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Original research

What techniques are recommended to undertake procedures that require asepsis?

Content and cluster analysis of information supplied international guidance

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SUMMARY

Background:

Health professionals frequently conduct procedures requiring asepsis but there is no definitive evidence-based guidance on how aseptic technique should be undertaken.

Objective: Undertake content and cluster analysis to compare and contrast information relating to the conduct of aseptic technique in national and international guidance.

Methods: Content and hierarchical cluster analysis.

Results: We identified 16 sources of information from organisations that generate infection prevention guidelines; provide advice about infection prevention in addition to other topics; generate guidance for procedures (e. g. wound care); practice manuals; MeSH and Wikipedia. Content related to: theory underpinning aseptic technique; terminology used; how and when it should be undertaken; and equipment. The nature and amount of information varied widely. Most frequently stated information related to: environment or equipment (n=13), followed by the absolute nature of asepsis and the importance of hand-hygiene (n=10); general personal protective equipment, the significance of pathogens, and no-touch techniques (n=8); that it is risk-based (n=7); the existence of key parts or sites, and that there are different types of aseptic technique (n=6). The most comprehensive sources were a wound care organisation in the United States, and a British internationally-used textbook. Least information was provided in some general infection prevention guidelines.

Conclusion: Progress with research and practice in relation to aseptic technique suffers through lack of common goals and understanding. This study is one step towards establishing

what constitutes aseptic technique, how and when it should be conducted, and equipment necessary. This is required to support practice, policy, education and may improve sustainability of health care resources.

Introduction

Breaches to skin and mucous membranes increase the risk of healthcare-associated infection, especially in the presence of indwelling invasive devices [1–3]. Significant differences are reported in the way that procedures requiring asepsis (PRA) are undertaken and there is debate concerning whether techniques to maintain asepsis are necessary or possible when dressing chronic wounds, during minor surgical procedures, or manipulating intravenous lines in situ long-term, especially outside acute care settings [4–6], confusing those responsible for delivering health care [7]. Numerous documents use the term ‘aseptic technique’ when referring to clinical procedures adopted to maintain asepsis [8–10]. Initial review of information sources suggested differences concerning the aims of ‘aseptic technique’ between documents and descriptions of how and when it should be undertaken. Greater clarity is required to inform practice, education and prudent use of resources. If aseptic technique is conducted unnecessarily, clinical procedures are over-complicated, adding to clinical workload and gratuitous use and disposal of expensive consumables. This in turn adds to carbon emissions at a time of political and environmental pressure to reduce the carbon footprint [11].

Methods

Objective

Our aim was to undertake content analysis, and compare and contrast information relating to the conduct of aseptic technique in guidance and other documents issued nationally and internationally.

Study procedure

Guidance was identified through electronic and hand searches. Searching excluded guidance related specifically to insertion and management of intravenous lines which are particularly high risk and have specific guidance. Wikipedia was included because it is widely used by clinicians as an easily accessible source of information, and the Medical Subject Heading (MeSH) 'asepsis' because of its function as the controlled vocabulary for the PubMed database. Directed content analysis was undertaken [12] applying the following codes: explicit statement of information relating to aseptic technique (code =1); information strongly suggested but not explicitly stated (code = 0.5); and absence of information (code = 0). Coding was undertaken by two members of the research team with third party arbitration in cases of disagreement.

We undertook hierarchical cluster analysis using euclidean distance and complete linkage with the `hclust` command in R [13] and plotted using `gplots` [14] to classify information about aseptic technique into categories according to similarity. This procedure takes an agglomerative approach to classification, initially placing each definition in its own cluster, then sequentially adding the most similar until all are included.

Results

Sixteen sources of clinical guidance containing information about the conduct of aseptic technique were identified. Full details are given in the supplementary file. They appeared in a range of different sources. These included: organisations responsible for generating official guidelines relating specifically to infection prevention [15–21]; organisations that included advice about infection prevention in addition to other topics [9,22]; organisations generating guidance for specific procedures (e. g. wound care) [23,24]; and manuals directing practice

[8,25,26]; and some miscellaneous definitions [27,28] (see Table 1). Only one document explicitly demonstrated the use of The Grading of Recommendations Assessment, Development and Evaluation (GRADE) [29] in its development [16] which is important for transparent decision making.

Table 1. Guidance offering information for the conduct of aseptic technique (italics relates to abbreviation used in Figure 1)

[INSERT TABLE 1]

Content analysis

Thirteen discrete items of information relating to aseptic technique were identified across all sources of guidance, Wikipedia and MeSH. These were placed into four domains: theoretical information, terminology used to describe aseptic technique, how and when aseptic technique should be undertaken and equipment necessary (see Table 2).

Table 2. Information about the conduct of aseptic technique contained in guidance for practice

[INSERT TABLE 2]

Figure 1 shows that the environment or equipment was most commonly cited (n=13), followed by: the absolute nature and the importance of hand-hygiene (n=10); general personal protective equipment, the significance of pathogens, and no-touch techniques (n=8); the risk-based nature (n=7); key parts or sites, and that there are different types of aseptic technique (n=6). Differentiation between clean and aseptic techniques (n=4); colonisation,

and the same technique being suitable for all settings (n=2) were least common. One document explicitly rejected clean techniques in the context of asepsis [26].

Figure 1. Heatmap showing items mentioned in each document

[INSERT FIGURE 1]

Cluster analysis

Hierarchical cluster analysis of information in the 16 sources of guidance, MeSH and Wikipedia are shown in Figure 2. There appear to be four main clusters. The first is formed by definitions from general infection control and bibliographic texts, these contain relatively little detail [8,9,19,27]. Closely allied to this cluster is one formed of a standardised technique [26], together with guidance based upon this [20], and surgical site infections [23]. The third cluster is formed by two general texts [16,25]. The final cluster comprises definitions produced for specific groups or tasks such as injection technique [22], wound care [15,24], central lines [21], and three more general definitions [17,18,28].

Discussion

Techniques to maintain asepsis are fundamental to infection prevention and considered important to contain the global risk of antimicrobial resistance [30]. Considering the importance with which it is accorded, aseptic technique has received little attention from researchers and policy-makers: ours appears to be the first study to compare and contrast information available in national and international guidance to inform practice, policy and education.

We established that information about aseptic technique is provided in disparate sources, often with little explanation of how it was derived or selected for inclusion. This makes implementing evidence-based approaches difficult. It is important to note that expert opinion is not a category of quality of evidence as it constitutes an interpretation of evidence by a particular expert or experts. However, it is important to differentiate expert evidence from opinion. Evidence refers to the use of facts. Opinion is a judgement but is not necessarily factual. This is exemplified by the difference between the results of a study and the conclusions; one is a factual statement and the other represents interpretation [31].

Numerous organisations prominent in development of guidelines for infection prevention do not provide any information about aseptic technique, for example Centers for Disease Control and the Society for Healthcare Epidemiology of America, while information from WHO relates specifically to administration of injections. The United Kingdom National Institute for Health and Care Excellence has also yet to produce full guidance.

Australia provided two official documents, a general infection control manual [16], and a more applied document entitled Principles for aseptic technique: Information for healthcare workers [15]. Unlike most other guidelines examined, the former document was written following a transparent process and used GRADE [29] for some but not all recommendations. For example, it contains a conditional recommendation ('it is suggested') that sterile gloves are used for aseptic procedures and contact with sterile sites (p. 87) 'based on limited empirical evidence, but on sound theoretical principles and is supported by expert advice'.

The amount of information provided in each of the sources of guidance was subject to considerable variation. The most detailed guidance was provided by Wound, Ostomy and

Continence Nurses Society [24] as part of a fact-sheet (11 items), and the Royal Marsden Manual of Clinical Nursing Procedures (8 items) [25]. Wikipedia also contained 8 items [28], but this was less clinically applied. The Association for Professionals in Infection Control and Epidemiology, Australian Principles of aseptic technique: Information for healthcare workers, Northern Ireland Regional Infection and Prevention Control Manual, and the Joint Commission Guidance contained 7 items each [15,18,20,21]. Least information was provided by the National Institute for Health and Care Excellence (1 item) [9], Epic3, MeSH and the National Infection Prevention and Control Manual: Glossary (2 items each) [8,19,27]. Those which contain the most comprehensive information and might appear to be the most useful in clinical practice and education, however, the lack of direct evidence for many aspects of the technique should reduce the strength of any recommendation that they make. This is mitigated if guidance is based on clinical evidence, as opposed to clinical opinion [31], although this can be hard to detect and the relative absence of published clinical evidence such as audit and other clinical data suggests that opinion outweighs evidence. More general definitions put more responsibility upon practitioners to interpret; although they allow clinicians to apply recommendations in their specific clinical area, but have the same limitation regarding the quality of evidence.

Progress with research and practice development in relation to aseptic technique contrasts sharply with what has been achieved for hand hygiene. Detailed guidelines for hand hygiene have been developed [32] and implemented internationally [33]. Adopting precise terminology (e. g. hand hygiene opportunity, hand hygiene event, hand hygiene adherence) has promoted development of audit tools and local, national and international comparisons of hand hygiene adherence which have informed policy, practice and education. Until the aims of aseptic technique and how and when it should be conducted can be agreed, little progress

will be possible in the development of audit tools to benchmark practice, research and education. Only a few rigorous studies have evaluated the effectiveness of aseptic technique and these have taken place in relation to low-risk procedures [34,35]. Further research is necessary to explore effectiveness in high fidelity simulation studies, then assuming favourable outcomes, for different procedures in clinical practice. Until sufficient information is available, agreement concerning the aims of aseptic technique and how and when it should be conducted should be sought through consensus methods (e. g. Delphi rounds) to provide much-needed interim guidance.

One approach could be to adapt the method provided in the Australian Information for healthcare workers document which differentiates ‘standard aseptic technique’ which refers to simple procedures with a small number of key parts and sites from ‘surgical aseptic techniques’ which is applied to more complex procedures [15]. A clinically more useful interpretation of this could be to differentiate low-risk from higher-risk procedures, the latter probably including implantable and central intravascular devices. Consensus may be needed to differentiate these before a full trial of this approach.

Our study suffers from three limitations. Firstly, it was restricted to definitions accessible via the internet and those available in English. Secondly, cluster analysis is a technique used to join similar observations sequentially until all are clustered: possible relationships between observations are open to interpretation which may be questioned and debated. Finally some of these documents comprised definitions from glossaries, while others were more detailed or were fact-sheets. This study was designed to replicate the process that a busy clinician might undertake to find a definition.

In conclusion, our study represents the first step towards establishing a common understanding of what constitutes aseptic technique, how and when it should be conducted and equipment necessary. Such information is required to support practice, policy, education and may help to improve sustainability of health care resources.

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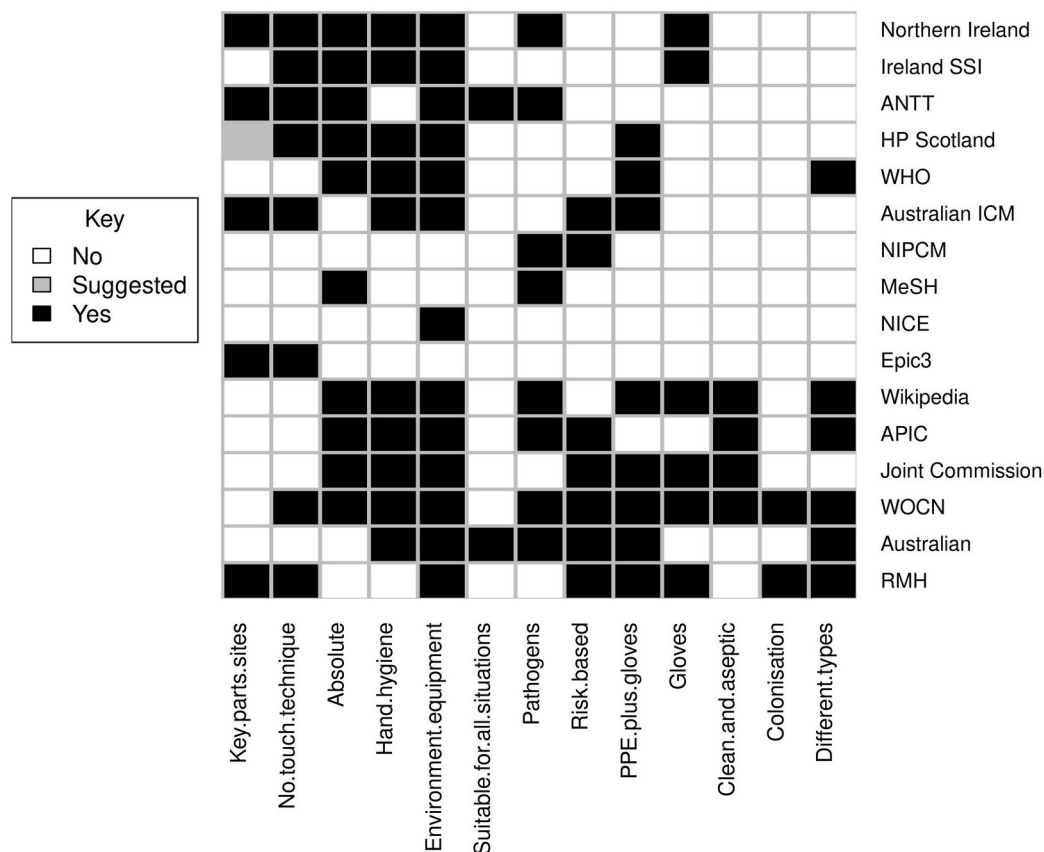
Table 1. Sources of guidance offering providing information about aseptic technique (italics relates to abbreviation used in Figure 1)

| |
|---|
| <p>Specific infection prevention guidelines</p> <p>Association for Professionals in Infection Control and Epidemiology (US) - APIC [18]</p> <p>Australian Principles of aseptic technique: Information for healthcare workers [15]</p> <p>Australian Guidelines for the Prevention and Control of Infection in Health Care (Australia) Australian ICM [16]</p> <p>epic3 (UK) epic3 [19]</p> <p>Joint Commission (US) Joint Commission [21]</p> <p>Other guidelines</p> <p>National Institute for Health and Care Excellence (UK) NICE [9]</p> <p>World Health Organization (international) WHO [22]</p> <p>Procedure-related guidelines (e. g. wound care)</p> <p>Health Protection Scotland (UK) HP Scotland [17]</p> <p>Preventing Surgical Site Infection (Ireland) Ireland [23]</p> <p>Wound, Ostomy and Continence Nurses' Society (US) WOCNS [24]</p> <p>The Association for Safe Aseptic Practice (UK) ANTT [26]</p> <p>Manuals</p> <p>Infection Prevention and Control Manual for Northern Ireland (UK) Northern Ireland [20]</p> <p>National Infection Prevention and Control Manual (UK) NIPCM [8]</p> <p>Royal Marsden Manual of Nursing (UK) RMH [25]</p> <p>Miscellaneous</p> <p>Medical Subject Headings (MeSH) (US) [27]</p> <p>Wikipedia (International) [28]</p> |
|---|

Table 2. Information about the conduct of aseptic technique in guidance for practice

| |
|--|
| Theoretical information |
| Aseptic technique should be regarded as absolute |
| Makes specific reference to pathogens |
| Differentiates infection and colonisation |
| Terminology used to describe AT |
| Mention of key parts and sites, or sterile field |
| How and when aseptic technique should be undertaken |
| Need for risk assessment |
| Need to undertake hand hygiene |
| Importance of non-touch technique |
| There are different approaches to asepsis |
| Differentiation between clean and aseptic technique |
| Suitability of aseptic technique in any clinical situation |
| Equipment needed to undertake AT |
| Sterile gloves |
| Personal protective equipment in addition to sterile gloves (e. g. masks, gowns) |
| Additional equipment (e. g. dressing trolleys, forceps) |

Figure 1. Heatmap showing items mentioned in each document



Key:

Absolute - Aseptic technique should be regarded as absolute

Pathogens - Makes specific reference to pathogens

Colonisation - Differentiates infection and colonisation

Key.parts.sites - Mention of key parts and sites, or sterile field

Risk.based - Need for risk assessment

Hand.hygiene - Need to undertake hand hygiene

No.touch.technique - Importance of non-touch technique

Different.types – There are different approaches to asepsis

Clean.and.aseptic - Differentiation between clean and aseptic technique

Suitable.for.all.situations - Suitability of aseptic technique in any clinical situation

Environment.equipment - Equipment needed to undertake AT

Gloves - Sterile gloves

PPE.plus.gloves - Personal protective equipment in addition to sterile gloves (e. g. masks, gowns)

I have tweaked *Suitable.for.all.situations* and *Different.types* to make them more obviously different

Figure 2. Hierarchical cluster analysis of definitions

