which has resulted in pan-association published guidance citing the need for mandatory modular emergency surgery training becoming an inherent part of the curricular pathway (ACPGBI et al. 2015). In Chapter 5 the UK Specialty Advisory Committee in General Surgery outcomes of 155 Higher Surgical Trainee CCT applications in 2013 were reported, and found that the use of workplace based assessments to demonstrate competence was poor. Median total operative experience was 1802 cases (range 783-3764), with two thirds of applicants achieving the indicative guideline of 1600 (unrelated to special interest,  $p=0.133$ ). Median emergency laparotomy caseload was 102 (1-335) with three quarters achieving the target, and GI trainees more likely to exceed the target than their non-GI counterparts (median 111 vs. 92,  $p<0.001$ ). Only in

the case of Hartmann's and Segmental Colectomy were the median number of operations performed lower than the level at which CCT competence was achieved in the current study (HMN 12 vs. 17, SC 42 vs. 52).

The relationship between experience and technical ability has been extensively reported via the study of learning curves, although their use within the context of surgical education remains controversial (Hopper et al. 2007). Serial measurement of operation specific outcomes can plot a surgeons position on a curve, with competence deemed to be the point at which curve trajectory flattens consistent with competent outcomes (Hopper et al. 2007). The use of PBAs to define competence is relatively new and rather than operative outcomes, summative trainer observation is used as a means of validated assessment, and comparison with learning curve performance has not been examined previously. With regard to cholecystectomy the current literature suggests that a learning curve of 50 cases exists, yet the results of this study suggest otherwise, with CCT competence achieved at a median caseload 40% higher (Moore and Bennett 1995).

Increasingly minimally invasive techniques and interventional radiology have led to a reduction in emergency Hartmann's procedures undertaken for diverticulitis, the commonest cause of colonic perforation (Salem et al. ; Ricciardi et al. 2009; Regenbogen et al. 2014). The low CCT target may be a reflection of this, however for what is potentially a very challenging operation, results suggest that competence is unachievable after performing only 5 cases. Somewhat surprisingly the operative experience required for L4C in appendicectomy was also significantly higher than the current CCT target (see Table 6.2). Arguably, variability in the uptake of the laparoscopic approach over the past decade may account for this, with exposure to both techniques



dependent on trainee hospital placement. The two techniques have not been evaluated individually in this study but as the majority of appendicectomies are now performed laparoscopically, competence should be achievable within current targets.

Segmental colectomy covers a heterogeneous group of operations with varying degrees of complexity ranging from the open right sided to the laparoscopic left sided resections. This may account for why competence in Segmental Colectomy was largely not achieved (Figure 6.2). Increasing the JCST target or stratification of SC into individual operations should be considered.

The apprenticeship model of training, introduced over a century ago in Halstead's surgical residency programme, based career progression on experience. Validated logbooks now provide the principal evidence and until recently, equated to competence in most surgical training programmes (Reznick 1993; Galasko and Mackay 1997). The advent of Work Based Assessments in UK surgical training was formalised by ISCP in 2007. The UK's Quality Assurance Agency Code of Practice states that all assessment must be explicit, equitable, and valid. Moreover, an optimal assessment tool must be easily understood and applicable to daily clinical practice, producing reliable results, that are both affordable and practical (Quality Assurance Agency for Higher Education ; Okoro et al. 2010). PBAs were introduced as part of the Orthopaedic Competence Assessment Project (OCAP) and have been validated in a number of studies, with a large prospective study showing it to have the highest overall construct validity, reliability and user satisfaction (Pitts et al. 2005). A recent report by Beard et al. demonstrated excellent PBA tool reliability despite inconsistent assessor training, suggesting that intensive assessor training may not be necessary for consistent scoring, due to intuitive

self-explanatory form design and descriptive anchor statements for establishing standards (Figure 6.1) which are well understood without the need for training (James et al. 2009; Beard et al. 2011). It is therefore reassuring that this tool provides a robust and reliable assessment of global competence acquisition. This study has a number of potential limitations. All of the HSTs were from a single UK deanery and the data therefore must be interpreted with caution. The data gathered is largely dependent on the accuracy with which trainees record operative logbook entries and the timing of their assessments. As CCT guidelines were introduced in 2013, it is possible that poorer engagement by senior trainees (on an earlier 2010 curriculum) from early in the cohort occurred, and may have increased the median operative numbers needed to demonstrate competence. Trainees are encouraged to submit assessments for all Consultant supervised training cases, however this is not always feasible and the results of the study may overestimate the operative experience required to meet level 4 competences because an assessment was not submitted for an earlier performed procedure. It is however self-evident that it is in a trainee's best interests to gain 3 level 4 PBAs sooner rather than later. In contrast the study has several strengths in that it represents original work, consists of a full set of data for consecutive HSTs in a single UK Deanery, and highlights the potential research benefits of ISCP generated data, which despite the limitations have produced clear statistical signals, which provide a valuable deeper insight into modern UK General Surgery operative training.

## **6.6 CONCLUSION**

This study has raised questions regarding curricular related specialty operative training standards which aid the acquisition of the knowledge and skill set required for independent consultant practice. European Working Time Regulations have reduced surgical training hours, with the inherent risk of providing lower levels of operative experience than hitherto, and it is important that the standards currently defined are monitored to quality assure the future consultant workforce. The discovery of variance in trainee achievement is unsurprising, given that the traditional UK surgical apprenticeship training model commonly persists, but operative experience and skill remain important for the explicit reason of patient safety. The ISCP represents a significant forward leap in surgical training and optimal operative training requires further profiling, including detailed examination of procedure specific learning curves and rates of change of competence, allied to enhanced simulation techniques, if the operative components of training programmes are to be optimised.

## **Chapter 7**

### **Modular Emergency General Surgery Training: Pilot study of a novel programme in a tertiary training centre**

## 7.1 SUMMARY

Pan-speciality Association consensus guidance advocates mandatory emergency General Surgery (EGS) training modules for Specialist Registrars (StRs). This pilot study aimed to evaluate the impact of one-month EGS modules for 11 StRs over a one-year period.

A cohort of eleven StRs were allocated a focused 4-week emergency surgery module in a tertiary centre undertaking over 350 laparotomies per annum, in addition to the 1:12 on-call duty rota. Primary outcome measures were numbers of indicative emergency operations performed in addition to validated PBAs, both during the EGS module and the whole training year.

The median number of laparotomies performed by StRs during the EGS module was 11 (range 5-15) compared with a total median of 31 (9-49) laparotomies during the whole training year. StRs attended 43.7% of the total laparotomies available during the module (range 24.1-63.7%). EGS modules provided more than a third of the StRs total emergency laparotomy experience, and a quarter of emergency colectomy, appendicectomy and Hartmann's procedure experience. No differences were apparent in EGS module-related outcomes, when comparing junior StRs (ST 3 to 5) with senior StRs (ST 6 to 8).

Significantly greater numbers of PBAs were completed during trainees EGS module related to laparotomy (32 vs. 14%;  $p < 0.001$ ) and segmental colectomy (48 vs. 22%;  $p = 0.019$ ), when compared with the PBAs completed during StRs standard on call duty rota, and the performance levels were maintained following module completion.

These findings provide an important baseline when considering future modular EGS training.

## 7.2 INTRODUCTION

Emergency surgical hospital admissions account for half of all UK general surgery presentations, resulting in as many as 50,000 emergency laparotomies annually (Barrow et al. 2013; Sharrock et al. 2015). Concern regarding variable and suboptimal outcomes, in particular high operative mortality (4 to 42%), has led to new service frameworks to be suggested, whilst a position joint document has been published by the Association of Coloproctology of Great Britain and Ireland (ACPGBI), the Association of Upper Gastro-intestinal Surgeons (AUGIS), and the Association of Surgeons of Great Britain and Ireland (ASGBI) (Awad et al. 2012; Saunders et al. 2012; ACPGBI et al. 2015).

To ensure consultant led, robust, sustainable, and safe Emergency General Surgery (EGS) services, training must be delivered and protected so that the competencies required for the award of a Certificate of Completion of Training (CCT) are achieved (Sharrock et al. 2015). Indeed the pan-association consensus document argues the need for longer attachments and specialist fellowships in EGS, with mandatory 6-month modules becoming an inherent part of the training pathway (ACPGBI et al. 2015). This form of intensive training, often referred to as “massed” practice, has been used to good effect within the military for a number of years. All general surgical trainees must achieve EGS competencies as defined in the 2013 general surgical curriculum, prior to CCT, demonstrated via work-based assessments (Intercollegiate Surgical Curriculum Programme ; Beard 2008). Minimum operative requirements include 100 emergency laparotomy cases (to include a minimum of 20 segmental colectomy and 5 Hartmann’s procedures), and 80 appendicectomies registered in a surgical logbook, a minimum of three level 4 (standard required for CCT) procedure-based assessments (PBA) in each

indicative procedure, and 10 level 4 case-based discussion (CBD) assessments relating to EGS) (JCST 2013).

Because of the initiatives introduced, as described in Chapter 1, allied to subspeciality development, trainees now have approximately 50 per cent less experience in EGS than previously (ACPGBI et al. 2015; Sharrock et al. 2015). Moreover, proposals described in the *Shape of Training* review risk reducing training in EGS further (Greenaway 2013). In Chapter 5 the Speciality Advisory Committee (SAC) curriculum concordance analysis reported that two thirds of General Surgery trainees achieved the minimum CCT operative caseload requirement of 1600, with three quarters meeting the target number of laparotomies. The necessary PBA requirements for the 6 indicative procedures in General Surgery were achieved by only 3% of the trainees.

The aims of this study were to implement and evaluate the impact of a novel EGS training module in a busy tertiary referral centre, to determine whether a dedicated month of EGS exposure would enhance trainee's experience.

### 7.3 MATERIALS AND METHODS

An Emergency General Surgery (EGS) module was instituted in August 2014 at the University Hospital of Wales, Cardiff. This module was approved by the medical workforce department and was EWTD and New Deal compliant. Each specialist registrar (StR) was allocated a 4-week emergency surgery block, in addition to the normal 1:12 on-call duty rota. The agreed hours of work were Monday to Wednesday (8am-9pm), and Thursday (8am-5pm), although a degree of flexibility was encouraged, to maximise training opportunities. Trainees had no elective commitments during this attachment. The EGS or CEPOD (Confidential Enquiry into Post-Operative Deaths) StR had the following roles and responsibilities:

- Attend the daily 8am Consultant post-take ward round (PTWR) and evening PTWR;
- Manage the CEPOD emergency operating list including review and consent of all patients;
- Priority access to ALL emergency laparotomies;
- Tasked with updating the National Emergency Laparotomy Audit (NELA) database prospectively, and complete / lock previous cases where possible(NELA Project Team 2015).

Eleven consecutive NTN specialist trainee registrars (3x ST3, 1x ST4, 2x ST6, 2x ST7, and 3x ST8) completed the above EGS module and were studied. Trainee logbooks and ISCP portfolios for both the period of the EGS module and the overall training year from 6<sup>th</sup> August 2014 to 17<sup>th</sup> July 2015 were interrogated. Trainees were blinded to the data collection process. Total numbers of procedures performed in the hospital were ascertained using the



prospective digital theatre management system, CEPOD theatre procedure books, and the NELA database.

Descriptive statistics were used where appropriate, with parametric data expressed as mean  $\pm$ SD, and non-parametric data as median (range).

Proportions were compared with Chi-squared or Fisher's exact tests ( $p < 0.050$  was considered significant). Statistical analysis was performed using the SPSS Statistics 20 package (IBM Corporation, Armonk, New York, USA).

## 7.4 RESULTS

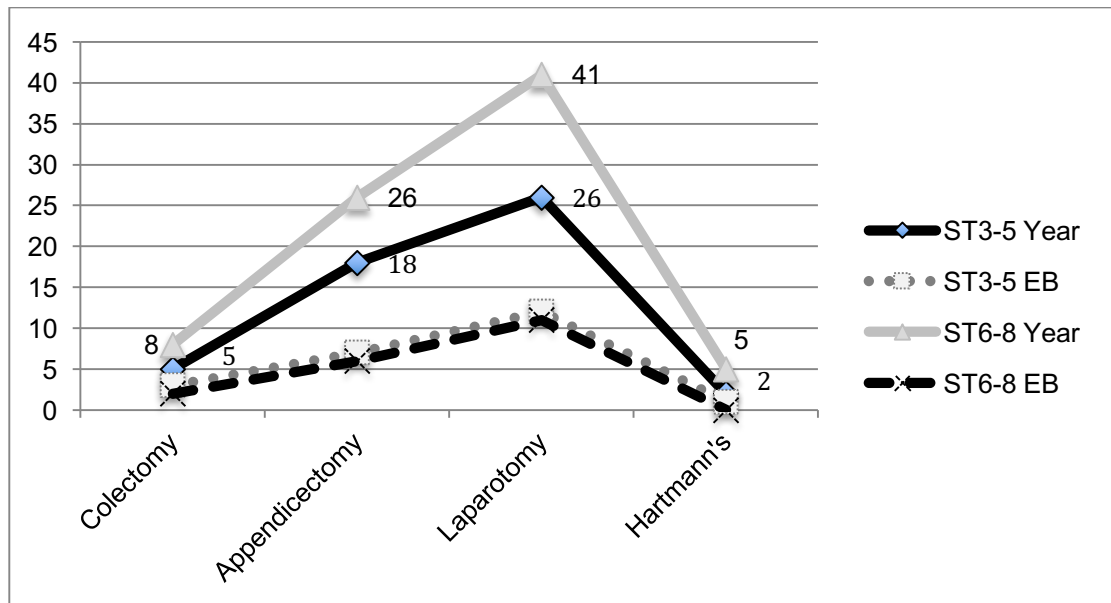
The total number of index procedures performed during the 50-week study period is shown in Table 7.1. Comparison of StR operative numbers in the first half of higher surgical training (intermediate and 1st year of higher I, ST3-5) with those in the second half (2<sup>nd</sup> year of higher I and higher II, ST6-8) is shown in Figure 7.1. Although more senior trainees performed more index procedures than their counterparts in ST3/4 during the course of the whole training year, the numbers of indicative procedures performed during the EGS block were comparable.

**Table 7.1 Number of index procedures performed in 50-week study period and 4-week emergency block**

Procedure	Appendicectomy	Emergency Laparotomy	Segmental Colectomy	Hartmann's Procedure
<b>Total* in study period</b>	302	354	104	38
<b>Median [range]</b>	25 [13-46]	31 [9-49]	7 [1-31]	5 [0-6]
<b>EGS Block* (% total)</b>	82 (27%)	120 (34%)	25 (24%)	10 (26%)
<b>Median [range]</b>	7 [3-14]	11 [5-15]	2 [0-5]	1 [0-4]

EGS, emergency general surgery; \*=total number of procedures for 11 StR combined.

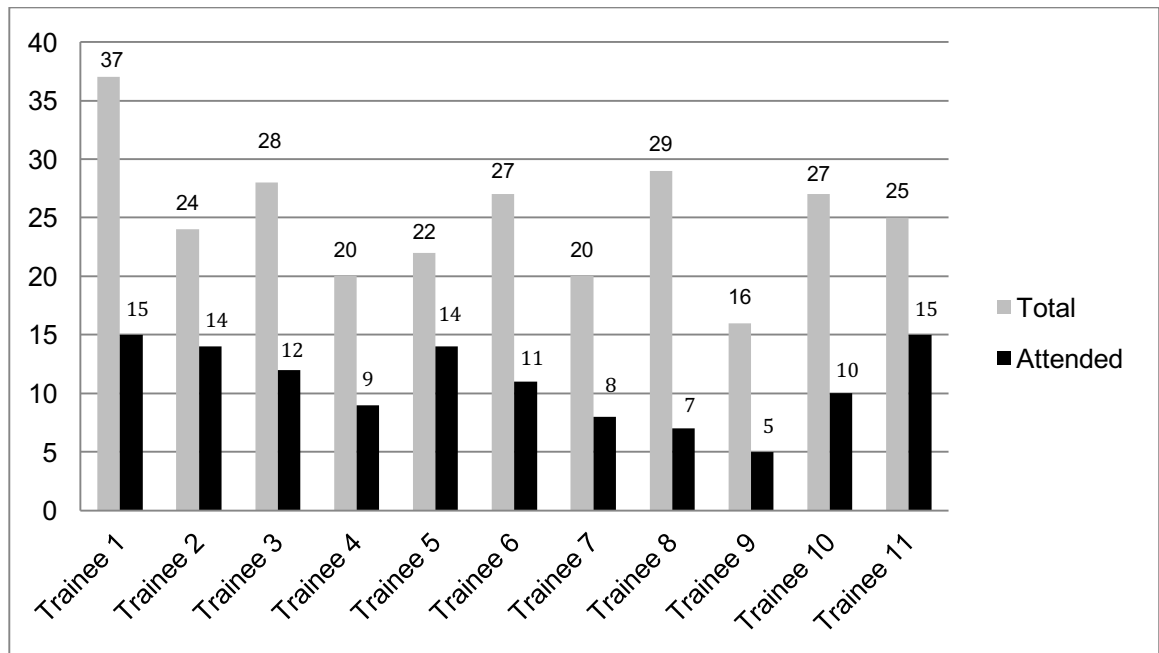
**Figure 7.1 Comparison of logbook numbers between ST3-5 trainees and ST6-8 trainees**



Year, total training year inclusive; EB, emergency block; numbers shown correspond to total year values.

The total number of laparotomy procedures performed in the hospital during the EGS modules was 275, of which 120 (43.7%) were undertaken by the EGS StR (range 24.1 to 63.7 per cent for individual EGS StRs). This total figure excludes laparotomy cases performed at weekends between EGS modules (an additional 30 cases). There were 49 laparotomies in which a second, non-EGS module StR attended; these cases have been double counted in the overall figures. Figure 7.2 shows the proportion of available laparotomies performed by each trainee.

**Figure 7.2 Proportion of emergency laparotomy cases performed related to sequential trainees in each 4-week block.**



A summary of PBA assessments related to specific emergency index procedures is shown in Table 7.2. The number of PBA assessments completed per trainee (median; minimum [IQR] maximum) for index emergency procedures was 11 (4, [9-12], 28) during the 50-week study period and 4 (0, [3-8], 15) during the 4-week EGS module. A total of 133 PBAs were undertaken during the training year, with median scores of 4 for most index procedures, both pre-, and during-, and for all index procedures post-EGS block (see Table 7.3).

**Table 7.2 Proportion of index procedures with accompanying PBA assessment for both total year and emergency block**

Procedure	Background (%) #PBA/#procedures	EGS block PBA (%) #PBA/#procedures	p-value
Appendicectomy	10/220 (5%)	5/82 (6%)	0.561
Laparotomy	33/234 (14%)	38/120 (32%)	<0.001
Segmental Colectomy	17/79 (22%)	12/25 (48%)	0.019
Hartmann's Procedure	12/28 (43%)	6/10 (60%)	0.468

EGS – Emergency General Surgery; PBA – Procedure Based Assessment

**Table 7.3 Procedure Based Assessment (PBA) scores pre-, during, and post-EGS block.**

Procedure	Total PBAs	Pre-EGS Block Median [range]	EGS Block Median [range]	Post-EGS Block Median [range]
Appendicectomy	15	3 [2-4]	4 [3-4]	4 [3-4]
Laparotomy	71	4 [3-4]	4 [2-4]	4 [3-4]
Segmental Colectomy	29	4 [2-4]	3 [2-4]	4 [2-4]
Hartmann's Procedure	18	4 [3-4]	4 [2-4]	4 [3-4]

EGS – Emergency General Surgery; PBA – Procedure Based Assessment

A total of 15 CBDs in emergency general surgery (median [range] per StR; 1 [0-3]) were performed during the EGS module (median [IQR] scores; 4[3-4]).

## 7.5 DISCUSSION

The principal findings of this study were that a 4-week EGS module provided a high-volume period of intense emergency general surgery exposure. Of the 354 laparotomies undertaken by StRs during the training year, a third (34 per cent) were performed during the EGS module, and approximately a quarter of the other index procedures. Extrapolating these figures to a unit with a similar workload implies that a similarly designed 6-month EGS placement might be expected to deliver approximately 70 laparotomies, 42 appendicectomies, 12 segmental colectomies and 6 Hartmann's procedures. Two such placements during a higher surgical training programme would more than fulfil the requirements for CCT target EGS indicative procedures. Review of historical data suggests that the operative numbers in this unit are predictable and sustainable.

The median number of index procedures undertaken during the EGS module was comparable irrespective of trainee grade. This is important because in broad terms, the more senior trainees performed more operative procedures than their junior counterparts during the rest of the training year, suggesting equanimity of access to training opportunities, and the requisite level of supervision for all concerned. Frequently, the majority of contemporary EGS training is provided, on the hoof, during pressurised periods of on-call shift work. Reports of poorer outcomes for patients admitted outside traditional working hours when compared with normal working hours, suggest that this model of training is not only suboptimal in terms of trainee educational value but also threatens patient safety (Sharrock et al. 2015). Moreover, when questioned, a majority of trainees state that they would value 6-month EGS attachments during higher surgical training, and it has been suggested that such modules

may both improve the trainee-trainer relationship, and also facilitate structured skill progression (ACPGBI et al. 2015; Sharrock et al. 2015). This potential benefit might arguably also mitigate the adverse influence of EWTD related restrictions on training time in EGS, although this impact is controversial, with Mahesh et al. reporting an increase in the proportion of cases offered for training at a high volume cardiac centre, following implementation of EWTD (Mahesh et al. 2014).

In a recent survey of 276 UK surgical trainees, only 15.4 per cent stated that they would accept a full time EGS consultant role, with less than 5 per cent expressing an interest in EGS as a primary career selection (ACPGBI et al. 2015). The concept of a post-CCT non (sub)-consultant grade of surgeon, for the provision of EGS has proven unpopular with trainees, and has been opposed by the Association of Surgeons in Training (ASiT) (Shalhoub et al. 2013; Shalhoub et al. 2014). Newly appointed consultants feel less confident in joining the consultant adult emergency rota without support than previously, again suggesting a training deficit (ACPGBI et al. 2015). Despite the fact that a significant minority of patients admitted to tertiary centres require specialist emergency surgery and intensive care input, Garner et al. estimated that a consultant with an alternative sub-specialist interest to that required undertook 30 per cent of complex emergency surgery, and the majority of such surgery was performed out of hours (Garner et al. 2006; Privette et al. 2015).

There is now an increased focus on gaining, proving and documenting competency in indicative emergency operations. Workplace-based assessment tools are an integral part of modern surgical training, and can facilitate competency progression (Shalhoub et al. 2014). Such tools have replaced the unreliable methods of technical skills assessments utilised previously (Moorthy

et al. 2003). PBA assessments are now a well-established, validated method for trainee assessment (Memon et al. 2010; Marriott et al. 2011). These assessments have been shown in prospective studies to have good construct validity, a mandatory component of a competency evaluator, and excellent reliability, whilst being superior to other assessment tools (Okoro et al. 2010; Beard et al. 2011; Marriott et al. 2011). It has been suggested that WBA assessments should continue throughout training, at an approximate rate of one per week (Shalhoub et al. 2014). A total of 76 WBA relating to the 4-index procedures evaluated (61 PBA, 15 CBD) were undertaken by the 11 trainees evaluated during EGS blocks, and the number of WBA per EGS month was approximately 7, which compares favourably with the mean number of 3.8 WBAs completed per month by ENT trainees within the Wales Deanery, and further demonstrates that the EGS module delivered WBAs at volumes consistent with CCT target numbers (Fishpool et al. 2014).

Arguably, the EGS module provided trainees with an environment which encouraged the completion of assessments to demonstrate competence progression, in that a significantly higher proportion of laparotomy and segmental colectomy cases were associated with a PBA assessment during the EGS block, than when undertaken during the general on-call rota. Despite this, the number of CBD assessments completed was overall modest, and although generally considered a positive tool for training by trainees, concerns have been raised regarding the implementation of such assessment tools, which may influence utilisation in this setting (Phillips et al. 2015). More likely, however, is a perception by trainees that EGS modules are designed to improve technical and operative competencies, with more emphasis placed on PBA completion. This rota based model for EGS meant that high volumes of operative cases

could be performed by trainees, associated with PBAs whenever possible. The compromise of such a module is a relative lack of continuity of care. This results from being on-call with several consultants during a 4-week block, and a lack of availability to be involved in the ongoing care of emergency admissions, due to operative commitments. An alternative team-based or ward-based model may nullify some of these concerns, but at the price of reducing operative experiences. An additional benefit of team-based EGS training is the rapid development of a trainer-trainee relationship to further enhance training, including targeted competency training, and assessment completion, particularly CBDs.

Overall, the median level of PBA achieved for each index procedure was high, with a median level of 4 in most cases before, during and after the EGS module. The high pre-EGS scores for trainees make it difficult to demonstrate improvements during the high-volume EGS block, although this data suggests that trainees were not becoming de-skilled following completion of the module. This is likely due to the fact that between 66 and 76 per cent of all index procedures were available for non-EGS module StRs, both during parallel daytime emergency operating sessions and out-of-hours. This allowed adequate exposure to emergency surgery as part of the normal on-call rota to maintain competency, to at least the level attained during the EGS modules.



## **7.6 CONCLUSION**

This novel 4 week emergency general surgery block delivered a high volume of index emergency procedures, allied to a learning environment suitable for PBA completion at a higher rate than would be expected during standard training.

These findings provide an important baseline when considering future possible modular based EGS training.

## **Chapter 8**

**The use of the Hirsch Index to assess scholarly activity amongst Consultant General Surgeons and to identify trainee academic opportunities.**

## 8.1 SUMMARY

The Hirsch Index (h-index) is often used to assess research impact, and on average a social science senior lecturer will have an h-index of 2.29, yet its validity within the context of UK General Surgery (GS) is unknown. The aim of this study was to calculate the h-indices of a cohort of GS consultants in a UK Deanery to assess its relative validity and potential use as a marker of academic training potential.

All 136 GS consultants from a single UK Deanery (14 Hospitals) were included. Individual h-indices and total publication counts were obtained for GS consultants via the SCOPUS and Web of Science (WoS) internet search engines. Assessment of construct validity and reliability of these two measures of the h-index was undertaken.

Median h-index (Scopus) was 5 (0–52) and TP 15 (0-369), and strong correlation was found between between h-index and TP ( $\rho = 0.932$ ,  $p < 0.001$ ), with the intra-class correlation between Scopus and WoS h-index also significant [ICC 0.973 (95% CI 0.962 to 0.981),  $p < 0.001$ ]. Academic GS consultants had higher h-indices than non-academic University Hospital and District General Hospital (DGH) consultants [Scopus 12 vs. 7 vs. 4, ( $p < 0.001$ ) and WoS 10.5 vs. 7 vs. 4 ( $p < 0.001$ )]. H-index was  $> 2.29$  in 57.4% of consultants. No subspecialty differences were apparent in median h-indices ( $p = 0.792$ ) and TP ( $p = 0.903$ ).

H-index is a valid GS research productivity metric with over half of consultants performing at levels equivalent to social science Senior Lecturers.

## 8.2 INTRODUCTION

The Hirsch Index (h-index), a measure of research impact, was first introduced in 2005 by Jorge E. Hirsch to objectively quantify an individual's cumulative research productivity and address the limitations of other traditional bibliometric indicators such as journal impact factor, publication number and citations (Hirsch 2005). It has rapidly gained favour for its emphasis on rewarding authors who publish work with a measurable effect in their field, and has been shown to outperform other bibliometrics when evaluating research performance within surgical specialties (Benway et al. 2009; Lee et al. 2009; Francisco A. Ponce and Andres M. Lozano 2010; Eloy et al. 2012; Colaco et al. 2013; Sharma et al. 2013; Svider et al. 2013; Paik et al. 2014; Svider et al. 2014). The main advantage of the h-index is that it incorporates two traditional measures of research productivity; the number of publications (quantity) and citations (quality). An author has an index  $h$ , if  $h$  of their  $N_p$  papers have at least  $h$  citations each, and their other papers ( $N_p - h$ ) have less than or equal to  $h$  citations each (Hirsch 2005). Therefore an author with an h-index of 10 will have 10 published papers that have each been cited at least 10 times. Because of this and its apparent insensitivity to authors that publish a high volume of low-impact papers or a low volume of high-impact papers, h-index has been adopted in many fields of science as a robust bibliometric. Although self-citation can have an effect, the h-index appears to be more resilient to this than other traditional metrics (Callaham M ; Engqvist and Frommen 2008; Eloy et al. 2012), and can be readily calculated using online bibliographic search engines, the most common being Elsevier's Scopus and Thomson Reuters' Web of Science. A UK study of 120 academics within the Social Sciences showed on

average full Professors had an h-index of 4.97 and Senior Lecturers 2.29 (London School of Economics 2011).

Within the context of UK General Surgery h-index validity has not been examined; indeed only one Canadian study reports its use in General Surgery and found significant differentiation related to academic rank and institutional affiliation (Sharma et al. 2013). The aim of this study was to assess the value, variability and validity of the HI as a marker of research performance and academic training potential for a cohort of General Surgery consultant trainers within a single UK Deanery. This is of particular contemporary relevance in light of the recent publication of the 2013 iteration of the UK Joint Committee on Surgical Training (JCST) GS Curriculum which mandates that Higher Surgical Trainees must possess at least 3 peer reviewed publications for successful award of a Certificate of Completion of Training (CCT) in general surgery (JCST 2013).

### **8.3 MATERIALS AND METHODS**

#### *Subjects*

All consultant general surgeons involved in training within the Wales Deanery were included. All data was collected in January 2015 and surgeons were categorised into: Academic, University Hospital, or District General Hospital. The collection of data and calculation of the h-index was obtained from 2 online bibliographic databases, Elsevier's SciVerse Scopus and Thomson Reuters' Web of Science.

#### *Scopus*

Using the author search function in Scopus, the surgeon's surname and initials

were entered, initially using only one initial to keep the search as broad as possible. All publications were reviewed and added to the My List function using the search results format. Using the view citation overview function the h-index, publication number and citation number were recorded. Mean citation per publication was calculated independently from the above numbers.

### *Web of science*

Using the author finder function in Web of Science, the same search was conducted. Subject categories were limited to life sciences, social sciences, biomedicine, multidisciplinary science and technology. Abstracts and conference papers were excluded. Relevant publications were then identified and the 'create citation report' function was used to calculate the h-index, publication number, citation number and a mean citation per publication.

If an author was not found on either search engine then the h-index was assumed to be 0. Each search was conducted on the same day to minimise bias, and all searches were completed within three days, by two authors independently. Significant differences in the final h-index and publication numbers obtained from both search engines were reviewed, repeated and cross-checked prior to inclusion in the study.

### *Construct validity*

An assessment of construct validity for this metric was undertaken by evaluating the differences in h-index among Academic, University Hospital, and DGH GS with the expectation that any valid marker of scholarly productivity would provide a higher value in surgeons with academic interests. As a secondary outcome measure, the impact of academic status and institution on the other

bibliometrics was measured, including publication numbers, citation numbers and mean citations per publication.

### *Statistical analysis*

Data was collected and analysed in SPSS<sup>®</sup> version 20 (SPSS, Chicago, Illinois, USA). Traditional measures of research productivity were compared and assessment of the intervariable reliability of the databases used for h-index calculation was performed. The null hypotheses were (1) h-index would not relate to academic status; (2) h-index would not relate to institutional affiliation; (3) no inter variable disagreement in h-index existed related to database used. Continuous data was explored for normality using the Kolmogorov-Smirnov test. As data sets did not conform to a normal distribution, analyses appropriate for non-parametric data were used in the form of Mann Whitney U and Kruskal-Wallis H tests. An assessment of reliability for the two measures of h-index was obtained using a Bland-Altman plot in which both the mean bias (the average difference of the h-index between the two measures) and the 1.96 SD agreement limits (a measurement of the range of differences) were calculated. This test provides a comparative analysis of two methods used to measure the same variable when neither is recognised as the gold standard. The use of the Intra Class Correlation Coefficient (ICC) allowed quantification of the degree of consistency between the two search engines.

## 8.4 RESULTS

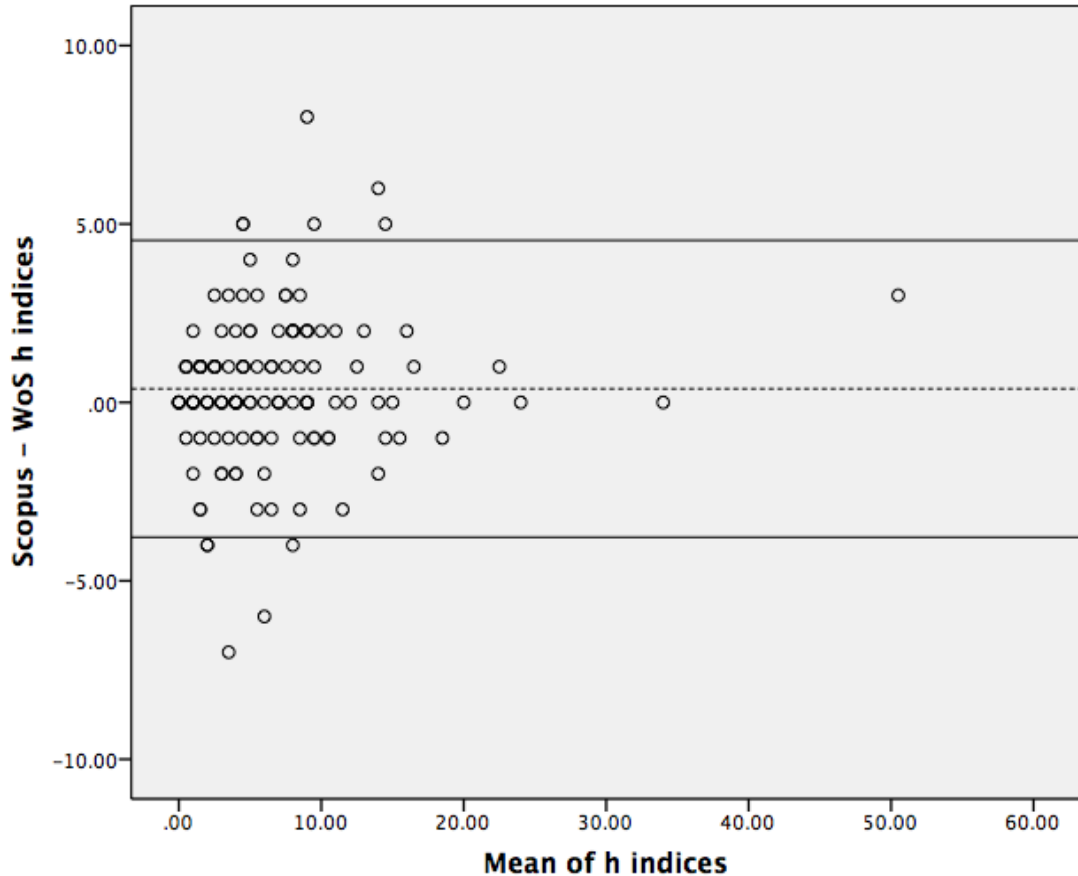
Data was available relating to 136 GS consultants in 14 hospitals across Wales. Subspecialty interests numbered seven, the largest cohort was colorectal surgery (47 consultants), and the smallest endocrine (3 consultants). Sixteen were in possession of an Academic title (5 substantive University status and 11 honorary titles). The overall median number of publications declared by Scopus and WoS was 15 (0-369) vs. 12.5 (0-291) respectively; h-indices were 5 (0-52) vs. 5 (0-49); median citation counts 119 (0-12233) vs. 130 (0-10239), and citations per paper 8.89 (0-46.45) vs. 8.85 (0-43.58) respectively. Median h-indices (Scopus vs. WoS) by subspecialty were: Endocrine 7 vs. 7, Vascular 6.5 vs. 7, UGI 6.5 vs. 6, HPB 6.5 vs. 5, Transplant 5 vs. 5, Breast 5 vs. 3 and Colorectal 4 vs. 4 (p=0.802 vs. p=0.541).

### *Assessment of reliability*

Using the Bland-Altman box plot, the mean bias (agreement) between Scopus and WoS was fair at 0.382 h-index points (95% CI -3.777554 to 4.542), but the range in agreement was considerable (-7 to 8, figure 1). The Intra class Correlation Coefficient was 0.973 (95% CI 0.962 to 0.981, p<0.001), which indicates a high degree of reliability between measurements (Figure 8.1).



**Figure 8.1 Bland–Altman plot for Scopus and Web of Science h-indices.**



The mean bias (the mean of the differences between the h-indices calculated by the two search engines) is represented by the dotted line with the solid lines representing  $\pm 1.96$  Standard Deviation of this bias.

*Assessment of construct validity*

Table 8.1 shows that the median h-indices of GS consultants in possession of an Academic title was significantly higher than University Hospital and DGH non-academics.

When Academic surgeons were excluded the difference in the h-indices of University Hospital vs. DGH GS alone reached statistical significance 7 vs. 4 ( $p < 0.001$ ) with both Scopus and WoS. The difference between Academic and University Hospital GS was also highly significant (Scopus  $p = 0.003$ , WoS  $p = 0.015$ ).

### *Comparison with other bibliometric measures*

H-index correlated with publication number (Scopus rho=0.927,  $p<0.001$ , WoS rho=0.917,  $p<0.001$ ), total citations (Scopus rho 0.959  $p<0.001$ , WoS rho 0.939  $p<0.001$ ), and mean citations per publication (Scopus rho 0.656  $p<0.001$ , WoS rho 0.573  $p<0.001$ ). Publication numbers were significantly higher in Academic than in University Hospital and DGH GS using both Scopus ( $p<0.001$ ), and WoS ( $p<0.001$ ) (Table 8.1).

**Table 8.1 H-index construct validity and bibliometrics related to surgeon status**

Consultant (n=136)	Scopus				WoS			
	HI	TP	C	C/P	HI	TP	C	C/P
<b>Academic (n=16)</b>	12 (1-52)	38	520	13.01	10.5 (1-49)	29.5	332.5	9.93
<b>University Hospital (n=39)</b>	7 (0-24)	18	172	9.23	7 (0-24)	18	174	10
<b>DGH (n=81)</b>	4 (0-18)	10	80	6.5	4 (0-19)	9	93	7.89
<b>p-value</b>	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.155

Ranges in parentheses. DGH (District General Hospital); WoS (Web of Science); HI (Hirsch Index); TP (Total Publications); C (Citations); C/P (Citations per Paper)

Academic GS consultants had significantly higher total citation numbers than University Hospital and DGH consultants using both search engines (Table 8.1). Mean citations per paper were also higher in Academic GS consultants using Scopus ( $p=0.001$ ), but no discernable difference was apparent using WoS, 9.93 vs. 10 vs. 7.89 ( $p=0.155$ ) (Table 8.1).

## 8.5 DISCUSSION

This is the first UK study to report the relative academic productivity related to a cohort of general surgeons as measured by the Hirsch Index, a bibliometric that attempts to evaluate both the quantity and influence of an author's academic publications. The principal findings were that 85% of surgeons (116) had published three or more papers with the median numbers being 15 (Scopus) and 12.5 (WoS) respectively. The median h-index of the full cohort of Wales

Deanery general surgeons was 5 using both the Scopus and Web of Science search engines. Publications were not apparent for 8% (Scopus) and 3% (WoS) of consultants. Higher h-indices were associated with surgeons who were in possession of substantive and honorary academic and University titles when compared to their DGH surgeon counterparts, which is in keeping with reports from a number of other surgical and medical specialties allied to surgery (such as ophthalmology, neurosurgery and anaesthesia) (Benway et al. 2009; Lee et al. 2009; Francisco A. Ponce and Andres M. Lozano 2010; Bould et al. 2011; Pagel and Hudetz 2011; Eloy et al. 2012; Colaco et al. 2013; Sharma et al. 2013; Svider et al. 2013; Paik et al. 2014; Svider et al. 2014).

Differences between the h-indices calculated using the two online databases were apparent, but overall statistical agreement between the two was good, with both providing very similar results for the different groups of surgeons. Sharma et al. also compared Scopus and Web of Science in their cohort of general surgeons, and although average agreement between the two search engines was excellent, the range of agreement was considerable with few outlying cases that risk skewing concordance, particularly relating to publications that were older in certain journals (Sharma et al. 2013). This variation can be explained by differing database journal coverage and date ranges of citations which have been found to produce quantitatively different citation counts and hence h-indices. Scopus for example, only accounts for publications that appeared after 1995, disadvantaging senior authors (Falagas et al. 2008; Kulkarni et al. 2009; Bould et al. 2011; Patel et al. 2013).

The h-index as a marker of academic achievement appears impervious to authors that publish frequently low impact research or those that may have a misleadingly high citation rate reflective of only one or two influential papers.

However the h-index has been criticised for a number of shortcomings, despite its obvious advantages over traditional metrics. The inability to compare scientists belonging to different fields or subspecialties, and to differentiate authorship order within the final manuscript can be significant (Cronin and Meho 2006). Researchers with little input to a paper can earn the same recognition as the primary author (Hirsch 2005). Also the type of research is not accounted for, so a potentially influential multicentre randomised control trial is not differentiated from small retrospective case series (Hirsch 2005). The h-index will also increase with time as older papers are more frequently cited, which will tend to favour senior researchers, a factor that needs to be considered when comparisons are made.

This study has a number of potential limitations. Difficulty in obtaining reliable bibliographic outputs for individuals with common names was a practical challenge. Individual authors can be identified based on name and affiliation but researchers frequently change or use different initials and affiliations confounding search results. Potential inaccuracies were minimised in this study by the use of two reviewers performing each search separately with differences cross-referenced and anomalies excluded. The study focussed on one UK Deanery and geographical region but a UK wide study would produce higher-powered results. Moreover, higher numbers of academic surgeons would facilitate further classification related to academic seniority allowing a more precise measure of validity to be performed. Honorary university titles are frequently awarded according to other professional contributions such as medical education rather than research expertise and this arguably represents a potential flaw in using this model as an assessment of construct validity (Fuller et al. 2009; Sharma et al. 2013). Differences in database citation counts

obtained can also produce h-indices that vary quite significantly, and several studies have reported potential disagreement between databases (Falagas et al. 2008; Kulkarni et al. 2009; Bould et al. 2011; Patel et al. 2013; Sharma et al. 2013). Future correlation with trainee scholarly activity can provide further evidence for the use of this bibliometric within rotational planning for trainees, however due to the time delays associated with producing peer reviewed publications, this correlation was beyond the scope of this study.

## **8.6 CONCLUSION**

H-index value has been reported to predict future academic productivity in a number of studies (Hirsch 2007; Lee et al. 2009). The findings of this study suggest that the use of the h-index provides a more robust measure of a surgeon's academic profile than traditional bibliometrics. It is evident that the level of published scholarly activity amongst General Surgeons is high, with h-indices equivalent to or above that of a Social Sciences Senior Lecturer (2.29) and Professor (4.97) in 57% and 40% of consultants. In the context of contemporary UK surgical training this metric may be used to identify where opportunities lie for trainees to engage in academic activity likely to result in publication. It seems self-evident that rotations that include time on an academic consultant firm or at a University Teaching Hospital would be associated with improved chances of a trainee achieving publications. With the most recent iteration of the JCST general surgical curriculum (2013) setting an indicative target number of three peer-reviewed publications during Higher Surgical Training, data such as this are valuable in allowing training programme directors and health education providers alike access to information to plan and tailor individual rotational programmes appropriately so that CCT requirements are achieved (JCST 2013).

## **Chapter 9**

### **General discussion and prospects**

This thesis has provided original and valuable insights into surgical trainee's clinical experience within a contemporary surgical training programme both before, during, and following reconfiguration of Core and Higher General surgical training. As well as examining previously unreported national educational outcomes, the attributes necessary for successful trainee progression into Higher Surgical Training were identified, as were hospital placements able to deliver the requisite operative and academic opportunities for achieving JCST defined curricular competencies.

### **9.1 CORE SURGICAL TRAINING RECONFIGURATION IN WALES**

Core Surgical Training (CST) in Wales has been recognised as an area of tangible concern, with the majority of trainees failing to secure a Higher Surgical Training (HST) number on completion, and trainee satisfaction rates amongst the lowest of all postgraduate medical specialties (Carr et al. 2011; GMC 2014). The ideal shape and duration of CST remains controversial and despite national recruitment and standardised assessments, little uniformity exists across deaneries with regard to rotational structure, duration of individual placements and the provision of themed rotations (Glancz 2013; Thomas et al. 2014).

A concerted effort to improve Wales Deanery training outcomes was undertaken through the reconfiguration of CST, resulting in a threefold improvement in national HST NTN appointment rates. Logistic regression analysis revealed that both reconfiguration and the publication of a solitary peer reviewed paper were independently predictive of appointment. The results suggest that the development of a training programme driven by stringent predefined curricular targets, a rigorous biannual appraisal system and an



emphasis on educational supervision, can significantly improve trainee outcomes. Arguably, as a result of these changes, trainees are better informed as to the attributes desirable for successful HST selection. The observed improvements correlate with that seen in trainees successful at HST appointment and therefore it seems logical that reconfiguration resulted in improved appointment rates. This opens the door for the development of educational contracts between trainees, Local Educational Providers and Deaneries, which embed within them evidence based standards of training that must be delivered, in the hope of maximising educational outcomes. The introduction of themed CST rotations weighted towards the trainee's desired specialty of choice, substantiates the theory that trainee opportunities to focus CV building and clinical exposure in their chosen career path are enhanced in themed rotations, improving their chances of HST NTN selection.

Further research should focus on subspecialty outcomes and career progression. The concept of 'boot camps' as a medical education tool has grown in popularity as a time-efficient way of improving knowledge, confidence and clinical skills (Parent et al. 2010b; Parsons et al. 2011; Blackmore et al. 2014; Singh et al. 2015). The 'boot camp' concept serves to deliver an intensive, simulation-rich programme of training at the commencement of a training rotation to facilitate more focused educational opportunities and greater acquisition of both technical and non-technical skills than would otherwise be offered in the clinical setting (Ferguson 2010; Parent et al. 2010a; Parsons et al. 2011; Sachdeva et al. 2011; Sonnadara et al. 2012). Within Wales, the development of such 'boot camps' may further enhance core surgical training

outcomes, and further research is needed to assess any associated potential educational value.

## **9.2 RURAL HOSPITAL ROTATIONS AT CORE**

Recruitment and retention of doctors in rural and remote hospitals in Wales is challenging, largely due to the perceived social isolation and lack of training opportunities. Recent advances in surgery have driven the centralisation of subspecialty services within the UK, with a large body of evidence demonstrating improved patient outcomes in high volume specialist centres (Scottish Executive 2000; NHS Executive 2001; Archampong et al. 2012; RCSEng 2013; Gibbons et al. 2015; RCSEd 2016). In Wales, the centralisation of major elective cancer and vascular services has had implications for training. This thesis has examined data from each CST post in rural and non-rural hospitals to allow accurate benchmarking and comparative analysis of training quality (Chapter 4). Reassuringly National HST appointment and operative experience was comparable. It was of note and arguably predictable, that with regard to certain intermediate operations such as inguinal hernia repair, trainee experience in rural hospitals was significantly greater. This may be a consequence of centralisation, leaving rural hospitals with a higher proportion of routine procedures suitable for junior level trainees. It would seem reasonable therefore that trainees in their early stages may benefit more from such rotations compared with those further ahead in their training seeking complex subspecialty training. A trend towards lower academic productivity in the rural placements was also observed, a probable reflection of the higher academic profile and established university support of surgeons working in larger teaching units, as demonstrated by the relative Hirsch Indices reported in Chapter 8.

Further research should investigate the effect of rural placement in Higher Surgical Training, with qualitative methodologies to ascertain trainee opinion.

### **9.3 CONTEMPORARY HIGHER SURGICAL TRAINING IN GENERAL SURGERY THE UK**

The introduction of the 2013 JCST guidelines for Certification of Completion of Training (CCT) in General Surgery has set a precedence for surgical training throughout the world, with evidence of competence as well as experience stipulated through validated assessment tools (JCST 2013). The first MMC cohort of trainees completed their training in 2013, however as the guidelines were only introduced toward the end of their training, recommendation for registration on the specialist register based on the guidance were only flexibly applied. Despite this it was considered appropriate that trainee achievements were measured against these guidelines, as the results reported in Chapter 5 demonstrated, the experience of current trainees is in line with that of a cohort of from previous years (Allum et al. 2013). It is reassuring that despite full EWTD implementation, experience has not diminished.

This particular study has highlighted the importance of vigilance and active management of training programmes as there still remains a proportion of trainees failing to achieve the necessary competence and operative experience. Trainees who are at risk of, or failing to progress as expected, need to be identified early and offered targeted training. The ability to obtain a unit's composite training outcome from data provided by the ISCP and ARCP process, means individualised rotations centered around targeted educational needs can be effectively created.

A follow-up of trainees from this study may provide further insight into the attributes, qualifications and academic achievements associated with successful consultant appointment in each subspecialty, and help inform trainees regarding future career planning. The relationship between operative experience and competence that was reported in Chapter 6, has provided valuable intelligence for evidence-based adjustment to future curriculum development.

#### **9.4 GENERAL SURGERY OPERATIVE EXPERIENCE VERSUS COMPETENCE**

Prior to the research undertaken for this thesis, no published data had examined the thresholds at which operative competence was achieved within surgical training (van Hove et al. 2010), as assessed by the PBA tool (Beard et al. 2011). Guidance for minimum operative numbers required for certification have however been used in surgical training programmes throughout the world (American Board of Surgery), and only recently introduced to the UK, on the background of data reporting operative experience of previous cohorts of CCT applicants (Allum et al. 2013; JCST 2013).

Within General Surgery in Wales, competence was only achievable in 2 of the 6 indicative operative targets set. With regards to Hartmann's procedure, segmental colectomy and cholecystectomy, this may be a reflection of the spectrum of disease and difficulties often encountered in such operations. A recent published report from the Yorkshire Deanery comparing experience and competence in these three procedures also reported grossly unachievable competence within set JCST operative targets (De Siqueira and Gough 2016). This discrepancy raises concerns, as results suggest competence requires a

higher level of experience than originally anticipated. Indicative procedure numbers should be set at a level reflective of not only the average experience achieved by previous cohorts of trainees, but also at a level that is sufficient for individual trainees to achieve competence.

Future research should investigate the correlation between experience and competence on a larger scale, allowing for the development of individualised learning curves for each indicative procedure, related to both case number and time in training. This is a novel approach to learning curve theory, which has traditionally used objective markers such as decreasing operative time and complications as surrogates for competence (Hopper et al. 2007). The growing use of simulation offers trainees the opportunity to develop and practise skills fundamental to an operation, in an environment outside of theatre (Milburn et al. 2012). Further research should also appraise the potential effect that a period of focused simulation training would have on learning curves in relation to the JCST specific indicative procedures.

## **9.5 TRAINING IN EMERGENCY GENERAL SURGERY**

Emergency surgery accounts for approximately half of the NHS surgical workload, and is associated with the highest morbidity and mortality (RCSEng 2011). The management of acute surgical patients is regarded as the most challenging, both in clinical decision making and workload, resulting in an innate lack of enthusiasm for EGS amongst consultant surgeons. Despite this, training has traditionally been ad hoc, and owing to relative underinvestment when compared to elective surgery, has been viewed as a 'Cinderella' specialty (Behar 2013). The transferrable skills amassed from elective practice, and the global time spent in training, were deemed sufficient to produce competent

emergency general surgeons (Sharrock et al. 2015).

Following EWTD and MMC, it is estimated that current trainees are exposed to 50% less EGS than trainees 20 years ago (ASGBI 2012). Despite recognition of its importance in the 2013 GS curriculum, clear deficiencies in UK EGS training still exist as evidenced by the results reported in Chapter 5. The old model of training in EGS is no longer tenable in the post MMC era, with on-call commitments largely viewed as service provision rather than dedicated training. Although the two must coexist, recommendations from the Royal College of Surgeons and Association of Surgeons in Training stipulate that dedicated training posts in EGS become rotational, with formalised educational supervision as per the traditional elective surgical subspecialty training (ACPGBI et al. 2015; Sharrock et al. 2015).

A novel approach to EGS was undertaken in a large University Hospital in Wales in which trainees were fully immersed in an emergency general surgery block for one month with structured training overseen by a lead consultant. Encouragingly, the 4-week EGS block delivered a high volume of index emergency procedures, allied to a learning environment suitable for completion of WBAs at a higher rate than would be expected during standard training. These findings provide an important baseline when considering possible future modular based EGS training. Probably just as important, is the likelihood that such posts, if extended to 6 month periods would ensure that in the vast majority of trainees, greater than 50% of operative experience and competence would be achieved.

## **9.6 USING THE HIRSCH INDEX TO IDENTIFY TRAINEE RESEARCH OPPORTUNITIES**

The GMC state that all doctors must 'provide effective treatments based on the best available evidence' and 'apply scientific method and approaches to medical research' (GMC 2013). In an attempt to ensure such skills are evidenced, the award of CCT in general surgery necessitates that all trainees publish 3 peer reviewed papers and present at 3 national or international meetings during training (JCST 2013). It is hence the responsibility of the trainee to engage in research, and the role of training programme directors to facilitate opportunities to undertake such academic activity.

Using the Hirsch Index (h-index), a bibliometric used to evaluate both the quantity and influence of published works, university affiliated academic GS consultants within the Wales deanery were found to have a higher research profile than non-academic University Hospital and District General Hospital (DGH) consultants, with a significant difference between each group. It seems self-evident therefore that opportunities for research activity for trainees are greater on rotations within university teaching hospitals because of consultant academic profile with studies showing that the h-index value predicts future academic productivity (Hirsch 2007; Lee et al. 2009).

Within the General Surgery setting, the h-index has been shown to be a validated measure of scholarly activity amongst consultant surgeons, and should be used to identify academic opportunities for trainees. Further research should correlate rotational trainee scholarly outputs with the cumulative h-indices of consultant firms for whom they work.

## **9.7 CONCLUSION**

Assumed surgical competence based on time spent in training has recently given way to a more structured training programme in which career progression is subject to the demonstration of validated competence assessments.

Workplace based assessments are now integral to the training pathway and are used to define quantifiable targets necessary for progression.

Further reforms to UK training are imminent following the recent endorsement of Professor Greenaway's "Shape of Training" review, in which a reduced training pathway producing more generalist surgeons, is envisaged (Greenaway 2013).

The Royal College of Surgeons have subsequently produced a report "Improving Surgical Training" which aims to facilitate some of the issues identified in the Greenaway report, and emphasises a competency based curriculum that can maximise educational opportunities and streamline the training pathway (RCSEng 2015). It is important however that any changes in training pathways are based on robust evidence, to ensure the high standards UK surgical training has been built on are maintained, and that surgery remains an attractive career prospect for future trainees. Future reconfiguration must ensure that at its completion, training continues to produce surgeons competent to practice within their chosen subspecialty



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## **APPENDIX 1**

### **Definition of emergency laparotomy for logbook recording**

An emergency laparotomy is a major procedure undertaken by most general surgeons, and covers a wide variety of operations and pathologies. For the purposes of this study, and UK logbook data entry, the operations defined as an emergency laparotomy are shown her.

What SHOULD be included:

All patients undergoing immediate / urgent / (+ ?expedited) abdominal surgery  
via:

- a) An abdominal incision or
- b) A laparoscopic approach or
- c) A combined laparoscopic and open approach

to treat:

- a) the first presentation of abdominal pathology (including trauma) or
- b) a specific post operative complication

What SHOULD NOT be included:

- a) Appendicectomy of any type as the sole surgical procedure
- b) Cholecystectomy of any type as the sole surgical procedure
- c) Diagnostic laparoscopy as the sole surgical procedure
- d) Planned "second look" laparotomy
- e) Implantation of organ transplants



Specific procedures that **SHOULD** be included:

- a) open or endovascular ruptured aortic aneurysm repair
- b) open mesenteric revascularisation
- c) heart beating multi-organ harvesting (maximum of 20 allowed to count for CCT purposes)

### **Logbook Classification**

#### *IMMEDIATE*

Immediate - within 1 hour

#### *URGENT*

surgery as soon as possible after resuscitation (less than 24 hours)

### **NCEPOD classification**

#### *IMMEDIATE*

Immediate life, limb or organ-saving intervention – resuscitation simultaneous with intervention. Normally within minutes of decision to operate.

#### *URGENT*

Intervention for acute onset or clinical deterioration of potentially life-threatening conditions, for those conditions that may threaten the survival of limb or organ, for fixation of many fractures and for relief of pain or other distressing symptoms. Normally within hours of decision to operate.

#### *EXPEDITED*

Patient requiring early treatment where the condition is not an immediate threat to life, limb or organ survival. Normally within days of decision to operate

## Procedures Counting as Emergency Laparotomy when performed as Immediate or Urgent

Anterior resection of rectum - complete operation {}  
Colectomy - left - complete operation {}  
Colectomy - right - complete operation {}  
Colectomy - sigmoid - complete operation {}  
Colectomy - subtotal {}  
Colectomy - total + ileorectal anastomosis {}  
Colectomy - total + ileostomy {}  
Colectomy - transverse {}  
Ileo-transverse by-pass {}  
Colostomy - formation  
Hartmann's - resection - perf / obstr {}  
Ileocaecectomy  
Re-operation - inflammatory bowel disease {}  
Laparoscopy - small bowel resection {}  
Laparoscopy - division of adhesions {}  
Laparoscopy - inoperable malignancy +/- by-pass {}  
Laparoscopy - post operative complications {}  
Laparoscopy - drainage of intrabdominal abscess / sepsis, no resection  
Laparotomy - small bowel resection {}  
Laparotomy - division of adhesions {}  
Laparotomy - inoperable malignancy +/- by-pass {}  
Laparotomy - post operative complications {}  
Laparotomy - drainage of intrabdominal abscess / sepsis, no resection  
Laparotomy - staging/diagnostic, no other procedure  
Combined transplant - multivisceral - donor {}  
Duodenum - oversew / bleeding DU {}  
Duodenum - perforated DU closure {}  
Gastrectomy - D2 subtotal {}  
Gastrectomy - D2 total {}  
Gastrectomy - subtotal {}  
Gastrectomy - total {}  
Gastric - gastrojejunostomy +/- vagotomy {}  
Gastric - limited operation / oversew / perforated ulcer {}  
Gastric - volvulus reduction / resection {}  
Hernia repair - paraoesophageal {G23.1}  
Oesophagus - rupture repair {}  
Spleen - splenectomy - trauma {}  
Spleen - splenic repair / conservation {}  
Liver - trauma - debridement/packing {}  
Pancreas - debridement/drainage of pancreatic abscess {}  
Pancreas - distal pancreatectomy {}

AAA - bifurcated graft - ruptured - complete operation {}  
AAA - tube graft - ruptured - complete operation {}  
Aorto-intestinal fistula repair {}  
Reconstruction - arterial - mesenteric {}  
Urology - laparotomy - bladder {}  
Urology - nephrectomy {}

## APPENDIX 2

### Publications, communications derived from work in this thesis

#### 1.1 PUBLISHED ARTICLES

Chapter 3 Abdelrahman, T., Thomas, C., Iorwerth, A., Pollitt, M.J., Holt, M. and Lewis, W.G., 2016. Core surgical training outcome in Wales. *The Bulletin of the Royal College of Surgeons of England*, 98(10), pp.456-459.

Chapter 5 Thomas C, Griffiths G, Abdelrahman T, Santos C, Lewis WG. Does UK surgical training provide enough experience to meet today's training requirements? *BMJ Careers*. 2015 May 11

Chapter 6 Abdelrahman T, Long J, Egan R, Lewis WG. Operative experience versus competence: a curriculum concordance and learning curve analysis. *J Surg Educ*. 2016 Jul-Aug;73(4):694-8.

Chapter 7 Egan RJ, Abdelrahman T, Tate S, Ansell J, Davies LM, Clark GWB, Lewis WG. Modular Emergency General Surgery Training: Pilot study of a novel programme in a tertiary training centre. *Ann R Coll Surg Engl*. 2016 Jun 6:1-4.

Chapter 8 Abdelrahman T, Brown J, Wheat J, Thomas C, Lewis WG. Hirsch Index value and variability related to general surgery in a UK Deanery. *J Surg Educ*. 2016 Jan-Feb;73(1):111-5.

Matthews A, Abdelrahman T, Lewis WG. Surgical education's 100 most influential articles: A bibliometric analysis. *J Surg Educ* 2016 Jun 22. pii: S1931-7204

#### 1.2 PUBLISHED ABSTRACTS

Abdelrahman, T., Long, J., Egan, R., Lewis, W. 2016. Operative experience versus competence in a single UK deanery: A curriculum concordance and learning curve analysis. *International Journal of Surgery* 36, p. S101.

Egan, R., Abdelrahman, T., Davies, L., Clark, G., Lewis, W. 2016. Modular Emergency General Surgery Training: Pilot study of a novel programme in a tertiary training centre. *British Journal of Surgery* 103, p. 5

Abdelrahman, T., Thomas, C., Iorwerth, A., Holt, M., Lewis, W. 2016. Core surgical training outcome in Wales: reconfiguration, reflection, and the rise of educational contracts. *British Journal of Surgery* 103, p. 5

Abdelrahman, T., Long, J., Egan, R., Lewis, W. 2016. Operative experience versus competence: a curriculum concordance and learning curve analysis. *British Journal of Surgery* 103, p. 49.

Matthews, A., Abdelrahman, T., Lewis, W. 2016. Surgical Education's 100 most influential articles. *British Journal of Surgery* 103, p. 156

Abdelrahman T, Brown J, Wheat J, Thomas C, Lewis WG. 2015. Value and variability of the Hirsch Index within the context of general surgery in a single UK Deanery *British Journal of Surgery* 102. pg 123-124

Abdelrahman T, Thomas C, Iorwerth A, Lewis WG. 2015. Rural rotations at core: Rarefied exposure or real experience? *British Journal of Surgery* 102. Pg 12-12

Abdelrahman T, Thomas C, Wheat J, Lewis WG. 2015 Relative value of rural placements within Higher Surgical Training Programmes *British Journal of Surgery* 102. Pg 12-12

Thomas C, Abdelrahman T, Santos C, Griffiths G, Lewis WG. 2015. Counting surgical competence; a curricular concordance analysis *British Journal of Surgery* 102 10-10

Abdelrahman T, Brown J, Wheat J, Thomas C, Lewis WG. 2015. Value and variability of the Hirsch Index within the context of gastrointestinal surgery in a single UK Deanery. *Gut*; 64:A393-A394

Abdelrahman T, Thomas C, Santos C, Griffiths G, Lewis WG. 2015. Counting Surgical Competence; A Gastrointestinal Perspective. *Gastroenterology*. 148 (4), S-202.

### **1.3 PRESENTATIONS TO LEARNED SOCIETIES**

#### **Operative experience versus competence: a curriculum concordance and learning curve analysis**

*International* oral presentation at Association of Surgeons of Great Britain and Ireland Annual Meeting, Belfast, May 2016

#### **Core surgical training outcome in Wales: reconfiguration, reflection, and the rise of educational contracts**

*International* oral presentation at Association of Surgeons of Great Britain and Ireland Annual Meeting, Belfast, May 2016

**Modular Emergency General Surgery Training: Pilot study of a novel programme in a tertiary training centre**

*International* oral presentation at Association of Surgeons of Great Britain and Ireland Annual Meeting, Belfast, May 2016

**Rural rotations at core: Rarefied exposure or real experience?**

*International* oral presentation at The Association for Medical Education in Europe AMEE, Glasgow, September 2016 and *International* oral presentation at Association of Surgeons of Great Britain and Ireland Annual Meeting, Manchester, April 2015

**Value and variability of the Hirsch Index within the context of gastrointestinal surgery in a single UK Deanery**

*International* poster presentation at Digestive Disorders Federation Combined Meeting, London, June 2015

**Counting surgical competence; A gastrointestinal perspective.**

*International* poster presentation at Digestive Diseases Week, Washington D.C. May 2015

**Value and variability of the Hirsch Index within the context of general surgery in a single UK Deanery**

*International* poster presentation at Association of Surgeons of Great Britain and Ireland Annual Meeting, Manchester, April 2015

**Relative value of rural placements within Higher Surgical Training programmes.**

*International* oral presentation at Association of Surgeons of Great Britain and Ireland Annual Meeting, Manchester, April 2015

## **APPENDIX 3**

### **Copies of published articles**

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