Davies, A., Spickett-Jones, F., Brock, P., Coy, K., & Young, A. (2017). Variations in guideline use and practice relating to diagnosis and management of infection in paediatric burns services in England and Wales: a national survey. *Burns*, 43(1), 215-222.
<https://doi.org/10.1016/j.burns.2016.07.032>

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Title Variations in guideline use and practice relating to diagnosis and management of infection in paediatric burns services in England and Wales: a national survey

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ABSTRACT

Background: Wound infection causes morbidity and mortality in burns. UK National Burns Care Standards state that guidance should be used to diagnose and treat burn wound infection. However, surveys of senior staff about standard operating procedures or guidance in UK burns services indicate that they are infrequently available (Papini et al., 1995; Lymperopoulos et al., 2015). Staff may have differing views and experiences of guidance use according to their role. This survey investigated the extent to which guidance is available, and current practices used for diagnosis and treatment of use and burn wound infection, both within and between paediatric burns services.

Methods: Staff from paediatric burns services in England and Wales were individually interviewed by two nurses about guidance and practices around antibiotic prophylaxis, diagnosis and management of burn wound infection and toxic shock syndrome, and antibiotic use. In each service staff from three categories were interviewed: lead consultant/burns specialist nurse, junior doctor/senior nurse, ward based nurse. Data were subjected to content analysis and reliably coded by two researchers using a coding frame. Guidance documents were also requested.

Results: Thirteen services took part. Staff in fewer than half of services reported that they had guidance for antibiotic prophylaxis, diagnosis, and management of burn wound infection. In nine services at least one staff member reported that they had guidance for antibiotic use. Guidance was available for diagnosis and management of toxic shock syndrome in ten services, and staff in five were consistently aware of it. One service routinely used antibiotic prophylaxis, but had no written guidance for it. In five services where at least one member of staff reported that they had guidance for diagnosing infection, at least one interviewed staff member was unaware of it. Swabbing practice varied between and within services, with 10

staff across six services cleaning before swabbing, and four staff in three services cleaning after.

Conclusions: There are limited available guidance documents across burns services, and variation between and within services relating to staff awareness of them. There are some consistencies in practice; the majority of services do not use antibiotic prophylaxis, and there is consistent prescribing for suspected infection and tests used for infection diagnosis.

Swabbing practices are less consistent. This survey indicates a need for evidence-based guidelines to be developed in order to meet national burns care standards, and for staff to be made aware of them and trained in their use. Guidelines do not need to replace clinical judgement and should be developed with the involvement of those who will implement them.

Highlights

- Antibiotic prophylaxis is rarely used.
- Most services have guidance for diagnosing and managing Toxic Shock Syndrome and antibiotic use.
- Fewer than half of services have guidance for diagnosing and managing wound infection.
- Staff awareness of guidance varies between and within services.
- Staff are inconsistent in swabbing practices.

Keywords: Burns, wound infection, guidelines, antibiotics

List of abbreviations:

NICE National Institute for Health and Care Excellence

CKS	Clinical Knowledge Summary
COBIS	Care of Burns in Scotland
SOPs	Standard Operating Procedures
VTCT	Vocational Training Charitable Trust

INTRODUCTION

Burn wound infection is a leading cause of morbidity and mortality in burns patients [1], and infection may delay healing [2, 3]. Children are at increased risk of wound infection due to immature immune systems [4]. Diagnosis of burn wound infection is difficult, particularly in paediatric patients; clinical signs including pyrexia are poor specific indicators of infection [5], and can be due to unrelated viral infections that children are at increased likelihood of experiencing compared with adults [6], or as a result of the normal inflammatory response to burn injury [7]. As a result, wound swab, blood microscopy and culture along with laboratory markers of sepsis are needed to establish the presence and nature of an infection [8]. Cultures require over 48 hours to provide a positive diagnosis. Point-of-care diagnostic devices are not yet available to provide a more timely diagnosis of clinically relevant burn wound infection.

Broad-spectrum antibiotics are typically prescribed where wound infection is suspected, until definitive diagnosis is made, following which antibiotics are stopped or narrower spectrum antibiotics are prescribed. Consequently there is a necessary over-use of broad spectrum antibiotics, due to the necessity that suspected infection is treated early to prevent development of sepsis, with associated risk of mortality [9]. However, over-use of broad spectrum antibiotics is implicated in the increasing problem of antimicrobial resistant bacteria [10]. Prudent use of broad-spectrum antibiotics (antibiotic stewardship) has been identified by the UK Department of Health as key factor in managing the risk of such antimicrobial resistance [11].

Guidelines and protocols in burn care have the potential to facilitate a standardised, evidence-based approach to the detection and treatment of burn wound infection. Meta-analysis has indicated that evidence-based guidelines to inform standardised practice can lead to more equitable care, better patient outcomes and a better process of care for patients [12]. This

view is supported by the NHS National Burn Care Standards, which state that all burns services should have in place agreed clinical guidelines covering several aspects of burn care, including management of burn wound infections and toxic shock syndrome [13]. However, the expected content of the guidelines is not stated.

To date there is currently little national-level, evidence-based guidance about diagnosis and treatment of infection in burn care that can be used at a local level. The National Institute for Health and Care Excellence (NICE) has developed a Clinical Knowledge Summary (CKS) indicating steps to be followed for the diagnosis and treatment of suspected burn wound infection in primary care [14]. This CKS indicates that there is no available evidence relating to burn wound injury, and that general guidance should be followed relating antibiotic use for skin infection. The Care of Burns Network in Scotland (COBIS) guidelines indicate steps for the management of infection in paediatric burns, and recommend intensive and frequent bacteriological surveillance of the patient, and early recognition of clinical bacteriological invasion with prompt appropriate antibiotic management [15]. However, detailed, evidence-based recommendations are not made about the frequency with which surveillance should be carried out, and how early recognition of bacterial invasion should be facilitated. The American Burns Association's expert-led and evidence-based consensus statement defines the clinical parameters required to diagnose sepsis and wound infection [8]. The authors describe sepsis as 'a change in the burn patient that triggers the concern for infection. It is a presumptive diagnosis where antibiotics are usually started and a search for a cause of infection should be initiated'. The diagnosis is therefore still retrospective and will not help in limiting over-use of antibiotics. Wound infection is also diagnosed in response to numbers of bacteria on biopsy, a procedure that is seldom undertaken in routine clinical practice in the UK.

There is therefore limited available guidance upon which to base local evidence-based guidelines for use in burns services, and the extent to which such guidelines have been developed and are in use is unclear. A survey of 39 burns service directors in the UK in 1995 found that 13 services had a written policy on antibiotic use, and nine used systemic antibiotic prophylaxis [16]. The use of these guidelines may have changed as a result of increasing evidence relating to the use of antibiotic prophylaxis in burns care [17, 18] and increasing concerns about the use of broad spectrum antibiotics in relation to antimicrobial resistance. More recently, a survey has been carried out with managers of 26 adult and paediatric burns services in the UK, to ascertain the availability of standard operating procedures (SOPs) relating to the patient care pathway set out in the National Burns Care Standards [6]. This indicated that only 12 units used any SOPs, with a mean of 2.1 SOPs per service. It is notable that neither survey has sought the views of junior doctors and nursing staff who are involved in activities relating to infection diagnosis and treatment, including observations and wound swabbing. It is conceivable that differing types of healthcare practitioners will have different perspectives and experiences relating to their awareness, understanding and application of guidance.

This survey of healthcare staff in paediatric burns services in England and Wales aims to provide up-to-date evidence describing the extent to which paediatric burns services have developed and implemented clinical guidance. Specifically, we aim to describe: i) the extent to which guidance is in place and is used for the diagnosis and treatment of burn wound infection, ii) current practice relating to antibiotic prophylaxis, detection of infection, antibiotic use and wound care, and iii) variations in practice between services and between staff within services.

METHODS

Design: A cross-sectional survey of burns service staff was undertaken in January to April 2015. Staff were interviewed by two research nurses using a structured questionnaire.

Questions were designed to elicit both categorical data (e.g. yes/no for available guidance, named antibiotics and dressings used), and qualitative data, to capture variations in practice and reasons for these. Interviews were audio-recorded and notes were taken.

Setting and participants: Fourteen burns services treating children in England and Wales were invited to participate in the survey. In each service a staff member from each of three categories was asked to participate in an individual interview: i) lead consultant or burns clinical specialist nurse, ii) junior doctor or senior nurse, iii) ward-based nurse.

The survey consisted of 19 structured questions. Data relating to seven topics are reported here: 1. availability of written guidance relating to i. antibiotic prophylaxis ii. diagnosis and management of wound infection, iii. diagnosis and management of Toxic Shock Syndrome (TSS), iv. antibiotic use for treatment of infection 2. criteria for admission with suspected infection, 3. investigations carried out where infection is suspected 4. criteria for commencement and discontinuation of antibiotics. Where available, written guidance documents were collected from services.

Analysis: Data were subjected to content analysis. A coding frame was developed to enable categorisation of interviewees' responses into discrete categories where possible. Where questions were open-ended, data were recorded as verbatim free text. To ensure consistency of coding, two researchers (AD, FSJ) coded a sample of 10% of data and assessed agreement. Where there was disagreement, consensus was reached through discussion, and changes made to the coding frame where necessary. The unit of analysis was burns service and data

are reported as frequencies. Consistency between staff members' responses relating to questions is indicated where appropriate. Inconsistency was indicated when one or more staff members gave a different response from the other interviewee/s.

RESULTS

Thirteen of the 14 invited services took part. Services were either exclusively paediatric (n=6) or provided care to both children and adults (n=7). Twelve sets of individual interviews were conducted, and one service requested that staff were interviewed as a group. In nine services, three staff members were interviewed, and in three services, two staff members were interviewed. Therefore, 34 sets of data were collected. The roles of interviewed staff are presented in table 1. No junior doctors were available to be interviewed.

INSERT TABLE 1 HERE

Use of guidance to inform standardised practice

Table 2 indicates the number of services where *at least one member of staff* reported that there was written guidance in their service relating to the topics investigated. At least one staff member in 10 services reported that guidance was available for the diagnosis and management of toxic shock syndrome (TSS). In contrast, staff reported that there was no guidance available in more than half of services for antibiotic prophylaxis, and diagnosis and management of burn wound infection.

INSERT TABLE 2 HERE

The extent to which staff were consistent about the availability of guidance varied according to guidance topic (see table 2; total n = 12). In seven services at least one member of staff

gave a differing response from their colleagues about the availability of guidance for diagnosing and managing burn wound infection. Staff were more consistent about the availability of guidance for antibiotic prophylaxis, antibiotic use and the diagnosis and management of TSS.

For each topic, fewer than half of services provided a copy of the relevant guidance document, and eight services did not provide any documents. One service provided guidance for all topic areas investigated. Of the remaining four services, two provided guidance in four or five topics and two services in two or three topics.

Antibiotic prophylaxis

At least one staff member in six services indicated that they had guidance relating to the use of antibiotic prophylaxis, and three services provided a copy of this guidance (see table 2).

Awareness of available guidance documents was poor: in one service that were able to provide a document, no staff were aware that it was available. In the remaining two services, at least one staff member was unaware of the document. In four services, no guidance document was provided, however at least one member of staff indicated that they were aware of written guidance (see figure 1).

One service indicated that they routinely used antibiotic prophylaxis in children aged less than five years of age. All three staff in this service were consistent in their responses and indicated that they prescribed oral Flucloxacillin for five days. However, they consistently reported that there was no specific written guidance relating to this.

Six services indicated that antibiotics were used on induction of anaesthesia for theatre, of which four provided detail indicating that a single dose of antibiotics was given. Four

services reported that they prescribed 48 hours of oral antibiotics where a biological dressing was used.

INSERT FIGURE 1 HERE

Diagnosing burn wound infection

In five services at least one staff member indicated that there was available guidance about diagnosing burn wound infection. Staff were inconsistent, however about the availability of the guidance in all five services, and three could not provide a guidance document. In the two services that provided guidance, at least one member of staff was unaware of its availability. In all services, staff consistently indicated that blood cultures and wound swabs would be taken in order to diagnose infection. Commonly reported additional tests included blood count (n=7), urine microbiology (n=5) and urea and electrolytes (n=5).

Diagnosing and managing toxic shock syndrome

Ten services indicated that they had written guidance for both diagnosis and management of toxic shock syndrome. Of these, staff in five services were consistent about the existence of guidance. Guidance was provided by five services, however in three services at least one staff member was unaware of it. In four services all staff reported that guidance was available, but in three of these no document was provided.

Swabbing practices

Staff at three services provided a consistent response regarding whether wounds were swabbed before or after cleaning. In one service all three staff indicated that they swabbed

after cleaning the wound, and in the other, all three staff indicated that they were inconsistent and cleaned before or after swabbing. The third service, interviewed as a group, indicated that they swabbed before cleaning. Of the remaining services, 10 staff across six services indicated that they swabbed before they cleaned the wound, and four staff across three services indicated that they swabbed after cleaning the wound. Three staff from three different services indicated that clinical judgement was used. The remaining services indicated that they swabbed before and/or after.

In ten services staff reported that swabbing timings and frequency was determined by clinical judgement. Two services indicated that they had no set procedures for when swabbing was carried out. In four services staff indicated that wound swabs were carried out on admission, and five services indicated that they were repeated at dressing changes. One member of staff in one service indicated that they swabbed before discharge to ensure that they had up to date information about the patient should they return with a suspected infection.

Managing wound infection

In six services at least one member of staff indicated that there was guidance available for managing wound infection. In one of these all three staff consistently indicated that they had guidance. In two services staff consistently reported that they did not have guidance. Two services provided a copy of their guidance. In both services at least one staff member was unaware of the available document.

The most commonly cited clinical and non-clinical triggers for admission where wound infection was suspected are presented in figure 2.

INSERT FIGURE 2 HERE

Antibiotic Use

In nine services, at least one staff member indicated that they had written guidance about antibiotic use. In three of these services staff specified that the antibiotic use policy was a hospital-wide policy as opposed to one specifically written for the burns service. Two sets of guidance were provided relating to antibiotic use in wound infection. In both services all staff were aware of the guidance. In the remaining seven services no document was given.

In one service staff consistently indicated that they waited for microbiology results before commencement of antibiotics, unless there were signs of sepsis. Staff in three services consistently indicated that they immediately commenced broad spectrum antibiotics while awaiting microbiology confirmation. In four services, staff were inconsistent in their responses. Four services did not respond to this question. The most frequent reasons cited for commencing antibiotics were: the child seeming systemically unwell, pyrexia or prolonged pyrexia, and the wound appearing to be infected. The most commonly used antibiotics for suspected infection were Penicillins. Macrolides and cephalosporins were less frequently used. Antibiotics used are presented in figure 3.

Where microbiology confirmed that no infection was present, staff in 10 services were inconsistent in their responses relating to the usual course of action. At least one member of staff in nine services indicated that patients would complete the full antibiotic course, and in eight services at least one member of staff reported that patients on intravenous antibiotics would be switched to oral antibiotics to complete the course. Staff gave consistent responses in only two services, with one service indicating that clinical judgement was used and one indicating that antibiotics were not automatically discontinued. Staff in a third service (interviewed as a group) also indicated that automatic discontinuation was not normal practice.

INSERT FIGURE 3 HERE

DISCUSSION

This survey aimed to investigate the availability and use of guidance, and practice relating to the diagnosis and management of burn wound infection in paediatric burns services in England and Wales. This survey updates and extends the findings of previous surveys [6, 16], by surveying varied burns service staff, including consultants, ward managers, and nurses, in order to identify differences in guidance availability, awareness and practices both between and within services.

The data indicate limited use and awareness of guidance documents across burns services. There were variations between and within services in relation to staff awareness and use of guidance. The data indicate some consistencies in practice, with the majority of services reporting that they no longer use antibiotic prophylaxis. There is also consistency in the tests used to diagnose infection and there is consistent conservative prescribing of broad-spectrum antibiotics where infection is suspected. In contrast, the data indicate less consistency around other diagnostic practices, including swabbing procedures.

Availability, awareness and use of guidance documents

The data indicate limited availability of guidance across all investigated topics. For the majority of the topics investigated, staff in more than half of services reported that they did not have guidance, suggesting a lack of compliance with the National Burns Care standards [13]. Fewer than half of services provided copies of their guidance, and only one service reported and provided it in all six topic areas. This suggests a lack of a guidance-use culture in burns services. However, it should be noted that this may only reflect poor awareness of available guidance amongst interviewed staff. Further investigation of the reasons for poor

adoption or limited awareness of guidance in services is required. This may inform strategies to increase the likelihood of their development and use.

Staff in the majority of services reported that there was guidance available for the diagnosis and management of TSS and were consistent in their reporting of it. Despite there being a relatively low incidence of TSS, it is interesting to note that this aspect of the National Burns Care Standards has been widely implemented in comparison with guidance for the diagnosis and management of burn wound infection. While only half of services indicated that they had guidance around the use of antibiotic prophylaxis, even without available guidance documents, there was generally consistent application of an evidence-based approach to avoiding the use of prophylaxis in burns care. This may have resulted from the effective dissemination of two recent systematic reviews investigating the use of antibiotics to manage the risks of infection in burns care [17, 18], and wider hospital-based policies relating to antibiotic prophylaxis.

The data indicate variations in the awareness of guidance within services. In several services where guidance was available and evidenced by the provision of documents, staff were unaware of them. Due to the small number of participants in this survey, it was not possible to investigate patterns in this data relating to staff roles. However, this finding suggests a need for staff training. Consideration needs to be given to how new and existing staff are informed about guidance and how it is adopted into routine care within a service.

Variations and consistencies in practice

Where wound infection is suspected, staff were consistent within and between services in their reporting that broad spectrum antibiotics are frequently prescribed and that courses were completed even when absence of infection is confirmed. Staff were also consistent in their

reporting that a cautious approach and over-treatment in children was typical, with pyrexia typically triggering antibiotic use before wound and blood cultures were available, and that there was a low threshold for admission, which took into account both clinical and social factors. There is no alternative to this care pathway until point of care tests to diagnose wound infection are available. Future research efforts should be directed towards the development of such technologies, in order to reduce unnecessary antibiotic prescribing.

One area of inconsistency in practice both between and within services was whether wounds are swabbed before or after cleaning. Staff in only three services were consistent about this and reported differing behaviours relating to whether they cleaned before or after a swab was taken. This finding supports previous surveys indicating inconsistent swabbing practices between nurses [19]. The evidence-base remains equivocal as to whether wounds should be cleaned before swabbing. While there is some evidence indicating that wound cultures are not affected by wound cleaning [20], there is also evidence to indicate that failure to clean before swabbing may result in altered wound cultures, with some studies suggesting that wound exudate may contain organisms that are not clinically relevant. Wound swabs taken after wound cleaning have been found to result in cultures that show greater correlation with cultures from the deeper wound [21, 22]. Therefore, swabbing without cleaning beforehand may result in over-prescribing of antibiotics to treat infection that is not present in the wound, or incorrect sensitivities being diagnosed. Further review of the evidence for swabbing technique, and the translation of this evidence into practice is required. A previous examination of wound swabbing practice suggests two potential protocols that may be adapted for use in the burns care setting [19].

Evidence-based practice and guidance in burns care

This survey indicates a need for guidance to be developed in order to meet national burns care standards, and that there is a need to ensure effective translation of guidance into clinical practice within paediatric burns services. Guidance, whether in the form of rigid protocols or more flexible guidelines should indicate what should be done for patients, when it should be done, where and by whom [23]. One means to ensure their clinical application is for them to be developed by those who will use them, taking into account the evidence, its quality, and how the guidance can be translated into practice. It is important to note that guidelines do not have to constrain clinical freedom or supersede clinical judgement [23]. It is acknowledged that clinical judgements are often required and that care can be varied to meet the needs of individual patients. Variations in practice, if systematically recorded, can be used to inform refinement of guidance, and may have the additional benefit of ensuring clinicians reflect upon their decision making. NICE guidance is available to inform the development of evidence-based guidelines [24], and a recent paper has described a replicable, explicit process and use of it for the development of standard operating procedures to meet the National Burns Care Standards [6].

A good quality evidence-base is needed to inform guidance and enable the standardisation of practice between services. However, it will be challenging to assure the quality and applicability of evidence, given the current lack of standardisation in care. The lack of standardisation both across services, but also between services, may impede the comparison of best available care standards with innovations, particularly in multi-site trials. Noise from variations in care practices may limit clear assessment of effectiveness.

Conclusions

This survey indicates that there are variations in the availability of guidelines and staff awareness of them, as well as practice around diagnosis and management of infection in burns care, both within and between paediatric burns services in England and Wales. Review and assessment of the evidence base, and development of guidance based upon it, has the potential to standardise and thus provide equitable and effective treatment for patients. Guidance can provide a flexible framework to inform practice, while taking into account the need for clinical judgement. Future research should focus on the development of point of care tests for wound infection to enable rapid diagnosis and prevent the over-use of broad spectrum antibiotics.

Acknowledgements

We should like to thank Julie Veale for conducting the interviews for this study, and all staff from burns services participating in the survey.

The Children's Burns Research Centre is part of the Burns Collective, a Healing Foundation initiative with additional funding from the Vocational Training Charitable Trust (VTCT) and the Welsh Government. The views expressed are those of the authors, and not necessarily those of the Healing Foundation or other funding bodies.

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