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Quantifying bacterial transfer from patients to staff during burns dressing and bed changes: Implications for infection control

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ABSTRACT

Routine nursing activities such as dressing/bed changes increase bacterial dispersal from burns patients, potentially contaminating healthcare workers (HCW) carrying out these tasks. HCW thus become vectors for transmission of nosocomial infection between patients. The suspected relationship between %total body surface area (%TBSA) of burn and levels of bacterial release has never been fully established.

Bacterial contamination of HCW was assessed by contact plate samples ($n = 20$) from initially sterile gowns worn by the HCW during burns patient dressing/bed changes. Analysis of 24 gowns was undertaken and examined for relationships between %TBSA, time taken for activity, and contamination received by the HCW.

Relationships between size of burn and levels of HCW contamination, and time taken for the dressing/bed change and levels of HCW contamination were best described by exponential models. Burn size correlated more strongly ($R^2 = 0.82$, $p < 0.001$) than time taken ($R^2 = 0.52$, $p < 0.001$), with levels of contamination received by the HCW. Contamination doubled with every 6–9% TBSA increase in burn size.

Burn size was used to create a model to predict bacterial contamination received by a HCW carrying out bed/dressing changes. This may help with the creation of burn-specific guidelines on protective clothing worn by HCW caring for burns patients.

1. Introduction

Advances in fluid resuscitation, organ support, and early excision and grafting have all improved survival rates following a severe burn [1]. However, this has also had the effect of shifting the cause of morbidity and mortality away from hypovolemia and towards sepsis. Sepsis is a primary risk factor of mortality following a burn [2,3]. It is now estimated that in patients with burns over 40% total body surface area (TBSA), 75% of all deaths are related to infection and/or inhalation injury [1]. Following a severe burn, physical, non-specific and specific immune defences are all affected, leading to a state of immunosuppression. Coupled with large bacteria-

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harbouring wounds, this renders burns patients both susceptible to infection and potent dispersers of bacteria [4]. The consequences of nosocomial propagation can be felt throughout the entire hospital, increasing costs and the risk of outbreaks of multidrug-resistant bacteria on the burns unit and beyond [5].

Transmission of infection between burns patients mainly occurs through airborne transmission or direct and indirect contact [1,6]. Routine nursing activity may create periods of increased bacterial dispersal into the air and onto surfaces and other individuals present in the vicinity. The present study examines the contamination of healthcare workers (HCW) resulting from burn wound dressing changes, which are often coupled with bed sheet changes.

Dressing changes on even small non-burn wounds create airborne dispersal of bacteria [7]. Bed sheet changes have also been shown to liberate bacteria into the air [8]. In the 1970s, attempts were made to link the size of a burn and the airborne dispersal of *Staphylococcus aureus* during a dressing change, which implied that the size of the burn was related to levels of bacteria found on settle plates over a period of days [9]. More recently, it was shown that 31% of dressing changes on methicillin resistant *S. aureus* (MRSA) positive burns patients liberated the organism into the air [10].

HCW uniforms are a potential reservoir of infection [11–13], and their contamination can be directly attributed to patients [14,15]. Not only can bacteria be transferred from burns patients to uniforms during dressing changes, but also laboratory simulations have demonstrated that these bacteria can be transferred from the uniform to patients [17,18]. Despite this, there is little consensus for the appropriate protective attire to be worn by HCW carrying out dressing changes on burns patients. In a survey of US burns units, only 24% of units required full protective coverage on entering a patient's room and changing a dressing [19]. UK guidelines are similarly vague and not burns-specific [20–22]. Quantitative data on key issues may help in their development. In this context, the current study was set up to address the hypothesis that the level of contamination received by a HCW would be related to the size of the burn and the time taken for the dressing change.

2. Materials and methods

2.1. Setting

Quantification of HCW contamination was carried out during burn dressing changes. For patients with larger burns, the dressing change would usually also incorporate a bed sheet change while rolling the patient to apply bandages (hereafter termed 'dressing/bed change'). Data including age of burn, recent routine wound swab results, time taken for the dressing/bed change to take place and the %TBSA burn were recorded for each patient. Patients were treated according to standard practice on our burns unit. We aim for early excision and split thickness skin autograft or coverage with a dermal substitute in all deep dermal and full thickness burns. Patients with superficial burns, or those deemed too sick for surgical intervention are managed conservatively with dressings and topical agents. Patients with burn wounds over 10 days old were excluded from the study.

2.2. Sample standardisation

To ensure that samples were taken from a standardised baseline, HCW were asked to don sterile, impermeable, disposable full-body gowns over their uniforms prior to performing dressing/bed changes. This was done to eliminate natural variations in bacterial contamination between different HCWs before the beginning of the dressing/bed change. It also provided a consistent sampling material, which was preferable to sampling from a variety of textures and surfaces including cotton and skin. Gowns were thus worn by the HCW only to facilitate the study design and sampling objectives. Usually, disposable plastic aprons would be worn over uniforms as routine bed/dressing changes are carried out. All HCW maintained standard hand hygiene by decontaminating hands and putting on fresh disposable gloves before entering the patient's room to carry out the nursing activity. Thereafter, with the exception of wearing disposable gowns rather than disposable plastic aprons over uniforms, the HCW carried out the dressing/bed change in the usual manner. Gloves were removed and hands washed following the dressing change and gown sampling, before leaving the room.

Samples were taken from the two most 'involved' HCW carrying out the dressing change, each of whom would usually stand either side of the bed and carry out undressing and redressing of wounds alongside one another. For smaller burns, one HCW often carried out the dressing change alone, and only one set of samples was obtained. Sampling during dressing/bed changes on any one patient was only carried out once.

2.3. Sampling sites

Following the dressing/bed change, and while the HCW was still wearing the disposable gown, and remained in the patient's room, the gown was sampled. To estimate the contamination that would be received during a dressing/bed change by a HCW who had not been wearing an apron, samples were taken from 20 sites across the front of the gown. The 20 'no apron' sites are illustrated in Fig. 1. Of note, the sites are all across the front of the gown, as it was the aim of the study to collect samples from areas that were likely to become most contaminated during dressing/bed changes. In order to estimate the protection afforded had a disposable plastic apron been worn, a subset of 15 'with apron' sites were analysed separately. These excluded five sampling sites on the chest and abdomen that would normally be covered by a disposable apron. These are also demonstrated in Fig. 1.

2.4. Bacteriological methods

Samples were taken from the 20 sites using 25 cm^2 Baird Parker Agar (BPA) contact plates that were pressed firmly against the sampling site for approximately 2 s, by the same investigator (SEB). BPA allows for selective isolation of staphylococcal-type organisms, which are an accepted marker of bacteria originating from a human source [23]. A selective