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Implementation of surgical site infection prophylaxis in children — a cross-sectional prospective study

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SUMMARY

Background: Surgical site infections (SSIs) are a common cause of morbidity and mortality in both adults and children. In paediatric surgery, evidence on specific prevention measures is lacking, and practices mainly depend on local guidelines and the preferences of the treating team.

Aim: To investigate current practices for children undergoing surgery with respect to SSI prevention using a standardized surveillance tool.

Methods: Nine Swiss paediatric surgery centres participated in a standard period prevalence study. SSI prevention measures were recorded in these hospitals over 7 consecutive

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days in October 2022 for any paediatric surgical procedure resulting in a surgical wound. The SSI prevention measures of interest were drawn from the most recent World Health Organization guidelines.

Findings: In total, 351 procedures were included. All Swiss language regions were represented. Traumatologic/orthopaedic surgeries were most common. Surgical antibiotic prophylaxis was administered in 161/351 (46%) cases, although in 33/161 (21%) cases, there was no indication for the administration of antibiotics. Alcohol-based or iodine-based solutions were most often used for surgical skin preparation. Antimicrobial-coated sutures were only used in 84/351 (24%) cases. Regional differences in prevention measures were noted between participating centres for skin preparation solution, suture material, wound dressing, and implementation of warming devices.

Conclusion: This study provides an overview of current SSI prevention practices in Swiss paediatric surgery centres, identifies targets for improvement, and highlights areas of clinical uncertainty requiring further investigation. The findings underscore the need for standardized guidelines to ensure consistent and evidence-based SSI prevention strategies in paediatric surgery.

Introduction

Surgical site infections (SSIs) are among the most common adverse events after surgical procedures. Largely preventable, SSIs pose a considerable burden for patients and healthcare systems alike by substantially increasing mortality, morbidity, re-admission and re-operation rates, duration of hospitalization and antibiotic treatment [1—4]. Infection prevention and control (IPC) programmes — consisting of intervention bundles, implementation monitoring and SSI surveillance — have been shown to be effective in reducing SSI rates [5—12]. Based on a systematic review, the World Health Organization (WHO) published comprehensive guidelines on the implementation of perioperative measures to prevent SSIs in 2016 [13]. The underpinning detailed summary of the relevant literature pertains largely to studies conducted in adult patients, with very limited robust evidence on appropriate prevention measures for children, despite potentially different SSI risks relating to age, duration and type of surgical procedure, and paediatric comorbidities [14,15]. A direct transfer of knowledge from adult surgery is further limited by considerable differences in physiology and wound healing [16,17]. Consequently, WHO guidance on SSI prevention measures in paediatric surgery is limited, and implemented measures are largely driven by local recommendations or the preferences of the treating team.

The objective of this study was to assess current SSI prevention measures in paediatric surgery across a network of Swiss hospitals using a standardized surveillance method. SSI prevention measures of interest were derived from WHO guidance.

Methods

Study design and data collection

SSI prevention measures were assessed within the Swiss paediatric clinical research network, SwissPedNet [18]. All university hospital paediatric surgical services and four additional acute paediatric surgical departments participated in a prospective period prevalence survey (PPS). The survey was based on the European Centre for Disease Prevention and Control's hospital-acquired infection point prevalence survey [19]. To capture a relevant and representative sample of emergency, urgent and elective paediatric surgical procedures, the PPS was conducted in each site over a period of 7 consecutive days in October 2022.

During the 7-day survey period, participating sites screened all surgical procedures performed in children aged ≤16 years. Any surgical procedure resulting in a surgical wound was considered relevant. Interventions such as surgical debridements or dressing changes, and interventions primarily involving oral mucosal surfaces or eyes were excluded.

Regarding SSI prevention measures of interest, these were drawn from the most recent WHO recommendations. The complete WHO SSI prevention guidelines were reviewed, and each recommendation was categorized as follows (Table I):

- recommendation relates to pre-operative period or to non-patient-related measures (e.g. surgical team);
- recommendation applicable to paediatrics and based on evidence generated within the paediatric population, or recommendation extended to paediatrics but no evidence from the paediatric population available;
- extension of recommendation to paediatrics not discussed, and no evidence from the paediatric population available; and
- recommendation considered not applicable to paediatrics by WHO due to lack of evidence, or guidance specifically states against extension to paediatrics.

Next, the authors considered which measures would be identifiable from routine anaesthesiologic and surgical documentation at the time of operation.

This resulted in the following data being collected as part of the PPS:

- patient-level data: demographics, type of surgery, American Society of Anesthesiologists' (ASA) score;
- perioperative preventive measures: perioperative choice and timing of antibiotic prophylaxis [prolonged or inappropriate administration of surgical antibiotic prophylaxis

Table I
Selected surgical site infection prevention methods

	Measure	Recommendation strength	Paediatric data	Extended to include paediatric surgery	Included in PPS
Preoperative	Preoperative bathing with plain or antimicrobial soap	Conditional	None	Yes, considering manufacturer's guidance	No
	Nasal mupirocin ± CHG washing for *Staphylococcus aureus* carriers	Strong (cardiothoracic and orthopaedic), conditional (rest)	None	No	No
	Avoid hair removal or use clipper	Strong	None	Yes	No
	Mechanical bowel prep with preoperative antibiotics for colorectal surgery	Conditional	None	No	No
	Improve nutritional status in underweight patients undergoing major survey	Conditional	None	No	No
	Avoid discontinuation of immunosuppressive medication prior to surgery	Conditional	Not discussed	Not discussed	No
	Surgical hand preparation with antimicrobial soap and water or ABHR	Strong	N/A	N/A	No
	SAP within 120 min before incision	Strong	None	Yes	Yes
Intraoperative	Use alcohol-based CHG-containing solutions for surgical site preparation	Strong	None	No	Yes
	Aim for 80% FiO_2 in patients undergoing GA with endotracheal intubation during procedure and for 2–6 h afterwards	Strong	None	No	No
	Apply intensive perioperative blood glucose control	Conditional	None	No	No
	Use goal-directed fluid therapy intraoperatively	Conditional	None	No	No
	Use warming devices to maintain normothermia	Conditional	None	Yes	Yes
	Consider use of wound protector devices in certain situations	Conditional	None	No	Yes
	Consider use of irrigation of incisional wounds with PVP-I	Conditional	None	No	Yes
	Consider prophylactic negative pressure wound therapy in high-risk wounds	Conditional	None	No	Yes
	Use triclosan-coated sutures	Conditional	Single study	Yes, considering manufacturer's guidance	Yes
	Avoid use of antimicrobial sealants after surgical site preparation	Conditional	Single study	Yes	Yes
	Avoid use of advanced dressing on primarily closed surgical wounds	Conditional	None	Yes	Yes
	Avoid antibiotic incisional wound irrigation	Conditional	Not discussed	Not discussed	Yes
	Use sterile disposable or reusable drapes and surgical gowns	Conditional	Not discussed	Not discussed	No
	Avoid use of plastic adhesive incise drapes	Conditional	Not discussed	Not discussed	No
	Avoid use of laminar airflow in patients undergoing total arthroplasty	Conditional	Not discussed	Not discussed	No
Postoperative	Avoid prolongation of SAP after completion of the operation	Strong	Not discussed	Not discussed	Yes
	Avoid continuation of SAP in presence of wound drain	Conditional	None	Yes	Yes

ABHR, alcohol-based hand rub; CHG, chlorhexidine gluconate; FiO_2, fraction of inspired oxygen; GA, general anaesthesia; N/A, not applicable; PVP-I, povidone iodine; SAP, surgical antimicrobial prophylaxis; PPS, period prevalence survey.

(SAP) was defined by degree of contamination and deviation from local SAP guidelines, if such existed], type of antiseptic agent for surgical skin preparation, use of sealants after surgical skin preparation; and

- intraoperative preventive measures: episodes of hypoxia and hypothermia, hypoglycaemia and transfusion of blood products; use of wound protection systems (protective film/drape, specimen bag), wound irrigation, use of

antimicrobial-coated suture material, placements of drains, use of vacuum therapy after wound closure, and use of antimicrobial wound dressings.

The data collection form was piloted prior to the PPS in one of the participating centres to ensure its suitability. Note that pre-operative measures not typically instituted immediately prior to surgery (e.g. *Staphylococcus aureus* decolonization measures), as well as measures rarely applicable in the paediatric population (e.g. hair removal), were not collected.

Statistical analysis

The authors were primarily interested in the extent of application of recommended SSI prevention measures and variability among participating centres. Descriptive statistics were calculated and graphical presentation of the data was achieved using Excel (Microsoft, Redwood, WA, USA) and R Version 4.2.1 (R Development Core Team, Vienna, Austria). Normally distributed continuous data are presented as mean and standard deviation. All non-parametric data are reported as median and interquartile range.

Results

In total, 366 surgical cases were surveyed in the nine participating centres, and 351 were included in the analysis (15 were excluded as the patients were aged >16 years).

Hospital data

All Swiss language regions (German *N*=6, French *N*=2, Italian *N*=1) were represented among the participating centres. Both university (*N*=5/9) and cantonal (district level) (*N*=4/9) hospitals participated. Only three of the nine centres had an established local general SSI surveillance programme (*N*=3); however, all centres participated in mandatory national post-appendectomy SSI surveillance.

Patient data and surgery characteristics

Patients were predominately school-aged (6–15 years, 52%, *N*=183/351), followed by pre-schoolers (3–6 years, 18%, *N*=63/351), toddlers (1–3 years, 11%, *N*=39/351), infants (<1 year, 11%, *N*=38) and young adults (>15 years, 8%, *N*=28/351). The majority of patients were male (65%, *N*=229/351). Generally, patients were attributed a low ASA score (ASA I, 60%, *N*=211/351).

Among the included surgical cases, traumatologic/orthopaedic (34%, *N*=118/351), urologic (18%, *N*=63/351) and abdominal (16%, *N*=57/351) surgeries, as well as interventions including the skin or soft tissue (15%, *N*=54/351), were most common (Table II). In the supplementary data in Table S2, the remaining types of surgery are listed. Surgical sites were predominately classified as clean (73%, *N*=255/351) or clean-contaminated (15%, *N*=52/351). Approximately one-quarter of the procedures were classified as emergency surgeries (26%, *N*=90/351). Implants or foreign materials were placed in 24% of cases (*N*=85/351).

Prevention measures

Surgical antibiotic prophylaxis

SAP was administered in 46% (*N*=161/351) of all cases. Cases where SAP was given were either clean-contaminated, contaminated or infected (*N*=60/161), or implants were used (*N*=68/161). In one of every five cases that received SAP (21%, *N*=33/161), the reason for the antibiotic administration remained unclear. When the wound was classified as clean, antibiotic prophylaxis was used in 40% (*N*=101/255) of cases, in many instances due to placement of implants (63%, *N*=64/101). The most common type of procedure in this group involved the musculoskeletal system. In contaminated wounds (class II–IV, clean-contaminated, contaminated or dirty/infected), SAP was given in 63% (*N*=60/95) of cases, with 10% (*N*=9/95) already under antibiotic therapy at the time of surgery (Supplementary Table S5). Of note, clean-contaminated surgeries that did not

Table II
Perioperative and intraoperative surgical site infection prevention measures by type of surgery

	Overall *N*=351	Intestinal tract *N*=57	Genitourinary tract *N*=63	Musculoskeletal *N*=118	Skin *N*=54	Rest *N*=59
Surgical antibiotic prophylaxis used						
No	176 (50%)	19 (33%)	48 (76%)	49 (42%)	39 (72%)	21 (36%)
Yes	161 (46%)	34 (60%)	14 (22%)	68 (58%)	12 (22%)	33 (56%)
Patient already under antibiotic therapy	14 (4.0%)	4 (7.0%)	1 (1.6%)	1 (0.8%)	3 (5.6%)	5 (8.5%)
Surgical skin preparation agent						
Alcohol-based	113 (32%)	20 (35%)	16 (25%)	49 (42%)	20 (37%)	8 (14%)
Iodine-based	106 (30%)	18 (32%)	30 (48%)	29 (25%)	9 (17%)	20 (34%)
Octenidine-based	35 (10.0%)	1 (1.8%)	7 (11%)	5 (4.2%)	13 (24%)	9 (15%)
Chlorhexidine-based	2 (0.6%)	0 (0%)	0 (0%)	1 (0.8%)	0 (0%)	1 (1.7%)
No skin disinfectant solution	7 (2.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	7 (12%)
Unknown	88 (25%)	18 (32%)	10 (16%)	34 (29%)	12 (22%)	14 (24%)
Suture material						
Antimicrobial-coated sutures	84 (24%)	14 (25%)	19 (30%)	23 (19%)	10 (19%)	18 (31%)
No suture material used	22 (6.3%)	1 (1.8%)	2 (3.2%)	6 (5.1%)	8 (15%)	5 (8.5%)
Non-coated sutures	225 (64%)	40 (70%)	42 (67%)	77 (65%)	35 (65%)	31 (53%)
Unknown	20 (5.7%)	2 (3.5%)	0 (0%)	12 (10%)	1 (1.9%)	5 (8.5%)

Data are *N* (%).

receive any SAP (*N*=21) were most often performed on the urinary tract or sexual organs (38%, *N*=8/21); ear, nose, mouth or pharynx (6%, *N*=29/21); or intestinal tract (19%, *N*=4/21). Implants were placed in 14% (*N*=3/21) of these cases.

In 93% (*N*=135/161) of cases, patients received one antibiotic agent as surgical prophylaxis. In 7% (*N*=26/351) of cases, more than one antibiotic agent was administered as surgical prophylaxis. The antibiotic agents administered most commonly as single SAP (*N*=135) were cefazolin (40%, *N*=54/135), cefuroxime (32%, *N*=43/135) and amoxicillin/clavulanic acid (17%, *N*=23/135). Other antibiotic agents administered as single SAP were co-trimoxazole, amoxicillin, fusidic acid, piperacillin/tazobactam and tobramycin (*N*=15/135). When more than one antibiotic agent was administered as SAP (*N*=26), the most common combinations were cefuroxim and metronidazole (*N*=16/26) and ceftriaxone and metronidazole (*N*=7/26) (Supplementary Table S6).

In 9% (*N*=15/161) of patients receiving SAP, the timing was incorrect according to WHO recommendations for the prophylaxis of SSIs, with 7% (*N*=11/161) administered after incision and 3% (*N*=4/161) administered more than 120 min prior to incision. In 25% (*N*=40/161) of patients receiving SAP, antibiotics were continued for >24 h postoperatively. In approximately half of the cases (40%, *N*=16/40), this was indicated due to suspected infection or dirty wound. However, in the remaining 24 cases (60%, *N*=24/40), no clear reason for antibiotic prolongation for >24 h postoperatively was given. Further analysis of these 24 patients showed that 33% (*N*=8/24) had clean wounds, 46% (*N*=11/24) had clean-contaminated wounds, and 21% (*N*=5/24) had contaminated wounds. Furthermore, implants were placed in 21% (*N*=5/24) of these 24 patients. Analysis of the cases with prolonged SAP by type of surgery resulted in 29% (*N*=7/24) of cases having interventions involving the urinary tract or sexual organs; 25% (*N*=6/24) having interventions involving the ear, nose, mouth or pharynx; and only three cases having interventions involving the intestinal tract or cardiovascular system (13%, *N*=3/24 for each).

Skin preparation and protection

Alcohol-based (e.g. Softasept) or iodine-based (e.g. Betadine) solutions were used in most surgical cases for surgical skin preparation (alcohol 32%, *N*=113/351; iodine 30%, *N*=106/351). In 10% (*N*=35/351) of cases, octenidine-based solutions were used (e.g. Octeniderm/Octenisept). Chlorhexidine (CHG)-containing solutions were only applied in a minority of cases (e.g. Chloraprep, 1%, *N*=2/351). Stratified by type of surgery, alcohol-based and iodine-based solutions were applied evenly among different procedures, whereas octenidine was mainly used in surgeries involving the skin (24%, *N*=13/54) (Table II). Among the surveyed procedures, 22 were performed on neonates (0–3 months old). In this group, an iodine-based solution was used in 46% (*N*=10/22) of cases, an alcohol-based solution was used in 23% (*N*=5/22) of cases, and either octenidine or CHG was used in 5% (*N*=1/22 each) of cases.

In a notable number of cases, the type of skin preparation was not documented (25%, *N*=88/351). Overall, wound protection devices (e.g. protective film/drape, specimen bag) were rarely used (*N*=9/351, 3%).

Wound management and skin closure

Wound irrigation was documented in 25% of cases (*N*=89/351) and was mainly performed with normal saline-based solutions (53%, *N*=47/89). For wound closure, non-coated sutures were recorded in the majority of cases (64%, *N*=225/351) independent of degree of contamination or type of surgery (Table II). Drains were placed in 7% (*N*=25/351) of cases. Advanced dressings on primarily closed wounds were applied in 45% (*N*=157/351) of cases.

General patient management

Blood product transfusion was noted in only 5% (*N*=16/351) of cases. Episodes of hypoxia (SpO_2 <85 %) were documented in only 2% (*N*=7/351) of cases, and no cases of hypoglycaemia (blood glucose <2.5 mmol/l) were recorded. Despite the reported use of warming devices (e.g. forced air-warming covers) in 48% (*N*=152/351) of all cases, hypothermia (core body temperature <36.0 °C) was still recorded in 10% (*N*=34/351) of all procedures.

Regional differences in prevention implementation

Differences in prevention measures implemented were noted between participating centres for surgical skin preparation agent, type of suture material, type of wound dressing used, and implementation of warming devices (Table III).

Discussion

In this cross-sectional prevalence survey, paediatric surgical cases were systematically identified and analysed to assess current practices in SSI prevention measures. Overall, the study demonstrated adequate adherence to local and WHO guidelines for SSI prevention for certain measures, such as SAP, maintenance of normothermia and application of warming devices, avoidance of hypoxic episodes, and placement of drains. On the other hand, some areas of unexplained variability in paediatric SSI prevention, despite available WHO guidance, were identified by the survey, such as choice of antiseptic solution for surgical skin preparation and use of coated sutures for wound closure.

In contrast to the WHO guidelines [13], CHG was only used in a minority of cases for surgical skin preparation, reflecting possible concerns for side effects in the paediatric population, such as local or systemic toxicity, mainly described in infants and neonates [20]. The most commonly applied antiseptic solutions in this population were alcohol, iodine and octenidine. Their use was mainly dependent on the type of surgical procedure and procedure-related characteristics. Colourless antiseptic solutions (octenidine-based solutions) and well-tolerated antiseptics that are effective in the case of mucous membrane involvement (octenidine and iodine-based solutions) were applied preferentially in cases involving the skin and genitourinary tract, respectively. Uncertainty about the optimal choice of antiseptic solutions is also reflected in the neonatal subgroup, where evidence of safety profiles of different antiseptic solutions in use is still equivocal [21–24].

While there is limited evidence regarding the optimal choice of antiseptic solutions in children, demonstrating the need for more studies on the efficacy and safety of antiseptic solutions in children, the use of antimicrobial-coated suture materials has been investigated in paediatric populations. A randomized controlled trial by Renko *et al.* demonstrated a significant reduction in SSIs with antimicrobial-coated sutures [25]. Despite these findings and recommendations from WHO [13], the present survey revealed that antimicrobial-coated sutures

Table III
Perioperative and intraoperative surgical site infection prevention measures by centre

	Overall N=351	Centre 1 N=24	Centre 2 N=42	Centre 3 N=25	Centre 4 N=38	Centre 5 N=42	Centre 6 N=35	Centre 7 N=42	Centre 8 N=37	Cantre 9 N=66
Surgical skin preparation agent										
Alcohol-based	113 (32%)	0 (0%)	35 (83%)	9 (36%)	0 (0%)	0 (0%)	0 (0%)	41 (98%)	28 (76%)	0 (0%)
Iodine-based	106 (30%)	24 (100%)	3 (7.1%)	9 (36%)	16 (42%)	4 (9.5%)	5 (14%)	1 (2.4%)	1 (2.7%)	43 (65%)
Octenidine-based	35 (10.0%)	0 (0%)	4 (9.5%)	1 (4.0%)	2 (5.3%)	1 (2.4%)	0 (0%)	0 (0%)	8 (22%)	19 (29%)
Chlorhexidine-based	2 (0.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (4.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
No skin disinfectant solution	7 (2.0%)	0 (0%)	0 (0%)	6 (24%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.5%)
Unknown	88 (25%)	0 (0%)	0 (0%)	0 (0%)	20 (53%)	35 (83%)	30 (86%)	0 (0%)	0 (0%)	3 (4.5%)
Suture material										
Antimicrobial-coated sutures	84 (24%)	0 (0%)	25 (60%)	18 (72%)	0 (0%)	0 (0%)	4 (11%)	0 (0%)	0 (0%)	37 (56%)
No suture material used	22 (6.3%)	2 (8.3%)	1 (2.4%)	4 (16%)	2 (5.3%)	2 (4.8%)	1 (2.9%)	1 (2.4%)	1 (2.7%)	8 (12%)
Non-coated sutures	225 (64%)	19 (79%)	16 (38%)	2 (8.0%)	36 (95%)	26 (62%)	29 (83%)	40 (95%)	36 (97%)	21 (32%)
Unknown	20 (5.7%)	3 (13%)	0 (0%)	1 (4.0%)	0 (0%)	14 (33%)	1 (2.9%)	1 (2.4%)	0 (0%)	0 (0%)
Advanced wound dressing										
None	192 (55%)	4 (17%)	33 (79%)	25 (100%)	1 (2.8%)	32 (76%)	30 (86%)	6 (14%)	31 (84%)	30 (45%)
Hydrocolloid, hydrogels or vapour-permeable films	136 (39%)	19 (79%)	6 (14%)	0 (0%)	34 (94%)	10 (24%)	4 (11%)	34 (81%)	6 (16%)	23 (35%)
Negative pressure wound dressing	4 (1.1%)	1 (4.2%)	0 (0%)	0 (0%)	1 (2.8%)	0 (0%)	1 (2.9%)	0 (0%)	0 (0%)	1 (1.5%)
Silver-impregnated wound dressing	17 (4.9%)	0 (0%)	3 (7.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (4.8%)	0 (0%)	12 (18%)
Missing	2	0	0	0	2	0	0	0	0	0
Warming device										
No	168 (53%)	23 (96%)	4 (9.5%)	21 (84%)	38 (100%)	40 (95%)	0 (0%)	2 (4.8%)	37 (100%)	3 (4.6%)
Yes	152 (48%)	1 (4.2%)	38 (90%)	4 (16%)	0 (0%)	2 (4.8%)	5 (100%)	40 (95%)	0 (0%)	62 (95%)
Missing	31	0	0	0	0	0	30	0	0	1

Data are *N* (%).

are used in <25% of cases in Switzerland, indicating that they are not yet considered the standard of care for SSI prevention in children.

However, a follow-up survey conducted among the participating centres after completion of the point prevalence study showed that six of the nine centres do, in fact, use antimicrobial-coated sutures routinely. The challenge is, however, that this practice is not always documented in the medical billing systems or surgical reports, making it difficult to extract reliable data from electronic health records. Additionally, only two centres indicated that they do not routinely use antimicrobial-coated sutures for SSI prevention.

For both antiseptic solutions and use of coated sutures, relevant variability was observed between centres. This was also observed for the use of advanced wound dressings and implementation of warming devices. Overall, variability in SSI prevention interventions among centres underlines the lack of evidence and hence guidelines and/or consensus for the best SSI prevention measures in common paediatric surgical procedures.

Finally, this survey has identified areas for improvement of SSI prevention measures, such as maintenance of intraoperative normothermia or adherence to guidelines for surgical antibiotic prophylaxis. No universal definition of hypothermia exists, but a core body temperature <36 °C has been proposed [13,26,27]. Although warming devices, such as air circulating blankets, are installed routinely in many centres, the present findings show that perioperative hypothermia is a common event in paediatric surgery [28–31].

As seen in this survey, prolonged postoperative administration of antibiotics has been observed frequently in the past [32–37]. Although the survey was not designed to analyse reasons for prolonged antibiotic administration in detail, it is speculated that the degree of contamination and type of surgery in these cases, combined with either the surgeon's preference or uncertainty regarding best practices, were key drivers (Supplementary Table S7). In particular, in clean-contaminated cases involving the urinary tract or sexual organs (e.g. circumcision), ear, nose, mouth, pharynx or intestinal tract (e.g. endoscopic resection of a polyp or appendectomy), or in cases of implants being placed (osteosynthesis or placement of central venous access), implementation of SAP may not be consistent and may vary between centres.The correct choice, timing and duration of SAP is an important target for quality improvement in SSI prevention. Overprescription of antimicrobials is a public health concern, as it tends to promote resistant organisms, drug-associated adverse events and other complications, such as *Clostridioides difficile* infection [32,36].

In summary, this study reveals variations in SSI prevention practices across Swiss paediatric surgery centres, driven by the absence of national guidelines and reliance on local policies or individual practices. Switzerland lacks a dedicated organization, such as the National Institute for Health and Care

Excellence (NICE) in the UK or the Centers for Disease Control and Prevention (CDC) in the USA, to govern surgical guidelines, and there is no national policy specifically for paediatric surgery. While key institutions such as Swissnoso, the Federal Office of Public Health, the Swiss Society for Infectious Diseases, the Swiss Society for Hospital Hygiene, and the Swiss Medical Association provide infection prevention guidance, no standardized framework exists for paediatric surgical settings.

International guidelines offer limited paediatric-specific recommendations. WHO and NICE guidelines provide general guidance in Europe, but NICE only offer a single paediatric-specific measure (antimicrobial sutures) [13,38]. Similarly, the CDC's SSI prevention guidelines in the USA primarily address paediatric considerations through antibiotic dosing adjustments, without comprehensive guidance for paediatric surgical settings [39]. These findings highlight the urgent need for standardized, paediatric-specific SSI prevention guidelines in Switzerland and beyond.

Although this study has highlighted important areas of uncertainty regarding SSI prevention in children, it is limited by incomplete documentation of key interventions. These include details on suture material, use of warming devices, irrigation solutions, types of surgical skin preparation agent, use of specimen bags, and inconsistencies in electronic health systems across centres. Accurate and thorough documentation of these factors is essential for studies such as this, as well as for the surveillance of SSI prevention strategies within IPCs. While a Swiss initiative (SwissPedData) exists to standardize hospital records for paediatric research, perioperative measures are still largely absent from the data collected [40].

Information on the occurrence of SSIs in individual patients was not collected, and therefore conclusions on the effectiveness of individual prevention measures cannot be drawn from this study. Nonetheless, it has demonstrated that multicentre prevalence surveys enable reliable monitorization of current applied practices, while simultaneously representing a feasible method in terms of invested resources.

In conclusion, this prevalence survey provided insight into current SSI prevention practices in Swiss paediatric surgery, and identified key areas for improvement, including better maintenance of normothermia and adherence to SAP guidelines. It also highlighted areas of clinical uncertainty, such as the optimal choice of antiseptic solution for surgical skin preparation, emphasizing the need for paediatric-specific trials. Accurate and comprehensive documentation of interventions is crucial to assess adherence to best practices and improve patient outcomes. To strengthen SSI prevention in paediatric surgery, further studies incorporating SSI monitoring and interventional trials are needed to generate robust evidence. Where evidence exists, clear national and international guidelines tailored to paediatric surgical care are essential to ensure standardized, evidence-based practices.

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Author contributions

CP, CS, CW, JAB, INB, US, CD, RK, GA, MMS, VAP, RG, KPB, RO, NJ, ML, MB, JM, AB and KM coordinated local data collection. CP, CS and INB analysed the data and produced the first draft of the manuscript. All authors critically reviewed and edited the manuscript.

Conflict of interest statement

None declared.

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Ethical approval

The project was submitted to the cantonal ethics committee of the lead institution (Ethikkommission Nordwest-und Zentralschweiz EKNZ, Req-2021-009 63) and was considered not to fall under the Swiss Human Research Act given its quality improvement character. Of note, all patient data were irreversibly anonymized by participating local teams at the point of data entry.

Availability of data and materials

The data capture forms are provided as supplementary material to this manuscript. Surveillance data can be obtained upon request from the corresponding author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhin.2025.03.018.

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