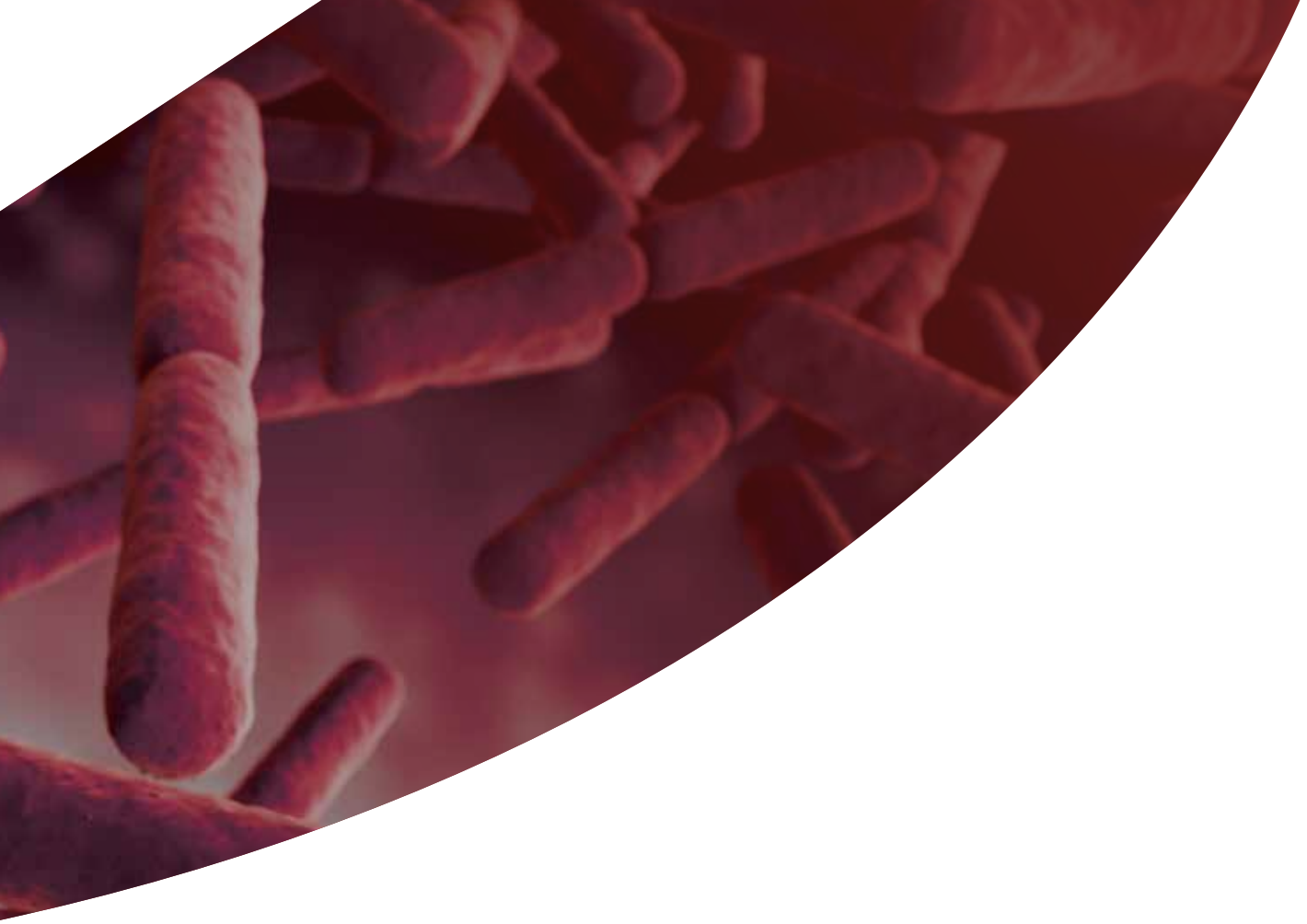

Royal Australasian College of Surgeons
Queensland Audit of Surgical Mortality (QASM)

HOSPITAL-ACQUIRED INFECTIONS AND QASM PATIENTS (JULY 2011 TO JUNE 2016)

Royal Australasian College of Surgeons

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INTRODUCTION

Infections are the modern day challenge of all hospital inpatients, especially in vulnerable patients who need surgical care. (Ref: Hicks, 2016)

Hospital-acquired infections in Queensland surgical patients (July 2011 to June 2016)

Hospital-acquired infections (HAIs) are infections patients can get while receiving medical treatment in a healthcare facility– they are a major, yet often preventable, threat to patient safety. (Ref: CDC, 2017)

Surgeons in Queensland hospitals report on whether or not the surgical patients under their care died with a clinically significant infection.

The Queensland Audit of Surgical Mortality (QASM) audits all surgical deaths in Queensland. This is possible because all surgeons are obliged by the Royal Australasian College of Surgeons (RACS) to participate in the audit as part of the Continuing Professional Development program.

All hospitals (public and private) in Queensland participate in QASM.

The data in this report is from all hospitals in Queensland.

This report covers 3,532 patients reported over five years (2011/2012 to 2015/216 years) to QASM.

Qualifiers

- Not all audit questions were answered.
- The data is provided by the surgeons who cared for the patients and not from an infection control program.
- A limitation of the audit is that it does not collect information on the number of days the patient is in hospital prior to confirmation of the presence of infection.
- This report does not include non-surgical patients.
- This report centres on infections acquired during the hospital admission.

PREVALENCE OF INFECTIONS

KEY POINTS

- More than one-third (34.7%) of surgically-related deaths were associated with an infective process.
- Nearly two-thirds (58.0%) of those patients, whose death was associated with an infective process, had acquired their infection(s) while in hospital.
- Infections were most commonly detected in the postoperative period (62.1%; 504/811).

A clinically significant infection was present in 34.7% (1,588/4,573) of all surgical patients who died in Queensland hospitals. This percentage has remained steady from 2011/12 to 2015/2016.

These infections were acquired either:

1. before admission to hospital (42.0%; 636/1,513), or
2. during the hospital admission (58.0%; 877/1,513).

HOSPITAL-ACQUIRED INFECTIONS

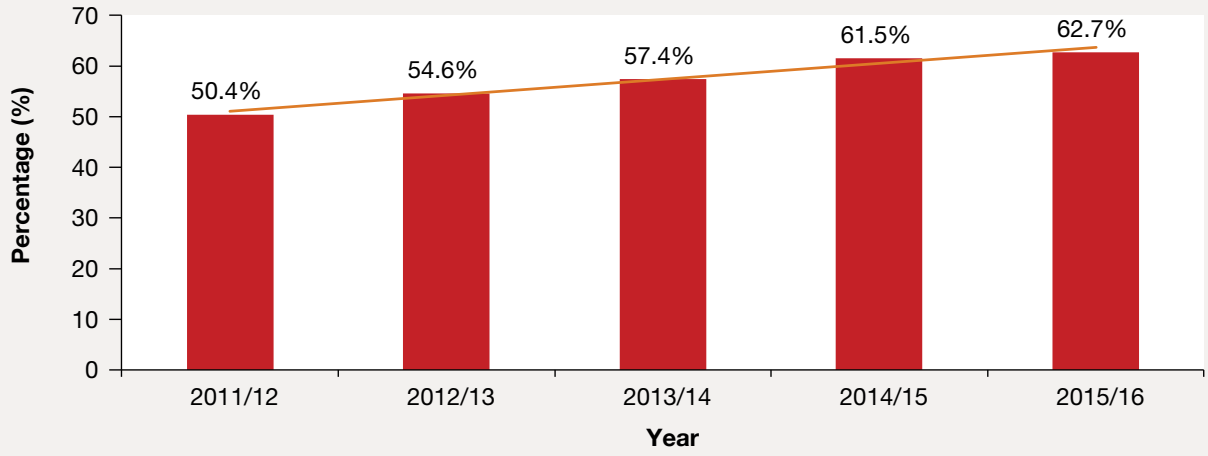
This QASM audit is most interested in the percentage of surgical patients who acquired their infections once they had been admitted to hospital for surgery.

There are two different times (preoperatively and postoperatively) and two different sites (surgical sites and other invasive sites) that are reported here about hospital-acquired infections.

Although the proportion of surgical patients who died with a clinically significant infection present has been constant over time, the proportion of patients who had infections, and acquired them as inpatients, is steadily increasing. This is a statistically significant trend (see Figure 1).

This trend could predict increases in costs for hospital systems and increased risks for patients in the future.
(Ref Thaden, 2016)

Figure 1: Percentage of surgical patients who died with infections and who had acquired those infections in hospital (as reported by surgeons) by year (n=1,588)



It is clear from the analysis of causative organisms that there are four main types of organisms acquired in hospital that have caused infections in patients who died. Those organisms are:

1. *Pseudomonas* species
2. *Escherichia coli*
3. *Staphylococcus* species
4. *Klebsiella* species

These are predominantly Gram negative organisms, common causes of enteric and urinary tract infections. There were also a high number of Gram positive infections with Staphylococcus species.

At present, it is not possible to determine the sources of these infections in the patients who died.

It is possible the infections became established in surgical patients because of exposure to pathogens in the hospital environment; it is also possible they occurred because of the inherent physical vulnerability of elderly patients experiencing the stresses of surgical procedures. (Ref Turrentine, 2006)

NOTE: Please see Lists 1 to 4.

LIST 1: INFECTIONS ACQUIRED IN HOSPITAL (PREOPERATIVELY)

SUMMARY

- n=158 patients; 56 patients (35.4%) had the infective organisms identified.
- Many patients had multiple pathogenic organisms present.
- The top five organisms identified:
  1. *Staphylococcus* species n=14 (8.6%)
  2. *Klebsiella* species n=13 (8.0%)
  3. *Pseudomonas* species n=8 (4.9%)
  4. *Clostridium* species n=4 (2.5%)
  5. *Streptococcus species* n=3 (1.9%)

LIST 1: INFECTIONS ACQUIRED IN HOSPITAL (PREOPERATIVELY)	
Clostridium difficile	1
Clostridium difficile	1
Clostridium difficile, colitis	1
Enterobacter (blood culture); *Candida* (blood culture); *E.coli* (urine)	1
Enterococcus – *Enterococcus faecium*, VRE – *Klebsiella pneumoniae*	1
Enterococcus faecalis	1
Enterococcus faecium; Escherichia coli	1
Escherichia coli	1
Escherichia coli, Candida, Clostridium	1
Escherichia coli, Mixed enteric contamination	1
Escherichia coli; Clostridium	1
Escherichia coli; Pseudomonas aeruginosa	1
Escherichia coli; Serratia marcescens	1
Fungal: *Paecilomyces lilacinus*	1
Gram negative bacilli and Yeast	1
Gram negative blood culture *Klebsiella.* – gram positive (aspirate)	1
Klebsiella	3
Klebsiella oxytoca	1
Klebsiella pneumonia, Proteus mirabilis	1
Klebsiella pneumoniae	1
Klebsiella; E.coli	1
MRSA; *E. coli*	1
MRSA; *E.coli; Enterobacter; Candida; Aspergilla*	1

Organisms listed in alphabetical order of first organism reported

LIST 1: INFECTIONS ACQUIRED IN HOSPITAL (PREOPERATIVELY)	
MRSA; *Strep constellatus*; mixed enteric	1
Multiple enteric organisms	1
Pantoea agglomerans	1
Proteus mirabilis	1
Pseudomonas	1
Pseudomonas aeruginosa, Enterobacter cloacae	1
Pseudomonas putida; Enterococcus	1
Pseudomonas	1
Pseudomonas; Klebsiella; Enterococcus	1
RSV; *Candida*	1
Staphylococcus	3
Staphylococcus aureus	2
Staphylococcus aureus (also systemic infection) on background of *Cryptococcus*	1
Staphylococcus aureus and *Pseudomonas*	1
Staphylococcus aureus bacteraemia (coagulase negative)	1
Staphylococcus aureus, Sputum grew. – Sacrum grew mixed coliforms + skin flora.	1
Staphylococcus capitis	1
Streptococcus C	1
Streptococcus fusarium	1
Streptococcus intermedius	1

Organisms listed in alphabetical order of first organism reported

LIST 2: INFECTIONS ACQUIRED IN HOSPITAL (POSTOPERATIVELY)

SUMMARY

- n=521 patients; 142 patients (27.3%) had infective organisms identified.
- Many patients had multiple pathogenic organisms present.
- The top four organisms identified:
  1. *Pseudomonas* species n=30 (5.8%)
  2. *Escherichia coli* n=26 (5.0%)
  3. *Staphylococcus* species n=21 (4.0%)
  4. *Klebsiella* species n=16 (3.1%)

LIST 2: INFECTIONS ACQUIRED IN HOSPITAL (POSTOPERATIVELY)	
Acinetobacter	1
Acinetobacter baumannii	1
Bacteroides fragilis	1
Bacteroides fragilis, Clostridium clostridioforme	1
Bacteroides thetaiotamicron, Escherichia coli & *Pseudomonas*	1
Bowel organisms from anastomotic leak	1
Candida	5
Candida albicans & *Citrobacter braakii*	1
Candida albicans, *Pseudomonas*; mixed enteric flora	1
Candida glabrata	2
Candida parapsilosis	1
Candida, Pseudomonas	1
Candida; Morganella and *Staph. epidermidis*	1
Candidaemia	1
Carbapenem-resistant *Acinetobacter*	1
Carbapenem-resistant *enterobacteriaceae*	1
Clostridium	1
Clostridium difficile	1
Coagulase negative *Staphylococcus, Escherichia coli*	1
Coagulase negative *Staphylococcus. Streptococcus. Pseudomonas aeruginosa*	1
Corynebacterium pseudodiphtheriticum	1
Cytomegalovirus	1
Enteric content	1
Enterobacter	2
Enterobacter aerogenes	1
Enterobacter cloacae	5

Organisms listed in alphabetical order of first organism reported

LIST 2: INFECTIONS ACQUIRED IN HOSPITAL (POSTOPERATIVELY)	
Enterobacter pneumonia, Staphylococcus epidermidis, Vancomycin Resistant *Enterococcus*	1
Enterobacter, Enterococcus of mixed bacteria, *Candida albicans*	1
Enterococcus	3
Enterococcus faecium	1
Enterococcus, Candida	1
Enterococcus, Streptococcus	1
Escherichia coli	12
Escherichia coli	1
Escherichia coli & *Staphylococcus*	1
Escherichia coli, Candida	1
Escherichia coli, Enterobacter	1
Escherichia coli, Serratia	1
Escherichia coli, Staphylococcus aureus	1
Escherichia coli, Coagulase-negative *Staphylococcus; Candida*	1
Extended spectrum *Beta lactamase*	1
Extended spectrum *Beta lactamase, Escherichia coli*	1
Extended spectrum *Beta lactamase,* Vancomycin Resistant *Enterococcus*	1
Gram negative *bacilli*	1
Gram negative *bacilli, Hafnia alvei & Candida*	1
Gram negative bacteria	1
Herpes simplex virus	1
Influenza A	1
Influenza B	1
Klebsiella	6
Klebsiella & *Candida*	2
Klebsiella & *Pseudomonas*	1
Klebsiella & *Serratia*	1
Klebsiella pneumoniae	3
Klebsiella pneumoniae, Proteus mirabilis	1
Klebsiella pneumoniae, Staphylococcus hominis, Enterobacter cloacae, Enterobacter aerogenes, Haemophilus influenzae, Candida albicans, Vancomycin Resistant *Enterobacter; Enterococcus faecium*	1
Klebsiella, Candida, Aspergillus fumigates	1
Methicillin-resistant *Staphylococcus aureus*	1
Methicillin-resistant *Staphylococcus aureus* & *Escherichia coli*	1
Mixed coliforms	1
Mixed enteric organisms, *Escherichia coli, Candida,* Other mixed flora	1
Moraxella catarrhalis	1
Morganella morganii, Klebsiella oxytoca	1

Organisms listed in alphabetical order of first organism reported

LIST 2: INFECTIONS ACQUIRED IN HOSPITAL (POSTOPERATIVELY)	
MRSA	1
Multiple organisms at different times	1
Multiple organisms isolated	2
Proteus mirabilis	2
Pseudomonas	8
Pseudomonas & *Enterobacter*	1
Pseudomonas aeruginosa	9
Pseudomonas aeruginosa, Candida albicans	1
Pseudomonas aeruginosa, Staphylococcus aureus	1
Pseudomonas aeruginosa; candida albicans; lactobacillus and anaerobic gram negative bacilli	1
Pseudomonas putida; Enterobacter cloacae	1
Pseudomonas species, *E coli*	1
Pseudomonas; Candida	1
Pseudomonas; Enterococcus; Coliform; mixed anaerobic bacteria; *Candida albicans*	1
Pseudomonas; Proteus; Klebsiella	1
Pseudomonas; VRE	1
Sensitive *Staphylococcus* Resistant Pseudomonas	1
Serratia marcescens	2
Serratia marcescens, Candida	1
Serratia marsescens, Staphylococcus aureus	1
Staph aureus, sputum – blood culture with *Citrobacter koseri*	1
Staph epidermidis, Enterococcus faecalis, Stenotrophomonas maltophilia & *Alcaligenes faecalis*	1
Staphylococcus aureus	1
Staphylococcus aureus	2
Staphylococcus aureus	1
Staphylococcus aureus /Enterobacter on ETA	1
Staphylococcus aureus in blood culture	1
Staphylococcus aureus; Candida albicans	1
Staphylococcus aureus; Pseudomonas aeruginosa	1
Staphylococcus capitis	1
Staphylococcus hominis (blood culture – PICC); *Pseudomonas aeruginosa* (PICC – MC&S)	1
Stenotrophomonas	1
Stenotrophomonas maltophilia	1
Steptococcus pneumoniae	1
Sternatrophamonas	1
Sterotrophomophilis	1
Streptococcus pneumoniae	2

Organisms listed in alphabetical order of first organism reported

LIST 3: INFECTIONS ACQUIRED IN HOSPITAL (SURGICAL SITE)

SUMMARY

- **n=80 patients; 62 patients (77.5%) had infective organisms identified.**
- Many patients had multiple pathogenic organisms present.
- The top four organisms identified:
  1. *Staphylococcus* species n=15 (18.8%)
  2. *Candida* species n=7 (8.8%)
  3. *Escherichia* coli n=7 (8.8%)
  4. *Enterobacter* species n=6 (7.5%)

LIST 3: INFECTIONS ACQUIRED IN HOSPITAL (SURGICAL SITE)	
Candida	1
Candida albicans	1
Candida glabrata – Enterococcus – Staphylococcus epidermidis – Multiple other organisms	1
Candida glabrata; VRE; HSV	1
Candida, Staphylococcus epidermidis, Staphylococcus epidermidis; Candida albicans; Vancomycin resistance *Enterobacteriaceae*	1
Citrobacter freundii	1
Coagulase negative *staphylococcus*	1
Deep wound infection – *Staphylococcus aureus*	1
Enterobacter cloacae	1
Enterobacter cloacae	2
Enterococci resistant to Vancomycin	1
Enterococcus, Candida	1
Enterococcus; Enterobacter; candida	1
Escherichia coli	3
Escherichia coli	1
Escherichia coli	1
Escherichia coli (ESBL)	1
Escherichia coli, Enterococcus	1
Escherichia coli, Gram negative bacillus, Gram positive coccus, *Enterococcus* species	1
Escherichia coli, Pseudomonas; Candida	1
Escherichia coli, Staphylococcus epidermidis, Staphylococcus hominis, Clostridium paraputrificum	1
Fungal	1
Gram negative *bacilli*	1
Gram negative *bacillus*	1

Organisms listed in alphabetical order of first organism reported

LIST 3: INFECTIONS ACQUIRED IN HOSPITAL (SURGICAL SITE)	
Gram positive *cocci*, Gram positive *bacilli*, *Candida*, *Staphylococcus aureus* positive	1
Klebsiella & *Escherichia coli*	1
Methicillin Sensitive *Staphylococcus aureus*	1
Methicillin Sensitive *Staphylococcus aureus*	1
Methicillin-resistant *Staphylococcus aureus*	1
Methicillin-resistant *Staphylococcus aureus*, mixed enteric flora	1
Mixed enteric	1
Morganella morganii, Klebsiella oxytoca, Haemophilus influenza	1
MRSA	1
Multi-bacterial	1
Multiple	2
Multiple gram negatives	1
Pseudomonas aeruginosa	1
Pseudomonas aeruginosa, Staphylococcus aureus	1
Staphylococcus aureus, Morganella morganii	1
Staphylococcus aureus, Stenotrophomonas maltophilia, Pseudomonas aeruginosa	1
Staphylococcus epidermidis	1
Staphylococcus haemolyticus, Corynebacterium jeikeium	1
Streptococci; Candida	1
Streptococcus anginosus	1
Vancomycin-resistant *Enterococcus*	1
Vancomycin-resistant *Enterococcus* & Methicillin-resistant *Staphylococcus aureus*	1

Organisms listed in alphabetical order of first organism reported

LIST 4: INFECTIONS ACQUIRED IN HOSPITAL (OTHER INVASIVE SITE)

SUMMARY

- n=75 patients; 32 patients (42.7%) had infective organism identified.
- Many patients had multiple pathogenic organisms present.
- The top three organisms identified:
  1. *Pseudomonas* species n=8 (10.7%)
  2. *Staphylococcus* species n=7 (9.3%)
  3. *Klebsiella* species n=5 (6.7%)

LIST 4: INFECTIONS ACQUIRED IN HOSPITAL (OTHER INVASIVE SITE)	
Candida albicans – Yeast	1
Clostridium tertium	1
Escherichia coli	1
Escherichia coli resistant to prescribed antibiotics	1
Gram negative *bacilli*	1
Klebsiella	3
Klebsiella oxytoca	1
Klebsiella pneumoniae	1
MRSA	1
MRSA /VISA (Vancomycin susceptible *Staphylococcus aureus*)	1
Multiple Gram negative organisms during admission – *Pseudomonas* and *Actinobacter* species predominately	1
Pseudomonas	3
Pseudomonas (urine culture)	1
Pseudomonas aeruginosa	1
Pseudomonas aeruginosa & *Enterococcus faecalis* infected ascites	1
Rhizopus oryzae	1
Sensitive *Staphylococcus aureus*	1
Sensitive *Staphylococcus aureus, Endocarditis*	1
Serratia	1
Serratia – Enterococcus Faecalis and *candida* – MRAB	1
Serratia marcescens and *Pseudomonas aeruginosa*	1
Staphylococcus	1
Staphylococcus	1
Staphylococcus aureus	3
Staphylococcus aureus; Staphylococcus capitis	1
Streptococcus millerii	1

Organisms listed in alphabetical order of first organism reported

CASE STUDY (HOSPITAL-ACQUIRED INFECTIONS)

Serious complications occurring after the patient has left hospital should be the primary and immediate responsibility of the treating surgeon.

A 63-year-old morbidly obese diabetic patient presented to hospital with pain and weakness of the legs. There was a past history of nephrectomy for renal cell carcinoma. While an inpatient and over the next week, the patient had CT and magnetic resonance imaging scans of the spine that showed severe multilevel degeneration with severe spinal canal stenosis in the lower lumbar spine.

Eleven days after admission the patient underwent spinal decompression at two levels, and a single level fusion with pedicle screws. Prior to surgery, 1 gram of intravenous Cephazolin was given. The postoperative recovery was slow and apparently without complication. On the night before discharge it was noted by nursing staff that the wound looked inflamed, and that there was a small amount of wound discharge. A swab was taken for culture. The patient was discharged the following day into the care of the local medical officer.

At review after 1 week, the local medical officer noted that the wound was infected and thought that treatment with Flucloxacillin was appropriate. The local medical officer was not, however, aware that the pre-discharge wound swab had grown Methicillin-resistant *Staphylococcus aureus* (MRSA).

The patient was readmitted to hospital two weeks after discharge with pus draining from the surgical wound. The patient subsequently had five surgical washouts and debridement. During the third of these procedures the metalwork was removed from the spine.

During this time the patient's health deteriorated and they were admitted to the ICU with pulmonary oedema and signs of sepsis. With continued deterioration it was decided that palliative care was appropriate, and this decision was made in conjunction with family members. The patient died soon after. The cause of death was an extradural abscess and sepsis, which occurred as complications of surgery for degenerative spondylosis with severe spinal stenosis.

Considerations

This case highlights the need for awareness of hospital-acquired infection, of the risk factors for infection and of prophylactic measures to minimise wound infection. This patient was obese and diabetic – both significant risk factors for wound infection.

The operative risk factors included the type of surgery – spinal surgery with implants; and the duration of surgery – more than three hours.

The patient was in hospital for 10 days prior to the operation and was almost certainly colonised by hospital-acquired organisms. Prophylaxis was directed towards MRSA. The use of Cephazolin was probably a poor choice under the circumstances and the dosage inadequate for the patient's weight.

While the choice of alcoholic Chlorhexadine was appropriate for prepping the skin, the addition of a full surgical scrub of the operation site with Chlorhexadine could have been a prudent precaution.

The nursing report of the state of the wound seems to have been dismissed. Any wound that is red and inflamed with a discharge should be considered infected and appropriate measures followed. Although a wound swab was taken and grew MRSA, there was no follow-up.

At the time it may have been prudent to keep the patient a few extra days until the culture and sensitivities were available. Although afebrile, a rise in blood sugar level in the two days prior to discharge should have raised awareness of an impending problem.

The current trend to discharge a postoperative patient into the care of the GP is fraught with problems, and under some circumstances could be seen as the surgeon discharging his or her responsibilities. A local medical officer is not best qualified to manage late postoperative complications, and may continue to treat the patient to the patient's detriment rather than refer back to the surgeon early.

Instructions to notify the surgeon immediately should a major complication occur after major surgery might be more prudent than having the GP continue to treat the patient without success.

Furthermore, the procedures and clinical pathways of the infection control need to be reviewed. A wound swab grew MRSA yet was not followed up other than to note that handling precautions should be taken the next time the patient attends hospital. Due diligence suggests that the chart should have been reviewed to see what measures had been taken for a wound infection.

As the patient had been discharged from hospital, a telephone follow-up would have expedited the return to hospital. By the time the patient was eventually readmitted the outcome was probably inevitable.

Comments

In summary, the issues that arise from this case are:

- There should be strong awareness of the risk factors for wound infection – particularly MRSA.
- Consideration that all patients who have been in hospital for more than two or three days are likely to have been colonised by hospital-acquired organisms. The length of stay for a patient who died with a clinically significant infection, was a median of 13 days (IQR 6 days to 25 days); for a patient who did NOT die with a clinically significant infection, it was a median of 7 days (IQR 3 days to 16 days).
- The use of maximum prophylactic measures – Vancomycin should be used for patients who have been in hospital for a period prior to surgery.
- There should be strong regard for the appearance of the wound – inflammation and discharge are signs of infection and should be treated as such, even if subsequently proven to be over-treatment.
- There should be follow-up of tests such as wound swabs; then treatment instituted when appropriate.

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Notes

Notes

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