A whole health economy approach to reducing MRSA bacteraemia incidence in diabetic foot ulcer patients

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Abstract

Introduction: Ulceration of the foot is a common problem among diabetic patients. Infection is a major risk in diabetic foot ulcers (DFU) and many of these are caused by *Staphylococcus aureus*, in particular meticillin-resistant strains (MRSA). The control and management of MRSA remains a significant challenge and all healthcare organisations in England are required to meet Zero Tolerance Objectives for cases of MRSA bacteraemia (MRSAB). This paper describes a collaborative approach across the health economy to investigate factors contributing to the acquisition of MRSA and MRSAB among DFU patients and make improvements to care to reduce the risk of healthcare-associated infections.

Methods: A collaborative approach between acute and community healthcare providers and commissioners was used to conduct Root Cause Analysis and drive improvement to prevent MRSA transmission in DFU patients.

Results: Screening of all DFU patients was initiated after 6 MRSAB were found to be associated with in DFU. In total 15 patients with the same MRSA antibiogram were identified. Following the implementation of actions focused on isolation, wound management, screening and cleaning no further cases were identified.

Conclusion: This outbreak has demonstrated the value of cross-sector collaboration in investigating HCAI in patients with DFU, improving patient care and reducing the risk of MRSA transmission in these vulnerable patients.

Keywords

Patient experience, antimicrobial drug resistance, meticillin-resistance *Staphylococcus aureus* (MRSA), diabetic foot ulcer, outbreak, bacteraemia

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Introduction

Diabetes is a common condition and causes a significant challenge to the National Health Service (NHS). The incidence of diabetes-related complications has risen with the increased life expectancy of the population (NICE, 2011). Among the complications of diabetes are foot problems, for example, infection, osteomyelitis, neuropathy and Charcot arthropathy, which are the most common cause of non-traumatic limb amputation (NICE, 2011). A lifetime risk of foot ulceration among diabetic patients has been estimated to be around 15% (Reiber et al., 1998). Tentolouris et al. (2005) identified almost 65% of ulcers to be infected, with *Staphylococcus aureus* (SA) being the most common

Gram-positive pathogen and 50% of those being meticillin-related SA (MRSA). Foot infections with MRSA have been associated with longer hospital stays, increased costs and greater mortality than meticillin-sensitive SA (Lipsky et al., 2004). Thus MRSA has emerged as a serious and common

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problem in patients with diabetic foot ulcers (DFU) (Dang et al., 2003; Tentolouris et al., 2005). Furthermore, patients with chronic ulcers colonised with MRSA have been shown to be at high risk of developing an MRSA bacteraemia (MRSAB) in an acute care setting (Roghmann et al., 2001). In the UK, MRSAB rates are used as a key performance indicator for healthcare organisations (Department of Health, 2009). It is considered unacceptable for a patient to acquire an avoidable MRSAB while receiving care in a healthcare setting and all organisations are set a Zero Tolerance Objective by the Department of Health (NHS England, 2014). The control and management of MRSA remains a significant challenge for healthcare organisations. This is especially so in this vulnerable group.

Local surveillance data had demonstrated a reduction in the percentage of MRSA in clinical specimens from 21% in 2007 to 8% in April 2012. Despite this local background reduction in MRSA, there were six cases of MRSAB affecting five DFU patients at the acute NHS Hospital Trust over an 18-month period between December 2010 and June 2012. This paper describes an investigation into the factors contributing to these cases of MRSAB and an outbreak of MRSA among patients with DFU. It describes a collaborative approach to the investigation and instigation of control measures, involving commissioners of local NHS services at the Primary Care NHS Trust (now the Clinical Commissioning Group), hospital clinicians, and Infection Prevention and Control Teams (IPCT) from acute and community services

Methods

The acute NHS Hospital Trust is a 1500-bed teaching hospital in the East Midlands region of England. It is a large tertiary hospital accepting referrals from a wide area. In order to meet the requirements of the Department of Health Zero Tolerance Objective, all cases of MRSAB that occur in both acute and community settings are subject to a root cause analysis (RCA) investigation conducted by the lead healthcare provider identified for each

bacteraemia case. The local surveillance data had indicated significant reductions in the number of cases of MRSAB since 2010. However, most cases that had occurred had been in patients that were persistently colonised with MRSA and who had other underlying co-morbidities that put them at higher risk of infection. In 2012, a review of the RCA investigations was undertaken on all MRSAB that occurred in patients with DFU. Because these patients had such complex health conditions, it relied on both community and acute healthcare services working together in collaboration with the healthcare commissioners to review the cases in depth and understand the root causes and contributory factors to these patients developing infections.

Ethical approval for this work was not required as it was based on surveillance and audit data and was conducted as part of a service improvement initiative.

Findings

Between December 2010 and June 2012 six MRSABs had been identified in five DFU patients. Five of the bacteraemias occurred within 48 h of admission to hospital and were investigated jointly by the IPCT from both the acute and community healthcare services. All of the patients were known to be colonised with MRSA prior to their bacteraemias and in four out of six cases there had been previous attempts at decolonisation. All patients had had previous hospital admissions. The RCA investigations identified areas along the patient pathway through both community and acute care that could be strengthened (Table 1).

Identification of the outbreak

In August 2011 one of these patients developed a second MRSAB while an inpatient. The source was an infected foot ulcer and associated osteomyelitis. The ensuing RCA investigation identified a cluster of a further six DFU patients who had acquired MRSA (although had not

Table 1. Critical issues identified from RCA investigations into the outbreak and MRSAB by community and acute care providers.

Clinical practice areas for strengthening	Issues arising not previously considered
<ul style="list-style-type: none"> Screening and decolonisation not carried out in a timely manner Aseptic non-touch technique not consistently carried out Not consistently isolating MRSA carriers when inpatients Inconsistent wound management plans Environment for dressing changes not completely fit for purpose 	<ul style="list-style-type: none"> Inconsistent onward referrals from community providers to acute care Patient / carer management of DFU and competency assessments Access to microbiology results. Results went to GP but not the clinicians managing the wounds Clearly defined roles and responsibilities of inpatient areas, DFU clinic and community care teams

developed a bacteraemia) linked to one ward and outpatient clinic. Cross-transmission was confirmed by a distinct and unusual antibiogram of the MRSA (Erythromycin, Flucloxacillin, Clindamycin, Trimethoprim, Ciprofloxacin resistant). The patient that developed the second MRSAB also had this antibiogram.

Subsequently, a further screening of all DFC patients was undertaken and weekly MRSA screening for all inpatients was instituted. An additional six cases were identified by 20 September 2011. A multidisciplinary outbreak meeting was then convened with senior medical and nursing staff from the clinical and infection prevention and control teams, and twice weekly MRSA screening of inpatients was introduced. This identified another three cases. In total, 15 patients with the same antibiogram were identified as being part of the outbreak. MRSA acquisition was attributed to the ward in 10 cases and in five cases to the diabetic foot clinic (DFC).

Contributory factors identified by the investigation

The ward involved had 18 beds arranged in three four-bedded bays and six single side-rooms. All DFU patients admitted to the Trust were transferred to this ward for specialist management. Many of the MRSA-positive DFU patients had been inpatients for prolonged periods of time due to their complex needs, with one patient being an inpatient for more than 12 months. As a result, ensuring infected patients remained in isolation proved challenging. The routine practice was for medical staff to inspect foot ulcers of all inpatients daily. The lack of designated treatment room facilities meant that all wounds had to be redressed at the bedside. An audit of practice in the ward conducted by the IPCT revealed that multiple wounds were sometimes exposed at the same time in the same bay and on occasions for lengthy periods.

The ward worked closely with the DFC, and many patients discharged from hospital attended the clinic on a regular basis for several weeks and months or even years after discharge. Patients were often admitted directly from clinic to the ward. The DFC ran sessions three times a week and was extremely busy and clinics often overran. The congestion meant that staff were unable to segregate known MRSA carriers. This was a particular problem if the patient required a plaster cast as there was just one room designated for this treatment. Observed dressing practices were sometimes inconsistent in aseptic non-touch technique principles (Rowley et al., 2010).

Actions taken in response to the outbreak

The following actions were put in place once the outbreak was identified:

- Rolling bay-by-bay environmental decontamination of the entire ward with sodium hypochlorite and complete curtain change

- Decontamination of the DFC environment with sodium hypochlorite and curtain change
- Environmental sampling of the ward and DFC using settle plates (one colony of MRSA was found on the ward and four colonies in the DFC)
- Screening of the ward and plaster room staff, and decolonisation of affected personnel (three members of staff were found to be colonised and were successfully decolonised)
- Twice-weekly screening of ward patients
- DFC identified one room for the sole use of MRSA patients
- Only one patient at a time to be in the plaster room in DFC
- Isolation precautions were strictly enforced on the ward for MRSA-positive patients
- Review of dressing practices on the ward and in DFC

The review of dressing practices identified several common problems between the two areas, therefore a standard operating procedure (SOP) for dressing practices to be used in both areas was created. This was followed by an education and assessment programme to introduce the SOPs in both areas.

Following the introduction of all these measures, there were no further cases for over 3 weeks and the outbreak was declared over on 23 November 2011. In addition, two subsequent improvements to practice were made: an increase in the number of DFC sessions from three to five per week, and the creation of a dedicated dressing's room on the ward separate from the bed areas.

Collaboration across the healthcare economy

Despite improvements in the care of DFU patients in the acute hospital there was a further MRSAB in February 2012. This patient did not have the same antibiogram as those involved in the outbreak. Since the complex and prolonged nature of care provision for DFU patients crosses community and acute care boundaries, it was felt necessary to have a 'healthcare economy' group approach to tackling the problem. A total of four meetings took place over a 15-month period. The purpose of the meetings was to:

- Gain a greater understanding of how the DFC operated;
- Understand how DFU patients are cared for in the community and identify the issues that faced all the clinicians caring for them across the patient pathway;
- Agree actions required to best meet the challenges to reduce the risk of further cases of MRSAB in DFU patients.

The first meeting was held in May 2012 and included the healthcare professionals detailed in Table 2.

There was variation in the follow-up protocols across the health economy with some patients being seen either by GP, Practice Nurses, Community Nurses, hospital outpatient clinics and some patients only attended DFC which resulted in limited professional input. Also, identifying DFU patients on admission to hospital and ensuring automatic referral to specialist diabetic care was not consistent. Other issues that were identified were more easily addressed and actions were quickly put into place. For example, an assessment flow-chart for all inpatients was produced and placed in the acute Trust nursing assessment document. This assessment quickly identified any DFU patient and ensured they were referred to the diabetes nurse specialists for advice and assessment and further follow up if necessary. Follow-up of patients was different across the health economy and ensuring clinical information was shared with relevant clinicians to appropriately treat and manage effectively was a key

action for this group. The outcomes of the healthcare economy collaboration are summarised in Table 3.

Discussion

The primary cause of the outbreak was thought to be due in part to inconsistent compliance with isolation precautions in long-stay MRSA carriers resulting in environmental contamination. The risks of cross-infection were increased by the dressing practices adopted on the ward and DFC. Environmental sampling of the ward did not provide significant evidence of this, however the ward had been cleaned prior to the sampling being undertaken. The importance of environmental contamination in contributing to hospital infection has been previously documented (Boyce, 2007).

Source or contact isolation of infected patients is a mainstay of infection control practices. However, unintended negative effects have been reported in the literature, such as anxiety and depression with long periods of isolation (Abad et al., 2010; Barratt et al., 2011; Soon et al., 2013; Wassenberg et al., 2010). Anecdotally some patients had a history of self-discharge which also may have influenced decisions about isolation. Not all side-rooms had en-suite bathrooms, which made enforcing strict isolation precautions even more difficult. Nevertheless, since most of the patients were regular inpatients they had built up good relationships with the ward nurses over time. This undoubtedly enabled the nurses to improve compliance once the outbreak demonstrated the need for better controls.

The issue of placing a patient under contact precautions raises ethical considerations. The issue of autonomy versus communitarianism being an example (Santos et al., 2008). An ethical framework in the context of the special relationship between clinicians and patients and their families suggests

Table 2. Health economy group membership.

Acute Trust IPCT
Community IPCT (representation from three teams)
Consultant Physician (Diabetes and Endocrinology)
Tissue Viability (Social enterprise community provider)
Podiatry
Community Infection Control Doctor
Deputy Director of Infection Prevention and Control (Acute Trust)
Ward Manager (DFU ward)
Senior Diabetic Nurse Specialist DFC
Public Health and Quality and Patient Safety representatives from the CCG
Matron (Diabetic ward and Outpatient area)
Diabetes Project Manager (Acute Trust)

Table 3. Outcomes following Health Economy Collaboration.

Outcomes of investigation	Improvements in service delivery
Refinements in patient pathway to ensure all wounds are assessed by a clinician weekly	Patients seen in DFU clinic are referred to the GP practice nurse or community nursing service for follow-up
Strengthened communication and partnership working between community and acute care providers to enhance consistency in clinical care provided across the county	Referral pathways reviewed and the process has been documented
Improved access to microbiology results in the community	Access to the hospital laboratory reporting system in the community has been provided
Clear and agreed roles and responsibilities of all involved within the patient pathway with clearly defined referral criteria	Standard operating protocol developed for referral
Clear and consistent patient-focused information	Patient information leaflet developed
Any carer that wishes to undertake some of the dressings is assessed in relation to a competency that has been developed and shared across the health economy	Competency assessment in dressing techniques for informal carers

that communitarianism provides a suitable foundation for the creation of infection control policies. Contagious diseases which can often pass between strangers raise questions about the moral obligations we owe to people with whom we share no 'special' relationship (Cheyette, 2011). In practice, the required level of compliance can be achieved with education rather than informed consent. The patients became very trusting of the care being delivered in the ward and clinic. Many patients as a consequence refused to be referred on to another clinician to manage their care between clinic appointments. There was again anecdotal evidence of this from the specialist clinicians. However, ensuring patients and their families and carers make well-informed decisions about their care requires them to have all the available evidence upon which to make their decision (NICE, 2011).

Patients should be encouraged where possible to participate in their care as this improves concordance. Concordance is synonymous with patient-centred care and the development of therapeutic relationships between patients and clinicians (Bell et al., 2007). However, wounds can deteriorate very quickly and it is essential to undertake regular clinical reviews of wounds to ensure deterioration or infection is identified promptly and treated appropriately. The revised pathway ensures all wounds are reviewed by a clinician at least weekly and if the patient or their carer wants to be responsible for undertaking some of the wound care then they are taught and competency assessed in accordance with wound care guidelines produced by the ward. A patient/carer leaflet was developed for use across community and acute care settings explaining the process.

The predominant reason many DFU patients are admitted to hospital is for administration of intravenous antibiotics and wound assessment/dressing changes. One initiative that is being considered is to run an outpatient clinic in a dedicated area of the ward where antibiotics can be given and wounds inspected and redressed without the need for an inpatient stay. This will hopefully improve the quality of life for these patients and be a more cost-effective method of treatment. Referral by DFC and the ward to clinicians in community care to review the wounds at least weekly facilitates improved communication between settings. Patients still have control over managing their wounds on a daily basis but there is now clinical support to highlight issues or concerns more quickly which will improve the long-term patient outcomes and quality of care being provided. It is important that the right care is provided in the right place at the right time, and by refining the patient pathway the health economy can now be assured that patients with DFU are being cared for appropriately and consistently across all healthcare environments.

In conclusion, if the investigation of the outbreak had focused only on the acute Trust there would have been improvements in practice but these would have occurred in only one area of the patient pathway. By reviewing the entire patient pathway, the whole health economy has

worked together to contribute to a positive change in practice and ensures a cohesive approach to the future management of this vulnerable patient group.

Limitations

This paper reviewed the literature in relation to MRSA bacteraemia and outbreaks, the effects of isolation in patients, concordance with treatment regimens and the complications of diabetes. However, the authors did not search the literature to review whether this had been reported elsewhere. The applicability of the recommendations we adopted locally are specific to the issues identified from our investigations. However, the review of the patient pathway across the health economy would be of benefit to other organisations experiencing similar concerns.

Conclusion

This outbreak investigation has demonstrated the risk of MRSAB associated with DFU patients and highlighted the potential for practice across both acute and community care pathways to contribute to the transmission of healthcare-associated infections in these vulnerable patients. It has also demonstrated the value of collaboration across the health economy between those providing and commissioning healthcare services, in order to improve patient care and preventing healthcare-associated infections.

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