Mongolian Emergency Service
Hospital Hygiene Project
MeshHp.mn

Surgical site infections (SSI)

Mongolia, January/February 2012

Walter Popp, University Clinics Essen, Germany

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Background

US: 300.000 SSIs per year

2 – 5 % of patients undergoing inpatient surgery

3 % mortality

2 – 11 times higher risk of death

75 % of deaths among patients with SSI are directly attributable to SSI

7 – 10 additional postoperative hospital days

Up to 10 billion $ annually

CDC

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Sources

Endogenous:
- Patient flora:
  - Skin
  - Mucous membranes
  - GI tract
- Seeding from a distant focus of infection

Exogenous:
- Surgical personnel (surgeon and team):
  - Soiled attire
  - Breaks in aseptic technique
  - Inadequate hand hygiene
- OR physical environment and ventilation
- Tools, equipment, materials brought to the operative field

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Background: Pathogenesis

Organisms Causing SSI
January 2006-October 2007

Staphylococcus aureus	30.0%
Coagulase-negative staphylococci	13.7%
Enterococcus spp.	11.2%
Escherichia coli	9.6%
Pseudomonas aeruginosa	5.6%
Enterobacter spp	4.2%
Klebsiella pneumoniae	3.0%
Candida spp.	2.0%
Klebsiella oxytoca	0.7%
Acinetobacter baumannii	0.6%

N=7,025

Hidron AI, et.al., Infect Control Hosp Epidemiol 2008;29:996-1011
Hidron AI et.al., Infect Control Hosp Epidemiol 2009;30:107–107(ERRATUM)

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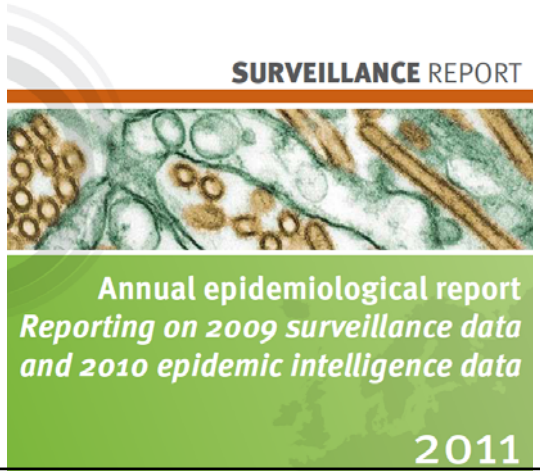

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SSI surveillance data for 2009 (with partial follow-up of patients who had undergone orthopaedic surgery until December 2010) were received from 16 networks and 13 countries and included 339,702 surgical interventions from 1,407 hospitals (compared with 315,935 surgical interventions from 1,434 hospitals in 2008).

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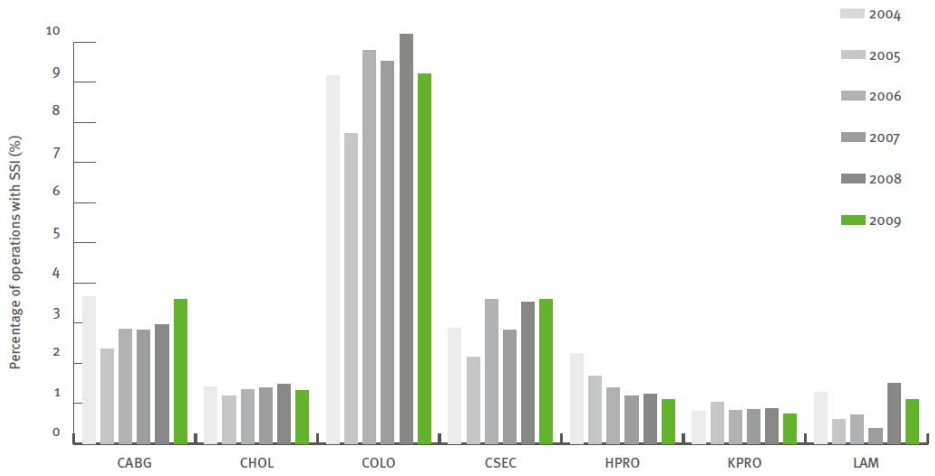
Figure 2.6.9. Trends in cumulative incidence of surgical site infections in Europe by category of surgical intervention, 2004–09



Source: HAI-Net SSI. CABG: coronary artery bypass graft; CHOL: cholecystectomy; COLO: colon surgery; CSEC: Caesarean section; HPRO: hip prosthesis; KPRO: knee prosthesis; LAM: laminectomy. Since data of all countries were pooled, methodological variations between and within countries may account for a part of the observed trends (see Discussion).

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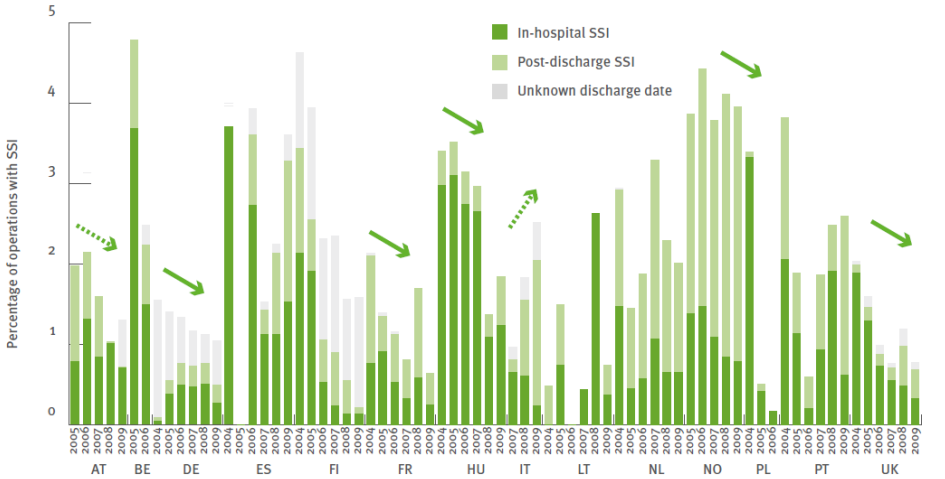
Figure 2.6.10. Trends in cumulative incidence of surgical site infections in hip prosthesis (HPRO) by country, 2004–09



Source: HAI-Net SSI. Belgium and Poland did not submit data for 2008–09 and trends for these countries were not analysed. New surveillance network in Spain since 2006. Arrows indicate statistically significant trends from 2004 to 2009, full line $p < 0.001$, dotted line $p < 0.05$. Interpretation of the data should be done with caution because on inter- and intra-country variations in methodology.

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Problems of definition and counting

Needs at least 2 days stay without infection.

Microbiologically confirmed?

What about detection after leaving hospital – 30 days!

Prophylactic antibiotics?

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Journal of Hospital Infection 75 (2010) 214–219

Available online at www.sciencedirect.com

Journal of Hospital Infection

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journal homepage: www.elsevierhealth.com/journals/jhin

Prevalence of hospital-acquired infections and antibiotic use in two tertiary Mongolian hospitals

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SUMMARY

Health statistics of Mongolia indicate that hospital-acquired infections (HAIs) occur in 0.01–0.05% of all hospital admissions. This is considerably lower than internationally reported rates. A one-day survey was conducted in two tertiary hospitals of Ulaanbaatar in September 2008 to estimate HAI prevalence, associated risk factors and patterns of antibiotic usage. Among 933 patients surveyed, 50 (5.4%) were diagnosed with HAI. Prevalence of surgical site infection was 1.1% (3.9% among surgical patients), bloodstream infection 0.3%, respiratory tract infection 1.3%, urinary tract infection 1.3%, and other HAI 1.4%. Microbiological investigations were only documented for 18.9% of all patients. A total of 558 patients (59.8%) were taking 902 courses of antibiotics; 92.1% of patients were prescribed antibiotics without a sensitivity test. Multiple logistic regression analysis revealed that HAI was significantly associated with the admission source, the hospital, length of hospital stay, surgical and other invasive procedures, urinary catheters and other indwelling devices. The study results were comparable with reports from some other developing countries and confirm that official statistics underestimate the true frequency of HAI in Mongolia.

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Reduction of nosocomial infections: how much is possible?

Device associated sepsis: reduction by up to 100%.
(Gozu et al. 2011, Srinivasan et al 2011, Cardo et al 2010, Weeks et al 2011, Umscheid et al. 2011)

Ventilation associated pneumonia: reduction up to 70 %.
(Yngström et al. 2007, Berenholtz et al. 2011, Umscheid et al. 2011)

Catheter associated urinary tract infections: reduction up to 70 %.
(Rebmann und Greene 2010, Umscheid et al. 2011)

Surgical site infections: reduction at least by 55 %.
(Umscheid et al. 2011)

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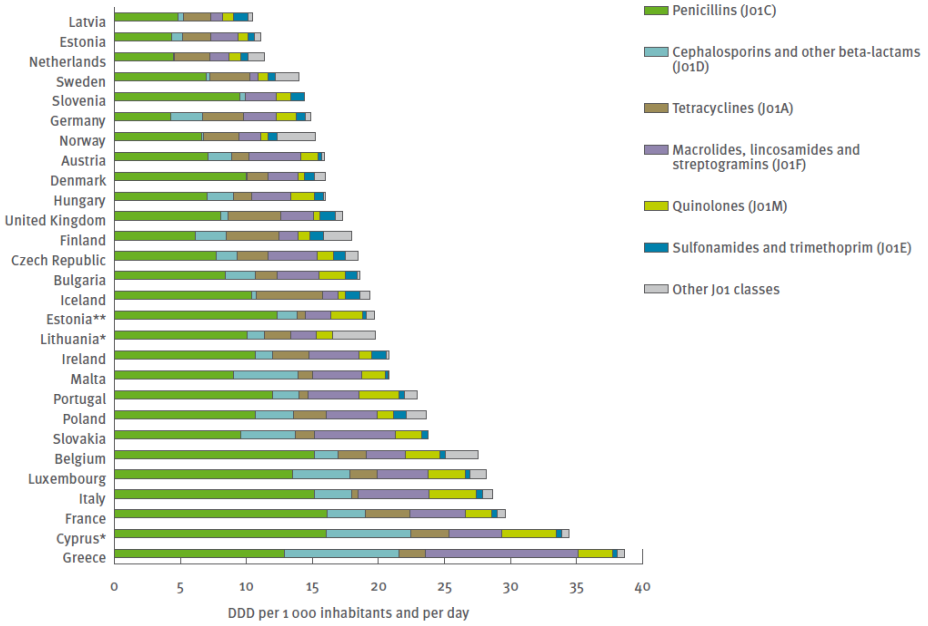
Figure 2.6.7. Outpatient antibiotic (ATC group J01) use subdivided into major antibiotic classes according to the Anatomical Therapeutical Chemical (ATC) classification, EU and EFA/EFTA countries, 2009



Source: ESAC. * Total use, i.e. including inpatients, for Cyprus and Lithuania. ** Reimbursement data, i.e. not including over-the-counter sales without a prescription, for Spain.

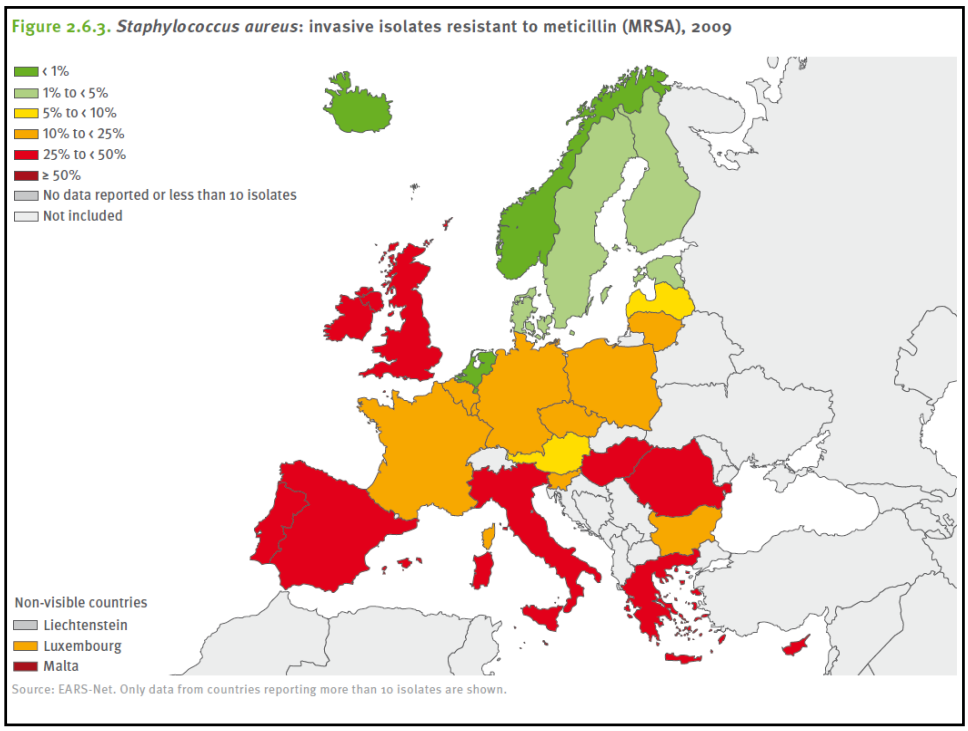
2.6 Antimicrobial resistance and healthcare-associated infection

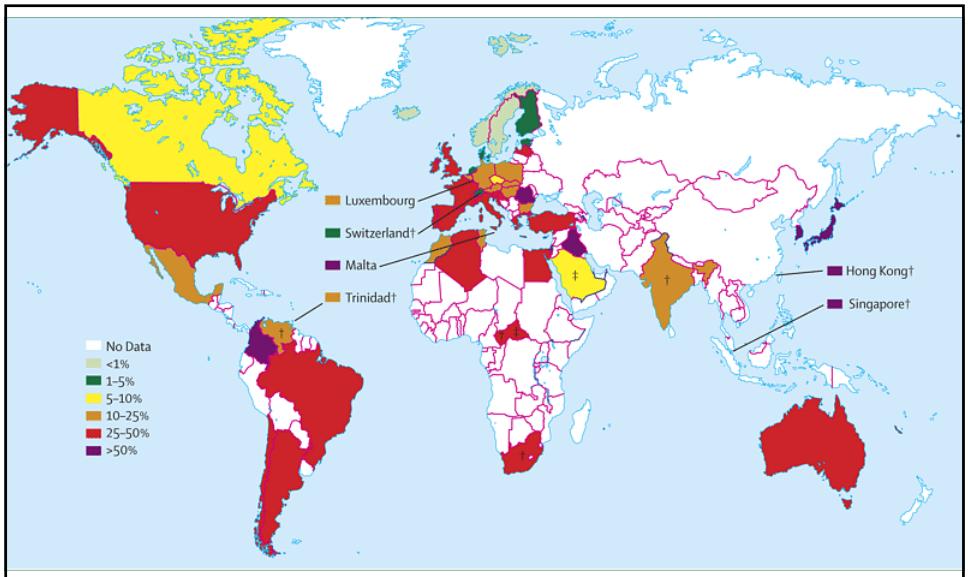
Resistance in *Escherichia coli*, the most common cause of bacteraemia by Gram-negative bacteria and of urinary tract infections, increases Europe-wide for all antimicrobial classes under surveillance.

Combined resistance to several antimicrobials continues to increase in some bacteria (e.g. *Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella pneumoniae*) and further reduces the available treatment options.

The occurrence of meticillin-resistant *Staphylococcus aureus* (MRSA) shows a decrease in some countries, although the MRSA proportions remain above 25 % in more than one third of the reporting countries.

Prevention and control of antimicrobial resistance call for international cooperation and concerted, multidisciplinary efforts at the national level.





Weltweite Prävalenz von MRSA
(Grundmann et al., Lancet 368, 2006, 874-885)

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E. Murphy, S. J. Spencer, D. Young, B. Jones, M. J. G. Blyth:

MRSA colonisation and subsequent risk of infection despite effective eradication in orthopaedic elective surgery

Journal of Bone and Joint Surgery 2011, 93-B, 548-551.

….
We screened 5933 elective orthopaedic in-patients for MRSA at pre-operative assessment. Of these, 108 (1.8%) were colonised with MRSA and 90 subsequently underwent surgery. Despite effective eradication therapy, six of these (6.7%) had an SSI within one year of surgery. Among these infections, deep sepsis occurred in four cases (4.4%) and superficial infection in two (2.2%). The responsible organism in four of the six cases was MRSA
. …

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. …

Which bacteria are important in Mongolia?

Rate of multiresistant bacteria?

Improve microbiological diagnosis!!

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Risk Factor	Comments
Nutritional status	In theory, malnutrition increases the risk of SSI; however, this is difficult to demonstrate. Some studies of malnutrition predict mortality but not SSI. The benefits of preoperative total parenteral nutrition in reducing the SSI risk are not proven.
Diabetes	There is a significant relationship between increased glucose levels (>200 mg/dL) in the peri-operative period and the risk of SSI. Good glycaemia control and stable serum glucose concentration is essential.
Smoking	Nicotine delays wound healing. Studies have associated cigarette smoking with an increase in SSI, however they are controversial.
Obesity	Obesity (Body Mass Index >40) has been associated with SSI, especially after cardiac and orthopaedic implant surgery.
Coexisting remote infection	Active infection, especially of the skin and respiratory tract, increases SSI risk in all types of surgery.
Colonisation with microorganisms	Nasal carriage of *S. aureus* is a risk factor for SSI. Some studies support pre-operative nasal mupirocin. However its use needs further evaluation, and there is concern about mupirocin resistance.
Length of preoperative stay	Prolonged preoperative hospitalisation has been associated with increased SSI risk, probably because it may indicate severe illness.
Perioperative transfusion	SSI has been associated with perioperative transfusion. However interpretation of data is difficult due to methodological problems.

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Risk Factor	Comments
Colonisation of the operative site - Antiseptic bath	A preoperative antiseptic shower or bath decreases skin microbial colony counts; however it has not definitively been shown to reduce SSI rates.
Colonisation of the operative site - Skin antisepsis	Antiseptics decrease skin colonisation of microorganisms. Preoperative skin preparation with an antiseptic solution is recommended for all operations. Iodophors, alcohols, and chlorhexidine are the most commonly used. Current data suggest that chlorhexidine is better than other products in prevention of SSI. More studies are needed.
Colonisation of the surgical team - Surgical scrub	The aim of a surgical scrub/rub is to reduce colonisation of the surgical team's hands. Various antiseptics have been used, e.g., alcohols, chlorhexidine, iodine/iodophors, parachloro-meta-xylenol, and triclosan. Isopropyl alcohol is considered the gold standard due to its rapid effect; chlorhexidine is used for its persistent action. Artificial nails increase bacterial and fungal colonisation of the hands despite adequate hand scrubs. No clinical trials have evaluated the effectiveness of surgical scrubs on SSI.
Preoperative shaving	Preoperative shaving of the surgical site is associated with a significantly higher SSI risk than using depilatory agents or no hair removal. Clipping hair immediately before an operation lessens the risk. However, the risk from either shaving or clipping increases when it is performed the night before surgery. Use of depilatories is better; however, it sometimes causes hypersensitivity. Some studies demonstrate that any hair removal is associated with increased SSI rates and suggest that no hair should be removed unless essential.
Infected or colonised surgical personnel	Personnel with skin diseases, such as psoriasis, active infections, or who are colonised with microorganisms, such as staphylococci, have been linked to outbreaks of SSIs. Health care organisations should exclude infected individuals from surgical activities.

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Risk Factor	Comments
Duration of operation	Lengthy operations are associated with an increased risk of SSI. Operation time should be kept to a minimum.
Contamination of the operative site - Antimicrobial prophylaxis	Antimicrobial prophylaxis reduces SSI and is recommended when a SSI would represent a catastrophe, e.g., in orthopaedic and other high-risk procedures. A single dose is usually sufficient (maximum of 3); timed to have a bactericidal concentration of the drug in the tissues at the time of the incision. Usually it is given at the induction of anaesthesia or, in any case, not more than 30 minutes before the skin is incised. The prophylactic agent should be safe, inexpensive, and have a spectrum that covers likely intraoperative contaminants. First and second generation cephalosporins are often used, e.g., cefazolin or cefuroxime. A second dose is recommended if the operation lasts >3 hours or involves rapid blood loss.
Foreign material in the surgical site (sutures and drains)	A foreign body may promote inflammation and act as a point of entry for microorganisms. Drains used to evacuate postoperative haematomas or serous fluids in the post-operative period increase incisional SSI risk. Drains should be passed through a separate incision away from the operative wound and removed as soon as possible; use closed suction. Monofilament suture material is the least irritating.
Hypothermia	Hypothermia causes vasoconstriction, decreased delivery of oxygen to the wound space, and impairment of leukocyte function.
Surgical technique	Breaks in aseptic technique, such as use of communal syringes or contamination of intravenous fluids or equipment, have been associated with SSI. Good surgical technique (effective homeostasis, gentle handling of tissues, and removal of devitalized tissues) reduces the risk. The risk of SSI is strongly associated with the experience of surgical teams. Institutions should select experienced surgeons for complex interventions and monitor surgical technique.

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Risk Factor	Comments
Operating room ventilation	An operating room should be at positive pressure relative to adjacent a to provide at least 20 air changes per hour. Use of ultra-clean air in the established. Use of ultraviolet radiation has not been shown to decre room air is directly proportional to the number of people and their mo numbers kept to a minimum.
Inanimate surfaces	Environmental surfaces, i.e., floor, walls, or tables, have not been a support the use of environmental disinfectants. Tacky mats placed overshoes is unnecessary.
Inadequate sterilisation of instruments	Sterilisation of instruments is an essential part of aseptic technique methods. Inadequate sterilisation has been associated with increased SS Flash sterilisation should only be performed in an emergency. The packaging, possibility for contamination of processed items during tr cycle parameters (time, temperature, and pressure). Flash sterilisation invasive devices.
Contamination from the surgical team - Surgical clothes and gloves	Barrier clothing and gloves are necessary to minimise exposure of membranes, and hair of the surgical team. It also protects the team fro prevent contamination of patients with respiratory pathogens. Surgica field by microbes from the hair and scalp. Footwear should be enclose dropped sharps and other contaminated items. Open footwear must never be worn. If there is a risk of spillage of blood or other high-risk body fluids, surgical waterproof boots should be worn. Sterile gloves minimise transmission of microbes from the hands of the surgical team to patients and prevent contamination of team members from blood and body fluids. Wearing two pairs of gloves may provide added protection.

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Basic Recommendations for Prevention[2-11, 16]

Preoperative

- Identify and treat all infections before elective operations.
- Maintain good control of diabetes.
- Keep preoperative hospital stay to a minimum.
- Do not remove hair preoperatively unless the hair at or around the incision site will interfere with the operation. If considered essential, remove hair immediately before the operation with a non-invasive procedure, e.g., clipper.

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- Use an antiseptic for skin preparation.
- Perform a preoperative surgical scrub for 2-4 minutes using an appropriate antiseptic. A surgical scrub can be performed using water-less products (e.g., alcohol-based hand rubs) in the absence of visibly dirty hands. Do not use a brush. Remove debris underneath the fingernails using a nail cleaner before the first procedure in the morning.
- Exclude personnel who have signs and symptoms of a transmissible infection from surgical activities. Personnel with draining skin lesions must be excluded until the infection is fully resolved.
- Administer prophylactic antibiotics according to local policy.
- Determine the level of experience required for surgeons in complex surgeries.

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Intraoperative

- Use a surgical checklist.
- Limit the duration of the procedure as much as possible.
- Sterilise all surgical instruments with validated methods. Do not use flash sterilisation routinely.
- Wear sterile gloves. Put gloves on after donning a sterile gown. Use water-repellent surgical gowns and drapes. Wear a surgical mask and a cap or hood to fully cover hair.
- Maintain positive pressure ventilation in the operating room with respect to the corridors and adjacent areas. Twenty air changes per hour are recommended. Filter all air, recirculated and fresh.
- Keep operating room doors closed except as needed for passage of equipment, personnel, and the patient.

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- Restrict entrance to the operating room to necessary personnel only and restrict their movement as much as possible.
- Adhere to principles of asepsis when performing interventions and invasive procedures in the operating room, e.g., when placing central venous, spinal, or epidural anaesthesia catheters or when dispensing and administering intravenous drugs.
- Handle tissue gently, maintain effective homeostasis, minimise devitalized tissue and foreign bodies (e.g., sutures, charred tissues, necrotic debris), and eliminate dead space at the surgical site.
- Use drains only if is necessary due to the patient's condition; then use closed suction drains. Place a drain through a separate incision distant from the operative incision. Remove it as soon as possible.

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- Keep the body temperature of the patient between 36.5 and 37°C during the operation (normothermia).
- Keep the glycaemia level to <200 mg/dL during the operation (normoglycaemia).
- Avoid use of artificial nails among the surgical team.
- Consider screening and decolonisation of carriers of *S. aureus* in high-risk patients if the SSI rates for this microbe are high and is not controlled by routine infection prevention measures.
- Do not perform special cleaning or closing of operating rooms after contaminated or dirty operations.
- Do not use over-shoes and tacky mats at the entrance to the operating room suite.

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Post-operative

- Don't touch the wound unless it is necessary.
- Review daily the necessity of continuing use of drains and take out when no longer necessary.
- Have an on-going surveillance system for SSI using standard definitions and risk classifications. Perform post-discharge surveillance for ambulatory surgery or short hospital stay patients.

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Preoperative Measures

Administer antimicrobial prophylaxis in accordance with evidence based standards and guidelines

- Administer within 1 hour prior to incision*
  - 2hr for vancomycin and fluoroquinolones
- Select appropriate agents on basis of
  - Surgical procedure
  - Most common SSI pathogens for the procedure
  - Published recommendations

*Fry DE. Surgical Site Infections and the Surgical Care Improvement Project (SCIP): Evolution of National Quality Measures. Surg Infect 2008;9(6):579-84.

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TABLE 6
MECHANISM AND SPECTRUM OF ACTIVITY OF ANTISEPTIC AGENTS COMMONLY USED FOR PREOPERATIVE SKIN PREPARATION AND SURGICAL SCRUBS

Agent	Mechanism of Action	Gram-Positive Bacteria	Gram-Negative Bacteria	Mtb	Fungi	Virus	Rapidity of Action	Residual Activity	Toxicity	Uses
Alcohol	Denature proteins	E	E	G	G	G	Most rapid	None	Drying, volatile	SP, SS
Chlorhexidine	Disrupt cell membrane	E	G	P	F	G	Intermediate	E	Ototoxicity, keratitis	SP, SS
Iodine/Iodophors	Oxidation/substitution by free iodine	E	G	G	G	G	Intermediate	Minimal	Absorption from skin with possible toxicity, skin irritation	SP, SS
PCMX	Disrupt cell wall	G	F*	F	F	F	Intermediate	G	More data needed	SS
Triclosan	Disrupt cell wall	G	G	G	P	U	Intermediate	E	More data needed	SS

Abbreviations: E, excellent; F, fair; G, good; Mtb, *Mycobacterium tuberculosis;* P, poor; PCMX, para-chloro-meta-xylenol; SP, skin preparation; SS, surgical scrubs; U, unknown.
Data from Larson E.[176]
* Fair, except for *Pseudomonas* spp.; activity improved by addition of chelating agent such as EDTA.

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GUIDELINE FOR PREVENTION OF SURGICAL SITE INFECTION, 1999

Alicia J. Mangram, MD; Teresa C. Horan, MPH, CIC; Michele L. Pearson, MD; Leah Christine Silver, BS; William R. Jarvis, MD; The Hospital Infection Control Practices Advisory Committee

Table 1: Persistence of clinically relevant bacteria on dry inanimate surfaces.

Type of bacterium	Duration of persistence (range)	Reference(s)
Acinetobacter spp.	3 days to 5 months	[18, 25, 28, 29, 87, 88]
Bordetella pertussis	3 – 5 days	[89, 90]
Campylobacter jejuni	up to 6 days	[91]
Clostridium difficile (spores)	5 months	[92–94]
Chlamydia pneumoniae, C. trachomatis	≤ 30 hours	[14, 95]
Chlamydia psittaci	15 days	[90]
Corynebacte		
Corynebacte		
Escherichia		
Enterococ		
Haemophil		
Helicobacte		
Klebsiella s		
Listeria spp		
Mycobacter		
Mycobacter		
Neisseria g		
Proteus vul		
Pseudomon		
Salmonella		
Salmonella		
Salmonella spp.	1 day	[92]
Serratia marcescens	3 days – 2 months; on dry floor: 5 weeks	[12, 90]
Shigella spp.	2 days – 5 months	[90, 106, 107]
Staphylococcus aureus, including MRSA	7 days – 7 months	[9, 10, 16, 52, 99, 108]
Streptococcus pneumoniae	1 – 20 days	[90]
Streptococcus pyogenes	3 days – 6.5 months	[90]
Vibrio cholerae	1 – 7 days	[90, 109]

Acinetobacter	3 days – 5 months
Clostridium diff. (spores)	5 months
E. coli	1,5 hours – 16 months
Enterococcus spp. Including VRE	5 days – 4 months
Pseudomonas	6 hours – 16 months
Staphylococcus aureus including MRSA	7 days – 7 months

Research article

Open Access

How long do nosocomial pathogens persist on inanimate surfaces? A systematic review

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* Corresponding author

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Heart surgery

Every year claiming that they have too many infections
… but: no numbers

Outbreak of VRE in summer 2011: 21 cases
- Better cleaning
- Changing organisation (handing over patient from OR to ICU…)
- Training
- Hand hygiene
- ….

See OP plan every day: big infections are reoperated

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Wound care

Sterile wound dressing for 24 – 48 hours.

After removal no new wound dressing if daily inspection of wound.

Immediate removal if suspected infection, moisture penetration, dirtying oder movement of dressing.

Aseptic removal of dressing and suture material.

Remove drains as early as possible.

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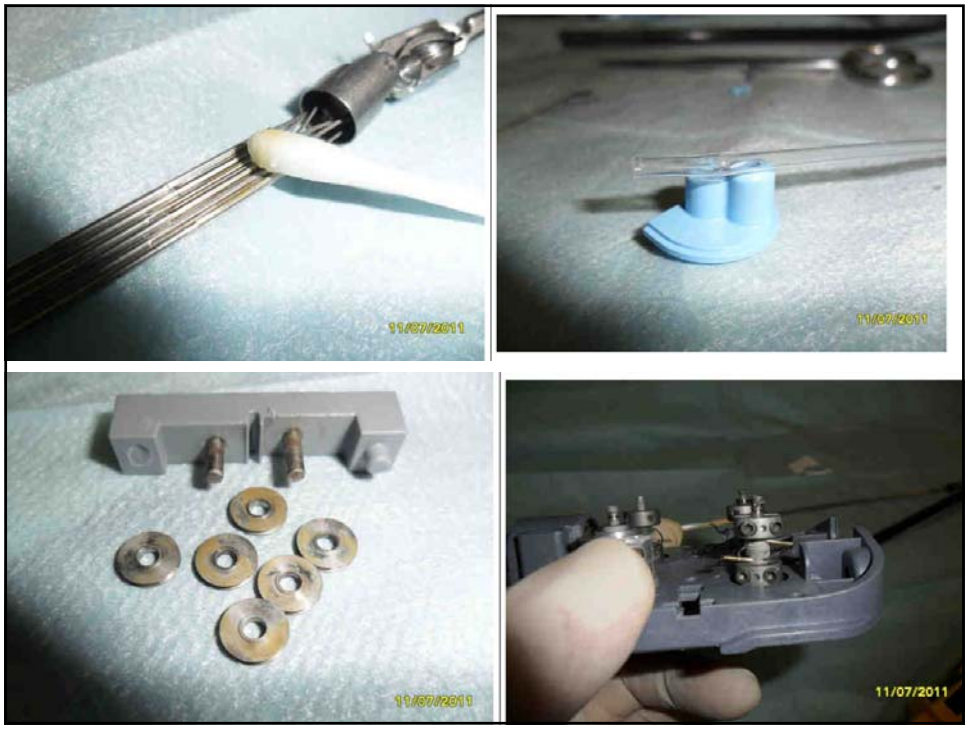

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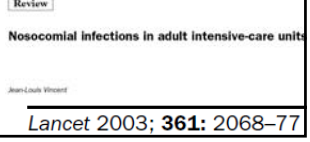
Factors that predispose to nosocomial infection

Related to underlying health status
Advanced age
Malnutrition
Alcoholism
Heavy smoking
Chronic lung disease
Diabetes
Related to acute disease process
Surgery
Trauma
Burns
Related to invasive procedures
Endotracheal or nasal intubation
Central venous catheterisation
Extracorporeal renal support
Surgical drains
Nasogastric tube
Tracheostomy
Urinary catheter
Related to treatment
Blood transfusions
Recent antimicrobial therapy
Immunosuppressive treatments—eg, corticosteroids
Stress-ulcer prophylaxis
Recumbent position
Parenteral nutrition


Review

Nosocomial infections in adult intensive-care units

Jean-Louis Vincent

Lancet 2003; **361:** 2068–77

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Campylobacter jejuni	up to 6 days	[91]
Clostridium difficile (spores)	5 months	[92–94]
Chlamydia pneumoniae, C. trachomatis	≤ 30 hours	[14, 95]
Chlamydia psittaci	15 days	[90]
Corynebacterium diphtheriae	7 days – 6 months	[90, 96]
Corynebacterium pseudotuberculosis	1–8 days	[21]
Escherichia coli	1.5 hours – 16 months	[12, 16, 17, 22, 28, 52, 90, 97–99]
Enterococcus spp. including VRE and VSE	5 days – 4 months	[9, 26, 28, 100, 101]
Haemophilus influenzae	12 days	[90]
Helicobacter pylori	≤ 90 minutes	[23]
Klebsiella spp.	2 hours to > 30 months	[12, 16, 28, 52, 90]
Listeria spp.	1 day – months	[15, 90, 102]
Mycobacterium bovis	> 2 months	[13, 90]
Mycobacterium tuberculosis	1 day – 4 months	[30, 90]
Neisseria gonorrhoeae	1 – 3 days	[24, 27, 90]
Proteus vulgaris	1 – 2 days	[90]
Pseudomonas aeruginosa	6 hours – 16 months; on dry floor: 5 weeks	[12, 16, 28, 52, 99, 103, 104]
Salmonella typhi	6 hours – 4 weeks	[90]
Salmonella typhimurium	10 days – 4.2 years	[15, 90, 105]
Salmonella spp.	1 day	[52]
Serratia marcescens	3 days – 2 months; on dry floor: 5 weeks	[12, 90]
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Research article

Open Access

How long do nosocomial pathogens persist on inanimate surfaces? A systematic review

Axel Kramer*[1], Ingeborg Schwebke[2] and Günter Kampf[1,3]

Low Resource Issues

Surgical site infections are typically higher in developing nations than in high-resource countries.[17] Minimal requirements for the prevention of SSIs include:

- Do not remove hair preoperatively unless hair at or around the incision site will interfere with the operation.
- Perform glycaemia control in cardiac and vascular surgery.
- Use an antiseptic agent for skin preparation immediately prior to the operation.
- Perform a preoperative surgical scrub using an antiseptic product.
- Administer a prophylactic antimicrobial agent when indicated according to established criteria.
- Sterilise all surgical instruments with validated methods.
- Adhere to principles of asepsis when performing interventions or invasive procedures in the operating room.
- Have an on-going surveillance system for SSI using standard definitions and risk classifications.

- Redose antibiotic at the 3 hr interval in procedures with duration >3hrs (* See exceptions to this recommendation in*Engelman R, et al. The Society of Thoracic Surgeons Practice Guideline Series:Antibiotic Prophylaxis in Cardica Surgery, Part II:Antibiotic Choice. Ann Thor Surg 2007;83:1569-76
- Adjust antimicrobial prophylaxis dose for obese patients (body mass index >30)*Anderson DJ, Kaye KS, Classen D, et al. Strategies to prevent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol 2008;29 (Suppl 1):S51-S61
- Use at least 50% fraction of inspired oxygen intraoperatively and immediately postoperatively in select procedure(s)*Maragakis LL, Cosgrove SE, Martinez EA, et al. Intraoperative fraction of inspired oxygen is a modifiable risk factor for surgical site infection after spinal surgery. Anesthesiology 2009;110:556-562. and
  Meyhoff CS, Wetterslev J, Jorgensen LN, et al. Effect of high perioperative oxygen fraction on surgical site infection and pulmonary complications after abdominal surgery: The PROXI randomized clinical trial. JAMA 2009;302:1543-1550.

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TABLE 7
SURGICAL WOUND CLASSIFICATION

Class I/Clean: An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.

Class II/Clean-Contaminated: An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

Class III/Contaminated: Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered are included in this category.

Class IV/Dirty-Infected: Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

Garner JS[1] and Simmons BP[2]

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GUIDELINE FOR PREVENTION OF SURGICAL SITE INFECTION, 1999

Alicia J. Mangram, MD; Teresa C. Horan, MPH, CIC; Michele L. Pearson, MD; Leah Christine Silver, BS; William R. Jarvis, MD; The Hospital Infection Control Practices Advisory Committee

TABLE 10
PHYSICAL STATUS CLASSIFICATION, AMERICAN SOCIETY OF ANESTHESIOLOGISTS*

Code	Patient's Preoperative Physical Status
1	Normally healthy patient
2	Patient with mild systemic disease
3	Patient with severe systemic disease that is not incapacitating
4	Patient with an incapacitating systemic disease that is a constant threat to life
5	Moribund patient who is not expected to survive for 24 hours with or without operation

* Reference 406.
Note: The above is the version of the ASA Physical Status Classification System that was current at the time of development of, and still is used in, the NNIS Risk Index. Meanwhile, the American Society of Anesthesiologists has revised their classification system; the most recent version is available at http://www.asahq.org/profinfo/physicalstatus.html.

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Resources for Implementation

WHO Surgical Safety Checklist

Surgical Safety Checklist

World Health Organization | Patient Safety

Before induction of anaesthesia (with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?
- ☐ Yes

Is the site marked?
- ☐ Yes
- ☐ Not applicable

Is the anaesthesia machine and medication check complete?
- ☐ Yes

Is the pulse oximeter on the patient and functioning?
- ☐ Yes

Does the patient have a:

Known allergy?
- ☐ No
- ☐ Yes

Difficult airway or aspiration risk?
- ☐ No
- ☐ Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?
- ☐ No
- ☐ Yes, and two IVs/central access and fluids planned

Before skin incision (with nurse, anaesthetist and surgeon)
- ☐ Confirm all team members have introduced themselves by name and role.
- ☐ Confirm the patient's name, procedure, and where the incision will be made.

Has antibiotic prophylaxis been given within the last 60 minutes?
- ☐ Yes
- ☐ Not applicable

Anticipated Critical Events

To Surgeon:
- ☐ What are the critical or non-routine steps?
- ☐ How long will the case take?
- ☐ What is the anticipated blood loss?

To Anaesthetist:
- ☐ Are there any patient-specific concerns?

To Nursing Team:
- ☐ Has sterility (including indicator results) been confirmed?
- ☐ Are there equipment issues or any concerns?

Is essential imaging displayed?
- ☐ Yes
- ☐ Not applicable

Before patient leaves operating room (with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:
- ☐ The name of the procedure
- ☐ Completion of instrument, sponge and needle counts
- ☐ Specimen labelling (read specimen labels aloud, including patient name)
- ☐ Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:
- ☐ What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

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World Health Organization. Safe Surgery Saves Lives http://www.who.int/patientsafety/safesurgery/en/ Accessed 19 Nov 2009

Modifiable risk factors

Antimicrobial prophylaxis: inappropriate choice, improper timing, inadequate dose

Skin preparation ineffective

Colorectal procedures: inadequate bowel prep/antibiotics, improper intraoperative temperature regulation

Excessive OR traffic

Inadequate wound dressing protocol

Improper glucose control

Colonisation with preexisting microorganisms

Inadequate intraoperative oxygen levels

CDC

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Table 4. Operations, Likely Surgical Site Infection (SSI) Pathogens, and References on Usage of Antimicrobial Prophylaxis*

Operations	Likely Pathogens†‡	References
Placement of all grafts, prostheses, or implants	*Staphylococcus aureus*; coagulase-negative staphylococci	269,282-284,290
Cardiac	*Staphylococcus aureus*; coagulase-negative staphylococci	251-253,462,463
Neurosurgery	*Staphylococcus aureus*; coagulase-negative staphylococci	241,249,258,259,261, 464,465
Breast	*Staphylococcus aureus*; coagulase-negative staphylococci	242,248
Ophthalmic Limited data: however, commonly used in procedures such as anterior segment resection, vitrectomy, and scleral buckles	*Staphylococcus aureus*; coagulase-negative staphylococci; streptococci; gram-negative bacilli	466
Orthopedic Total joint replacement Closed fractures/use of nails, bone plates, other internal fixation devices Functional repair without implant/device Trauma	*Staphylococcus aureus*; coagulase-negative staphylococci; gram-negative bacilli	60,243-246,254, 255,467-473
Noncardiac thoracic Thoracic (lobectomy, pneumonectomy, wedge resection, other noncardiac mediastinal procedures) Closed tube thoracostomy	*Staphylococcus aureus*; coagulase-negative staphylococci; *Streptococcus pneumoniae*; gram-negative bacilli	240,247,474,475
Vascular	*Staphylococcus aureus*; coagulase-negative staphylococci	250,463,476,477
Appendectomy	Gram-negative bacilli; anaerobes	263,452,478
Biliary tract	Gram-negative bacilli; anaerobes	260,262,479-484
Colorectal	Gram-negative bacilli; anaerobes	200,239,256,287 289,485-490
Gastroduodenal	Gram-negative bacilli; streptococci; oropharyngeal anaerobes (e.g., peptostreptococci)	256,257,491-493
Head and neck (major procedures with incision through oropharyngeal mucosa)	*Staphylococcus aureus*; streptococci; oropharyngeal anaerobes (e.g., peptostreptococci)	494-497
Obstetric and gynecologic	Gram-negative bacilli; enterococci; group B streptococci; anaerobes	270-280,435
Urologic May not be beneficial if urine is sterile	Gram-negative bacilli	267

*Refer to "Antimicrobial prophylaxis in surgery," The Medical Letter, 1997,[268] for current recommendations of antimicrobial agents and dosage.
†Likely pathogens from both endogenous and exogenous sources.
‡Staphylococci will be associated with SSI following all types of operations.

Guideline for Prevention of Surgical Site Infection, 1999

Table 7. Surgical Wound Classification

Class I/Clean: An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.

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Guideline for Prevention of Surgical Site Infection, 1999

Table 10. Physical Status Classification, American Society of Anesthesiologists*

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Guideline for Prevention of Surgical Site Infection, 1999