Quality improvement report

Eradication of methicillin resistant *Staphylococcus aureus* by “ring fencing” of elective orthopaedic beds

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Abstract

Problem Deep infection after joint arthroplasty can be catastrophic, leading to further surgery, loss of the prosthesis, disability, and risk of mortality. Twenty nine new cases of methicillin resistant *Staphylococcus aureus* occurred in the first year after elective orthopaedic surgery was centralised to a district general hospital in Essex.

Design Prospective trial to establish whether ring fencing of elective orthopaedic beds and introduction of simple infection control measures has an effect on the rates of postoperative infections and number of patients treated.

Participants and setting All patients undergoing primary hip or knee replacement in a district general hospital in Essex, England, between July 1999 and July 2001.

Main measures for improvement Number of patients having joint replacement; number of all postoperative infections in the participant group; number of cases of methicillin resistant *Staphylococcus aureus*.

Strategies for change Ring fencing of the elective orthopaedic ward and introduction of simple infection control measures.

Effects of change The incidence of all postoperative infections decreased from 43/417 to 15/488 ($P < 0.0001$), with no new cases of methicillin resistant *Staphylococcus aureus*.

Lessons learnt The introduction of a ring fenced elective orthopaedic ward and simple infection control measures allowed 17% more patients to be treated and significantly reduced the incidence of all postoperative infections.

Background

Methicillin resistant *Staphylococcus aureus* (MRSA) is an organism that possesses the *mecA* gene and the penicillin binding protein PBP2a and is resistant to methicillin and oxacillin. Deep infection after joint arthroplasty can be catastrophic, leading to further surgery, loss of the prosthesis, disability, and risk of mortality.¹ MRSA is a particularly difficult organism to treat because of the need to use antibiotics that are expensive, potentially toxic, or both. Other postoperative hospital acquired infections may also result in

increased morbidity and mortality and prolonged hospital stay.

Outline of problem

Until April 1998 a dedicated stand alone orthopaedic hospital did all elective orthopaedic surgery in the Mid Essex region. After centralisation of such surgery to the main district general hospital, the number of healthcare associated infections in this group of patients increased (fig). In the year after the move to the general hospital 29 new cases of MRSA were identified on the wards where elective orthopaedic patients were nursed—22 colonisations and seven infections (four surgical site wound infections, one urinary tract infection, one lower respiratory tract infection, and one case of septicaemia in a patient who had had elective total knee arthroplasty, resulting in death).

Strategies for change

For one year (July 1999 to July 2000) we recorded the rate of postoperative infections of all types (for example, chest infections, urinary tract infections, surgical site wound infections) in patients undergoing hip or knee joint arthroplasty. Patients were treated using the standard precautions against infection used in most orthopaedic units in the United Kingdom—that is, short admission time before surgery, ultra clean air theatres, standard theatre hygiene and precautions, and prophylactic intravenous antibiotics.

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Effect of change in location on number of infections

In July 2000 we “ring fenced” the 28 beds in the elective orthopaedic ward. Only patients having elective orthopaedic surgery (including joint replacement) were admitted to the ward. Orthopaedic liaison nurses swabbed all patients (nose, perineum, and any skin lesions) in the community for MRSA and methicillin sensitive *Staphylococcus aureus*. Patients testing positive for either organism were started on a staphylococcus decontamination regimen in the community. Because of concerns about gastrointestinal carriage of MRSA, we took the approach of “once positive, always positive.” We did not allow any patient who had ever had MRSA to be admitted to the ring fenced ward. We isolated these patients on another orthopaedic ward and gave them teicoplanin prophylaxis perioperatively in addition to our standard regimen.

We excluded trauma patients, day surgery patients, and patients from other specialties from the ring fenced ward. We rigorously enforced the British Orthopaedic Association recommendations on sterile procedures in operating theatres.² Trauma patients who were deemed low risk for MRSA (young, first admission to hospital, not been in a nursing home or other healthcare institution) were swabbed on admission to the “non-ring fenced” ward. If they had negative swabs, we allowed them into a single bedded side room on the ring fenced ward if a shortage of beds existed in the rest of the hospital and spaces were available on the ring fenced ward.

In addition to standard precautions, we instituted a code of dress and behaviour (box). Nursing staff started a regimen of wearing a disposable apron and gloves for each interaction with a patient. We installed an alcohol hand rub by each bed and instructed staff to use it before and after each consultation. Medical staff left jackets at the door to the ward and donned clean white coats for the purpose of ward rounds. The coats were left on the ward after rounds and laundered daily. Visitors were not allowed to sit on the beds.

We gave the nursing sister in charge responsibility for ensuring implementation of the infection control standards among the nurses, cleaning staff, and doctors visiting the ward. The adherence to the standards by senior nursing and medical staff led to a general change in culture within the unit and adherence by all staff.

We minimised the use of bank and agency staff and expected all such personnel to comply with the same standards as regular staff. We informed nursing agencies of the ward policy, so that any agency nurses were aware of what was expected before the start of their shift.

We took microbiology samples (urine, sputum blood cultures, or wound swabs) from any patient deemed on clinical grounds to have a postoperative infection. All clinical infections recorded were supported by positive microbiology results.

Effect of the change

In the year before ring fencing, we did 417 lower limb arthroplasties. In the year after ring fencing, owing to more predictable bed management and fewer complications, we did 488 lower limb arthroplasties. The number of patients undergoing arthroplasty thus

Infections before and after ring fencing ($P < 0.0001$)

	No of infections (No of MRSA)	No of joint replacements
Before ring fencing	43 (9)	417
After ring fencing	15 (0)	488

increased by 17% without any increase in theatre capacity or number of beds.

The total number of all infections (including urinary tract, chest, or superficial or deep surgical site wound infections) in postoperative patients decreased from 43/417 (nine of which were MRSA) before ring fencing to 15/488 after the introduction of ring fencing ($P < 0.0001$). No cases of MRSA occurred in arthroplasty patients after ring fencing (table).

Preoperatively, 8/488 patients swabbed positive for MRSA skin colonisation in the community and were admitted to a non-ring fenced ward where they were isolated and received teicoplanin prophylaxis. No post-operative infections of any kind occurred in this group during the study period.

Precautions taken to prevent infections

Staff

- Hand decontamination at ward entrance and before and after each patient contact by using alcoholic rub
- Clean uniform:
 - Daily for shift
 - Staff from other clinical areas in previous shift
- Clean ward white coat:
 - Orthopaedic doctors
 - Visiting staff
- Aprons for direct patient contact
- Minimal jewellery: wedding ring or small earrings only. No wrist watches, nail varnish or polish, or false nails
- Antibiotic strictly prescribed according to hospital guidelines
- Urinary catheter on patients' non-operated side and off the floor

Patients and visitors

- Policy:
 - Explained during pre-admission consultation (patients)
 - Explained during first visit (visitors)
- Restricted hours of visiting, maximum of two visitors
- Visitors to use chairs provided and not to sit on the bed
- Minimum number of presents (for example, flowers, food, and drink)

Premises

- Policy leaflet displayed at ward entrance
- Cleaning:
 - Visitors' chairs and foot stools once a day
 - Bed frames three times a week
 - Nurses' stations once a day
 - General hospital cleaning schedule strictly enforced (kitchen, doors, sinks, toilets, bathrooms)
 - Bed linen changed at least once a day

Lessons learnt

Ring fencing of elective orthopaedic beds and simple infection control measures significantly reduced the incidence of postoperative infections in patients undergoing joint arthroplasty, and MRSA was eradicated. As a consequence of fewer complications and more predictable bed occupancy, as well as not having beds blocked for long periods by trauma patients and non-orthopaedic patients, we were able to do 17% more joint arthroplasties without increasing the number of operating lists, beds, or surgeons.

Staff, patients, and visitors had to undergo a major change in culture in order to implement the changes. The senior medical and nursing staff acted as role models in the implementation of new policy, as described by Ching and Seto.³

We acknowledge that the reduction in infection rate was achieved by several factors: ring fencing, simple infection control measures, and reducing the number of agency staff to a minimum. However, the model as a whole shows important and significant results.

This work showed an increase in healthcare associated infection, including MRSA, in an elective orthopaedic ward containing patients from other specialties, including trauma. The importance of the theatre environment on joint arthroplasty has been understood for many years; we have shown that the ward environment is also highly important in the rate of infection in patients having joint arthroplasty.

Plowman et al suggested that hospital acquired infection increases patients' length of stay (up to 11 days per case) and the cost of treatment (£2917 per case).⁴ Although infection in joint replacement

surgery may be caused by direct contamination at the time of surgery, the total infection rates can be further reduced with an appropriate ward environment. We strongly recommend the ring fencing of elective orthopaedic patients and simple infection control measures to reduce the risk of postoperative infection and allow an increase in the number of patients treated.

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Contributors: LCB coordinated the project, collected the data, wrote the paper, operated on patients, and participated in infection control regimens. ELT advised on setting up the study, devised the decontamination protocol, advised on infection control procedures, and devised treatment regimens for infected patients. WWW and JDT devised, set up, and coordinated the project, educated staff in infection control procedures, operated on patients, and advised on data collection. LCB is the guarantor.

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- 2 British Orthopaedic Association recommendation on sterile procedures in operating theatres. London: BOA, 1999. www.boa.ac.uk/BOAsterilerech.htm (accessed 22 June 2004).
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The Tao of Pooh—a philosophy that changed my practice

My mother in law gave me *The Tao of Pooh* by Benjamin Hoff for Christmas, I suspect because she thought my mentality was suited to the cuddly toy of the title. I dutifully added it to my collection of books to read while on holiday, intending to have a complete break from books and journals about medicine. However, when I settled down to read it, on a sunny beach far from my consulting room, I was struck by its relevance to my work, and *The Tao of Pooh* has made a greater change to my practice than much of my regular medical reading.

Hoff uses the characters from A A Milne's *Winnie the Pooh* books to illustrate and explain the basics of Taoist philosophy, showing how Pooh himself is the epitome of the Taoist thinker, enjoying life with simplicity but not stupidity. The author explains that Taoists try to appreciate, learn from, and work with whatever happens in life, whereas, in contrast, Confucians seek to impose order on a chaotic world and Buddhists see life's tribulations as obstacles to be overcome before achieving Nirvana. He describes how *Tao* is the Way, which can be understood but not defined, and illustrates key elements of *Tao* such as *P'u*, the uncarved block, and *Wu wei*, going with the flow. In case you should think that this book is altogether too simplistic, I should add that Hoff touches on the writings of Lao-Tse (author of the *Tao Te Ching*), Chuang-tse, the poet Li Po, and other Taoist philosophers, giving his own translations of passages from their writings.

While reading the book, I began to see how the NHS is governed by a Confucian hierarchy of rules and regulations that do little to contribute to the harmony of life in general practice. Mischievously, I thought of general practitioners as Buddhists

overcoming the trials and tribulations of the New Contract in a bid to achieve the Nirvana of 1000 quality points. I realised, however, that general practice is a chaotic discipline far more suited to the Taoist approach of going with the flow—the *Wu wei*. In Hoff's descriptions of A A Milne's characters I could see myself striving to be like the learned Owl, whilst actually being a mixture of the busybody Rabbit and the pessimistic Eeyore.

Hoff has shown me how the ideal is to be a simple character such as Pooh himself, the eponymous *P'u*, the uncarved block—accepting life, work, and other people as they are rather than trying to impose order on them. I now seek to accept and move with events as they occur, preferring not to try to impose change nor viewing change as an obstacle to be overcome. This approach spills over into consultations, keeping them simple, letting the patient direct the flow. "Shades of Balint," I hear you say; well, maybe Balint was a Taoist. I use Confucian protocols and guidelines, but I try to mellow them, fitting the protocol to the circumstance rather than the other way round. Above all, I keep things simple so as not to lose the *Wu wei*.

There is a long way to go yet, and I cannot see the NHS, general practice, or myself ever becoming wholly Taoist in approach. However, any dilution of the increasing complexity and disharmony of NHS general practice with a little Taoist thinking must be a good thing. Learning is not wisdom, and wisdom is not learning; however, through reading this book, I think that I have gained a little of both.

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