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Healthcare-Associated Infections in General Surgery: Surveillance, Audit, and Evidence-Based Prevention Across the Perioperative Pathway

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Abbreviations:
AMR: antimicrobial resistance;
ASA: American Society of Anesthesiologists;
CDI: *Clostridioides difficile* infection;
CDC: Centers for Disease Control and Prevention;
ECDC: European Centre for Disease Prevention and Control;
HAI: healthcare-associated infection;
IPC: infection prevention and control;
MDR: multidrug-resistant;
MRSA: methicillin-resistant *Staphylococcus aureus*;
NHSN: National Healthcare Safety Network;
SSI: surgical site infection;
WHO: World Health Organization.

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Rezumat

Infecțiile asociate asistenței medicale în chirurgia generală: supraveghere, audit și prevenție bazată pe dovezi pe întregul parcurs perioperator

Infecțiile asociate asistenței medicale (IAAM) rămân o problemă importantă de siguranță a pacientului, iar în chirurgia generală infecția de situs chirurgical (ISC) este un rezultat perioperator relevant şi măsurabil. Incidența observată depinde însă de definiția utilizată şi de intensitatea supravegherii; metodele limitate la perioada de spitalizare pot omite cazuri diagnosticate după externare. Prezentul review narativ structurat sintetizează critic recomandările actuale privind definițiile, monitorizarea, auditul, rezistența antimicrobiană şi prevenția perioperatorie, cu accent pe aplicabilitatea în chirurgia generală. Sunt prioritizate intervențiile cu suport consistent în ghiduri şi sinteze recente: profilaxia antibiotică adecvată, antisepsia tegumentară cu soluții pe bază de alcool, prevenirea hipotermiei, disciplina aseptică, utilizarea judicioasă a anti-microbienelor şi supravegherea post-externare. Bundle-urile perioperatorii de măsuri pot contribui la reducerea incidenței ISC, dar efectul observat depinde de intervențiile incluse, de complianță şi de contextul implementării; dovezile disponibile nu arată că pachetele mai extinse sunt în mod automat superioare. Pentru implementare sunt propuse un set restrâns de indicatori de audit şi un pachet perioperator de măsuri adaptabil resurselor locale. Supravegherea digitală şi instrumentele de inteligență artificială sunt promițătoare, însă necesită validare locală, evaluarea impactului clinic şi menținerea confirmării umane a cazurilor.

Cuvinte cheie: infecții asociate asistenței medicale, infecție de situs chirurgical, supraveghere, audit, profilaxie antimicrobiană, rezistență antimicrobiană, chirurgie generală

Abstract
Healthcare-associated infections (HAIs) remain an important patient-safety problem, and surgical site infection (SSI) is a clinically relevant and measurable perioperative outcome in general surgery. Observed SSI incidence depends on the surveillance definition and the intensity of case finding; approaches restricted to the index admission may miss infections diagnosed after discharge. This structured narrative review critically synthesises current guidance and selected evidence on HAI definitions, surveillance, audit, antimicrobial resistance, and perioperative prevention, with emphasis on general surgical practice. Priority is given to interventions supported consistently by contemporary guidelines and evidence syntheses: appropriate antimicrobial prophylaxis, alcohol-containing skin antisepsis, avoidance of peri-operative hypothermia, aseptic practice, antimicrobial stewardship, and post-discharge case finding. Care bundles can reduce SSI, but their effect depends on the interventions included, adherence, and context; current evidence does not show that larger bundles are inherently more effective. A concise audit dashboard and an adaptable peri-operative prevention bundle are proposed. Digital surveillance and artificial intelligence may reduce surveillance workload, but current evidence supports their use as adjuncts requiring local validation and human case confirmation rather than as replacements for established surveillance systems.

Keywords: healthcare-associated infection, surgical site infection, surveillance, audit, perioperative prevention, antimicrobial prophylaxis, antimicrobial resistance, general surgery

Introduction

Healthcare-associated infections are infections related to healthcare delivery that were not present or incubating at admission. In surgical services, SSI is particularly important because it links patient factors, operative practice, antimicrobial use, and continuity of care after discharge. Current CDC/NHSN and ECDC frameworks classify SSI as superficial incisional, deep incisional, or organ/space infection and apply procedure-specific surveillance periods of 30 or 90 days (1,2). Since a substantial proportion of SSIs become apparent after discharge, case-finding strategies confined to the index admission can underestimate incidence (3,4).

HAIs remain common in European acute-care hospitals, and SSI carries substantial clinical and economic consequences (5-7). These data support prevention, but they do not justify comparing crude SSI rates across hospitals without attention to case mix and surveillance intensity.

In Romania, national rules provide a framework for HAI surveillance and reporting. A recent analysis of Romanian legislation shows progressive alignment with European surveillance principles, while also describing persistent implementation challenges (8). Differences between reported and actively detected HAI rates should therefore be interpreted cautiously: they may reflect case definitions, post-discharge capture, diagnostic access, hospital case mix, and reporting practice, rather than a single underlying cause.

Materials and Methods

This structured narrative review was designed to provide a critical synthesis of current evidence on HAI surveillance and perioperative SSI prevention in adult general surgery. Reporting and scientific reasoning were informed by the domains of the SANRA (Scale for the Quality Assessment of Narrative Review Articles) framework, which addresses the justification and aims of a review, description of the literature search, referencing, scientific reasoning, and presentation of relevant data (9). The review was intended to support clinical interpretation and implementation rather than to estimate a pooled treatment effect.

Search Strategy

The literature search covered publications from 1 January 2021 to 31 May 2026. PubMed/MEDLINE and the Cochrane Library were searched, and current guidance and surveillance documents were retrieved from WHO, ECDC, CDC/NHSN, and SHEA / IDSA / APIC sources. Search terms combined healthcare-associated infection, surgical site infection, surveillance, post-discharge surveillance, audit and feedback, perioperative bundle, antimicrobial prophylaxis, antimicrobial resistance, automated surveillance, and artificial intelligence using AND/OR as appropriate. Reference lists of key guidelines and evidence syntheses were also examined. Official public-health guidance and surveillance reports were eligible because of their normative or epidemiological role.

Inclusion Criteria

The search prioritised English-language sources published between 1 January 2021 and 31 May 2026. Earlier publications remained eligible when they were methodologically or historically foundational, continued to inform contemporary guidance, or addressed a question not adequately covered by newer evidence syntheses. Eligible sources addressed adult surgical populations and at least one of the following areas: SSI/HAI definitions or surveillance; clinical or economic burden; perioperative infection prevention; antimicrobial prophylaxis or stewardship; antimicrobial resistance; audit and feedback; implementation; or digital surveillance and artificial intelligence. Evidence from non-surgical settings was included only when it informed general IPC, audit, or digital-surveillance principles.

Exclusion Criteria

We excluded superseded guidance, paediatric-only studies, conference abstracts, and studies without clear relevance to perioperative infection prevention or surveillance. Non-peer-reviewed sources were excluded except for official normative and surveillance documents issued by WHO, ECDC, CDC/NHSN, or comparable public-health bodies.

Evidence Appraisal and Interpretation

Because this was a narrative review, we did not perform an independent, duplicate study-by-study risk-of-bias assessment or assign de novo GRADE ratings. Evidence was appraised at the level of each clinical domain, considering study design, directness to adult general surgical practice, consistency across sources, and the certainty or risk-of-bias judgements reported in the source guideline or systematic review when available. Recommendations supported by concordant contemporary guidelines and consistent evidence syntheses were regarded as guideline-concordant practices. Interventions supported by heterogeneous, indirect, or predominantly observational evidence were interpreted as context-dependent. Digital and implementation approaches with limited prospective validation were considered emerging. We did not upgrade or downgrade certainty beyond assessments reported by the original sources. The source-selection pathway is shown in *Fig. 1.* Because individual search records were not prospectively logged for this narrative review, a numerical PRISMA flow diagram was not reconstructed.

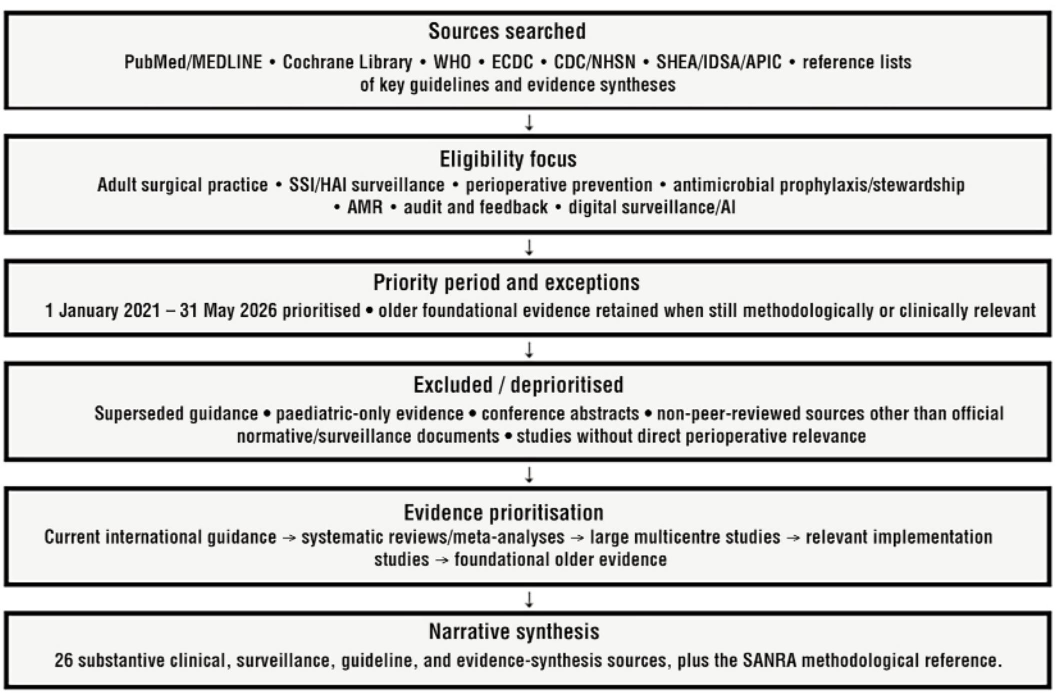

Figure 1. Source-selection pathway for the structured narrative review.
The diagram summarises the sources searched, eligibility criteria, evidence prioritisation, and final narrative synthesis.
Because search records were not prospectively logged, the pathway is schematic rather than a numerical PRISMA flow diagram.

Definitions, Burden, and Scope of Surgical HAIs

Valid surveillance depends on precise and consistently applied definitions. Current ECDC and CDC/NHSN frameworks distinguish superficial incisional, deep incisional, and organ/space SSI and apply procedure-specific attribution criteria and surveillance periods (1,2). Attribution rules and surveillance windows directly affect measured SSI rates and should remain consistent when rates are compared over time. *Table 1* summarises the principal SSI categories and surveillance windows relevant to general surgical practice. Other HAIs encountered in surgical patients, including CDI and device-associated infections, require application of their respective surveillance definitions and are not detailed here.

Healthcare-associated infections remain a substantial burden in European acute-care hospitals. The 2022-2023 ECDC point-prevalence survey estimated that approximately 4.3 million patients in EU / EEA hospitals acquire at least one HAI each year, underscoring their continuing relevance to patient safety and healthcare delivery (5). In surgical populations, the consequences of SSI extend beyond infection itself and include prolonged hospitalisation, additional diagnostic and therapeutic procedures, readmission, reoperation, and increased resource use. Recent national data from France illustrate the magnitude of this burden: following digestive surgery, SSI was associated with approximately 13 additional hospital days and €5,246 in additional hospital costs, although excess resource use varied substantially across procedure groups (6). Similar findings have been reported in Germany. In a retrospective analysis involving 79 hospitals, patients with SSI had a median hospital stay of 28 versus 12 days, median case costs of €19,008 versus €9,040, and higher in-hospital mortality than patients without SSI (7). Although differences in study design, procedure mix, surveillance methods, and healthcare financing limit direct comparison between settings, these findings consistently identify SSI as an important source of clinical and economic burden and support prevention as a patient-safety and resource-utilisation priority (5-7).

These estimates are derived from observational hospital data. Procedure complexity, baseline patient risk, length-of-stay practices, and national financing structures influence measured excess cost and stay; the figures therefore illustrate the burden associated with SSI rather than a uniform estimate of preventable attributable cost (6,7).

Microbiology and Antimicrobial Resistance

The microbiology of surgical site infection reflects the operative field, wound class, procedure type, prior healthcare exposure, antimicrobial use, and local hospital ecology. Clean procedures are predominantly associated with skin flora, particularly *Staphylococcus aureus* and coagulase-negative staphylococci, whereas clean-contaminated and contaminated abdominal operations involve a broader spectrum that includes Enterobacterales, enterococci, and anaerobic organisms (10-12). In ECDC surveillance data for 2018-2020, *Enterococcus* species (17.6%), *Escherichia coli* (17.2%), and *Staphylococcus aureus* (15.2%) were the most frequently reported microorganisms. These findings support procedure-specific interpretation of microbiological findings rather than a single empirical model for all surgical infections (12).

Resistance patterns further influence the management of postoperative infection. Clinically relevant resistant phenotypes include methicillin-resistant S. aureus (MRSA), vancomycin-resistant enterococci, extended-spectrum beta-lactamase-producing and carbapenem-resistant Enterobacterales, carbapenem-resistant Acinetobacter baumannii, and resistant Pseudomonas aeruginosa. The 2024 WHO Bacterial Priority Pathogens List classifies carbapenem-resistant A. baumannii, third-generation cephalosporin-resistant Enterobacterales, and carbapenem-resistant

Table 1. Surgical site infection classification and surveillance framework for general surgery

SSI category	Core surveillance concept	Typical window / trigger
Superficial incisional SSI	Infection involving skin and subcutaneous tissue of the incision, meeting the applicable surveillance criteria for purulent drainage, microbiological evidence, deliberate opening with compatible findings, or diagnosis.	30 days after the operative procedure; outpatient wound review, microbiology results, and readmission may identify cases after discharge.
Deep incisional SSI	Infection involving the deep soft tissues of the incision, including fascia and muscle, meeting protocol-defined clinical, microbiological, imaging, or operative criteria.	30 or 90 days, according to procedure category and surveillance system; case finding may involve readmission, imaging, or reoperation.
Organ/space SSI	Infection involving an organ or anatomical space opened or manipulated during the operation, meeting protocol-defined clinical, microbiological, imaging, or operative criteria.	30 or 90 days, according to procedure category and surveillance system; imaging, microbiology, drain findings, readmission, or reoperation may identify cases.

SSI: surgical site infection. Exact diagnostic criteria, attribution rules, and surveillance periods should follow the surveillance system in use; current ECDC and CDC/NHSN frameworks define procedure-specific surveillance periods and criteria for superficial incisional, deep incisional, and organ/space SSI (1,2).

Enterobacterales as critical-priority pathogens. Vancomycin-resistant E. faecium, carbapenem-resistant P. aeruginosa, and methicillin-resistant S. aureus are included in the high-priority group (13). European surveillance similarly indicates persistent geographical heterogeneity in AMR and increasing incidence of several resistant pathogen–antimicrobial combinations, including carbapenem-resistant K. pneumoniae and vancomycin-resistant E. faecium (14). These surveillance data predominantly concern invasive isolates rather than SSI specifically and should therefore be interpreted as regional resistance context rather than as direct estimates of the microbiology of surgical wounds.

For surgical practice, AMR is relevant to treatment, prophylaxis, and stewardship, but resistance concerns should not automatically lead to broader perioperative prophylaxis. Prior colonisation or infection with resistant organisms, recent antimicrobial exposure, healthcare contact, procedure-specific flora, and local susceptibility data may influence empirical treatment and, in selected circumstances, prophylactic strategy. Contemporary guidance nevertheless favours procedure-specific prophylaxis and discourages routine expansion of antimicrobial coverage - including routine vancomycin use - in the absence of a defined indication (10,11). Once postoperative infection is established, microbiological sampling and susceptibility results should support narrowing or adjustment of therapy together with source control. The internationally used MDR definition remains acquired non-susceptibility to at least one agent in three or more antimicrobial categories (15). Thus, local microbiological surveillance and anti-microbial stewardship should complement SSI prevention rather than drive indiscriminate broad-spectrum antimicrobial use.

Surveillance and Audit: From Case Finding to Improvement

Case Finding and Denominators

Passive reporting is vulnerable to missed cases, particularly after discharge. Active surveillance using standard definitions, chart review, readmission linkage, outpatient wound assessment, or structured telephone follow-up generally identifies more SSIs (3,4). The resulting increase in measured incidence should not be interpreted automatically as deterioration; it may indicate improved ascertainment. Post-discharge methods should be proportionate to procedure volume and local access to follow-up rather than identical across all surgical services. Evidence supporting post-discharge surveillance consistently indicates improved case ascertainment, although the principal studies differ in procedure type, duration of follow-up, and method of patient contact (3,4). These findings support extending case finding beyond discharge but do not establish a single follow-up method as optimal for all surgical services.

Raw counts are insufficient for benchmarking. At minimum, surveillance should use procedure-specific denominators and record major case-mix variables such as urgency, wound class, surgical approach, duration, and ASA status. NHSN risk-adjusted measures such as the Standardized Infection Ratio are useful only when numerator and denominator data are collected consistently (2).

Audit and Feedback

Outcome and process measures provide different information. Outcome measures track infection rates, whereas process measures identify potentially modifiable gaps in care. A focused dashboard can therefore pair SSI rates and readmissions with prophylaxis timing, indicated re-dosing, postoperative antimicrobial duration, temperature monitoring, skin-preparation adherence, and completion of post-discharge follow-up (*Table 2*). Audit frequency should reflect procedure volume and the ability to act on the data.

Audit and feedback can improve professional practice, although effects vary. The 2025 Cochrane review suggests that audit and feedback may be more effective when they address important performance gaps, use relevant comparators, facilitate engagement with the feedback, and include a feasible improvement plan (16).

Evidence-Based Prevention Across the Perioperative Pathway

Preoperative Preparation

Risk reduction begins with identification of modifiable factors, but the strength of evidence differs between interventions. Smoking cessation, nutritional assessment in patients at risk of malnutrition, and perioperative glucose management are recommended components of optimisation; the appropriate target and timing should follow patient- and procedure-specific protocols rather than a single universal threshold (10,11). S. aureus screening and decolonisation are best established for selected high-risk populations and procedures and should not be presented as mandatory for all general surgical patients (10,11).

Hair should not be removed routinely; when removal is necessary, clippers are preferred to razors. Alcohol-containing skin antisepsis is recommended unless contraindicated (10,11). A 2025 European

Table 2. Focused audit dashboard for a general surgery service

Domain	Metric	Suggested denominator / interpretation
Outcome	SSI rate by selected procedure group	SSI cases / procedures; review with stable case definition and follow-up.
Outcome	30-day wound-related readmission	Wound-related readmissions / procedures or discharges.
Prophylaxis	Timely prophylaxis	Eligible cases receiving the indicated agent within the recommended pre-incision interval.
Prophylaxis	Re-dosing when indicated	Cases correctly re-dosed / cases meeting drug- or procedure-specific criteria.
Stewardship	Post-closure prophylaxis	Eligible cases in which prophylaxis was discontinued at incisional closure, unless a documented therapeutic indication required antimicrobial treatment.
Intraoperative	Temperature monitoring / normothermia	Cases with perioperative temperature monitoring and avoidance of clinically relevant hypothermia.
Surveillance	Post-discharge case ascertainment	Eligible procedures with completed structured follow-up or reliable record linkage.
Bundle	All-or-none bundle adherence	Cases receiving every locally selected core bundle element.

Review frequency should be determined by procedure volume and the speed with which the team can act on the data; monthly review is pragmatic for many high-volume services but is not a universal standard.

guideline for gastrointestinal and hepatopancreatobiliary surgery suggests alcohol-based chlorhexidine when mucous membranes are not involved but did not make recommendations for several direct concentration or formulation comparisons because high-quality evidence was insufficient (17). A 2024 systematic review and meta-analysis suggested that chlorhexidine-alcohol may reduce SSI risk compared with aqueous or alcoholic iodine solutions, although differences in antiseptic concentration, wound class, and surgical populations remain relevant to interpretation (18).

Antimicrobial Prophylaxis

Prophylaxis is effective when the correct drug and dose reach adequate tissue concentrations before incision. Practical audit points are agent selection for the procedure, weight-adjusted dosing when indicated, administration within the recommended pre-incision interval, and intraoperative re-dosing according to drug half-life, procedure duration, or major blood loss (10,11,19). A 2022 meta-analysis suggested a lower SSI risk with intraoperative re-dosing, although the overall certainty of evidence was low and antibiotic regimens and re-dosing protocols were heterogeneous (19).

Routine continuation after incision closure should be avoided in the absence of established or suspected infection or another procedure-specific therapeutic indication (10,11). A meta-analysis of 52 randomised trials found no additional SSI benefit from postoperative continuation when contemporary best-practice prophylaxis standards were otherwise followed (20). Avoiding unnecessary postoperative exposure also supports antimicrobial stewardship and reduces selection pressure.

Intraoperative and Postoperative Care

Contemporary SSI guidance supports maintenance of normothermia, appropriate glycaemic management, sterile technique, and minimisation of avoidable breaks in aseptic practice (10,11). The strength of evidence is not the same for all of these measures: antimicrobial prophylaxis and skin antisepsis have a more direct evidence base than some environmental practices. Measures such as limiting unnecessary operating-room traffic are reasonable infection-control standards, but the direct effect on SSI incidence is less certain and should not displace higher-yield interventions.

After surgery, wound assessment, device review, hand hygiene, and antimicrobial stewardship remain central. Patients should receive clear instructions on warning signs and a defined route for rapid review. Post-discharge surveillance should be integrated with clinical follow-up whenever feasible so that case finding serves both patient care and quality measurement (1,3,11). *Fig. 2* summarises the perioperative pathway and the continuous measurement loop.

Implementation, Safety Culture, and Resource-Sensitive Priorities

Perioperative bundles are useful because they convert multiple recommendations into a small number of observable actions. Results differ according to study design and bundle composition. In the 2022 meta-analysis by Wolfhagen et al., interrupted time-series studies showed reductions in SSI, whereas results from randomised trials were heterogeneous; larger bundles were not demonstrably better simply because they contained more components (21). Bundle design should therefore favour a limited number of evidence-supported actions that can be delivered reliably and audited, rather than maximal complexity. A practical example is presented in *Table 3*. Interpretation of bundle studies requires caution because several interventions are introduced simultaneously, and before-and-after designs remain vulnerable to secular changes in practice. In the Wolfhagen meta-analysis,

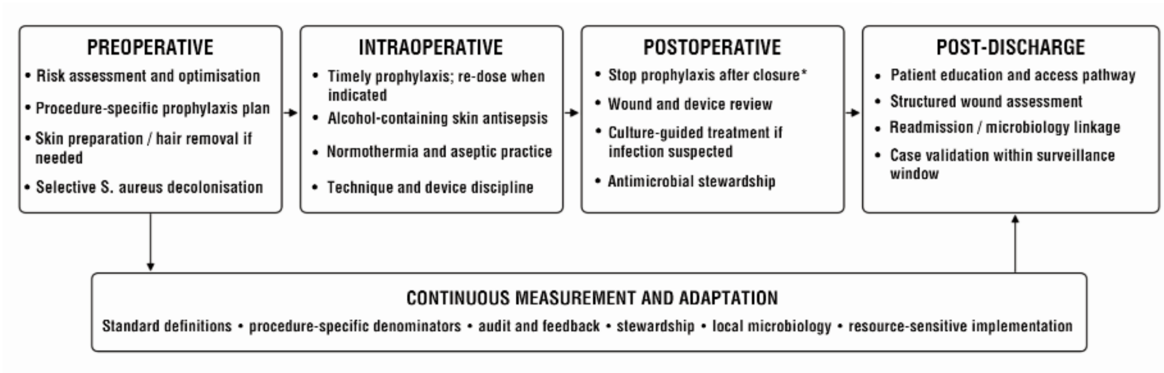

Figure 2. Perioperative pathway for SSI prevention and surveillance.

effect estimates differed by study design; bundle-level outcomes cannot therefore determine the contribution of individual components with confidence (21).

In hospitals with limited personnel, laboratory access, or informatics infrastructure, implementation should start with clinically important interventions that can be implemented and measured with limited infrastructure: standard case definitions, one or two high-volume procedure groups, reliable prophylaxis, alcohol-based skin preparation, temperature monitoring where feasible, early review of suspected infection, and simple post-discharge case finding. WHO provides both an implementation manual and an SSI surveillance protocol designed to support adaptation in settings with limited resources (22,23). Advanced molecular diagnostics, automated dashboards, or AI should be added only when the basic surveillance and response pathway is functioning, and the additional system can be maintained.

A non-punitive approach to case review may make

Table 3. Adaptable perioperative SSI prevention bundle

Domain	Core action	Evidence basis / implementation note	Audit metric
Antimicrobial prophylaxis	Correct procedure-specific agent and dose; administer within recommended pre-incision interval.	Guideline-concordant core practice supported consistently across contemporary SSI-prevention guidance; exact agent, dose, and timing remain procedure specific (10,11).	% eligible cases compliant
Re-dosing	Re-dose when drug half-life, procedure duration, or major blood loss indicates loss of adequate tissue concentration.	Guideline-supported practice. Meta-analysis suggests lower SSI risk when re-dosing is pharmacologically indicated, but overall certainty was low, and regimens were heterogeneous (10,19).	% indicated cases re-dosed
Postoperative prophylaxis	Discontinue prophylactic antibiotics at incisional closure unless a documented therapeutic indication exists.	Guideline-concordant recommendation; systematic review found no additional SSI benefit from routine postoperative continuation when appropriate perioperative prophylaxis was otherwise provided (10,20).	% eligible cases stopped at closure
Skin preparation	Use an alcohol-containing antiseptic unless contraindicated; follow product safety and drying requirements.	Guideline-concordant use of an alcohol-containing preparation. Meta-analytic evidence suggests that chlorhexidine-alcohol may reduce SSI risk compared with aqueous or alcoholic iodine solutions, but formulation, concentration, wound class, and study-level limitations restrict universal formulation-specific conclusions (10,11,17,18).	Protocol adherence
Temperature	Monitor perioperative temperature and avoid hypothermia.	Recommended in contemporary SSI guidance; direct intervention evidence is less extensive than for antimicrobial prophylaxis and skin antisepsis (10,11).	% cases meeting local temperature process target
Asepsis / hand hygiene	Maintain sterile technique and hand-hygiene standards; minimise avoidable breaks in asepsis.	Core IPC standard. Direct SSI evidence varies by the individual environmental or behavioural measure; these measures should not be interpreted as having equivalent procedure-specific evidence (10,11,24).	Observed compliance/ event review
Post-discharge surveillance	Provide warning signs and a defined review route; complete procedure-appropriate case finding.	Important for valid SSI ascertainment. Evidence supports detection beyond discharge, whereas the optimal method and intensity of follow-up remain context dependent (1-4).	% eligible cases with follow-up
Bundle reliability	Measure all-or-none completion of locally selected core elements.	Implementation evidence is supportive but heterogeneous. Benefit appears to depend on evidence-based component selection and reliable delivery rather than simply on the number of bundle elements (21).	% cases with all core elements

Evidence interpretations summarise the certainty and limitations reported in the cited guidelines and evidence syntheses; they do not constitute de novo GRADE ratings. Local policy should specify the exact agent, dose, timing, re-dosing interval, and eligibility criteria for each procedure group.

surveillance findings easier to discuss and act upon. Organisational culture should, however, be treated as a contextual determinant and should not be inferred as the cause of low reported infection rates without supporting data. Leadership support is most useful when it protects time for multidisciplinary review, ensures access to IPC expertise, and links feedback to feasible corrective actions (16,24).

Digital Surveillance, Rapid Diagnostics, and Artificial Intelligence

Digital surveillance can combine microbiology, antimicrobial prescribing, procedure codes, readmissions, imaging, and clinical documentation to prioritise records for review. Rapid organism identification and resistance testing may shorten time to targeted therapy when linked to stewardship workflows, but the clinical value of rapid diagnostics appears greatest when results are linked to stewardship review or direct communication with prescribers (25-28).

AI-based surveillance remains an adjunct to infection-prevention review; evidence for replacing human case validation is not established. A 2025 systematic review and meta-analysis of 249 studies reported pooled sensitivity of 0.835 and specificity of 0.899 for AI-based HAI surveillance, but only 30 studies deployed a user-facing tool and only nine tested systems in routine clinical practice; fewer than 8% explicitly evaluated outcomes such as workload, costs, or patient benefit (27). For SSI surveillance, local validation is particularly important because documentation practices, procedure mix, coding, and post-discharge data vary between hospitals. Models should therefore be assessed for calibration, false-negative cases, data drift, interpretability, and workflow impact, with human adjudication retained for final case classification. In resource-constrained settings, simpler rule-based automation may be more sustainable than complex machine-learning systems if performance is comparable. Pooled diagnostic accuracy should not be interpreted as evidence of improved clinical outcomes or reduced surveillance workload. Most published systems have not been evaluated prospectively in routine workflows, so current evidence supports AI primarily as a case-finding aid rather than as an independently validated surveillance strategy (28).

Limitations

This review retains the limitations of a structured narrative synthesis. The search was targeted rather than exhaustive and study selection was not duplicated. An independent study-by-study risk-of-bias assessment was not performed across all primary studies; instead, evidence was critically appraised according to design, directness, consistency, and the quality or certainty assessments reported by source guidelines and systematic reviews where available. This approach is not equivalent to a formal systematic-review appraisal, and the evidence interpretations presented here should not be regarded as de novo GRADE ratings. The literature spans different operations, definitions, healthcare systems, and implementation designs, so findings from one surgical population may not transfer directly to another. The source-selection figure is schematic because search records were not prospectively logged. The proposed dashboard and bundle are implementation tools derived from current guidance and evidence syntheses, not externally validated scoring systems, and should be adapted to local procedure mix, microbiology, staffing, and surveillance capacity.

Conclusions

Reducing HAIs in general surgery requires reliable measurement and dependable execution of a small number of evidence-supported practices. For SSI, the priorities are standardised case definitions, post-discharge case finding, procedure-specific denominators, appropriate antimicrobial prophylaxis, alcohol-containing skin antisepsis, avoidance of perioperative hypothermia, aseptic practice, stewardship, and timely review of suspected infection. Audit should focus on measures that teams can change and should be coupled with feedback that leads to a defined action.

The same framework can be scaled to local resources. Basic surveillance and high-yield perioperative processes should precede complex technological solutions. Digital tools and AI may improve efficiency, but their value depends on local validation, integration into clinical workflows, and evidence that they improve surveillance quality or resource use without missing clinically important infections. Surveillance should provide reliable enough data to guide clinical and organisational action without placing an unrealistic burden on local teams.

Conflicts of Interest

The authors declared no potential conflicts of interest.

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