Reducing surgical site infection in a hospital in Singapore

Surgical site infection (SSI) is preventable and achieving zero SSI rates for every clean operation should be the goal of all surgeons. This paper describes one hospital’s strategy for reducing SSIs, enhancing the care of patients and promoting a culture of patient safety. All clean and clean-contaminated elective gastrointestinal and hernia operations were managed using four specific interventions. SSI rates were compared to historical data.

INTRODUCTION
The authors’ hospital has 1,440 beds, making it the second largest public acute care hospital with specialty centres in Singapore. The clinicians’ expertise is well-supported by state-of-the-art facilities and medical equipment. The surgical department is composed of upper gastrointestinal, hepatobiliary, colorectal, vascular, urology and trauma teams, each performing a wide range of surgical operations [Fig 1].

Although there is evidence on preventing surgical site infection (SSI) dating back to the 1970s, these practices were not standardised in the hospital.

In 2006, the authors implemented an SSI prevention project to improve the surgical infection rate on elective gastrointestinal and hernia operations in the hospital.

STRATEGY FOR CHANGE
The Clinical Practice Improvement Program (CPIP) is a training programme for clinical leaders aimed at improving the quality of health care. It was developed by Wilson and Harrison and was first implemented in New South Wales, Australia, in 1999 [1].

The hospital adopted this programme and has used the CPIP to train clinicians since early 2000. During the planning stage of the CPIP project, the team brainstormed all the risk factors for SSI.

The risk factors were categorised and summarised in a fish-bone diagram [Fig 2]. All the staff involved in the project were given the opportunity to vote on the top risk factors. Staff participation in voting encourages a deeper sense of project ownership and improves motivation. A Pareto chart was then used to identify and prioritise the most important risk factors for intervention planning [Fig 3]:

- Skin preparation
- Prophylactic antibiotic regimen
- Routine glucose monitoring
- Postoperative core temperature monitoring.

IDENTIFIED INFECTION PROBLEMS
Before the SSI project, surgical site hair was removed with a razor by the operating room attendants soon after anaesthesia had been administered. However, this practice is associated with increased SSI rate due to the potential for micro-injuries to the skin, which can predispose the skin to contamination and infection [2, 3].

In addition, there was no standard prophylactic antibiotic guideline in the hospital. This meant that the choice of prophylactic antibiotic was guided by the preference of the surgeons. The timing of prophylactic antibiotic administration was also variable. As a way of combating these inconsistencies, the following new interventions were standardised and implemented.

Skin preparation
Firstly, razors were replaced by electric clippers when performing preoperative hair removal. This is because shaving by razors was a known risk factor for SSI [2, 3]. Posters were used to remind staff to use clippers in the operating room, operating room attendants were trained to use clippers,

References
and patients were instructed not to shave themselves preoperatively.

All razors were removed from operating rooms and the team worked with the purchasing department to provide a continuous supply of clippers.

Prophylactic antibiotic regimen
Surgeons, pharmacists and the infection control team were all involved in developing a standardised prophylactic antibiotic guideline that was consistent with international recommendations[4, 5]. The guideline specifically stated that antibiotics must be administered within 30 minutes of a surgical incision as per the recognised evidence-based practice for SSI prevention[6]. Classen et al convincingly demonstrated that the SSI rate is at its lowest point when antimicrobial prophylaxis is administered within the first hour of anaesthesia induction[6].

Where surgery was scheduled to last for more than four hours or where the estimated blood loss was expected to exceed one litre, a repeat dose of antibiotics was administered.

The guideline was circulated to all operating room staff and anaesthetists to encourage compliance. Notices, proforma, checklists and posters describing the prophylactic antibiotic guideline were used as reminders. The proforma and checklists served to prompt clinicians and track their compliance to the protocol as they signed off when action was taken. The antibiotic dosage was adjusted according to the patient’s body weight. Medications were stocked in the hospital according to the standard drugs inventory.

Routine glucose monitoring
A mandatory glucose monitoring regimen was introduced for diabetic patients. Post Anaesthesia Care Unit (PACU) and ward nursing officers were responsible for monitoring and controlling diabetic patients’ postoperative blood glucose levels at six-hourly intervals to ensure that they were kept below 11.1mmol/l.

Postoperative core temperature monitoring
A target of keeping patients’ postoperative core body temperature within the range of 36–38°C was set. Maintaining normothermia has many benefits and has been shown to reduce the risk of complications and cost. Perioperative unplanned hypothermia is a
Unplanned hypothermia increases the likelihood of postoperative myocardial infarction, admission to intensive care units and mortality rates. Warmed intravenous (IV) fluids, increased ambient temperature in the hospital’s operating room and the use of warming blankets during surgical procedures can also maintain normothermia in patients.

**RESULTS**

With the bundle of interventions described above, the hospital’s overall SSI rate was reduced year on year at the following rates:

- 3.1% in 2005
- 0.7% in 2006
- 0.4% in 2007
- 1.1% in 2008
- 1.2% in 2009.

When compared with data from the US’s National Nosocomial Infections

**References**


Surveillance (NNIS)\(^9\) records, the hospital’s SSI rates were lower than the NNIS mean SSI rate of 3.4% for gastrointestinal and hernia operations. (The NNIS is a collaborative surveillance system that collects data on nosocomial infections. The data is reported voluntarily by participating hospitals to estimate the magnitude of the nosocomial infection problem in the US and to monitor trends in infections and risk factors.)

**GENERAL POSTOPERATIVE WOUND MANAGEMENT**

The postoperative care bundle is part of the comprehensive wound management programme that has the aim of reducing SSI in the hospital. The following routine practices are also employed by the surgery department:

- The routine laparotomy wound closure involves mass closure of the wound with PDS\(^{TM}\) II (polydioxanone) suture (Ethicon), a monofilament absorbable suture. Subcuticular skin closure is applied where aesthetics is an overriding consideration.

- For clean and clean contaminated wounds, the skin is apposed with either metal staples (Proximate\(^{TM}\) Plus [Ethicon] or Appose\(^{TM}\) [Convien]) or absorbable staples (Inorb\(^{TM}\) [Incisive Surgical]). Absorbable staples are preferred to metal staples for skin apposition because of their superior aesthetic outcome. Additionally, they obviate the risk of suture track infection and inflammation. More studies are needed to investigate the impact of absorbable staples in SSI reduction.

- Early suture removal is preferred for interrupted wound closure. Sutures and staples are removed on the eighth day postoperatively.

- Dressing using chlorhexidine and normal saline for wound cleansing is advised. In the authors’ hospital all laparotomy wounds are covered with Opsite\(^{TM}\) Post-Op (Smith & Nephew) before the reversal of anaesthesia. The dressing is left on for 48–72 hours postoperatively unless it becomes soiled or soaked with blood. Thereafter, the dressing is removed for wound inspection and the wound is exposed. If the wound is clean, any further cleaning is performed with normal saline.

- If a deep SSI is suspected, Kaltostat\(^{TM}\) (Convatec) or hydrogel dressings are recommended. Clinicians in the authors’ hospital are not currently using antimicrobial dressings as antimicrobial products are being progressively introduced. However, the hospital is in the midst of converting from the PDS II suture (mentioned above) to the PDS\(^{TM}\) II Plus antibacterial suture (Ethicon), which is impregnated with triclosan. The use of antimicrobial dressings will probably be the next phase.

**THE FUTURE**

The main focus for future implementation is to produce a guideline for the use of antibiotic-impregnated sutures. Preliminary data demonstrates a reduction in SSI rates with the use of antibacterial-coated sutures for surgical wound closure. For instance, in vitro studies using triclosan-coated sutures demonstrate a considerable reduction in bacterial adherence to the sutures\(^{10}\).

The triclosan-coated suture was also reported to be effective in reducing cerebrospinal fluid shunt infection\(^{11}\) as well as sternal wound infection\(^{12}\). The authors remain to be convinced of the use of the antibacterial-coated suture in abdominal wound closure as there is limited data in the current studies. In light of this, the authors’ team is planning to conduct a randomised controlled trial to answer this question before full implementation.

**AUTHOR DETAILS**

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