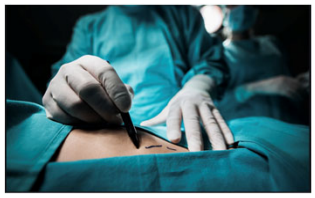
Surgical Site Infection Prevention
Spinal & Cranial Surgery

2023 Neurosurgical Society of Alabama Conference
Dr. Molly Fleece
UAB Infectious Diseases & Associate Healthcare Epidemiologist

UAB MEDICINE

SURGICAL SITE INFECTIONS (SSI)



- One of the **most common** and costly hospital-acquired infections (HAI)
- 2021 NHSN data:
  21,186 SSIs
  2,759,027 operative procedures
- Estimated approximately **60%** of all SSIs are deemed preventable using **evidence-based strategies**

NHSN 2019 SSI Protocol. https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf
Multistate point-prevalence survey of health care-associated infections. NEJM 2014.
JAMA 2023

RISK IS A MYRIAD EVENT
SSI FISHBONE DIAGRAM

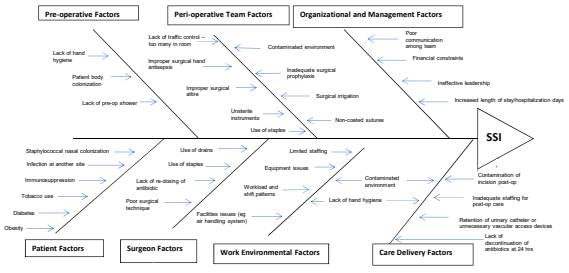


Image adapted from: http://www.7sbundle.com

SSI PREVENTION

Who has a seat at the table?

4

Image adapted from: https://www.stclair.org/infection-prevention/ ./.org/infection-prevention/

SSI PREVENTION IN HISTORY

Gold was used for cranioplasty inlay

Purulence – good or bad for wound healing?

Dressing changes BID in winter, TID in summer

Shave head before surgery

Antiseptic gauze

Handwashing

Penicillin

Prehistoric period

Egyptian & Babylonian period

Greek & early Byzantine period

Islamic Golden Age

Middle Ages

16th-18th centuries

19th & 20th centuries

First use of head dressings

Beer & wine used to cleanse wounds

Wine-soaked dressings

Catgut for wound healing

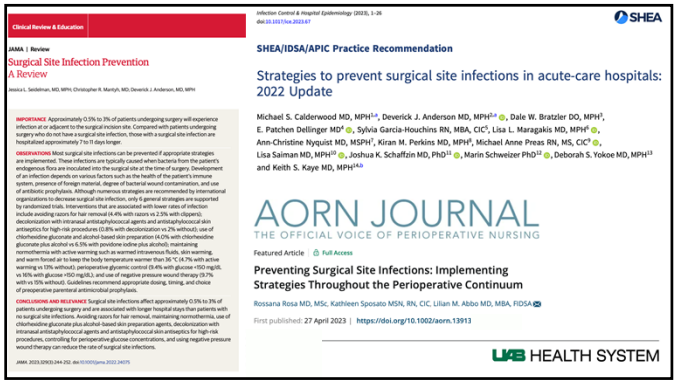
Avoid pouring boiling oil into wounds

Turpentine & egg yolk to promote wound healing

Silver tubes to drain cerebral abscesses

5

Prevention of SSIs after brain surgery: the prehistoric period to the present. Neurosurg Focus 2019



Clinical Review & Education

JAMA | Review

Surgical Site Infection Prevention
A Review

Jessica L. Seidelman, MD, MPH; Christopher R. Mantyh, MD; Deverick J. Anderson, MD, MPH

IMPORTANCE Approximately 0.5% to 3% of patients undergoing surgery will experience infection at or adjacent to the surgical incision site. Compared with patients undergoing surgery who do not have a surgical site infection, those with a surgical site infection are hospitalized approximately 7 to 11 days longer.

OBSERVATIONS Most surgical site infections can be prevented if appropriate strategies are implemented. These infections are typically caused when bacteria from the patient's endogenous flora are inoculated into the surgical site at the time of surgery. Development of an infection depends on various factors such as the health of the patient's immune system, presence of foreign material, degree of bacterial wound contamination, and use of antibiotic prophylaxis. Although numerous strategies are recommended by international organizations to decrease surgical site infection, only 6 general strategies are supported by randomized trials. Interventions that are associated with lower rates of infection include avoiding razors for hair removal (4.4% with razors vs 2.5% with clippers), decolonization with intranasal antistaphylococcal agents and antistaphylococcal skin antiseptics for high-risk procedures (0.8% with decolonization vs 2% without), use of chlorhexidine gluconate and alcohol-based skin preparation (4.0% with chlorhexidine gluconate plus alcohol vs 6.5% with povidone-iodine plus alcohol), maintaining normothermia with active warming such as warmed intravenous fluids, skin warming, and warm forced air to keep the body temperature warmer than 36 °C (4.7% with active warming vs 13% without), perioperative glycemic control (9.4% with glucose <150 mg/dL vs 16% with glucose >150 mg/dL), and use of negative pressure wound therapy (9.7% with vs 15% without). Guidelines recommend appropriate dosing, timing, and choice of preoperative parenteral antimicrobial prophylaxis.

CONCLUSIONS AND RELEVANCE Surgical site infections affect approximately 0.5% to 3% of patients undergoing surgery and are associated with longer hospital stays than patients with no surgical site infections. Avoiding razors for hair removal, maintaining normothermia, use of chlorhexidine gluconate plus alcohol-based skin preparation agents, decolonization with intranasal antistaphylococcal agents and antistaphylococcal skin antiseptics for high-risk procedures, controlling for perioperative glucose concentrations, and using negative pressure wound therapy can reduce the rate of surgical site infections.

JAMA. 2023;329(3):244-252. doi:10.1001/jama.2022.24075

Infection Control & Hospital Epidemiology (2023), 1–26
doi:10.1017/ice.2023.67

SHEA

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent surgical site infections in acute-care hospitals: 2022 Update

Michael S. Calderwood MD, MPH[1,2], Deverick J. Anderson MD, MPH[2,3], Dale W. Bratzler DO, MPH[4], E. Patchen Dellinger MD[4], Sylvia Garcia-Houchins RN, MBA, CIC[5], Lisa L. Maragakis MD, MPH[6], Ann-Christine Nyquist MD, MSPH[7], Kiran M. Perkins MD, MPH[8], Michael Anne Preas RN, MS, CIC[9], Lisa Saiman MD, MPH[10], Joshua K. Schaffzin MD, PhD[11], Marin Schweizer PhD[12], Deborah S. Yokoe MD, MPH[13] and Keith S. Kaye MD, MPH[14,15]

AORN JOURNAL
THE OFFICIAL VOICE OF PERIOPERATIVE NURSING

Featured Article | Full Access

Preventing Surgical Site Infections: Implementing Strategies Throughout the Perioperative Continuum

Rossana Rosa MD, MSC, Kathleen Sposato MSN, RN, CIC, Lilian M. Abbo MD, MBA, FIDSA

First published: 27 April 2023 | https://doi.org/10.1002/aorn.13913

UAB HEALTH SYSTEM

SSI SURVEILLANCE

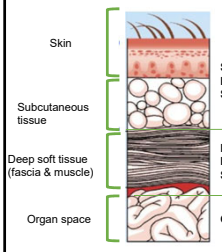


Table 2. Surveillance Periods for SSI Following Selected NHSN Operative Procedure Categories. Day 1 = the date of the procedure.

30-day Surveillance				90-day Surveillance	
Category	Operative Procedure	Category	Operative Procedure	Category	Operative Procedure
AAA	Abdominal aortic aneurysm repair	LAM	Laminectomy	BRST	Breast surgery
AMP	Limb amputation	LTP	Liver transplant	CARD	Cardiac surgery
APPY	Appendix surgery	NECK	Neck surgery	CBGB	Coronary artery bypass graft with both chest and donor site incisions
AVSD	Shunt for dialysis	NEPH	Kidney surgery	CBGC	Coronary artery bypass graft with chest incision only
BILI	Bile duct, liver or pancreatic surgery	OVRY	Ovarian surgery	CRAN	Craniotomy
CEA	Carotid endarterectomy	PROST	Prostate surgery	FUSN	Spinal fusion
CHOL	Gallbladder surgery	REC	Rectal surgery	FX	Open reduction of fracture
COLO	Colon surgery	SB	Small bowel surgery	HER	Hernia repair
CSEC	Cesarean section	SPLE	Spleen surgery	HPRO	Hip prosthesis
GAST	Gastric surgery	THOR	Thoracic surgery	KPRO	Knee prosthesis
HTP	Heart transplant	THYR	Thyroid and/or parathyroid surgery	PACE	Pacemaker surgery
HYST	Abdominal hysterectomy	VHYS	Vaginal hysterectomy	PVBY	Peripheral vascular bypass surgery
KTP	Kidney transplant	XLAP	Exploratory laparotomy	VSHN	Ventricular shunt

https://www.cdc.gov/nhsn/pdfs/pscmanual/17pscnosinfdef_current.pdf - Chapters 9 & 17

SSI SURVEILLANCE

Table 3. Specific Sites of an Organ/Space SSI

Category	Specific Site	Category	Specific Site
BONE	Osteomyelitis	MED	Mediastinitis
BRST	Breast abscess or mastitis	MEN	Meningitis or ventriculitis
CARD	Myocarditis or pericarditis	ORAL	Oral cavity infection (mouth, tongue, or gums)
DISC	Disc space infection	OREP	Deep pelvic tissue infection or other infection of the male or female reproductive tract
EAR	Ear, mastoid infection	PJI	Periprosthetic joint infection
EMET	Endometritis	SA	Spinal abscess/infection
ENDO	Endocarditis	SINU	Sinusitis
GIT	Gastrointestinal (GI) tract infection	UR	Upper respiratory tract, pharyngitis, laryngitis, epiglottitis
IAB	Intraabdominal infection, not specified elsewhere	USI	Urinary System Infection
IC	Intracranial infection	VASC	Arterial or venous infection
JNT	Joint or bursa infection	VCUF	Vaginal cuff infection
LUNG	Other infection of the lower respiratory tract		

CNS-CENTRAL NERVOUS SYSTEM INFECTION

IC-Intracranial infection (brain abscess, subdural or epidural infection, encephalitis)

Intracranial infection must meet at least **one** of the following criteria:

1. Patient has organism(s) identified from brain tissue or dura by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment, for example, not Active Surveillance Culture/Testing (ASC/AST).
2. Patient has an abscess or evidence of intracranial infection on gross anatomic or histopathologic exam.
3. Patient has at least **two** of the following signs or symptoms: headache*, dizziness*, fever (>38.0°C), localizing neurologic signs*, changing level of consciousness*, or confusion*
   And at least one of the following:
   a. organism(s) seen on microscopic examination of brain or abscess tissue obtained by needle aspiration or during an invasive procedure or autopsy.
   b. imaging test evidence suggestive of infection (for example, ultrasound, CT scan, MRI, radionuclide brain scan, or arteriogram), which if equivocal is supported by clinical correlation, specifically physician documentation of antimicrobial treatment for intracranial infection.
   c. diagnostic single antibody titer (IgM) or 4-fold increase in paired sera (IgG) for organism.
4. Patient ≤1 year of age has at least **two** of the following signs or symptoms: fever (>38.0°C), hypothermia (<36.0°C), apnea*, bradycardia*, localizing neurologic signs*, or changing level of consciousness*, for example, irritability, poor feeding, lethargy
   And at least one of the following:
   a. organism(s) seen on microscopic examination of brain or abscess tissue obtained by needle aspiration or during an invasive procedure or autopsy.
   b. imaging test evidence suggestive of infection, (for example, ultrasound, CT scan, MRI, radionuclide brain scan, or arteriogram), which if equivocal is supported by clinical correlation, specifically, physician documentation of antimicrobial treatment for intracranial infection.
   c. diagnostic single antibody titer (IgM) or 4-fold increase in paired sera (IgG) for organism.

SSI RISK FACTORS

Table 1. Modifiable and Nonmodifiable Patient-Related Factors Associated With Surgical Site Infections

Factor	Pathophysiology
Patient-related, modifiable	
Diabetes	Hyperglycemia impairs the innate immune system and promotes glycosylation of proteins, which compromises wound healing.[16] Diabetes can lead to higher perioperative glucose levels and hyperglycemia that is more difficult to treat.[17]
Immunosuppressive medications and conditions	Immunosuppressive clinical conditions or medications diminish the inflammatory phase of wound healing.[18,19]
Malnutrition	Malnutrition can decrease collagen synthesis, granulation formation in surgical wounds, and result in poor tissue healing. Hypoalbuminemia weakens innate immunity by prompting macrophage apoptosis and diminishing macrophage activation. Low albumin also accelerates the seepage of interstitial fluid into the surgical wound and promotes general tissue edema.[20]
Obesity	Adipose tissue has less blood flow, which inhibits the delivery of oxygen and antibiotics.[21-23]
Preoperative infections	Prior to elective surgery, recognize and treat all infections (even if they are distant from the surgical site).[24]
Tobacco use	Tobacco use causes vasoconstriction, which can progress to alterations in collagen metabolism, decreased inflammatory response, and relative ischemia.[25]
Patient-related, nonmodifiable	
Age	The skin's basement membrane and dermis thin with increasing age, and the skin loses its reserve of cutaneous blood vessels and nerves that diminish wound healing.[26,27]
History of prior skin and soft tissue infections	A history of skin and soft tissue infections may be indicative of issues with inherent immunity and propensity for infection.[28]
History of radiation therapy	Treatment with radiation induces underlying tissue injury and inhibits wound healing.

JAMA 2023

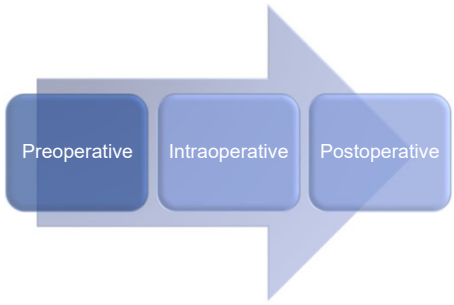
SSI RISK FACTORS

Table 3. Selected Risk Factors for and Recommendations to Prevent Surgical Site Infection (SSI)

Risk Factor	Recommendation	Quality of Evidence
Preparation of patient		
Hair removal	Do not remove unless hair will interfere with the operation[a]; if hair removal is necessary, remove outside of the operating room by clipping. Do not use razors.	HIGH
Preoperative infections	Identify and treat infections remote to the surgical site (eg, urinary tract infection in the presence of prior to elective surgery.[4,101] Do not routinely test or treat for asymptomatic bacteriuria except in urologic procedures.[4,102]	MODERATE
Operative characteristics		
Surgical scrub (surgical team members' hands and forearms)	Use appropriate antiseptic agent to perform preoperative surgical scrub.[4,354] For most products, scrub the hands and forearms for 2–5 minutes.	MODERATE
Skin preparation	Wash and clean skin around incision site. Use a dual agent skin prep containing alcohol unless contraindications exist.[4]	HIGH
Antimicrobial prophylaxis	Administer only when indicated.[4] Select appropriate agents based on surgical procedure, most common pathogens causing SSI for a specific procedure, and published recommendations.[15] Administer within 1 hour of incision to maximize tissue concentration.[15] Discontinue antimicrobial agents after incisional closure in the operating room.[4]	HIGH
Blood transfusion	Blood transfusions increase the risk of SSI by decreasing macrophage function. Reduce blood loss and need for blood transfusion to greatest extent possible.[355–357]	MODERATE
Surgeon skill/technique	Handle tissue carefully and eradicate dead space.[4]	LOW
Appropriate gloving	All members of the operative team should double glove and change gloves when perforation is noted.[358]	LOW
Asepsis	Adhere to standard principles of operating room asepsis.[4]	LOW
Operative time	No formal recommendation in most recent guidelines; minimize as much as possible without sacrificing surgical technique and aseptic practice.	HIGH
Operating room characteristics		
Ventilation	Follow American Institute of Architects' recommendations for proper air handling in the operating room.[4,208]	LOW
Traffic	Minimize operating room traffic.[4,207,208]	LOW
Environmental surfaces	Use an Environmental Protection Agency (EPA)–approved hospital disinfectant to clean visibly soiled or contaminated surfaces and equipment in accordance with manufacturer's instructions.[4]	LOW
Sterilization of surgical equipment	Sterilize all surgical equipment according the device manufacturer's validated parameters: cycle type, time, temperature, pressure, and dry time. Minimize the use of immediate use steam sterilization.[4,208]	MODERATE

IDHE 2023

PERIOPERATIVE CONTINUUM



PREOPERATIVE

- Nasal decolonization
- Antimicrobial prophylaxis
- Hair removal
- Preoperative skin cleansing
- Treat infections remote to surgical site
- Optimize modifiable risk factors

NASAL DECOLONIZATION

MRSA BACTEREMIA | Alabama | ↑ 51% Higher Compared to Nat'l Baseline

ORIGINAL ARTICLE

Intranasal Mupirocin to Prevent Postoperative *Staphylococcus aureus* Infections

Trish M. Perl, M.D., Joseph J. Cullen, M.D., Richard P. Wenzel, M.D., M. Bridget Zimmerman, Ph.D., Michael A. Pfaller, M.D., Deborah Sheppard, Jennifer Twombley, R.N., Pamela P. French, M.D., M.P.H., Loreen A. Herwaldt, M.D., and the Mupirocin and the Risk of Staphylococcus aureus Study Team*

TABLE 4. OVERALL AND *STAPHYLOCOCCUS AUREUS*–SPECIFIC RATES OF NOSOCOMIAL INFECTION AMONG PATIENTS WHO RECEIVED MUPIROCIN AND THOSE WHO RECEIVED PLACEBO.

TYPE OF INFECTION	MUPIROCIN RECIPIENTS			PLACEBO RECIPIENTS		
	TOTAL (N=1933)	*S. AUREUS* CARRIERS (N=444)	NONCARRIERS (N=1489)	TOTAL (N=1931)	*S. AUREUS* CARRIERS (N=447)	NONCARRIERS (N=1484)
	number/total number (percent)					
Nosocomial infection*	218/1933 (11.3)	57/444 (12.8)	161/1489 (10.8)	220/1931 (11.4)	72/447 (16.1)	148/1484 (10.0)
Nosocomial *S. aureus* infection*	45/1884 (2.4)	17/430 (4.0)	28/1454 (1.9)	55/1886 (2.9)	34/439 (7.7)†	21/1447 (1.5)
Surgical-site infection	152/1933 (7.9)	44/444 (9.9)	108/1489 (7.3)	164/1931 (8.5)	52/447 (11.6)	112/1484 (7.5)
S. aureus surgical-site infections‡	43/1892 (2.3)	16/432 (3.7)	27/1460 (1.8)	46/1894 (2.4)	26/439 (5.9)	20/1455 (1.4)

*This group includes *S. aureus* infections of the bloodstream, respiratory tract, catheter, and surgical site.

†P=0.02 for the comparison with the *S. aureus* carriers in the mupirocin group (odds ratio, 0.49; 95 percent confidence interval, 0.25 to 0.92).

‡Since not all wounds were cultured, the causative organisms were unknown for 49 nosocomial infections in the mupirocin group (14 were in *S. aureus* carriers, 12 of whom had surgical-site infections; and 35 were in noncarriers, 29 of whom had surgical-site infections), and 45 nosocomial infections in the placebo group (8 were in *S. aureus* carriers, 8 of whom had surgical-site infections; and 37 were in noncarriers, 29 of whom had surgical-site infections).

JANUARY 7, 2010

Preventing Surgical-Site Infections in Nasal Carriers of *Staphylococcus aureus*

Lonneke G.M. Bode, M.D., Jan A.J.W. Kluytmans, M.D., Ph.D., Heiman F.L. Wertheim, M.D., Ph.D., Diana Bogaers, I.C.P., Christina M.J.E. Vandenbroucke-Grauls, M.D., Ph.D., Robert Roosendaal, Ph.D., Annet Troelstra, M.D., Ph.D., Adrienne T.A. Box, B.A.Sc., Andreas Voss, M.D., Ph.D., Ingeborg van der Tweel, Ph.D., Alex van Belkum, Ph.D., Henri A. Verbrugh, M.D., Ph.D., and Margreet C. Vos, M.D., Ph.D.

Table 2. Relative Risk of Hospital-Acquired *Staphylococcus aureus* Infection and Characteristics of Infections (Intention-to-Treat Analysis).

Variable	Mupirocin–Chlorhexidine (N=504)	Placebo (N=413)	Relative Risk (95% CI)*
	no. (%)		
S. aureus infection	17 (3.4)	32 (7.7)	0.42 (0.23–0.75)
Localization of infection			
Deep surgical site‡	4 (0.9)	16 (4.4)	0.21 (0.07–0.62)
Superficial surgical site‡	7 (1.6)	13 (3.5)	0.45 (0.18–1.11)

NEJM 2002
NEJM 2010

HAIR REMOVAL

Special challenges for neurosurgical procedures – hair & hair removal

Hair as possible source of infection?
Extended dry times if alcohol-based skin antiseptics are used

J Neurosurg 115:670–678, 2011

Neurosurgery and shaving: what's the evidence?

A review

*MARIKE L. D. BROEKMAN, M.D., PH.D.,[1,2] JANNEKE VAN BEIJNUM, M.D.,[3] WILCO C. PEUL, M.D., PH.D.,[3] AND LUCA REGLI, M.D., PH.D.[1,2]

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SPINE Volume 32, Number 15, pp 1575–1577
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Does Shaving the Incision Site Increase the Infection Rate After Spinal Surgery?

Suat E. Çelik, MD, and Ayhan Kara, MD

Optimal approaches to skin preparation prior to neurosurgery. Neurosurgery. 2020

ANTIMICROBIAL PROPHYLAXIS

Clinical practice guidelines for antimicrobial prophylaxis in surgery

DALE W. BRATZLER, E. PATCHEN DELLINGER, KEITH M. OLSEN, TRISH M. PERL, PAUL G. AUWAERTER, MAUREEN K. BOLON, DOUGLAS N. FISH, LENA M. NAPOLITANO, ROBERT G. SAWYER, DOUGLAS SLAIN, JAMES P. STEINBERG, AND ROBERT A. WEINSTEIN

Am J Health-Syst Pharm. 2013; 70:195-283

Type of Procedure	Recommended Agents[a,b]	Alternative Agents in Pts Withβ-Lactam Allergy	Strength of Evidence[c]
Neurosurgery Elective craniotomy and cerebrospinal fluid-shunting procedures	Cefazolin	Clindamycin,[d] vancomycin[d]	A
Implantation of intrathecal pumps	Cefazolin	Clindamycin,[d] vancomycin[d]	C
Spinal procedures with and without instrumentation	Cefazolin	Clindamycin,[d] vancomycin[d]	A

*Reasonable to add single preoperative dose of vancomycin to recommended agents if known to be colonized with MRSA
**For procedures in which pathogens other than staphylococci and streptococci are likely, an additional agent with activity against those pathogens could be considered

- Antibiotic choice
- Antibiotic timing
- Antibiotic duration

Clinical practice guidelines for antimicrobial prophylaxis in surgery. American Journal of Health-System Pharmacy. 2013

ANTIBIOTIC CHOICE

World Neurosurgery
Volume 171, March 2023, Pages e745–e751

Original Article

Impact of Penicillin Allergy–Based Alternative Antibiotics on the Risk of Postoperative Central Nervous System Infection: A Retrospective Cohort Study

Tong Niu [1], Xinjie Bao [2], Junji Wei [2], Yili Shi [1], Wenbin Ma [2], Renzhi Wang [2]

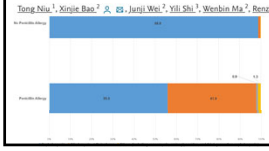

Table 2. Logistic Regression Analysis of Risk Factors for Postoperative Central Nervous System Infection

Variable	OR	95% CI	*P* Value
Age	1.04	1.02–1.06	<0.001
Penicillin allergy	2.02	1.15–3.55	0.014
Diabetes mellitus	2.62	1.28–5.37	0.008
Multiple surgeries	2.26	1.10–4.64	0.027
Hyperlipidemia	2.16	1.19–3.90	0.011
CSF leak	4.15	1.85–9.32	0.001
Operation duration >3 hours	9.85	5.36–18.08	<0.001

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ANTIBIOTIC TIMING

Timing of Antimicrobial Prophylaxis and the Risk of Surgical Site Infections
Results From the Trial to Reduce Antimicrobial Prophylaxis Errors

Steinberg, James P. MD[1]; Braun, Barbara I. PhD[2]; Hellinger, Walter C. MD[3]; Kusek, Linda RN, MHA[2]; Buzkirk, Michele R. MHA[2]; Bush, Andrew J. PhD[2]; Dellinger, E. Patchen MD[4]; Burke, John P. MD[5]; Simmons, Bryan MD[6]; Krichevsky, Stephen B. PhD[7,8] Trial to Reduce Antimicrobial Prophylaxis Errors (TRAPS) Study Group
Author Information

Annals of Surgery 250(1):p 10-16, July 2009. | DOI: 10.1097/SLA.0b013e3181ad95ca

- Start within 60 minutes of surgical incision (*120 minutes for vancomycin, fluoroquinolones)
- Patient weight-based dosing
- Redose, if indicated

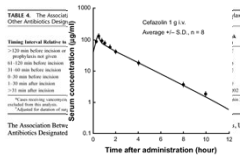

TABLE 5. Infection Risk and Intraoperative Dosing in Surgeries Lasting at Least 4 Hours*

Intraoperative Redosing in Surgeries Lasting ≥ 4 h	Infection/N at-Risk	Infection Risk	Risk Odds Ratio for Infection From Conditional Logistic Regression (95% CI)
Recommended preoperative timing†			
Redosing	2/112	1.8%	Referent Group
No redosing	22/409	5.5%	3.08 (0.74, 12.90), $P = 0.06$
Suboptimal preoperative timing			
Redosing	2/35	5.8%	Referent Group
No redosing	8/143	5.7%	0.98 (0.22, 4.41), $P = 0.98$

*Excluding cases receiving vancomycin/fluoroquinolones.
†Recommended was defined as within 60 min prior to incision according to the guidelines.

Infection Risk and Intraoperative Dosing in Surgeries Lasting at Least 4 Hours

Timing of Antimicrobial Prophylaxis and the Risk of Surgical Site Infections. Annals of Surgery 2009.
Safety and efficacy of cefazolin sodium in the management of bacterial infection and in surgical prophylaxis. Clinical Medicine: Therapeutics. 2009.

ANTIBIOTIC DURATION

The effects of avoiding extended antimicrobial drain prophylaxis on *Clostridioides difficile* and postprocedural infection rates: a 5-year retrospective

CLINICAL ARTICLE
J Neurosurg 137:1153–1159, 2022

Alexandria C. Marino, MD, PhD,[1] Evan D. Robinson, MD,[2] Jakob A. Durden, BA,[3] Heather L. Cox, PharmD,[2,4] Amy J. Mathers, MD,[2] and Mark E. Shaffrey, MD[1]

[1]Department of Neurological Surgery, University of Virginia; [2]Division of Infectious Diseases and International Health, Department of Medicine, University of Virginia; [3]University of Virginia School of Medicine; and [4]Department of Pharmacy Services, University of Virginia Health, Charlottesville, Virginia

TABLE 2. Incidence of *C. difficile* infection

Variable	Extended PPDP	Limited PPDP	p Value
Total cases	27	7	
Incidence/1000 patient days	1.1	0.31	0.0020

Decrease from 0.5% to 0.07% per procedural encounter

TABLE 3. Per-procedure SSI- and EVD-associated meningitis/ventriculitis rates according to PPDP time period

Variable	Extended PPDP	Limited PPDP	p Value
SSI	56 (1.2%)	58 (1.4%)	0.39
SSI (drain cases)	25 (1.1%)	34 (1.6%)	0.13
SSI (instrumented spine)	19 (1.4%)	21 (1.5%)	0.71
EVD-associated infection	6 (3.1%)	5 (2.3%)	0.62

No significant change, similar in all subgroups

85% relative risk reduction, preventing at least 1 C. difficile infection every 2 months on the neurosurgery service

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Oct. 2011, p. 4607–4613 Vol. 55, No. 10
0066-4804/11/$12.00 doi:10.1128/AAC.00562-11

Nonconcordance with Surgical Site Infection Prevention Guidelines and Rates of Surgical Site Infections for General Surgical, Neurological, and Orthopedic Procedures▽‡

Barnaby Young,[1]†* Tat Ming Ng,[2]†* Christine Teng,[2,4] Brenda Ang,[1] Hwei Yee Tai,[1] and David C. Lye[1,3]

Infectious Diseases, Communicable Disease Centre, Tan Tock Seng Hospital, Singapore, Republic of Singapore[1]; Pharmacy, Tan Tock Seng Hospital, Singapore, Republic of Singapore[2]; Anesthesia, Tan Tock Seng Hospital, Singapore, Republic of Singapore[3]; Pharmacy, National University of Singapore, Singapore, Republic of Singapore[4]; and Department of Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Republic of Singapore[5]

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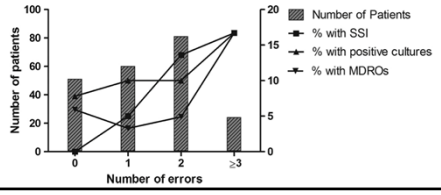


INTRAOPERATIVE

- Surgical hand scrub
- Normothermia
- OR traffic
- Optimize environmental cleaning & facilities
- Surgical site preparation
- Surgical attire
- Blood glucose management
- Minimize immediate use sterilization
- Enhanced patient oxygenation
- Sterile technique
- Blood transfusions
- Surgical safety checklist

SURGICAL SITE PREPARATION

Special challenges for neurosurgical procedures - neurotoxicity

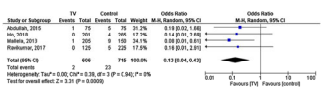
POSTOPERATIVE

- Surgical dressings
- Wound care
- Prompt removal of vascular access devices
- Prompt removal of urinary catheters

UNRESOLVED ISSUES

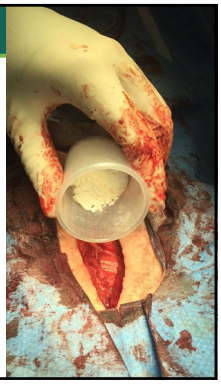
- Antimicrobial powders
- Antimicrobial sutures
- Optimal frequency of CSF sampling of EVDs
- Type of EVD catheter

ANTIMICROBIAL POWDERS



Spine Surgical Procedures	Infection	Control (No Vancomycin)	Treatment (Vancomycin)	Total
Instrumented	Not infected	298	296	594
	Infected	6 (1.98%)	6 (1.99%)	12 (1.98%)
	Total	304	303	606
Noninstrumented	Not infected	168	130	298
	Infected	2 (1.18%)	1 (0.76%)	3 (0.99%)
	Total	170	131	301
Grand total		474	433	907
Total infection rate		1.68%	1.65%	1.65%

Statistics of Spine Surgery in the Control and Treatment Groups



Spine 2013
Journal of Neurosurgery: Spine SSPI. 2018.
World neurosurgery 2022

ANTIMICROBIAL SUTURES

Additional approaches for preventing SSI:

- Use antiseptic-impregnated sutures as a strategy to prevent SSI (Quality of evidence: moderate)

Strategy	Guideline Source			
	Centers for Disease Control and Prevention	American College of Surgeons and Surgical Infection Society[2]	Society for Healthcare Epidemiology of America/ Infectious Diseases Society of America[3]	World Health Organization[4]
Antimicrobial sutures	Consider use of triclosan-coated sutures	Triclosan sutures recommended for wound closure in clean and clean-contaminated abdominal procedures when available	Do not routinely use antiseptic-impregnated sutures as a strategy to prevent SSI	Use of triclosan-coated sutures suggested

ASHN 2023.

SSI PREVENTION BUNDLE

SSI PREVENTION BUNDLE

October 2016

Implementation of an Infection Prevention Bundle to Reduce Surgical Site Infections and Cost Following Spine Surgery

Joseph Featherall, BS[1], Jacob A. Miller, BS[1], E. Emily Bennett, MD[2,3], Daniel Lubelski, MD[4], Hannah Wang, BS[1], Tagreed Khalaf, MD[2], Ajit A. Krishnaney, MD[1,2,3]

> Author Affiliations | Article Information

JAMA Surg. 2016;151(10):988-990. doi:10.1001/jamasurg.2016.1794

50% reduction in SSIs and an $866 per capita reduction in the surgical episode of care cost

> World Neurosurg. 2021 Apr;148:206-219.e4. doi: 10.1016/j.wneu.2020.12.137. Epub 2021 Jan 4.

Cranial Surgical Site Infection Interventions and Prevention Bundles: A Systematic Review of the Literature

Michael Mann [1], Christina Huang Wright [2], Tarun Jella [1], Collin M Labak [3], Berje Shammassian [3], Shaarada Srivatsa [1], James Wright [3], Lilly Engineer [4], Martha Sajatovic [5], Warren Selman [3]

Affiliations + expand

PMID: 33412319 DOI: 10.1016/j.wneu.2020.12.137

cSSI rate 7.8% -> 3.7%

cSSI rate 3.2% -> 2.1%

cSSI 23.8% ->2.8%

SSI PREVENTION BUNDLE

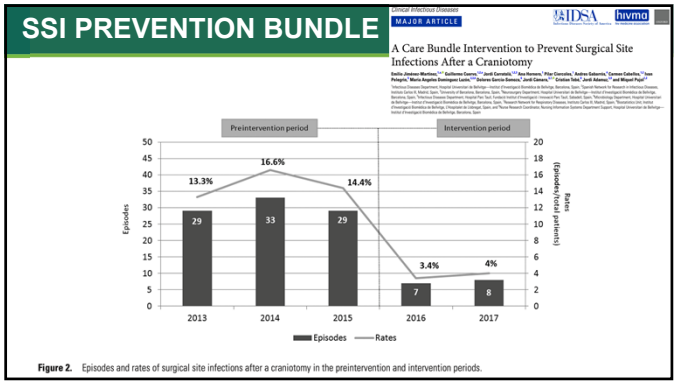


Figure 2. Episodes and rates of surgical site infections after a craniotomy in the preintervention and intervention periods.