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Knowledge and Evidence-Based Nursing, Pharmacist and Lab Technician Practices for Prevention of Surgical Site Infections: A Narrative Review Study

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ABSTRACT: **Background:** Surgical site infections (SSIs) are important healthcare-associated infections that can complicate recovery after surgery. They may lead to additional treatment, prolonged hospitalization, increased costs, and patient distress. Prevention relies on coordinated multidisciplinary measures across preoperative, intraoperative, and postoperative care. Staff nurses contribute directly through hand hygiene, aseptic technique, preparation of patients and equipment, wound care, surveillance, and education, while pharmacists optimize surgical antimicrobial prophylaxis and aseptic compounding, and clinical laboratory technicians support timely microbiological diagnosis, antimicrobial susceptibility testing, and environmental surveillance. **Aim:** To review knowledge domains and evidence-based clinical practices relevant to the prevention of SSIs among staff nurses, pharmacists, and clinical laboratory technicians, and to discuss multidisciplinary factors and strategies that strengthen adherence to evidence-based prevention. **Methods:** This narrative review synthesizes published guidance and literature concerning SSI prevention, drawing on recommendations from the World Health Organization, the Centers for Disease Control and Prevention, and professional infection-prevention organizations. **Discussion:** SSI prevention is multifactorial. Essential nursing responsibilities include understanding infection definitions and risk factors, applying hand hygiene at the correct moments, maintaining sterile fields, supporting appropriate skin antisepsis and antimicrobial prophylaxis processes, delivering aseptic wound care, documenting observations, and educating patients. Pharmacists reinforce prevention through antimicrobial stewardship, weight- and allergy-adjusted prophylaxis selection, redosing

protocols, and sterile preparation of intravenous infusions and antiseptics, whereas laboratory technicians ensure pre-analytical specimen integrity, accurate pathogen identification, antibiogram generation, and sterilization quality monitoring. Knowledge and reported practice may not align perfectly because behavior is also affected by staffing, supplies, training, leadership, and workplace norms. **Conclusion:** Continuing education, competency-based practice assessment, accessible protocols, reliable supplies, audit with feedback, and a supportive safety culture are important strategies for improving SSI prevention. A review-based manuscript should distinguish guideline recommendations from locally observed performance.

1. INTRODUCTION

Surgical site infection is an infection associated with an operative incision or an anatomical area involved in a surgical procedure. Depending on its depth and location, an SSI may involve the skin and subcutaneous tissue, deeper incisional tissues, or an organ or space opened or manipulated during surgery. SSI is a clinically significant complication because infection can delay healing, require antimicrobial treatment or additional procedures, and interfere with a patient's return to normal activities. Prevention is therefore an integral part of surgical safety and quality of care. The burden of SSI is not distributed uniformly. Risks vary with the type of operation, wound contamination category, duration of surgery, patient comorbidities, and the effectiveness of perioperative processes. The WHO describes SSI as a substantial global patient-safety concern and emphasizes evidence-based prevention suitable for adaptation to different health systems. Its global guidelines contain recommendations covering the pre-, intra-, and postoperative periods and are based on systematic reviews of evidence [1].

Infection prevention is a team responsibility, but staff nurses have repeated and close contact with patients and surgical environments. Nurses participate in preoperative assessment and preparation, assist in maintaining aseptic conditions, manage dressings, monitor postoperative wounds, and provide education before discharge. Their knowledge influences how they interpret protocols and respond to possible contamination or early signs of infection. Their practice affects whether essential measures are reliably implemented. The CDC guideline for SSI prevention outlines key measures including appropriate patient bathing, correctly timed antimicrobial prophylaxis when indicated, suitable intraoperative skin preparation, perioperative glycemic control, and maintenance of normothermia. The recommendations require coordinated clinical decision-making; nurses' role is to understand the protocol, implement nursing actions within their scope, verify relevant steps, and communicate concerns to the responsible team [2]. This narrative review examines the knowledge and practice domains relevant to SSI prevention among staff nurses, pharmacist and laboratories with emphasis on evidence-based care, educational needs, and clinical quality improvement.

2. REVIEW APPROACH AND SCOPE

This manuscript is presented as a narrative review of evidence-based guidance and literature relevant to staff nurses' knowledge and practices in surgical site infection prevention. Its scope covers infection definitions and risk factors, prevention recommendations across the perioperative period, nursing responsibilities, and educational and organizational influences on adherence. The synthesis draws on the guidance and publications cited in the reference list, including recommendations from the World Health Organization, the Centers for Disease Control and Prevention, and professional infection-prevention organizations. It is not a primary survey or a systematic review, and no original participant data are reported. SSIs can be categorized as superficial incisional, deep incisional, and organ/space infections. The categories describe anatomical depth and structures involved, and standardized surveillance definitions support consistent reporting. Clinical assessment remains necessary because wound appearance, pain, drainage, fever, and systemic symptoms may vary according to the procedure, patient status, and infection site. Nurses should be alert to concerning changes and escalate them promptly rather than independently diagnosing an infection [3].

SSI prevention involves coordinated measures throughout the perioperative continuum. Before surgery, these may include patient preparation, risk assessment, and appropriate site preparation; during surgery, aseptic technique, skin antisepsis, and safe instrument handling are central; afterward, incision care, observation, documentation, and discharge guidance support prevention. Effective implementation depends not only on nurses' knowledge but also on the conditions in which care is delivered. Interruptions, supply shortages, unclear instructions, and workload may impede adherence; assessment should therefore consider knowledge, observed performance, and workplace context [1,2]. The 2022 SHEA-led update frames prevention as a system of essential practices, including evidence-aligned policies and

adherence monitoring. These recommendations are discussed further in relation to education and organizational support [4].

3. EVIDENCE AND GUIDANCE FOR SSI PREVENTION

3.1 International recommendations and evidence

WHO's 2018 second edition presents 29 recommendations across 23 topics, informed by systematic reviews, for SSI prevention throughout the perioperative continuum. It is intended for international use and permits adaptation to local resources, evidence, and patient preferences [1]. Supporting evidence for selected pre-, intra-, and postoperative measures is also described in related publications. The CDC's 2017 guideline was developed following a targeted systematic review and provides recommendations for selected prevention practices. The guideline includes patient bathing before surgery, appropriate timing of antimicrobial prophylaxis, alcohol-based intraoperative skin preparation unless contraindicated, perioperative glycemic control, and maintenance of normothermia [2]. It also advises against applying topical antimicrobial agents to the surgical incision for routine SSI prevention. Nurses need to know which actions are nursing responsibilities and which require coordination with prescribers or the surgical team. The SHEA-led acute-care update additionally emphasizes appropriate prophylaxis, avoiding unnecessary hair removal, staff and patient education, and measurement of adherence [4]. Its focus complements guideline recommendations by addressing implementation [5,6].

3.2 Hand hygiene and aseptic practice

Hand hygiene is a core infection prevention measure and applies before aseptic tasks, after exposure risks, and after patient or environmental contact. WHO's hand hygiene guidance presents the 'Five Moments' framework, supporting hand hygiene before touching a patient, before clean or aseptic procedures, after body-fluid exposure risk, after touching a patient, and after touching patient surroundings. In surgical care, staff must also follow surgical hand preparation protocols before donning sterile gown and gloves [7]. Aseptic technique aims to prevent contamination of key parts and key sites. It involves preparing a clean workspace, using sterile items where required, avoiding contact with sterile surfaces, and recognizing and correcting breaches. The technique used should be appropriate to the procedure and institutional policy. Nurses should not treat gloves as a substitute for hand hygiene, and glove use should correspond to anticipated exposure and the task.

3.3 Wound care and postoperative observation

Postoperative wound care requires careful assessment and consistent adherence to dressing protocols. Nurses should inspect the incision as clinically indicated, observe for changes such as increasing redness, warmth, swelling, pain, drainage, wound separation, or systemic symptoms, and document relevant findings. Dressing changes should follow the prescribed or institutional protocol, with hand hygiene before and after care and aseptic handling of wound-contact materials. The decision about dressing type, timing of the first dressing change, and use of specialized dressings may depend on the procedure and clinician instructions. Evidence does not support indiscriminate use of topical antimicrobial products on every incision. Staff nurses should follow the local protocol and seek clarification when an order is unclear or inconsistent with policy [2].

3.4 Education, training, and compliance

Training should include the rationale behind prevention measures, demonstration of correct technique, and opportunities for return-demonstration. Competency-based assessment can reveal technique errors that a written knowledge test may not detect. Training is especially important during orientation, when policies are updated, after audit findings identify gaps, and when staff move into a new clinical area. Education alone may be insufficient when environmental barriers persist. Availability of sinks or alcohol-based hand rub, sterile dressing supplies, adequate staffing, manageable workload, and supportive leadership all influence the feasibility of consistent practice [4]. A quality-improvement approach should examine both staff behavior and the system conditions that enable or impede it.

4. KNOWLEDGE DOMAINS FOR SSI PREVENTION

4.1 Definition, classification, and clinical manifestations

Staff nurses should be able to explain what constitutes an SSI and distinguish superficial incisional, deep incisional, and organ/space infection categories. Understanding classification supports accurate communication and surveillance. However, nurses should use established institutional criteria and should not assume that every postoperative fever or wound redness is an SSI. Clinical context, timing, procedure, and other causes must be considered by the healthcare

team. Possible warning signs include purulent drainage, increasing tenderness, erythema, warmth, swelling, wound edge separation, fever, or deterioration in the patient's overall condition. Some infections may present subtly, especially in patients with impaired immune response. Knowledge should include escalation pathways and the importance of timely review [6,7].

4.2 Risk factors

Patient-related risk factors can include diabetes, obesity, smoking, malnutrition, immunosuppression, and conditions that impair tissue perfusion or healing. Procedure-related factors may include duration, wound classification, complexity, and contamination. Care-process factors can include breaks in aseptic technique, inadequate skin antisepsis, inappropriate antimicrobial prophylaxis processes, or suboptimal instrument reprocessing. Nurses should understand these factors sufficiently to contribute to risk identification and prevention without attributing infection to a single cause [4].

4.3 Hand hygiene, PPE, and surgical hand preparation

Knowledge should cover indications for hand hygiene, technique, product selection under local policy, and the limitations of gloves. Personal protective equipment should be selected based on exposure risk and the task. Surgical hand preparation must follow the approved protocol and manufacturer instructions, and personnel should allow hands and forearms to dry appropriately before gowning and gloving. Staff must understand that sterile gloves can become compromised and that a suspected breach requires corrective action.

4.4 Skin antisepsis and hair removal

Preoperative skin preparation should use an approved antiseptic agent suited to the patient, operative site, and contraindications. Staff should understand the importance of correct application, contact time, and complete drying, particularly when alcohol-containing products are used, to reduce fire risk. Hair should not be removed routinely; if it interferes with the procedure, removal should be performed using a clipper according to protocol rather than a razor [4].

4.5 Sterile-field maintenance and equipment handling

Maintaining a sterile field requires awareness of the boundaries of sterile areas, correct handling of sterile packs, checking package integrity and expiry or indicator status as applicable, and avoiding unnecessary movement or contamination. Nurses should monitor for wet, torn, or compromised packaging and should not use items when sterility is uncertain. Instruments and reusable devices must undergo validated cleaning, disinfection, and sterilization processes in accordance with institutional and manufacturer requirements [4].

4.6 Antimicrobial prophylaxis awareness

Antimicrobial prophylaxis is a medical and team-based process. Nurses may be involved in confirming orders, administering medication within their scope, documenting administration, and communicating delays or allergies. Knowledge should include that prophylaxis is selected according to procedure-specific guidance and timed to achieve appropriate tissue concentrations at incision. Unnecessary prolonged postoperative antibiotics should not be initiated by nursing staff; decisions must follow the responsible clinician and institutional guideline [2,4].

4.7 Environmental and instrument infection control

Environmental cleaning, safe handling of contaminated instruments, appropriate waste segregation, and adherence to sterile processing protocols are necessary parts of SSI prevention. Nursing personnel should know the local pathways for transport of contaminated equipment, cleaning of patient-care surfaces, and reporting of equipment failures. These practices protect not only the surgical patient but also staff and other patients [4].

4.8 Patient and caregiver education

Patient teaching should use clear, culturally and linguistically appropriate language. Core topics include the prescribed incision-care routine, dressing instructions, avoiding unapproved topical products, and recognizing symptoms that require clinical advice. Written materials and teach-back can reinforce understanding; detailed discharge practices are addressed below.

5. NURSING PRACTICES ACROSS THE PERIOPERATIVE PERIOD

5.1 Preoperative period

Preoperative nursing care begins with assessment and preparation. Nurses should review relevant patient information, identify known allergies or sensitivities to antiseptic products, and communicate risk factors that may need clinical management. Patient bathing instructions should follow institutional policy and the procedure-specific guideline. The operative site should be prepared with approved products and the nurse should confirm that the patient's skin is suitable for the planned preparation. Hair removal should be avoided unless necessary. When required, a clipper and appropriate technique should be used in accordance with protocol. Nurses should ensure that equipment and supplies are available, check the integrity of sterile packs, and support completion of the surgical safety checklist. They should also help ensure that patient questions about wound care and infection prevention are addressed [8].

5.2 Intraoperative period

Intraoperative nursing practice includes surgical hand antisepsis, sterile gowning and gloving, preparation and protection of the sterile field, and safe handling of instruments. Staff should remain attentive to potential contamination, including contact between sterile and nonsterile surfaces, compromised gloves, wet packs, or unexpected movement near the field. A breach should be communicated immediately and corrected according to protocol rather than ignored. The nursing team supports appropriate skin antisepsis by applying the approved product as directed, allowing sufficient drying, and observing precautions for pooling or ignition risk. Nurses should contribute to the safe workflow around antimicrobial prophylaxis, temperature management, and glucose monitoring when these are part of the assigned clinical protocol. These measures require coordination with anesthesia and surgical personnel [8].

5.3 Postoperative period

Postoperative nurses should assess the incision according to the care plan, maintain clean or aseptic technique during dressing care, and record relevant findings. Hand hygiene is required before and after dressing manipulation. If the dressing becomes saturated, displaced, or contaminated, the nurse should respond according to the prescribed protocol and report significant concerns. The nurse should monitor the patient's general condition and communicate suspected infection promptly. Documentation should be factual and should include the wound condition, drainage characteristics where present, patient-reported symptoms, actions taken, and escalation. Avoid vague terms such as 'wound okay' when a more specific description is needed [9].

5.4 Discharge and continuity of care

SSI prevention continues after discharge. Nurses should provide written and verbal instructions on dressing care, hygiene, follow-up appointments, and warning signs. Patients should know whom to contact if concerns arise. Teach-back asking the patient to explain the instructions in their own words can reveal misunderstandings and permit clarification. Discharge education should be tailored to the patient's language, health literacy, and available support.

5.5 Pharmacist practices in surgical site infection prevention

5.5.1 Antimicrobial prophylaxis optimization and stewardship

Clinical and hospital pharmacists play a vital role in surgical antimicrobial prophylaxis (SAP) by ensuring evidence-based agent selection, weight-adjusted dosing, allergy verification, and timely administration prior to surgical incision [1,2,4]. For most prophylactic regimens, intravenous administration within 60 minutes before incision (or within 120 minutes for agents requiring prolonged infusion, such as vancomycin or fluoroquinolones) is essential to achieve bactericidal serum and tissue concentrations at the time of bacterial exposure [2,4,5]. Pharmacists also establish automated electronic order sets and intraoperative redosing alerts for prolonged procedures or significant blood loss, while preventing unnecessary postoperative continuation of prophylactic antibiotics after incision closure, thereby reducing antimicrobial resistance and Clostridioides difficile infection risks [2,4,9,10].

Pharmacists' review should begin during preoperative planning rather than at the time of incision. The review includes confirming that the selected agent is appropriate for the procedure and the expected organisms, checking the documented allergy history and the nature of any previous reaction, and assessing patient-specific factors that may affect dose selection. Body weight, renal function, relevant comorbidities, and current antimicrobial exposure should be considered in accordance with the institutional protocol. When an allergy label is unclear, the pharmacist should

communicate with the prescriber and surgical team so that an effective and safe prophylactic option can be selected without avoidable delay [2,4,9].

A reliable prophylaxis process also depends on coordination between pharmacy, nursing, anesthesia, and surgery. Pharmacists can support standardized order sets that specify the recommended agent, dose, route, administration window, and criteria for intraoperative redosing. Redosing may be required when an operation continues beyond the recommended interval for the selected drug or when substantial blood loss occurs; the decision should follow the drug-specific protocol and be documented in the medication record. Pharmacy teams can help ensure that prophylactic agents are stocked in appropriate locations and that orders are available early enough for administration before incision [2,4,9].

Antimicrobial stewardship is equally important in the prophylactic setting. Pharmacists should distinguish prophylaxis intended to prevent infection from treatment intended for an established or suspected infection. They can review postoperative antibiotic orders, identify duplicate or unnecessarily broad coverage, and promptly clarify orders that extend prophylaxis without a documented therapeutic indication. Such review supports guideline-concordant duration and reduces avoidable antimicrobial exposure, selection pressure for resistant organisms, and medication-related harm [4,9,10].

5.5.2 Aseptic compounding, antiseptic formulary management, and perioperative medication safety

In perioperative pharmacy practice, strict adherence to United States Pharmacopeia (USP) <797> sterile compounding standards prevents extrinsic microbial contamination of intravenous admixtures, regional anesthesia solutions, and irrigation fluids [11]. Pharmacists evaluate and standardize evidence-based preoperative skin antiseptics—such as alcohol-based chlorhexidine gluconate or povidone-iodine formulations—ensuring appropriate packaging, single-use unit availability, and staff awareness of flammability and contraindications [1,2,4]. Furthermore, pharmacists contribute to perioperative glycemic management protocols and medication reconciliation (such as managing immunosuppressive or anticoagulant therapies) to mitigate patient-related SSI risk factors [2,4,9].

The pharmacy service should maintain a controlled process for preparing, labeling, storing, and distributing sterile products used in the perioperative environment. This includes appropriate environmental controls, personnel training, cleaning procedures, beyond-use dating, and documentation required by applicable sterile-compounding standards. Each preparation should be traceable to its ingredients, preparation time, and responsible personnel. Standardized concentrations and ready-to-administer products, where suitable, can reduce calculation and preparation variability and help limit avoidable handling at the point of care. These safeguards are consistent with the contamination-prevention principles addressed in USP General Chapter <797> [11].

Formulary management is another practical contribution. Pharmacists can work with infection prevention and surgical teams to select approved antiseptic products, define their intended uses, and make product information readily accessible. Selection and use should account for the operative site, patient age where relevant, known sensitivities or contraindications, product instructions, and institutional policy. Staff education should emphasize correct application, required contact and drying time, avoidance of pooling, and fire precautions for alcohol-containing preparations. Pharmacy should also monitor product availability and communicate substitutions so that an unreviewed alternative is not introduced into perioperative practice [1,2,4].

Medication reconciliation and perioperative medication review provide opportunities to identify factors that may influence infection risk or the safe delivery of surgery. Pharmacists can flag medicines and clinical conditions requiring coordinated review, including therapies that affect immune response or blood glucose, while avoiding unilateral changes to prescribed treatment. They may contribute to approved glycemic-management pathways and verify that medication orders are appropriate for the patient's current clinical status. Clear documentation and communication with the responsible prescriber are essential when a medication-related concern is identified [2,4,9].

5.5.3 Multidisciplinary collaboration and postoperative antimicrobial de-escalation

Postoperatively, pharmacists collaborate with surgeons, nurses, and infectious disease specialists to review culture and susceptibility findings, transition empirical broad-spectrum therapy to targeted narrow-spectrum agents, optimize pharmacokinetic/pharmacodynamic dosing in patients with altered renal or hepatic function, and counsel patients at discharge regarding prescribed wound-care or antimicrobial regimens [9,10].

When postoperative infection is suspected or confirmed, pharmacists help connect microbiological results with an appropriate antimicrobial plan. They should review the indication for treatment, the quality and timing of available

culture specimens, the identified organism, and the susceptibility report, and then discuss whether empirical therapy can be narrowed, changed, or discontinued with the treating team. Therapy should be individualized to the infection site, severity, likely or confirmed pathogen, and patient characteristics; laboratory findings should be interpreted in their clinical context rather than in isolation [3,9,10,12].

Pharmacists can also assess dose, interval, route, duration, and monitoring requirements during treatment. Renal or hepatic impairment, changing organ function, body size, drug interactions, and potential adverse effects may require reassessment. Where applicable, pharmacokinetic and pharmacodynamic principles can support an effective exposure while limiting toxicity. The pharmacist should communicate recommendations and follow-up needs to prescribers and nurses, including relevant laboratory monitoring and criteria for reviewing therapy [9,10].

At discharge, medication counseling should clarify the purpose of each prescribed antimicrobial, the dose and duration, administration instructions, important adverse effects, and what the patient should do if a dose is missed or a problem occurs. Patients should be advised not to use leftover antibiotics or apply non-prescribed antimicrobial products to the incision. Coordination with nursing discharge education helps ensure that antimicrobial instructions are consistent with the wound-care plan and follow-up arrangements [4,9,10].

5.6 Clinical laboratory technician practices in surgical site infection prevention

5.6.1 Pre-analytical specimen quality and microbiological diagnostics

Clinical laboratory technicians and medical microbiologists are central to accurate SSI detection and targeted therapy. Reliable diagnosis begins with strict pre-analytical standards: laboratory personnel guide clinical staff on collecting deep tissue biopsies, aspirates, or properly sampled wound specimens prior to initiating empirical antimicrobial therapy, while discouraging superficial swabbing of colonized skin that can yield misleading polymicrobial results [3,12]. Timely specimen transport, Gram staining, aerobic and anaerobic culturing, and rapid molecular identification accelerate pathogen detection [12].

The laboratory's contribution begins before a specimen reaches the analyzer or culture bench. Laboratory personnel should make collection requirements available to clinical teams, including the preferred specimen type, required container or transport medium, minimum quantity where specified, and any special handling requirements. Specimens should be clearly labeled with the patient's identifiers, anatomical source, collection date and time, and relevant clinical details. Incomplete labeling, leakage, unsuitable containers, or prolonged transport may compromise interpretation; such problems should be managed according to a documented specimen-acceptance and rejection policy, with prompt communication to the requesting team [3,12].

For suspected deep or organ/space SSI, appropriately collected aspirates or tissue specimens generally provide more useful information than superficial swabs, which may recover colonizing organisms rather than the pathogen responsible for the infection. When clinically feasible, specimens should be obtained before antimicrobial treatment is started, without delaying urgent treatment in an unstable patient. Anaerobic specimens require suitable collection and transport conditions, and the laboratory should be informed when anaerobic infection is suspected. These steps help preserve organism viability and improve the value of subsequent culture results [3,12].

On receipt, laboratory staff should verify specimen identity and suitability, prioritize urgent samples, and process them using validated procedures. Direct Gram stain can provide an early indication of organism morphology and inflammatory cells, while aerobic and anaerobic culture supports organism recovery and subsequent identification. Rapid molecular methods may be useful where available and indicated, but their results should be interpreted alongside specimen source, microscopy, culture, and the patient's clinical presentation. Timely reporting of preliminary and final findings allows the clinical team to reassess empirical treatment and infection-control measures [3,12].

5.6.2 Antimicrobial susceptibility testing, antibiograms, and outbreak surveillance

Laboratory technicians perform standardized antimicrobial susceptibility testing (AST) and promptly communicate critical findings such as methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum beta-lactamase (ESBL)-producing Enterobacterales, or carbapenem-resistant organisms to guide targeted therapy and contact precautions [3,12,13]. Cumulative institutional antibiograms generated by the microbiology laboratory directly inform surgical prophylaxis guidelines and formulary updates [9,13]. In addition, laboratory technicians collaborate with infection prevention and control teams by archiving isolates for molecular typing during suspected SSI clusters or surgical outbreaks [12,13].

Antimicrobial susceptibility testing must be performed using current, standardized methods and the laboratory's approved quality-control procedures. Technicians should ensure that the organism tested is clinically relevant, that inoculum preparation and testing conditions meet the method requirements, and that results are reviewed before release. Unusual, inconsistent, or technically questionable findings should be investigated or referred according to laboratory policy. Accurate susceptibility results are important because they help clinicians select targeted therapy and avoid ineffective or unnecessarily broad antimicrobial treatment [12,13].

Critical or epidemiologically important findings require prompt communication through an established notification pathway. This may include detection of MRSA, ESBL-producing Enterobacterales, or carbapenem-resistant organisms. The report should identify the organism and relevant susceptibility pattern clearly, and the time and recipient of critical-result communication should be documented. The laboratory should coordinate with infection prevention personnel when results may require additional precautions, investigation of possible transmission, or review of other patients and procedures [3,12,13].

Cumulative antibiograms provide a local summary of antimicrobial susceptibility patterns and can inform empirical treatment and review of surgical prophylaxis guidance. Their usefulness depends on consistent organism identification, appropriate data inclusion, avoidance of duplicate isolates in accordance with the applicable standard, and transparent presentation of the analysis period and limitations. Laboratory staff should work with antimicrobial stewardship, pharmacy, and infection prevention teams to explain changes in resistance patterns and to ensure that antibiogram findings are interpreted appropriately rather than applied as a substitute for patient-specific culture results [9,13].

When an unusual increase in SSI cases or a cluster of similar organisms is identified, laboratory personnel can support the investigation by reviewing culture records, comparing organism and resistance profiles, retaining isolates where appropriate, and coordinating additional characterization or typing with reference services. Timely exchange of information with infection prevention and surgical teams may help identify a shared source or transmission pathway and guide proportionate control measures. The laboratory's role is to provide reliable microbiological evidence and maintain traceable records that support the wider outbreak investigation [3,12,13].

5.6.3 Sterilization validation, environmental monitoring, and biosafety

Beyond diagnostic testing, laboratory technicians support perioperative infection control through biological and chemical indicator verification of steam and low-temperature sterilizers, microbiological quality testing of water and environmental surfaces when indicated, and strict adherence to biosafety and hand hygiene protocols to prevent cross-contamination within the laboratory and clinical interfaces [7,12,13].

Laboratory personnel may contribute to quality assurance for sterilization and reprocessing services through the testing and documentation activities assigned by institutional policy. Biological indicators provide evidence about the performance of a sterilization cycle, while chemical indicators help show whether specified process conditions have been reached; the two have different purposes and should not be treated as interchangeable. Results must be interpreted against the sterilizer manufacturer's instructions and the facility's validated procedures. A failed or unexpected indicator result should be reported promptly so that affected loads can be managed and the cause investigated before items are released for patient use [4,7,13].

Environmental and water microbiological testing should be undertaken when indicated by a defined surveillance plan, an investigation, or a specific concern, rather than as an isolated substitute for routine cleaning and process control. Sampling locations, methods, frequency, acceptance criteria, and responsibilities should be established in advance. Results outside the expected range should be communicated to infection prevention, environmental services, sterile processing, and other responsible departments so that repeat testing and corrective action can be considered. Interpretation should take account of the sampling method and the clinical or operational question being investigated [4,12,13].

Within the laboratory, standard precautions remain essential. Staff should use task-appropriate personal protective equipment, perform hand hygiene at the required moments, handle sharps safely, decontaminate work surfaces, and use appropriate containment when manipulating potentially infectious material. Specimen processing areas should be organized to reduce cross-contamination between samples and between clean and contaminated workflows. Equipment maintenance, spill response, waste disposal, and incident reporting should follow documented biosafety procedures. These measures protect laboratory personnel and help preserve the reliability of microbiological results used in SSI diagnosis and surveillance [7,12].

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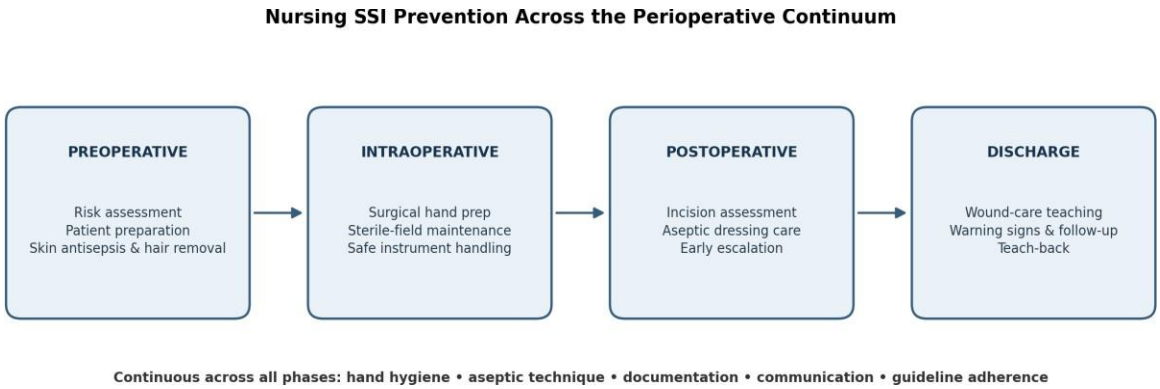

Figure 1. Nursing actions with pharmacist & Laboratories results for surgical site infection prevention across the perioperative continuum.

Table 1. Summary of actions and assessment priorities across the perioperative period.

Perioperative phase	Core actions	Assessment / communication focus
Preoperative	Review preparation and risk factors; support approved bathing and skin preparation; avoid unnecessary hair removal; verify supplies and checklist steps.	Allergies/sensitivities, risk factors, preparation completion, concerns communicated.
Intraoperative	Perform hand antisepsis; maintain sterile field; handle instruments safely; monitor for contamination; follow skin antiseptic instructions.	Sterility integrity, breach recognition and immediate escalation, protocol adherence.
Postoperative	Hand hygiene; aseptic dressing care; wound assessment; factual documentation; prompt escalation of concerning signs.	Incision appearance, drainage, symptoms, patient condition, actions and escalation.
Discharge	Provide written/verbal wound-care advice; teach warning signs; use teach-back; reinforce follow-up.	Patient understanding, contact pathway, follow-up instructions.
Pharmacist (Perioperative & Stewardship)	Verify allergies and weight-adjusted SAP dosing; ensure timely pre-incision administration and intraoperative redosing; enforce USP <797> sterile compounding; manage antiseptic formulary and perioperative glycemic protocols; discontinue unnecessary postoperative prophylaxis [1,2,4,9–11].	Prophylaxis timing/redosing compliance, renal/hepatic dose adjustments, culture-guided antimicrobial de-escalation, and multidisciplinary order-set adherence.
Clinical Laboratory Technician (Diagnostic & Surveillance)	Enforce pre-analytical specimen quality (aspirates/tissue over superficial swabs); perform Gram stain, culture, and standardized AST; validate sterilization biological indicators; maintain biosafety and aseptic sample handling [3,7,12,13].	Rapid escalation of multidrug-resistant organisms, cumulative surgical antibiogram reporting, and isolate typing for SSI outbreak surveillance.

6. FACTORS INFLUENCING NURSES' KNOWLEDGE AND PRACTICE

6.1 Educational preparation and continuing professional development

Initial nursing education provides foundational knowledge, but SSI prevention recommendations and local protocols may evolve. Continuing professional development helps staff refresh knowledge, understand updates, and practice

technical skills. Training frequency and format should be determined by policy, competency requirements, audit results, and observed needs.

6.2 Professional experience and clinical exposure

Experience can improve familiarity with workflows and recognition of common risks, but length of service alone does not ensure adherence. Experienced staff may also normalize shortcuts when practices are not reinforced. A balanced approach includes mentoring, peer learning, periodic competency assessment, and consistent application of standards across seniority levels.

6.3 Workload, staffing, and supply availability

High workload, interruptions, insufficient staffing, and unavailable supplies can impede correct practice. If alcohol-based hand rub, sterile dressing sets, or appropriate protective equipment are not readily accessible, compliance becomes more difficult. Institutions should consider these system factors during audits and avoid interpreting every observed lapse as solely an individual failure.

6.4 Leadership, safety culture, and communication

Leadership support influences whether infection prevention is treated as a priority. A positive safety culture encourages staff to report contamination events, ask for assistance, and receive constructive feedback. Clear communication during handovers and use of checklists can reduce omissions. Managers should ensure protocols are easy to access and that staff know where to find guidance.

6.5 Monitoring and feedback

Audit and feedback can help teams understand current practice and track improvement. Monitoring should use defined indicators, consistent observation methods, and feedback that is timely and actionable. Examples include compliance with hand hygiene at selected moments, observed dressing technique, or completion of key checklist steps. SSI outcome surveillance should be performed by appropriately trained personnel using standardized definitions and interpreted in relation to procedure mix and other factors.

7. DISCUSSION

SSI prevention is a shared responsibility across the continuum of care. Because nursing roles span preparation, intraoperative support, wound care, observation, and patient teaching, the domains reviewed here can inform staff orientation, continuing education, and competency assessment. Knowledge and practice should be evaluated as distinct but connected constructs. Knowledge tests can assess understanding of definitions, risks, and recommendations. Observational checklists can assess whether technique is correctly performed in practice. Self-report tools may be useful for perceived behavior but can be affected by recall and social-desirability bias. Observation has limitations too, including the possibility that staff alter behavior when observed. Combining methods and interpreting results cautiously can improve assessment.

Guidelines should be translated into concise local protocols that define who performs each step, when it is performed, and how deviations are escalated. Protocols should not be copied without considering procedure type, patient characteristics, available resources, and national guidance. WHO explicitly supports adaptation of its global recommendations to local settings [1]. Organizational support is essential to sustain implementation. Education alone may have limited impact when supplies, staffing, leadership, or work processes present barriers; monitoring and feedback should therefore be paired with system-level improvement [4].

Patient and caregiver involvement can support continuity after discharge, but it should complement—not replace—the institution's responsibility to provide safe care. Nurses should ensure patients know how to follow the care plan and access help when concerns arise. Taken together, the evidence supports assessing nurses' knowledge alongside clinical practice and workplace conditions. Research and quality-improvement initiatives can use clearly defined settings, validated assessment tools, appropriate ethical oversight, and transparent analysis to guide targeted interventions.

8. IMPLICATIONS FOR NURSING PRACTICE

8.1 Nursing education

Educational programs should address classification, risk factors, prevention guidance, aseptic technique, wound assessment, and patient communication. Case-based instruction and return-demonstration can assess application of knowledge, especially for technical skills and response to breaches.

8.2 Clinical administration

Administrators should maintain accessible protocols and reliable supplies, incorporate unit-specific responsibilities into orientation, and use audit findings to guide supportive feedback and competency follow-up.

8.3 Infection prevention and control teams

Infection prevention teams should coordinate with nursing educators on training and standardized audit tools. Reports should be actionable, and SSI rates when assessed should be interpreted with attention to case mix, procedure type, and surveillance completeness.

8.4 Patient safety

Reliable prevention practices contribute to a safer perioperative environment. Reporting near misses and breaches allows the team to learn from process failures before harm occurs. A just and supportive culture, combined with clear accountability and evidence-based protocols, can strengthen patient safety.

9. RECOMMENDATIONS

1. Conduct regular education sessions on SSI prevention based on current WHO, CDC, and institutional recommendations.
2. Use competency-based assessment with demonstration and return-demonstration for key aseptic procedures.
3. Maintain easily accessible written protocols for preoperative skin preparation, sterile technique, postoperative wound care, and escalation of suspected infection.
4. Ensure uninterrupted availability of hand hygiene products, approved antiseptics, sterile supplies, and appropriate PPE.
5. Promote correct hand hygiene and reinforce that gloves do not replace hand hygiene.
6. Avoid routine hair removal; when needed, follow approved clipper-based methods and institutional guidance.
7. Use audit and feedback to assess selected process indicators and target improvement efforts.
8. Encourage immediate reporting and correction of sterile-field breaches and compromised sterile supplies.
9. Provide clear patient and caregiver education on wound care, warning signs, and follow-up.
10. Review protocols periodically and update staff when evidence or institutional policies change.
11. Support a non-punitive learning culture while maintaining professional responsibility for safe practice.

CONCLUSION

Surgical site infection prevention is a central component of safe surgical nursing care. Staff nurses contribute through knowledge of infection risks and guideline recommendations, as well as consistent performance of hand hygiene, aseptic technique, wound management, patient education, and timely communication. Effective prevention requires more than individual knowledge: it depends on practical competency, clear protocols, adequate supplies, leadership support, and monitoring with feedback. A structured assessment of knowledge and observed practice can identify educational needs and guide quality improvement. This narrative review presents the relevant knowledge and practice domains without introducing fabricated primary data or statistical findings.

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The original author and the corresponding author's supervisor wrote the first drafts of the manuscript. All authors are contributed to data collection and editing, designed the tables, and approved the final submission to the journal.

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The author declares no conflict of interest.

ETHICS STATEMENT

Not applicable; this narrative review did not involve human participants or animal experiments.

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