Surgical Site Infection (SSI) Prevention

- The implementation of complex infection control bundles to prevent colorectal surgical site infections: a survey of SHEA research network hospitals
- Burden and severity of respiratory syncytial virus infection in adults with cardiovascular diseases: A systematic literature review
- Prophylactic Negative Pressure Wound Therapy Reduces Superficial Surgical Site Infection Risk of Emergency Surgery Patients: Results of a Multicenter Randomised Prospective Clinical Trial
- Sepsis after trauma-evolving paradigms in stress biology and host response failure
- Optimal duration of antimicrobial prophylaxis in patients undergoing distal pancreatectomy: A multicenter cohort study
- A Case of Delayed Refractory Mycobacterium mageritense Abdominal Wall Abscess in a Kidney Transplant Recipient
- Antibiotic stewardship program (ASP) implementation is more effective than the national action plan for rational drug use
- Measures to prevent surgical site infections in neurosurgery: survey and comparative analysis

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Surgical Site Infections (SSI) are a significant cause of postoperative morbidity, mortality, and increased healthcare costs. Prevention requires a **multimodal strategy** involving preoperative, intraoperative, and postoperative measures.

Preoperative Measures

- **Patient optimization**
  - Glycemic control: maintain glucose <180 mg/dL
  - Smoking cessation ≥4 weeks before surgery
  - Screen and decolonize MRSA (nasal mupirocin, chlorhexidine showers)
- **Antiseptic bathing** the night before and morning of surgery (chlorhexidine)
- **Hair removal** only if necessary — use clippers, not razors
- **Antibiotic prophylaxis**
  - Administer within 60 min of incision (cefazolin standard)
  - Adjust for allergy or MRSA risk (vancomycin or clindamycin)
  - Redose if surgery >4 hours or major blood loss

Intraoperative Measures

- **Skin antisepsis** with alcohol-based chlorhexidine (preferred)
- **Normothermia** maintenance (≥36ºC)
- **Glucose monitoring** intraoperatively
- **High inspired oxygen (FiO_2 80%)** during and after surgery
- **Minimize operative time** and tissue trauma
- **Limit traffic and door openings** in the OR
- **Strict aseptic technique** and sterile handling of instruments

- **Use of minimally invasive techniques** where applicable

Postoperative Measures

- **Wound care**
  - Keep dressing intact for 48 hours unless soiled
  - Avoid unnecessary dressing changes
- **Glycemic control**
- **Surveillance** for early signs of infection
- **Judicious use of postoperative antibiotics** (not routinely needed)

Neurosurgery-Specific Considerations

- Preoperative antibiotics tailored to flora (e.g., cefazolin or vancomycin)
- Strict **asepsis in handling drains** (e.g., EVDs, subgaleal)
- Ensure **watertight dural closure** to prevent CSF leak
- Minimize **foreign body exposure** (e.g., hemostatics, implants)
- Early detection of implant-related infections (shunts, plates, cranioplasties)

Guidelines and References

- CDC 2017 Guideline for the Prevention of SSI
- WHO 2016 Global Guidelines for the Prevention of SSI
- NICE Clinical Guideline: Surgical Site Infections
- Sánchez-Viguera C, Badia JM. Measures to prevent surgical site infections in neurosurgery: survey and comparative analysis. *Neurocirugia (Engl Ed)*. 2025 Jul 1. doi:10.1016/j.neucie.2025.500678.

There are three phases in prophylaxis of surgical site infections (SSI):

Preoperative Surgical site infection prevention

Intraoperative Surgical site infection prevention

Postoperative Surgical site infection prevention

There is lack of consensus and paucity of evidence with SSI prophylaxis in the postoperative period.

Use of postoperative surgical antimicrobial prophylaxis was not correlated with SSI rates at the hospital level after adjusting for differences in procedure mix and patient characteristics [1)]

To systematically evaluate the literature, and provide evidence-based summaries on postoperative measures for SSI prophylaxis in spine surgery Tan et al. published a systematic review, meta-analysis, evidence synthesis.

A systematic review conforming to PRISMA guidelines was performed utilizing PubMed (MEDLINE), EMBASE, and the Cochrane Database from inception to January 2019. The GRADE approach was used for quality appraisal and synthesis of evidence. Six postoperative care domains with associated key questions were identified. Included studies were extracted into evidence tables, data synthesized quantitatively and qualitatively, and evidence appraised per GRADE approach.

Forty-one studies (9 RCT, 32 cohort studies) were included. In the setting of pre-incisional antimicrobial prophylaxis (AMP) administration, use of postoperative AMP for SSI reduction has not been found to reduce rate of SSI in lumbosacral spine surgery. Prolonged administration of AMP for more than 48h postoperatively does not seem to reduce the rate of SSI in decompression-only or lumbar spine fusion surgery. Utilization of wound drainage systems in lumbosacral spine and adolescent idiopathic scoliosis corrective surgery does not seem to alter the overall rate of SSI in spine surgery. Concomitant administration of AMP in the presence of a wound drain does not seem to reduce the overall rate of SSI, deep SSI, or superficial SSI in thoracolumbar fusion performed for degenerative and deformity spine pathologies, and in adolescent idiopathic scoliosis corrective surgery. Enhanced-recovery after surgery (ERAS) clinical pathways and infection-specific protocols do not seem to reduce rate of SSI in spine surgery. Insufficient evidence exists for other types of spine surgery not mentioned above, and also for non-AMP pharmacological measures, dressing type & duration, suture & staple management and postoperative nutrition for SSI prophylaxis in spine surgery.

Despite the postoperative period being key in SSI prophylaxis, the literature is sparse and without consensus on optimum postoperative care for SSI prevention in spine surgery. The current best evidence is presented with its limitations. High quality studies addressing high risk cohorts such as the elderly, obese and diabetic populations, and for traumatic and oncological indications are urgently required [2)].

Surgical site infections are a common, multifactorial problem after spine surgery. There is compelling evidence that improved risk stratification, detection, and prevention will reduce surgical site infections [3)].

Today’s health care environment demands more than ever of surgeons and the hospitals they work in. Payors, including Medicare, increasingly refuse to pay for treating complications deemed preventable, such as surgical site infections.

Surgical site infection prevention in

neurosurgery

- Measures to prevent surgical site infections in neurosurgery: survey and comparative analysis
- Impact of Dual Antibiotic Prophylaxis on 90-Day Surgical Site Infection Rates Following Posterior Spinal Fusion for Juvenile Scoliosis: A Single-Center Study of 296 Cases
- Additive Manufacturing, Thermoplastics, CAD Technology, and Reverse Engineering in Orthopedics and Neurosurgery-Applications to Preventions and Treatment of Infections
- Surgical site infections with multi-drug resistant organisms in patients undergoing neurosurgery: a retrospective comparative cohort study from Turkey
- Effect of the number of door openings in the operating room on surgical site infections: individual-patient data meta-analysis
- Population pharmacokinetics of cefazolin in neurosurgical antibiotic prophylaxis
- Antibiotics consumption in neurosurgery versus appendectomy: a call for antibiotic stewardship initiatives
- Physician Awareness Combined With Perioperative Infection Prevention Bundles Results in Durable Neurosurgical Infection Control and Cost Savings

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Surgical site infections (SSIs) are a significant concern in neurosurgery due to the potential for devastating complications, including meningitis, brain abscess, osteomyelitis, and hardware infections. Preventing SSIs requires a multidisciplinary approach involving perioperative measures, sterile techniques, and postoperative management. Below is an evidence-based framework for SSI prevention in neurosurgical procedures.

Preoperative Measures

Patient Optimization - Screening & Eradication of Carriers:

1. Nasal decolonization with **mupirocin** and **chlorhexidine bathing** in patients colonized with *Staphylococcus aureus*.

- **Glycemic Control:**

1. Maintain blood glucose <180 mg/dL in diabetic patients.

- **Nutritional Optimization:**

1. Correct hypoalbuminemia and address malnutrition preoperatively.

- **Smoking Cessation:**

1. Encourage cessation at least 4 weeks before surgery to improve wound healing.

- **Preoperative Antibiotic Prophylaxis:**

1. **First-line:** Cefazolin 2 g IV (3 g if ≥120 kg) within 60 minutes before incision.

2. **Beta-lactam allergy:** Clindamycin or vancomycin.
3. **MRSA colonization:** Vancomycin in addition to cefazolin.
4. **Redosing:** Repeat antibiotics in procedures lasting >4 hours or with excessive blood loss.

Intraoperative Strategies

Sterile Techniques & Infection Control - **Standardized Surgical Preparation:**

1. Skin antisepsis with **chlorhexidine-alcohol** (preferred over povidone-iodine).
2. Avoid hair removal if unnecessary; if needed, use clippers instead of razors.

- **Strict Aseptic Technique:**

1. Proper hand hygiene, sterile gloves, and gowning.
2. Double gloving for CSF-contact procedures.
3. Limiting operating room (OR) traffic to reduce contamination.

- **Intraoperative Antibiotics:**

1. Ensure redosing if the surgery is prolonged (>4 hours) or excessive bleeding occurs.

- **Minimize Operative Time & Tissue Trauma:**

1. Precise hemostasis and reduced retraction to minimize tissue damage.

- **Use of Antimicrobial-Impregnated Devices:**

1. **Ventriculostomy catheters:** Silver- or antibiotic-coated catheters reduce external ventricular drain (EVD) infections.
2. **Dural substitutes:** Prefer autologous dura or antimicrobial-treated synthetic substitutes.

- **CSF Leak Prevention:**

1. Ensure a **watertight dural closure** and use sealants where needed.

- **Normothermia:**

1. Maintain patient temperature to prevent hypothermia-induced immune suppression.

Postoperative Management

Wound Care - **Dressing Management:**

1. Use occlusive or antimicrobial dressings for 48–72 hours.
2. Avoid frequent dressing changes to prevent contamination.

- **Early Drain Removal**

1. External drains (EVD, lumbar drains) should be removed **as soon as clinically feasible** (preferably within 5 days).

- **Antibiotic Duration:**

1. Prophylactic antibiotics should be **discontinued within 24 hours postoperatively** unless there is an active infection.

Monitoring & Early Intervention - **Regular Wound Inspections:**

1. Monitor for signs of SSI (erythema, swelling, discharge, fever).

- **Early Diagnosis & Treatment:**

1. Consider MRI with contrast if deep infection is suspected.
2. CSF analysis if meningitis or ventriculitis is a concern.

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Special Considerations in High-Risk Patients

- **Cranioplasties & Hardware-Implant Procedures:**

1. Antibiotic-impregnated bone cement for cranioplasty.
2. Consider staged procedures in cases of contaminated wounds.

- **Spinal Instrumentation:**

1. Extended antibiotic coverage in high-risk spinal fusion cases.
2. Local vancomycin powder application in spine surgery may reduce infection rates.

- **Reoperations:**

1. Higher risk of SSI; meticulous debridement and wound closure are essential.

Conclusion

A **multimodal** approach incorporating **preoperative screening, strict intraoperative sterile techniques, and vigilant postoperative care** significantly reduces SSIs in neurosurgery. Implementing **evidence-based guidelines and standard protocols** in neurosurgical practice ensures optimal patient outcomes and reduces morbidity related to infections.

A study found that patient body mass index and male sex were associated with an increased risk of SSI. Operating room personnel turnover, a modifiable, work flow-related factor, was an independent variable positively correlated with SSI [4].

Triclosan-containing sutures

Triclosan-containing sutures.

Survey-based observational comparative analysis

In a survey-based observational comparative analysis Cristina Sánchez-Viguera et al. from the Hospital Regional Universitario de Málaga ; Hospital General de Granollers, Granollers, Spain published in the Neurocirugia Journal to assess the awareness and adoption of evidence-based measures to prevent surgical site infections (SSI) among Spanish neurosurgeons via a 64-question survey distributed to SENEC members. Despite valuing international (81.7%) and national (78.7%) guidelines, significant gaps exist in clinical practice: overuse of prolonged antibiotic prophylaxis (10.6%), non-drying of antiseptics (38.2%), adhesive drape usage (77.4%), low use of alcohol-based skin prep (37%), and minimal double-gloving (16.7%). Hair removal, mostly performed by surgeons themselves, diverges significantly from other specialties. Drainage use is common (60.7%), nutritional assessment rare (7.5%), and feedback/training on SSI prevention minimal (37.2% and 16.5%, respectively). The authors advocate for targeted training and engagement in SSI prevention programs [5)]

Critical Review

- **Strengths:** Large sample (n=123) among national neurosurgeons; survey addresses a broad spectrum of SSI prevention measures; novel focus on the neurosurgeon’s role in hair removal logistics.

- **Limitations:** Self-reported data subject to recall and social desirability biases; small cohort limits stratified analysis by institution type or case volume; no evaluation of actual SSI rates—publication elsewhere cites ≈4.3–4.9% SSI in neurosurgery

- **Methodological concerns:** The definition of “gap” relies exclusively on self-report. Lack of correlation with clinical outcomes weakens inference about real-world impact.

- **Evidence context:** Several key issues highlighted—e.g., alcohol-based skin prep, minimal double-gloving—are supported by international guideline consensus, including Delphi initiatives

- **Generalizability:** Results likely reflect practice across Spanish neurosurgical centers but may not extrapolate to other countries with different SSI rates, guidelines adherence, and training practices.

Verdict (0–10)

5/10

Useful for identifying training and implementation gaps, but insufficient rigor without outcome data and objective practice verification.

Takeaway for Practicing Neurosurgeons

Understanding deficiencies in infection control practices is the first step; neurosurgeons should push for institutional programs with hands-on training, feedback loops, and alignment with SSI-prevention bundles.

Bottom Line

Survey reveals widespread disconnect between guideline knowledge and practice among neurosurgeons, especially in hair management, skin prep, and intraoperative habits. Steps toward active involvement in SSI programs and institutional reinforcement are urgently required.

`Measures to prevent surgical site infections in neurosurgery: survey and comparative analysis`, Sánchez-Viguera C, Badia JM; *Neurocirugia (Engl Ed)*. Published online June 2, 2025. doi:10.1016/j.neucie.2025.500678. Corresponding author: cristinarevistasas@hotmail.com

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