National Center
for Infection Control

Swissnoso Annual Report

Epidemiology of healthcare-associated infections in Switzerland 2022

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Executive summary

Surveillance remains the cornerstone of healthcare-associated infection (HAI) prevention, operating at both the local hospital and the national level. Its primary objective is to detect any alarming trends in HAI rates and to evaluate the effectiveness of preventive interventions in support of the national goal of reducing HAIs (NOSO Strategy). This report provides comprehensive information on the epidemiology of HAIs in 2022, covering a large proportion of the 182 Swiss acute care hospitals.

Of the 13,916 patients from 108 Swiss hospitals included in the 2022 **Swiss Point Prevalence Survey (CH-PPS)**, 826 were diagnosed with at least one HAI, representing a prevalence of 5.9%. The HAI prevalence remained unchanged compared to the results of the 2017 nationwide survey.

Swissnoso, in collaboration with its project partners, is currently supporting two types of **HAI surveillance modules** in Swiss hospitals – one for surgical site infections (SSIs) and another for catheter-associated urinary tract infections (CAUTIs) – while modules for central line-associated bloodstream infections (CLABSIs), ventilator-associated pneumonia (VAP) and non-ventilator-associated hospital-acquired pneumonia (nvHAP) are under development. To enable national HAI surveillance to benefit from the rapid advances occurring in data science, Swissnoso has launched a **digitalisation strategy** synchronised with other national digital health initiatives. The plan is to provide Swiss acute care hospitals with comprehensive infection prevention and control (IPC) software to produce results automatically and in near-real-time for hospital dashboards and send anonymised data to the Swissnoso data centre.

The 12-month **SSI surveillance** period 2020–2021 included 41,956 procedures across 162 Swiss acute care hospitals, with SSI rates varying according to procedure type. Since 2011, SSI incidence has decreased or remained stable for most surgical interventions, but it has increased in rectal surgery and Caesarean section. Swissnoso strongly recommends that Swiss hospitals participate in its **SSI intervention module**, which promotes and monitors adherence to six evidence-based SSI prevention measures. Swissnoso has set specific infection rate goals for selected surgical settings.

In its first year (2022), the Swissnoso **CAUTI surveillance module** included 156,072 patients at 20 hospitals. Altogether, 26,331 patients (16.9%) were catheterised at least once, and the overall CAUTI incidence rate was 1.5 (95% CI: 1.27–1.72) per 1,000 catheter-days. For comparison, the 2021 CAUTI rate across approximately 2,600 US acute care hospitals was 0.9 per 1,000 catheter-days, using the same CAUTI definition. Twelve hospitals provided data on catheter indication, showing that a valid indication was lacking for approximately 14% (1,687) of 11,926 catheter insertions. The Swissnoso **CAUTI intervention module**, which is designed to lower CAUTI rates and improve catheter insertion indications, is still awaiting more buy-in from Swiss hospitals.

In 2022, 19,913 **SARS-CoV-2** infections and 2,419 **influenza infections** were diagnosed at the 19 Swiss acute care hospitals participating in the CH-SUR surveillance network. Among these infections, **18% and 9%, respectively**, were **healthcare-associated**, with a similar distribution of age, comorbidities and sex for both viruses and a reported attributable mortality of 3% for patients with Covid-19 and 1% for patients with influenza. Swissnoso, in collaboration with stakeholder groups, will continue to publish recommendations on IPC and the management of respiratory viruses to mitigate the impact of influenza-like illness in the acute care setting.

The CH-PPS showed that 34% of patients had one or more antibiotics prescribed on the day of the survey, a similar proportion to that seen in the 2017 CH-PPS (33%). In the context of HAIs, careful monitoring of antimicrobial use and resistance continues to be needed in view of the increasing detection of specific carbapenem-resistant Gram-negative bacteria and vancomycin-resistant enterococci, as well as recent detections of *Candida auris* in Swiss hospitals. Swissnoso is working with the Federal Office of Public Health (FOPH) on the establishment of an **outbreak investigation centre** to improve the early detection, management and notification of epidemiologically relevant phenomena.

A **self-assessment** of IPC structures and processes at Swiss hospitals within the CH-PPS 2022 showed an "advanced" level overall, but room for improvement remains with regard to the implementation of multimodal HAI prevention interventions, IPC education and training, and monitoring and feedback of adherence to infection prevention measures. The ***Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals*** issued by Swissnoso and partner organisations provide guidance for IPC leaders, hospital administrations, health authorities and policymakers on closing potential gaps in the organisation of effective IPC.

Significant opportunities for HAI prevention

Swissnoso is planning to:

- **Provide additional semi-automated surveillance and intervention modules.**
- **Establish an outbreak investigation centre to detect, notify and manage outbreaks at the hospital and regional level.**
- **Invest in a digitalisation strategy to leverage the rapid advances expected in data science. Comprehensive IPC software provided to hospitals will automate data collection, thus freeing up staff resources to implement and run HAI prevention programmes.**
- **Expand data analysis across HAI types, so as to increase knowledge of successful prevention strategies.**

Swiss acute care hospitals are expected to:

- **Continue engaging in a goal-oriented reduction of HAI through participating in surveillance and multimodal HAI prevention programs, e.g., in the Swissnoso SSI, CAUTI, and future intervention modules.**

- **Go beyond the *Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals* once they are met.**

- **Foster adequate IPC know-how among staff and provide them with feedback on their adherence to infection prevention measures.**

- **Invest in IT interfaces between hospital databases and national platforms, such as the future IPC software to be developed by Swissnoso.**

Abbreviations

ANRESIS	Swiss Centre for Antibiotic Resistance
ANQ	Swiss National Association for Quality Development in Hospitals and Clinics
BSI	Bloodstream infection
CAUTI	Catheter-associated urinary tract infection
CDC	Centers for Disease Control and Prevention
CH-PPS	Swiss Point Prevalence Survey
CH-SUR	Hospital-based sentinel surveillance
CI	Confidence interval
CLABSI	Central line-associated bloodstream infection
Covid-19	Coronavirus disease 2019
CUR	Catheter utilisation ratio
ECDC	European Centre for Disease Prevention and Control
FOPH	Federal Office of Public Health
ICU	Intensive care unit
IPC	Infection prevention and control
IPCAF	Infection Prevention and Control Assessment Framework
IQR	Interquartile range
HAI	Healthcare-associated infection
HCW	Healthcare worker
MDRO	Multidrug-resistant organism
MRSA	Methicillin-resistant *Staphylococcus aureus*
NHSN	National Healthcare Safety Network (CDC)
NOSO	National Strategy for the Monitoring, Prevention and Control of HAIs
nvHAP	(non-ventilator-associated) Hospital-acquired pneumonia
RT-PCR	Reverse transcription polymerase chain reaction
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SSI	Surgical site infection
StAR	Strategy on Antibiotic Resistance
UTI	Urinary tract infection
VAP	Ventilator-associated pneumonia
VRE	Vancomycin-resistant enterococci
WHO	World Health Organization

Contents

1. Introduction

High-quality national surveillance of healthcare-associated infections (HAIs) aims to detect any alarming trends in HAI rates and to evaluate the effectiveness of preventive interventions. Surveillance thus supports the national goal of reducing HAIs (NOSO Strategy) [1], which has been described as an integral part of patient safety in Switzerland.[1] This report presents the 2022 HAI surveillance results and related information and proposes measures to improve HAI surveillance and infection prevention and control (IPC).

In 2022, Swiss acute care hospitals were still facing the challenges of the Covid-19 pandemic – in particular, a significant shortage of healthcare workers. In consultation with the Federal Office of Public Health (FOPH) and key stakeholders, Swissnoso continued to provide recommendations on IPC measures to help hospitals remain operational while protecting those individuals most at risk. According to the 2022 Swiss Point Prevalence Survey (CH-PPS), the national HAI prevalence was 5.9%, unchanged from the 2017 result. While this does not, per se, indicate any change in HAI prevalence during the Covid-19 pandemic (in contrast to the increase in HAIs reported in other countries [2,3,4]), a potential negative impact of the Covid-19 pandemic on hospital operations may have effectively nullified the effects of preventive efforts.

The CH-PPS 2022 incorporated the WHO Infection Prevention and Control Assessment Framework (IPCAF), a self-assessment tool used to determine the local implementation status of IPC and identify areas requiring improvement. Surgical site infections (SSIs) accounted for nearly a third of all HAIs in the CH-PPS 2022, remaining one of the most important types of HAI in Switzerland. The Swissnoso SSI surveillance results guide prevention efforts, such as the Swissnoso SSI intervention module, which was recently adapted to improve SSI outcomes for certain procedures (by reducing *Staphylococcus aureus* wound infections) and SSI rates following colon surgery. Similarly, results from the national monitoring of catheter-associated urinary tract infections (CAUTIs), launched in 2022, provide critical information for optimising prevention measures.

Surveillance modules for central line-associated bloodstream infections (CLABSIs) and for ventilator-associated (VAP) and non-ventilator-associated hospital-acquired pneumonia (nvHAP) are being developed to support hospitals in monitoring and reducing these HAIs in the coming years. Significant efforts are underway to increase automation of HAI surveillance so as to optimise data accuracy and timeliness for faster, cost-effective and targeted implementation of IPC measures.

[1] The importance of supporting patient safety at the national level was highlighted by Alain Berset, President of the Swiss Confederation, at the Ministerial Summit on Patient Safety held in February 2023: https://www.ihi.org/communities/blogs/if-its-not-safe-its-not-care-notes-from-the-2023-global-ministerial-summit-on-patient-safety

National surveillance is complemented by targeted intervention modules, which play a vital role in preventing SSIs (ongoing), CAUTIs (starting in 2023) and other HAIs, for which additional modules are currently being developed.

Swissnoso, in consultation with the FOPH, continues to coordinate IPC measures for multidrug-resistant organisms (MDROs) and other important pathogens, such as *Candida auris*, in Swiss acute care hospitals. While progress has been made with the implementation of the *Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals* [5], continued efforts are needed at all levels to reduce HAIs and improve patient safety in acute care hospitals.

2. Swissnoso HAI surveillance modules

2.1. Point prevalence survey (CH-PPS 2022)

The Swiss Point Prevalence Survey (CH-PPS) on HAIs and antimicrobial use is part of two national strategies – the strategy for the monitoring, prevention and control of HAIs (NOSO Strategy) [1] and the Strategy on Antibiotic Resistance (StAR) [6]. In 2022, the second CH-PPS was conducted as part of the NOSO Strategy, with financial support provided by the FOPH [7]. To allow benchmarking with other European countries, Swissnoso followed the PPS protocol [8,9] of the European Centre for Disease Prevention and Control (ECDC).

As in the first national CH-PPS in 2017, a large proportion of Swiss acute care hospitals participated. In addition, between 21 and 34 hospitals continued to participate in 2018, 2019 and 2021. Regular point prevalence surveys have become part of routine surveillance activities at many acute care hospitals, as recommended by the *Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals* [5].

Between April and June 2022, despite pandemic-related challenges, 108 Swiss acute care hospitals reported data for 13,916 patients (**Table 1**). Of these hospitals, 76 were small, 24 were medium-sized and 8 were large. The latter group included all 5 general university hospitals and the 2 independent university children's hospitals. This sample represents more than half of all small hospitals and about three quarters of all medium-sized and large hospitals, comprising 76% of the total bed capacity of Swiss acute care hospitals.[2] As regards the type of hospitals, 53 primary care, 36 secondary care, 10 tertiary care and 9 specialised hospitals participated in the survey.

[2] Based on the updated 2017 list of bed capacity in Swiss acute hospitals and the PPS hospital size classification: 148 small hospitals (<200 beds), 32 medium-sized hospitals (200–650 beds) and 7 large hospitals (>650 beds) [7]

Table 1 Characteristics of hospitals participating in the CH-PPS 2022

	No. of hospitals	No. of patients
All	**108**	**13,916**
Small hospitals (<200 beds)	76	4,416
Medium-sized hospitals (200–650 beds)	24	4,857
Large hospitals (>650 beds)	8	4,643
University hospitals	5	3,404
Primary care hospitals	53	3,633
Secondary care hospitals	36	4,794
Tertiary care hospitals	10	4,934
Specialised hospitals [a]	9	555
Public hospitals	63	10,834
Private not-for-profit hospitals	21	1,793
Private for-profit hospitals	24	1,289

[a] Six centres with a predominantly surgical or orthopaedic focus, and one centre each with a geriatric, paediatric or neuro-rehabilitative focus

HAI prevalence

Of the 13,916 patients included in the 2022 CH-PPS, 826 were diagnosed with one or more HAIs, representing an overall HAI prevalence of 5.9% (95% CI: 5.5–6.3%), as shown in **Figure 1.** The Figure also indicates the prevalence of HAIs attributable to the reporting hospital and of HAIs contracted during the current stay at the reporting hospital.

No statistically significant differences in HAI prevalence were observed either for all hospitals participating between 2017 and 2022 (**Figure 2**; N.B. no survey was conducted in 2020 because of the pandemic) or for the 69 hospitals participating in both national surveys (2017 and 2022) (**Figure 3**). HAI prevalence was higher in large, tertiary care and university hospitals than in small, primary care and non-university hospitals, probably due to the differences in case mix and medical/surgical services between these hospital categories (**Figure 4**).

In 2022, SSIs were the most prevalent type of HAI (28.8%), followed by lower respiratory tract (20.0%), urinary tract (16.3%) and bloodstream infections (14.0%), similar to 2017 (data not shown).

Figure 1 HAI prevalence in Switzerland in 2022. *Left*: HAI prevalence in all participating hospitals, regardless of where the infection was acquired; *middle*: prevalence of HAIs attributable to the hospital reporting the HAI; *right*: prevalence of HAIs contracted during the current hospital stay

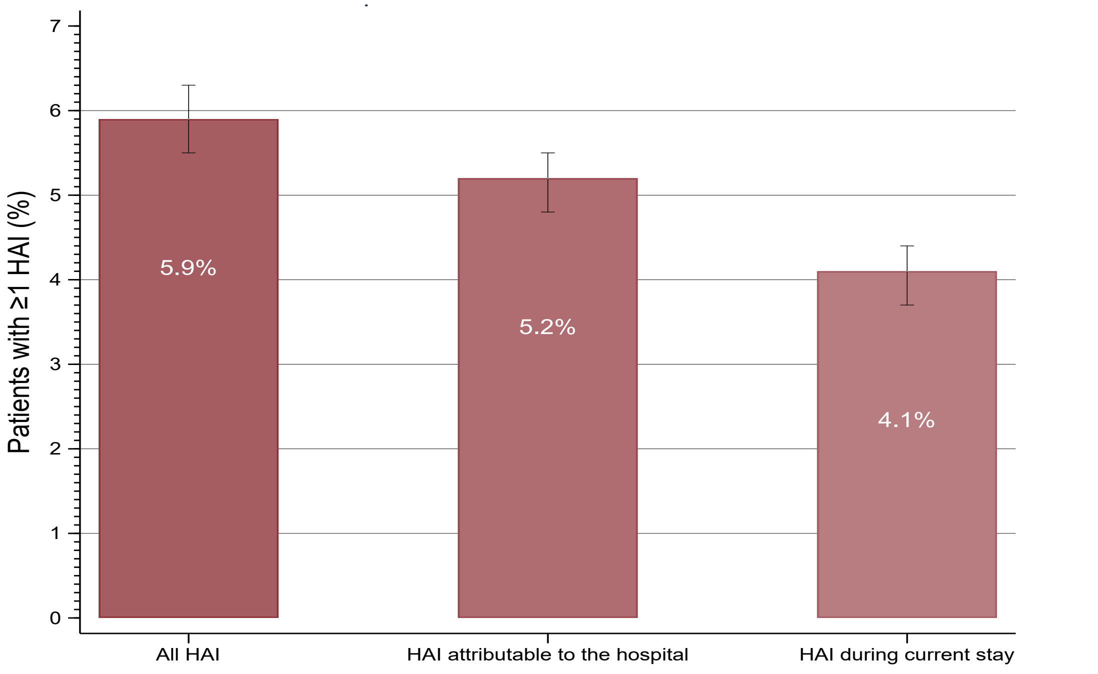


Figure 2 HAI prevalence in all hospitals participating over the period 2017–2022 (i.e. in every year except 2020).

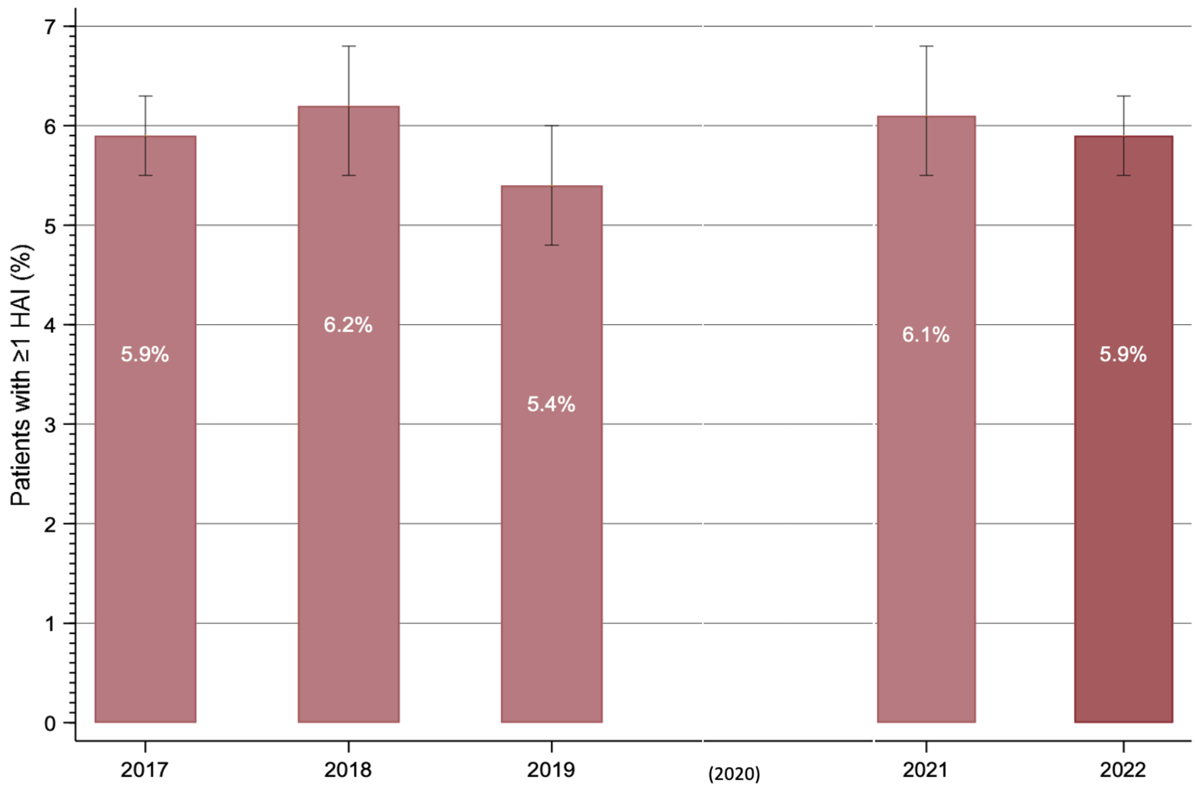


Figure 3 HAI prevalence in hospitals (n=69) participating in both national surveys (*left*: CH-PPS 2017; *right*: CH-PPS 2022)

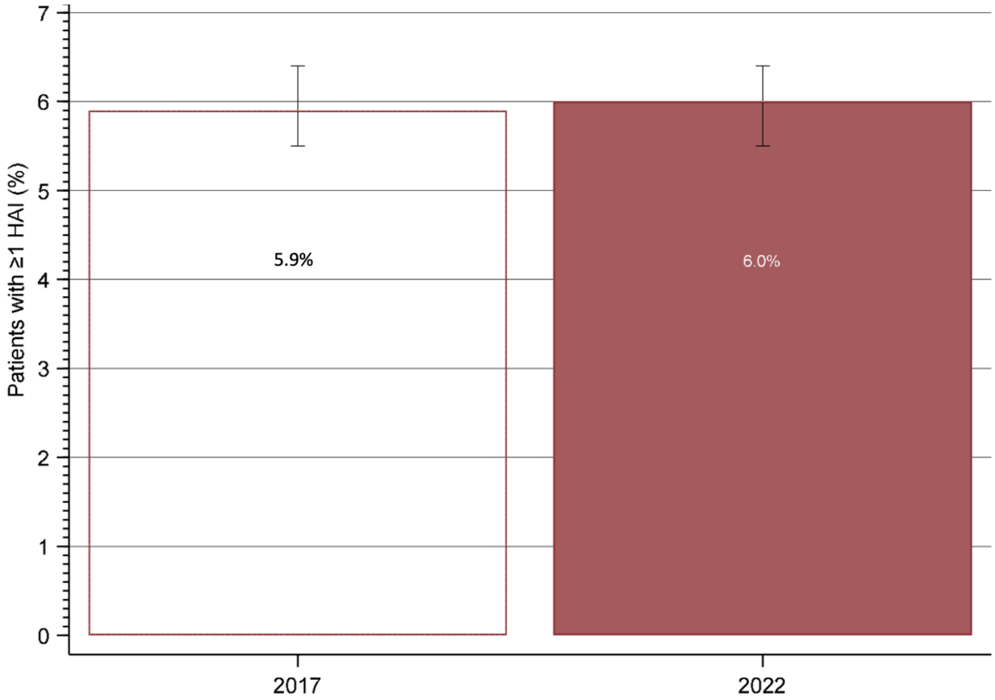
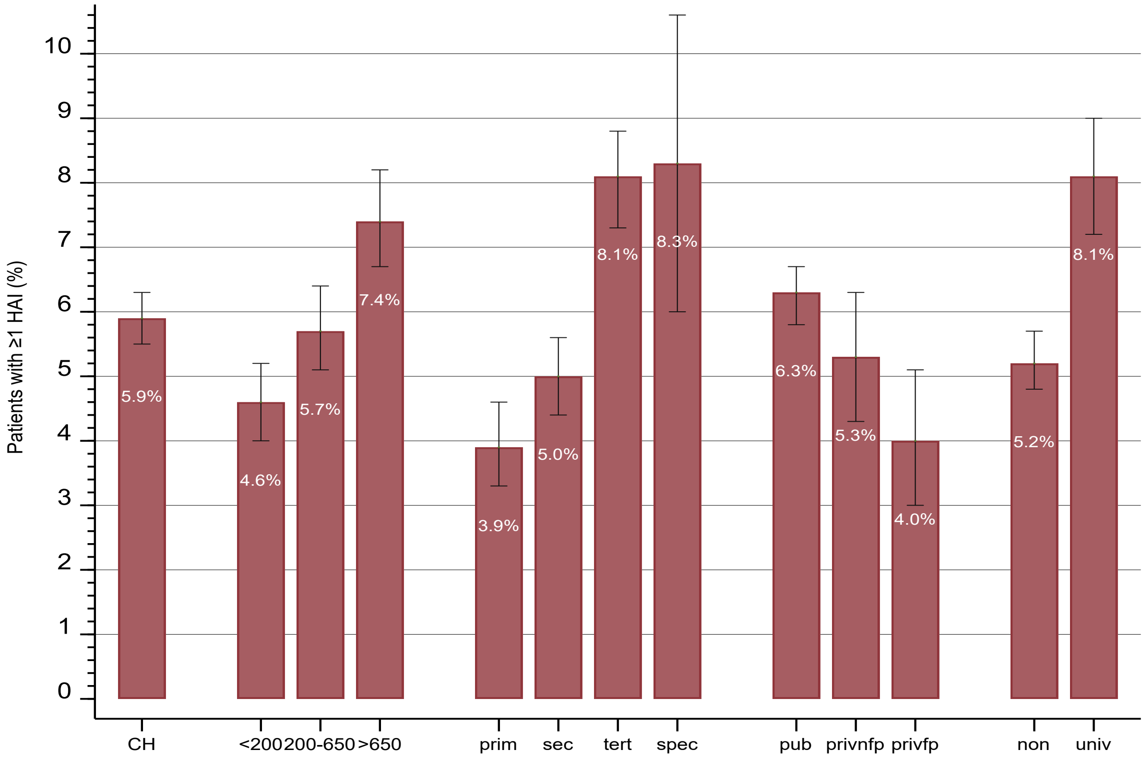


Figure 4 HAI prevalence in CH-PPS 2022, overall (CH) and by hospital size (small: <200 beds; medium-sized: 200–650 beds; large: >650 beds) and type (primary, secondary, tertiary care and specialised hospitals; public, private not-for-profit and for-profit hospitals; non-university and university hospitals).



Prevalence of antimicrobial use

Overall, 34% of patients were prescribed at least one antimicrobial on the day of the survey. The proportion of patients on antimicrobials remained similar over the years for all participating hospitals (**Figure 5**). However, when considering the subset of hospitals (n=10) that participated in all surveys conducted since 2017, antimicrobial use was statistically higher in 2022 than in 2017 (**Figure 6**). Analysis by hospital size (small: <200 beds; medium-sized: 200–650 beds; large: >650 beds) and by hospital type (primary, secondary and tertiary care centres; and specialised, public, private for-profit, private not-for-profit, university and non-university hospitals) did not reveal any differences in antimicrobial use.

Figure 5 Prevalence of antimicrobial use in all participating hospitals from 2017 to 2022

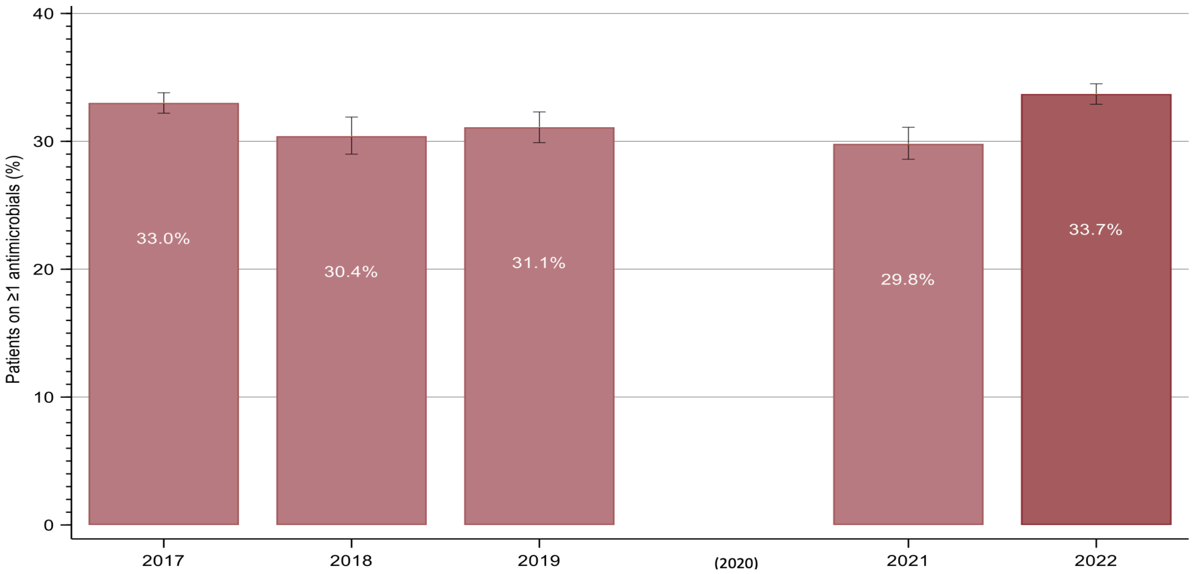
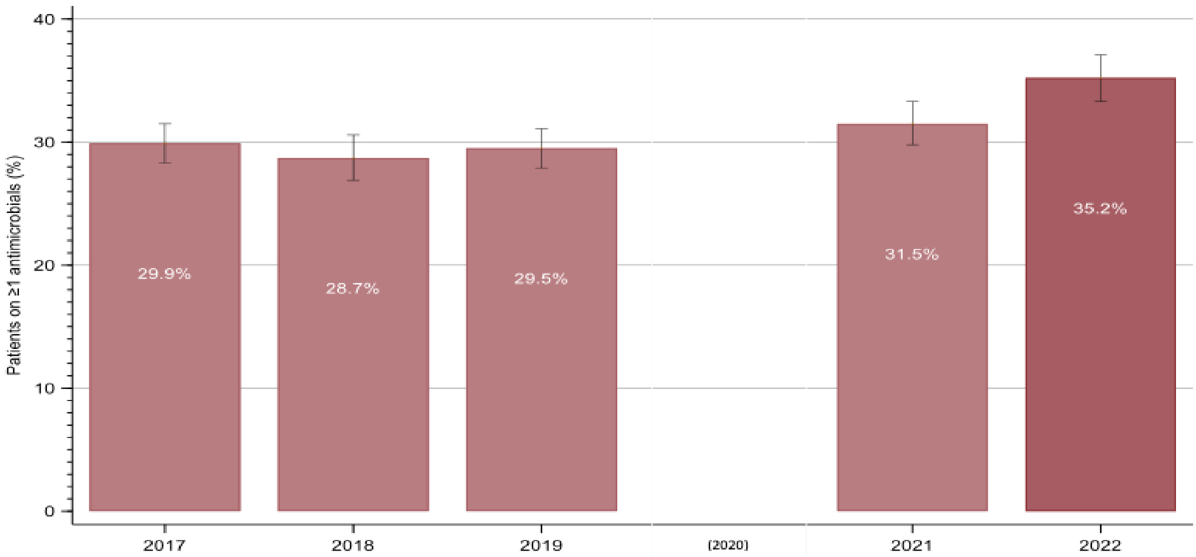


Figure 6 Prevalence of antimicrobial use in the subset of hospitals (n=10) participating in all surveys between 2017 and 2022. Antimicrobial use was statistically higher in 2022 than in 2017 (p<0.001).



Infection Prevention and Control Assessment Framework survey

In connection with the implementation of the *Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals*, hospitals were invited to complete the WHO Infection Prevention and Control Assessment Framework (IPCAF) survey [10]. This involves a self-assessment questionnaire concerning local IPC resources and processes, based on the eight WHO IPC core components (programmes; guidelines; education and training; HAI surveillance; multimodal strategies for implementing IPC activities; monitoring/audit of IPC practices and feedback; workload, staffing and bed occupancy; and built environment, materials and equipment). The tool allows hospitals to evaluate the status of the various IPC components and to identify gaps and areas for improvement. A maximum score of 100 can be achieved in each of the eight core component sections (i.e. 800 for the entire survey). The overall score is stratified into four groups: inadequate (0–200), basic (201–400), intermediate (401–600) and advanced (601–800).

The median IPCAF score for all hospitals was 626 (IQR 579–679), corresponding to an advanced level. Of the 84 participating hospitals or hospital networks, 29 (34.5%) were at an intermediate level, with a median score of 548 (IQR 490–580). All the other hospitals were at an advanced level, with a median score of 663 (IQR 628–688) (**Figure 7**). With the exception of scores on environment and materials (no difference between intermediate- and advanced-level hospitals), intermediate-level hospitals had consistently lower scores across all core components, particularly in surveillance and multimodal strategies (**Figure 8)**.

Figure 7 Overall median IPCAF score (and IQR) by hospital IPC level.

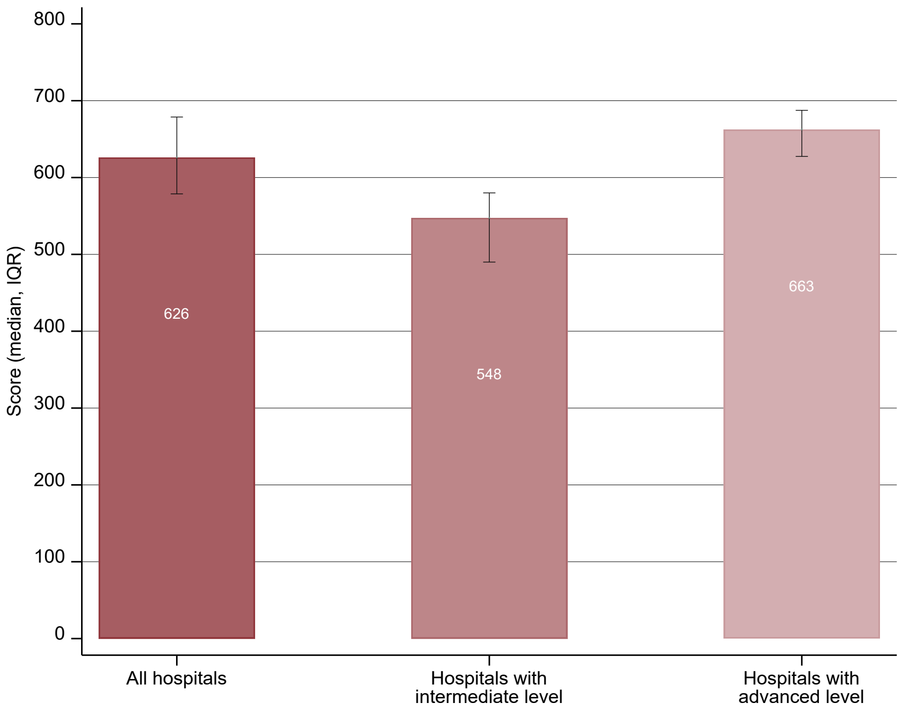
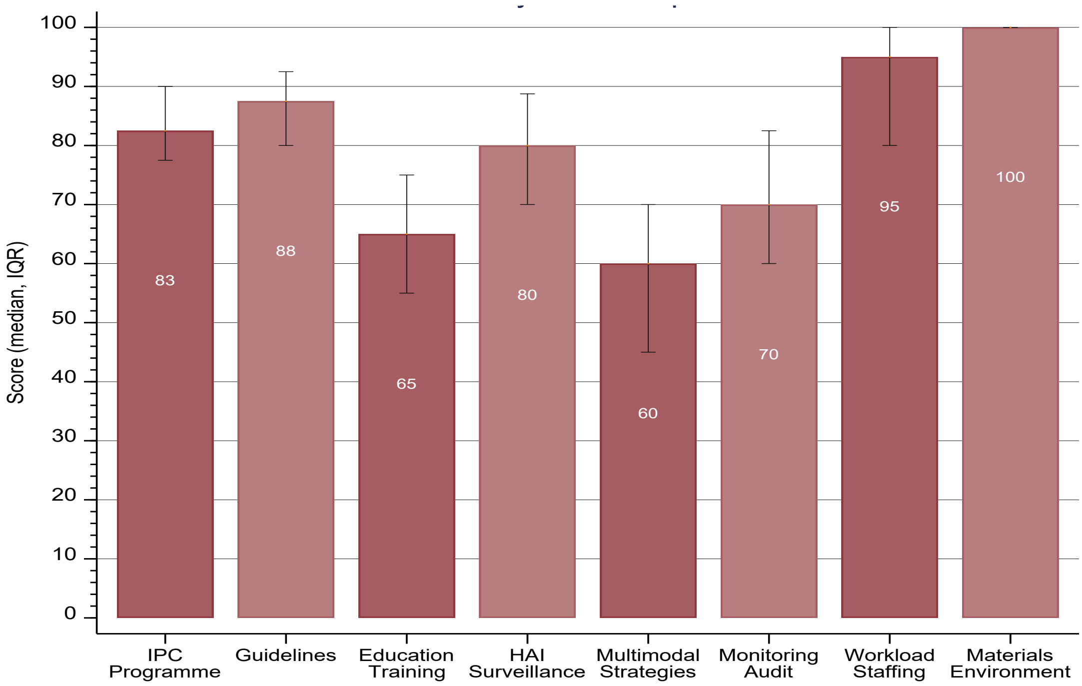


Figure 8 Overall median IPCAF score (and IQR) by WHO IPC core component.

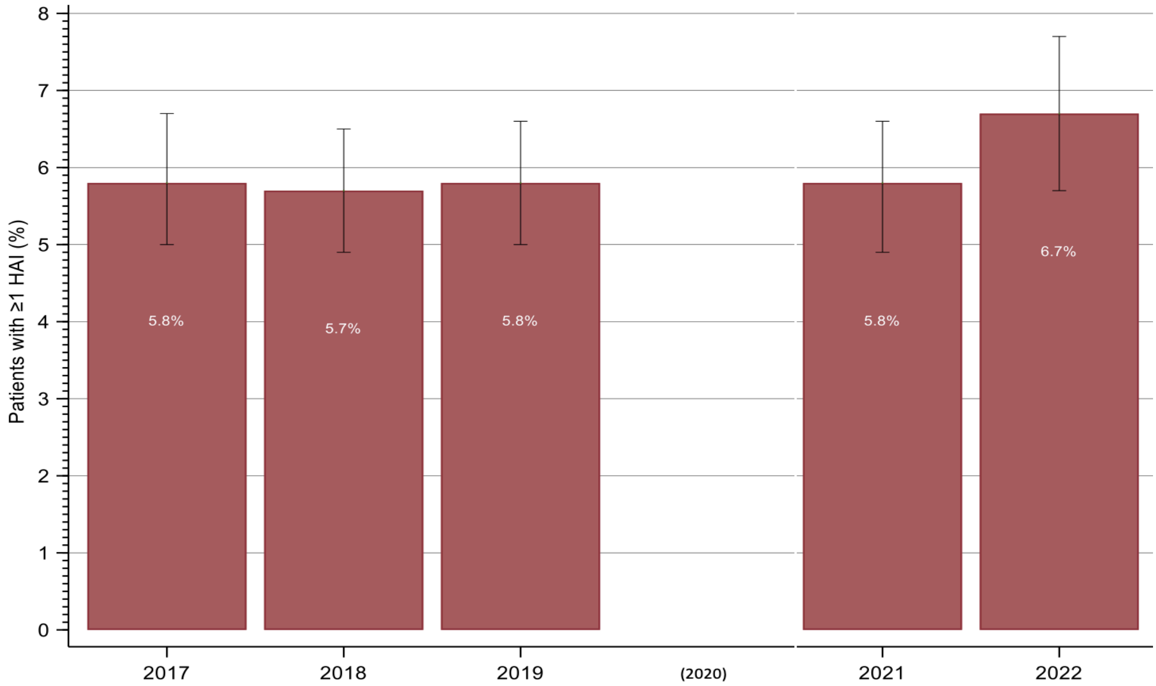


Discussion and key points for IPC

Healthcare systems and, in particular, acute care settings worldwide were severely affected by the Covid-19 pandemic. While responding to the extraordinary demands of the pandemic, hospitals had to maintain the operation of as many routine services as possible. Evidence shows that this extraordinary strain on hospital capacity had numerous implications for patient safety. In a recent WHO review summarising the impacts of the Covid-19 pandemic on health systems [11], safety gaps associated with risks and preventable harm were identified, requiring further assessment. There were disruptive effects on systems, processes and the healthcare workforce. However, positive developments were also noted, such as increased awareness and the systematic implementation of IPC measures across healthcare institutions.

Nevertheless, trends reported for HAI prevalence in the acute care setting during the pandemic differ. For example, several centres in the United States reported increases in HAIs, including central line-associated bloodstream infections (CLABSIs), catheter-associated urinary tract infections (CAUTIs), ventilator-associated pneumonia (VAP) and bloodstream infections (BSIs) due to methicillin-resistant *Staphylococcus aureus* (MRSA) [2,3,4]. In the CH-PPS, no difference in HAI prevalence was observed between 2017 and 2022 for all participating hospitals. However, in the subset of hospitals participating in all surveys (n=10), HAI prevalence was higher in 2022, although the difference was not significant (**Figure 9**). Thus, an effect of the Covid-19 pandemic on HAI prevalence in Switzerland cannot be ruled out.

Figure 9 HAI prevalence in hospitals (n=10) participating in all surveys between 2017 and 2022



The similar prevalence of antimicrobial use observed for all participating hospitals between 2017 and 2022 confirms stable antimicrobial consumption, as reported by the Swiss Centre for Antibiotic Resistance (ANRESIS).[3] Within the limitations of a point prevalence survey, antimicrobial use data will continue to inform antimicrobial stewardship efforts under the StAR strategy.

The results of the IPCAF survey indicate that Switzerland scores high on IPC structures and processes. However, while infrastructure and materials are excellent from a global perspective, there is room for improvement in multimodal HAI prevention strategies, continuous staff education and training, and the performance of audits with constructive feedback. By 2024, we should be able to compare these results with evaluations in other European countries. Detailed results and interpretation are available in the full CH-PPS report [7].

- **Hospitals must implement the *Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals* defined by the NOSO Strategy for IPC in acute care hospitals.**
- **Hospitals must provide education and training for staff, carry out audits and monitoring with actionable feedback, and implement at least one multimodal HAI prevention strategy.**

[3] ANRESIS. Inpatient antibiotic consumption in recent years (up to 2021), available online at: https://www.anresis.ch/antibiotic-consumption/ambulatory-care/

2.2. Surgical site infection surveillance

The Swissnoso surgical site infection (SSI) surveillance module is conducted in collaboration with the Swiss National Association for Quality Development in Hospitals and Clinics (ANQ). Participation in this module is mandatory for all Swiss acute care hospitals. The surveillance module produces critical indicators of surgical treatment quality for healthcare professionals and service providers (further information on the SSI surveillance module is available online).

The programme uses an internationally recognised method based on the principles of the CDC's National Healthcare Safety Network (NHSN). The observation period is 30 days for surgical procedures without and 12 months for procedures with implants (i.e. implantation of foreign materials), the latter having been reduced to 90 days as of 1 October 2021. In the event of a suspected infection identified post-discharge during a telephone interview with the patient, the attending physician is contacted for additional information. SSIs are diagnosed according to the above-mentioned CDC criteria and classified as superficial incisional, deep incisional or organ/space infections.

Using an online form, data is entered manually in a secure Swissnoso database hosted by Medical Registries and Data Linkage (SwissRDL) at the Institute of Social and Preventive Medicine, University of Bern.

SSI surveillance monitors several procedures across surgical specialities such as abdominal surgery, gynaecology, orthopaedics, cardiac and spinal surgery. As of 1 October 2021, arterial vascular surgery of the lower limb was added to the registry as a new procedure. The procedures are defined according to the Swiss Classification of Surgical Interventions (CHOP version 2021). Participating hospitals and clinics must monitor at least three types of procedures. At the beginning of a 12-month observation period, the institution may change the types of procedures monitored. Surveillance of colon surgery and paediatric appendectomy (<16 years) is mandatory in hospitals where this type of surgery is offered. The observation period runs from October to September of the following year.

Results

The following results cover the period from October 2020 to September 2021, with 162 hospitals participating and 41,956 procedures analysed. **Table 2** shows SSI rates by type of surgery and depth of infection. In the 2020–2021 surveillance period, fewer procedures were included than in previous periods (2018–2019: 60,950; 2019–2020: 52,968). This is explained by the interruption of surveillance between November 2020 and March 2021 due to the Covid-19 pandemic, and the suspension of elective surgical activity in some institutions during the pandemic.

Table 2 Infection rates by type of procedure and depth of infection for non-implant and implant surgery

Procedure type	Hospitals n	Procedures n	Infections n	Infection rate % (95% CI)	Depth/distribution of infection Superficial n (%)	Deep n (%)	Organ/space n (%)
Period: 1 October 2020–30 September 2021[1]							
Appendectomy	80	3,155	60	1.9 (1.5–2.5)	19 (31.7)	7 (11.7)	34 (56.7)
Cholecystectomy	29	2,155	41	1.9 (1.4–2.6)	19 (46.3)	2 (4.9)	20 (48.8)
Hernia operation	40	1,802	19	1.1 (0.6–1.6)	15 (78.9)	4 (21.1)	0 (0.0)
Colon surgery	95	3,817	475	12.4 (11.4–13.5)	128 (26.9)	46 (9.7)	301 (63.4)
Rectal surgery	12	185	32	17.3 (12.1–23.5)	4 (12.5)	2 (6.3)	26 (81.3)
Gastric bypass	14	813	17	2.1 (1.2–3.3)	6 (35.3)	1 (5.9)	10 (58.8)
Caesarean section	30	3,421	76	2.2 (1.8–2.8)	45 (59.2)	10 (13.2)	21 (27.6)
Hysterectomy	21	1,134	53	4.7 (3.5–6.1)	12 (22.6)	3 (5.7)	38 (71.7)
Laminectomy without implant	23	1,839	22	1.2 (0.8–1.8)	8 (36.4)	7 (31.8)	7 (31.8)
Period: 1 October 2019–30 September 2020[a]							
Cardiac surgery							
All procedures	12	3,044	99	3.3 (2.7–3.9)	38 (38.4)	19 (19.2)	42 (42.4)
Coronary artery bypass	12	1,320	49	3.7 (2.8–4.9)	24 (49.0)	12 (24.5)	13 (26.5)
Valve replacement	11	919	25	2.7 (1.8–4.0)	8 (32.0)	4 (16.0)	13 (52.0)
Elective total hip replacement	100	10,699	125	1.2 (1.0–1.4)	39 (31.2)	10 (8.0)	76 (60.8)
Elective knee replacement	65	8,155	77	0.9 (0.7–1.2)	21 (27.3)	8 (10.4)	48 (62.3)
Laminectomy with implant	19	262	3	1.1 (0.2–3.3)	1 (33.3)	1 (33.3)	1 (33.3)
Spondylodesis	24	1,495	51	3.4 (2.6–4.5)	11 (21.6)	11 (21.6)	29 (56.9)

[a] Patients with non-implant surgery are followed up for 30 days, and those with implant surgery for one year post-procedure.

Since the start of national SSI surveillance on 1 June 2009, a total of 580,930 procedures have been analysed. Between 1 October 2011 and 30 September 2021, significant overall decreases in infection rates (all infection depths) were observed for appendectomy (p<0.001), gastric bypass (p<0.001), hernia surgery (p=0.0019), colon surgery (p=0.002), cardiac surgery (all procedures, p<0.001), coronary artery bypass (p<0.001), elective hip replacement (p=0.002) and laminectomy with implant (since 2013; p=0.0035). Conversely, significant increases in infection rates were observed for rectal surgery (p<0.001) and Caesarean section (p=0.002), while overall infection rates remained stable for cholecystectomy, hysterectomy (despite a significant increase during the last two years), elective knee replacement, spondylodesis and laminectomy without implant (**Figure 10** and **Figure 11**).

Figure 10 Infection rates from 1 October 2011 to 30 September 2021 for appendectomy, cholecystectomy, hernia repair, colon and rectal surgery, gastric bypass surgery, Caesarean section and hysterectomy.

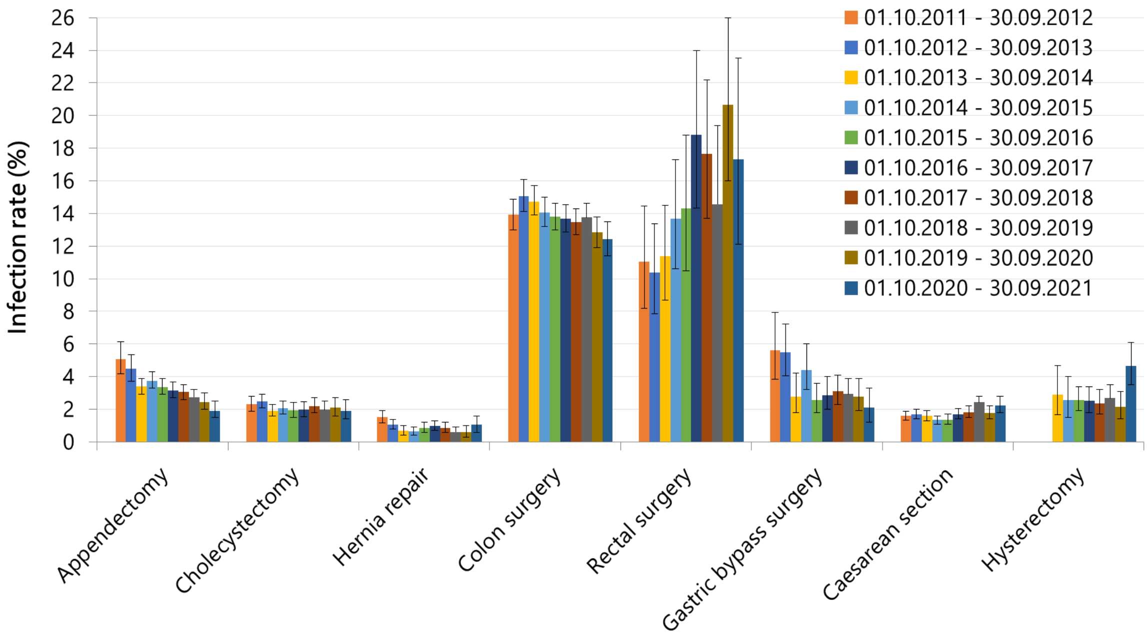
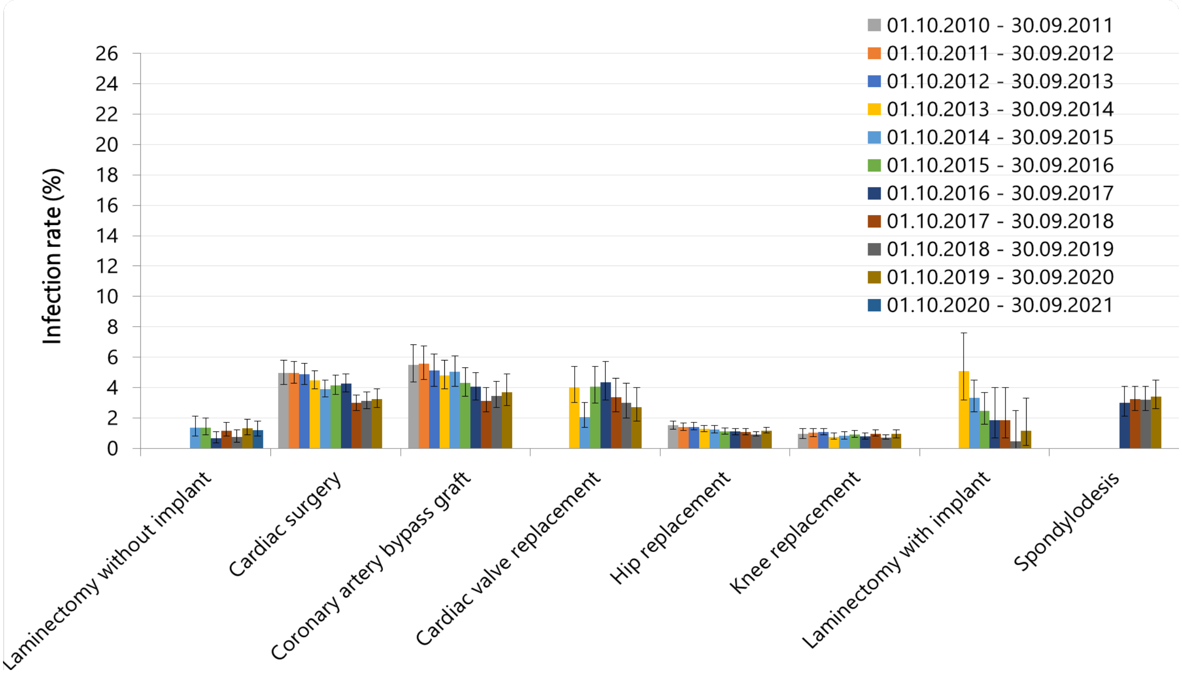


Figure 11 Infection rates from 1 October 2010 to 30 September 2021 for laminectomy without implant, cardiac surgery, coronary artery bypass graft, cardiac valve replacement, hip and knee replacement, and laminectomy with implant



Compared to the previous period (2019–2020), the proportion of cases with appropriate timing of antibiotic prophylaxis has improved for appendectomy (71% vs 68.8%, p=0.048), rectal surgery (contamination class II, 85% vs 65.5%, p<0.0001), cardiac surgery (contamination class I, 82.5% vs 78.5%, p<0.0001) and coronary artery bypass (contamination class I, 84% vs 78.6%, p<0.0001). Conversely, in 2020–2021, fewer implant laminectomy patients received prophylaxis within one hour prior to surgery than in the previous period (contamination class I, 74.7% vs 82.9%, p=0.034). Similarly, the proportion of patients receiving antibiotic prophylaxis before skin incision in Caesarean section (as recommended by the national guidelines) was lower (62.5% vs 71.5%, p<0.001). In contrast, the proportion receiving such prophylaxis after umbilical cord clamping was higher than before (28.7% vs 15.8%, p<0.001).

The national comparative report with SSI surveillance results for October 2020–September 2021 was published in June 2022 [12]. Specific reports (in German or French) for October 2021–September 2022 were provided to the 152 participating hospitals in April 2023 (including benchmarking adjusted for non-modifiable risk factors). The results by hospital and national reports are published on the ANQ website (https://www.anq.ch/de/fachbereiche/akutsomatik/messergebnisse-akutsomatik).

Discussion and key points for IPC

For several (though not all) types of procedures, SSI rates have decreased since surveillance began. This suggests a positive impact of surveillance on the quality of care and patient safety in Swiss hospitals, which might be due to actions taken or reinforced when SSI rates are made visible through monitoring. Initial progress has also been made with the timing of antibiotic prophylaxis for some surgical procedures. Here, there is still room for improvement for all types of procedures, and even more so for some specific types.

Compared with international data, Swiss SSI rates seem relatively high at first glance. However, such comparisons are only possible to a limited extent due to methodological differences, including definitions, case inclusion criteria and post-discharge follow-up, as well as uncertainties concerning the validity of internationally collected data. In no other country is post-discharge monitoring as thorough as in Switzerland, where the quality of data collection in hospitals and clinics is regularly reviewed. The **SSI surveillance validation process** promotes good case detection and improves data quality, and only a few surveillance systems in other countries rely on a similar process. In this context, a study based on Swissnoso data shows a correlation between the quality of surveillance and infection rates: institutions with the lowest infection rates have the lowest quality of surveillance [11]. This suggests that the quality of surveillance, as assessed by Swissnoso audits, needs to be considered when comparing SSI rates between hospitals.

Participating in the **Swissnoso SSI intervention module**[4] helps hospitals to measure adherence to proven preventive measures, which can improve the prevention of SSIs, quality of care and patient safety. The module initially included three measures (hair removal, antibiotic prophylaxis and skin disinfection) with a positive impact shown in hospitals participating in the pilot phase. Three more measures have been added: bowel decontamination (short course of oral antibiotics within two days prior to elective colorectal surgery), cutaneous and nose decontamination for *Staphylococcus aureus* for 3–5 days before arthroplasty and heart surgery, and control of perioperative glycaemia.

The goal of introducing these measures is to enable a hospital to reduce *Staphylococcus aureus* SSIs for implant surgeries by up to 50%, to reduce SSIs following colon/rectal surgeries by 25% and to reduce SSIs in diabetic patients by 10% within two years.

- ♦ **Hospitals are encouraged to participate in the SSI intervention modules that help hospitals to measure adherence to proven measures for improving SSI prevention, quality of care and patient safety.**

[4] https://www.swissnoso.ch/module/ssi-intervention/ueber-ssi-intervention/das-modul

2.3. Catheter-associated urinary tract infection surveillance

Data collection for the Swissnoso CAUTI surveillance module started on 1 January 2022. This module monitors symptomatic catheter-associated urinary tract infections (CAUTIs). Due to the SARS-CoV-2 Omicron BA.1 wave, not all 20 hospitals were able to start as planned. Data collection was thus made optional from 1 January to 31 March. Nevertheless, 14 hospitals provided data during that quarter.

From 1 April 2022, most of the 20 participating hospitals provided data continuously. Quarterly reports were provided on the catheter utilisation ratio (CUR), infection rate and indications, with benchmarking (except for the first quarter). The first annual report was completed in March 2023. Of the participating hospitals, 16 were small (<200 beds), three were medium-sized (200–650 beds) and one was large (>650 beds).

From 1 January to 31 December 2022, data was collected for 156,072 inpatients with 29,198 urinary catheters. Overall, 26,331 patients (16.9%; 95% CI: 16.69–17.06) were catheterised at least once. Catheter-days per 100 patient-days amounted to 12.55 (95% CI: 12.48–12.62), and the mean duration of catheterisation was 4.08 days (95% CI: 4.03–4.13). The highest CURs were found in ICUs (25.84%; 95% CI: 24.41–27.3), with 19.36 catheter-days per 100 patient-days (95% CI: 18.89–19.83). The mean duration of catheterisation was longest on medical wards (5.67 days; 95% CI: 5.55–5.79). A total of 176 symptomatic CAUTIs were diagnosed, resulting in an overall CAUTI incidence rate of 1.5 (95% CI: 1.27–1.72) per 1,000 catheter-days. All data is shown in Fehler! Verweisquelle konnte nicht gefunden werden..

Twelve hospitals provided the clinical indications for catheterisation in addition to the surveillance data reported above. A valid indication was reported for 10,239 of 11,926 inserted catheters (85.9%; 95% CI: 85.22–86.48). An evidence-based indication was thus lacking in approximately 14% of cases (**Table 3**). The most common indications were surgery (45%), urinary retention (20%) and urinary monitoring (13%).

Table 3 CAUTI surveillance data for all 20 hospitals and for 4 major organisational units (surgery, medicine, obstetrics & gynaecology, intensive care; 93.6% of all patients), including 95% confidence intervals.

	Total n=20	Surgery n=18	Medicine n=17	OB/GYN n=13	ICU n=6
Total patients	156,072	68,933	52,717	20,908	3,592
No. of catheters	29,189	15,883	6,607	5,151	1,048
Symptomatic CAUTIs	176	68	79	5	12
Catheter utilisation ratio					
Patients with catheters / patients [%]	16.87 (16.69–17.06)	20.96 (20.65–21.26)	10.69 (10.42–10.95)	23.5 (22.92–24.08)	25.84 (24.41–27.3)
Catheter-days / 100 patient-days	12.55 (12.48–12.62)	17.04 (16.92–17.17)	10.28 (10.18–10.38)	11.93 (11.73–12.13)	19.36 (18.89–19.83)
Duration of catheterisation (days) [mean]	4.08 (4.03–4.13)	3.79 (3.74–3.84)	5.67 (5.55–5.79)	2.33 (2.29–2.37)	4.93 (4.62–5.24)
Symptomatic CAUTIs					
Infections/100 patient-days	0.02 (0.02–0.02)	0.02 (0.02–0.02)	0.02 (0.02–0.03)	0.005 (0–0.01)	0.04 (0.02–0.08)
Infections/1,000 catheter-days	1.48 (1.27–1.72)	1.14 (0.88–1.44)	2.11 (1.67–2.63)	0.42 (0.14–0.98)	2.31 (1.19–4.02)
Urinary catheters with clinical indication					
Hospitals providing data on indication	n=12 hospitals	n=11 hospitals	n=10 hospitals	n=9 hospitals	n=4 hospitals
Indicated catheters / all catheters [%]	85.85 (85.22–86.48)	88.27 (87.44–89.06)	75.62 (74.07–77.11)	94.75 (93.75–95.64)	81.94 (77.01–86.21)

Discussion and key points for IPC

The urinary catheter utilisation rate was lower than in the “progress! Urinary catheter safety” pilot programme conducted by Patient Safety Switzerland and Swissnoso, which had shown a 21.02% (95% CI: 20.32–21.73) post-intervention catheterisation rate and 13.53 (95% CI: 13.29–13.78) catheter-days per 100 patient-days. This may have been due to the success of the above-mentioned programme, in terms of a “signal effect” on hospitals not participating in the pilot, or it may have been due to the heterogeneity of participating hospitals. In addition, there may have been differences in the samples included; therefore, no definitive conclusions can be drawn.

The 2022 CAUTI rate in Switzerland is in keeping with the results of the pilot programme. By way of international comparison, the CAUTI rate is higher than the 2021 rate of 0.9 per 1,000 catheter-days reported from approximately 3,700 acute care hospitals in the US using the same CAUTI definition as Swissnoso [13].

The most effective CAUTI prevention strategies rely on reducing catheter utilisation, both by decreasing new catheterisations and limiting the duration of catheterisation. According to our data, the duration of catheterisation is longest in ICUs, and rates of symptomatic CAUTIs are highest in medical patients. In contrast, surgery and obstetrics & gynaecology exhibit lower infection rates, with the latter having particularly low rates. At the same time, the percentage of indicated catheters ("appropriate catheterisation") was lower in ICU and in medical patients. Preventive activities should thus ideally focus on ICUs and medical wards first, as they offer the most room for improvement.

Readily actionable parameters of our analysis include the proportion of catheterised patients, the duration of catheterisation and the percentage of indicated catheters. While the catheterisation rate may already be decreasing due to awareness campaigns, tackling the duration of catheterisation will necessitate daily re-evaluation of the indication and the introduction of catheter removal decision flowcharts for acute urinary retention [14] and instructions for catheter removal after surgery [15]. Finally, a concise and mandatory indication list decreases unnecessary catheterisation and complications [16].

The CAUTI intervention module [17] based on the intervention opportunities mentioned above started on 1 April 2023, in a collaboration between Swissnoso and Patient Safety Switzerland. Initial results are expected at the beginning of 2024.

- **Daily re-evaluation of urinary catheter indications, catheter removal algorithms and mandatory indication lists decrease unnecessary catheterisation and the risk of CAUTIs. Hospitals are encouraged to follow these measures, which are included in the new national CAUTI intervention module.**

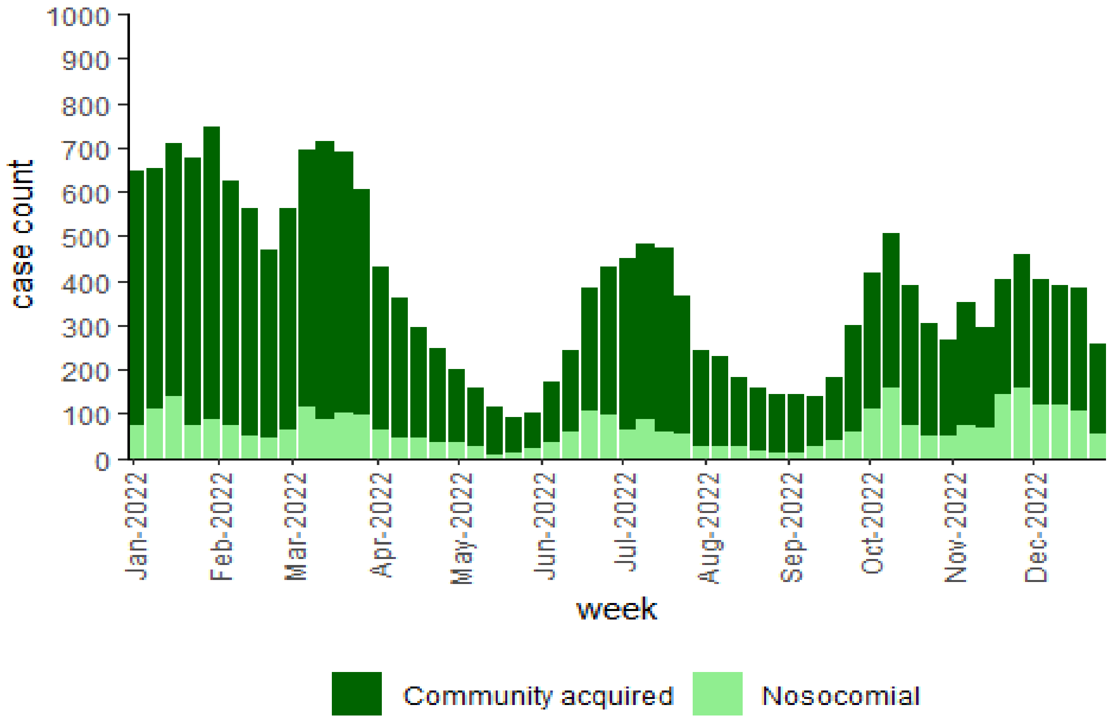
3. Surveillance of healthcare-associated respiratory virus infections

3.1. SARS-CoV-2 infections

Since March 2020, hospitalisations of Covid-19 patients have been recorded in a hospital sentinel surveillance system (Covid-19 hospital-based surveillance/CH-SUR). From 1 January 2022 to 31 December 2022, 19 hospitals actively participated in data collection on Covid-19 hospitalisations, including most cantonal and university hospitals, covering a large proportion of hospitalised paediatric and adult patients throughout Switzerland. CH-SUR collects data on Covid-19 patients hospitalised for more than 24 hours, including nosocomial SARS-CoV-2 infections. Nosocomial (healthcare-associated) Covid-19 cases are defined as patients with a laboratory-confirmed Covid-19 diagnosis (positive SARS-CoV-2 RT-PCR or antigenic test) or clinical and/or radiological and/or serological evidence of Covid-19 five days or more after hospital admission. This report only includes nosocomial SARS-CoV-2 infections identified in the institution reporting the case.

From 1 January 2022 to 31 December 2022, a total of 19,913 Covid-19 hospitalisations were recorded in CH-SUR, including 3,535 nosocomial SARS-CoV-2 infections (18%) (**Figure 12**).

Figure 12 Number of Covid-19 hospitalisations per week recorded in CH-SUR from 1 January 2022 to 31 December 2022, according to the site of acquisition of the infection.



Of the 3,535 patients with nosocomial SARS-CoV-2 infections, 1,808 (51%) were female. A total of 2,659 patients (75%) were aged 65 years or older, 785 (22%) were between 16 and 64, and 91 (3%) were under 16.

Nosocomial SARS-CoV-2 cases were most frequently found in medical wards (1,258 patients; 36%), followed by geriatric (799; 23%) and surgical wards (626; 18%).

The majority of nosocomial Covid-19 patients (3,134; 89%) had at least one comorbidity, including hypertension (1,825; 52%), chronic cardiovascular disease (1,549; 44%), diabetes (732; 21%), oncological disease (723; 20%), dementia (648; 18%), neurological disease (612; 17%), chronic respiratory disease (592; 17%) or obesity (515; 15%).

A total of 2,115 nosocomial SARS-CoV-2 infections (60%) occurred among vaccinated patients – including 593 patients (17%) with a last dose received within the past six months – while 552 (16%) occurred among non-vaccinated patients. The vaccination status was unknown for 868 patients (25%).

Most nosocomial Covid-19 patients (3,276; 92%) did not develop viral pneumonia and were not admitted to intermediate or intensive care units. The most common complications were respiratory complications (654; 19%), including pneumonia (391; 11%) and acute respiratory distress syndrome (37; 1%), followed by cardiovascular complications (137; 4%).

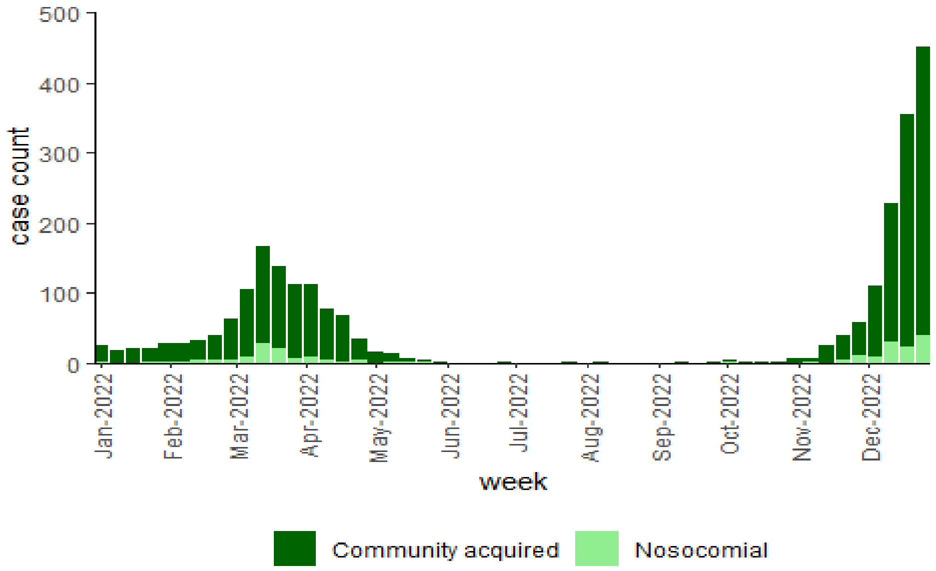
Over this period, 320 patients with nosocomial Covid-19 (9%) died during hospitalisation. In 92 (29%) of these cases, death was causally related to Covid-19. In 157 cases (49%), it was unrelated to Covid-19, and in the remainder of cases the cause of death was indeterminate.

A total of 2,815 patients with nosocomial Covid-19 (80%) were discharged from the hospital. Of these patients, 1,654 (59%) were discharged home, 487 (17%) to a long-term care facility and 450 (16%) to a rehabilitation centre, while 112 (4%) were transferred to another hospital. For the remaining 400 patients (11%), the outcome (still in hospital, discharged or deceased) was not confirmed at the time of data extraction.

3.2. Influenza infections

Since 2018, hospitalisations of influenza patients have been recorded in a hospital sentinel surveillance system (hospital-based surveillance/CH-SUR) [18]. From 1 January 2022 to 31 December 2022, 18 hospitals actively participated in data collection on influenza hospitalisations, including most cantonal and university hospitals, covering a large proportion of hospitalised paediatric and adult patients throughout Switzerland. CH-SUR collects data on influenza patients hospitalised for more than 24 hours, including nosocomial influenza infections. Nosocomial influenza cases are defined as patients with a laboratory-confirmed influenza diagnosis three days or more after hospital admission.

Figure 13 Number of influenza hospitalisations per week recorded in CH-SUR from 1 January 2022 to 31 December 2022, according to the site of acquisition of the infection.



From 1 January 2022 to 31 December 2022, a total of 2,419 influenza hospitalisations were recorded in CH-SUR. Of these cases, 2,201 (91%) were community-acquired (**Figure 13**), including 2,158 (98%) influenza A and 38 (2%) influenza B infections. A total of 218 (9%) nosocomial influenza infections were recorded, including 212 (97%) influenza A and 6 (3%) influenza B infections. This report only includes nosocomial influenza infections identified in the institution reporting the case.

Of the 218 patients with nosocomial influenza infections, 121 (56%) were female. A total of 160 patients (73%) were aged 65 years or older, 44 (20%) were between 16 and 64, and 14 (6%) patients were under 16. Nosocomial influenza cases were most frequently found in medical wards (74 patients; 34%), followed by geriatric (46; 21%), surgical (27; 12%) and paediatric wards (8; 4%).

The majority of patients with nosocomial influenza (186; 85%) had at least one comorbidity, including hypertension (98; 45%), chronic cardiovascular disease (95; 44%), chronic respiratory disease (45; 21%), dementia (45; 21%), diabetes (42; 19%), obesity (42; 19%), oncological disease (38; 17%), neurological disease (30; 14%) or chronic kidney disease (27; 12%).

For most patients (182; 83%), the vaccination status was unknown.

The most common complications of nosocomial influenza infections were respiratory complications (59; 27%), including pneumonia (36; 17%) and acute respiratory distress syndrome (1; 0.5%), followed by cardiovascular complications (10; 5%).

A total of 11 patients with nosocomial influenza (5%) were admitted to intermediate care and 15 (7%) to intensive care units. Over this period, 11 patients with nosocomial influenza (5%) died during hospitalisation. In 2 (18%) of these cases, death was causally related to influenza. In 6 cases (55%), it was unrelated to influenza, and in 3 cases (27%) the cause of death was indeterminate. A total of 191 patients with nosocomial influenza (88%) were discharged from the hospital. Of these patients, 117 (61%) were discharged home, 29 (15%) to a long-term care facility and 26 (14%) to a rehabilitation centre, while 10 (5%) were transferred to another hospital. For the remaining 16 patients (7%), the outcome (still in hospital, discharged or deceased) was not confirmed at the time of data extraction.

Discussion and key points for IPC

Following its arrival in late 2021, the SARS-CoV-2 Omicron variant rapidly became predominant and caused large case numbers in the Swiss population early in 2022. Significant transmission was observed in acute care hospitals, even though protective equipment, vaccination and treatment options were readily available (unlike at the beginning of the pandemic). This was most likely due to the higher transmissibility and fast viral replication rate of Omicron, and high positivity rates in the general population (rendering pooled testing to identify asymptomatic HCWs increasingly ineffective), as well as the varying adherence to and, ultimately, the removal of modified standard precautions in hospitals (universal masking was discontinued in most hospitals by the second half of 2022). In acute care hospitals, great IPC efforts continued to be needed to reduce transmission risks amid limited quarantine/isolation rooms and testing capacities.

At the same time, population immunity was increasing, and the risk of severe disease was low. Following the federal decision on a phased lifting of Covid-19 measures for the Swiss population in February 2022, Swissnoso – in close consultation with the FOPH and relevant stakeholders – continued to publish recommendations on IPC and the management of respiratory viruses. The focus of the recommendations gradually shifted towards protecting at-risk individuals in the acute care setting and maintaining the operation of routine hospital services.

The Covid-19 pandemic affected the transmission dynamics of other respiratory viruses, such as influenza and RSV. Following lower activity in 2020 and 2021 compared to pre-pandemic levels, an unusually early increase in influenza was seen in many parts of Switzerland in autumn 2022 [18]. Concurrently, RSV activity increased rapidly, putting substantial pressure on paediatric units [19,20].

- **Continuing surveillance of nosocomial respiratory virus infections is crucial to inform IPC recommendations for mitigating the impact of influenza-like illness on acute care hospitals.**

- **Swissnoso, in collaboration with stakeholder groups, will continue to publish recommendations on IPC and the management of respiratory viruses to mitigate the impact of influenza-like illness in the acute care setting.**

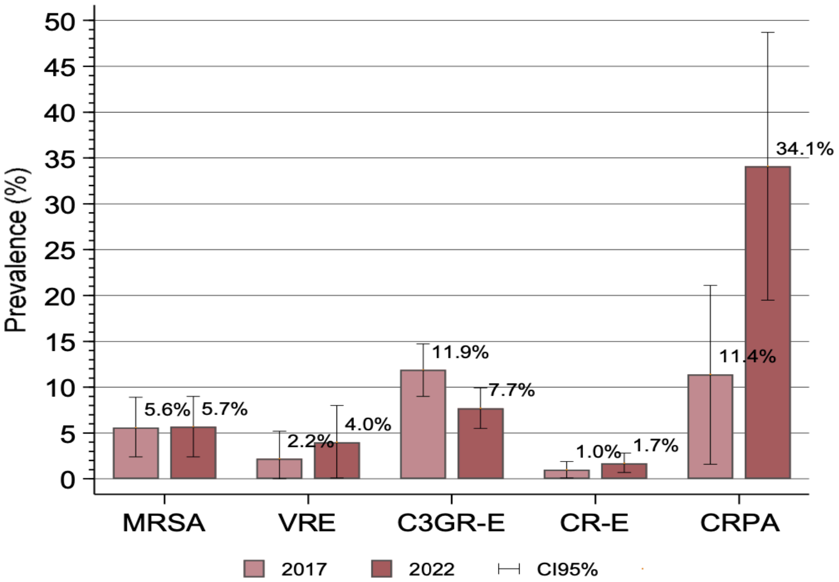
4. Surveillance of microorganisms relevant for healthcare-associated transmission

4.1. Multidrug-resistant organisms

Resistance data from CH-PPS/NOSO

A comparison of CH-PPS results for 2017 and 2022 shows a nearly threefold increase in the prevalence of carbapenem-resistant *Pseudomonas aeruginosa* and an almost twofold increase in vancomycin-resistant enterococci (VRE) and third-generation cephalosporin-resistant Enterobacterales in HAIs with documented positive microbiological results (**Figure 14**). However, the differences are not statistically significant.

Figure 14 Prevalence of selected resistant microorganisms: pathogen-resistance combinations in 2017 vs 2022 CH-PPS. The 2022 prevalence figures are: MRSA: n=11 (5.7%) methicillin-resistant *Staphylococcus aureus* among n=194 *S. aureus* isolates; VRE: n=4 (4%) vancomycin-resistant enterococci among n=99 relevant enterococcal isolates; C3GR-E: 44 (7.7%) third-generation cephalosporin-resistant Enterobacterales and n=10 (1.7%) carbapenem-resistant Enterobacterales (CR-E) of n=573 Enterobacterales isolates; CRPA: n=15 (34.1) carbapenem-resistant *Pseudomonas aeruginosa* of n=44 isolates. NB: There were no major differences between the national surveys in 2017 and 2022 in terms of microbiological testing rates of all HAIs (69.0% vs 72.4%) and corresponding culture positivity rates (93.1% vs 94.4%) [7].



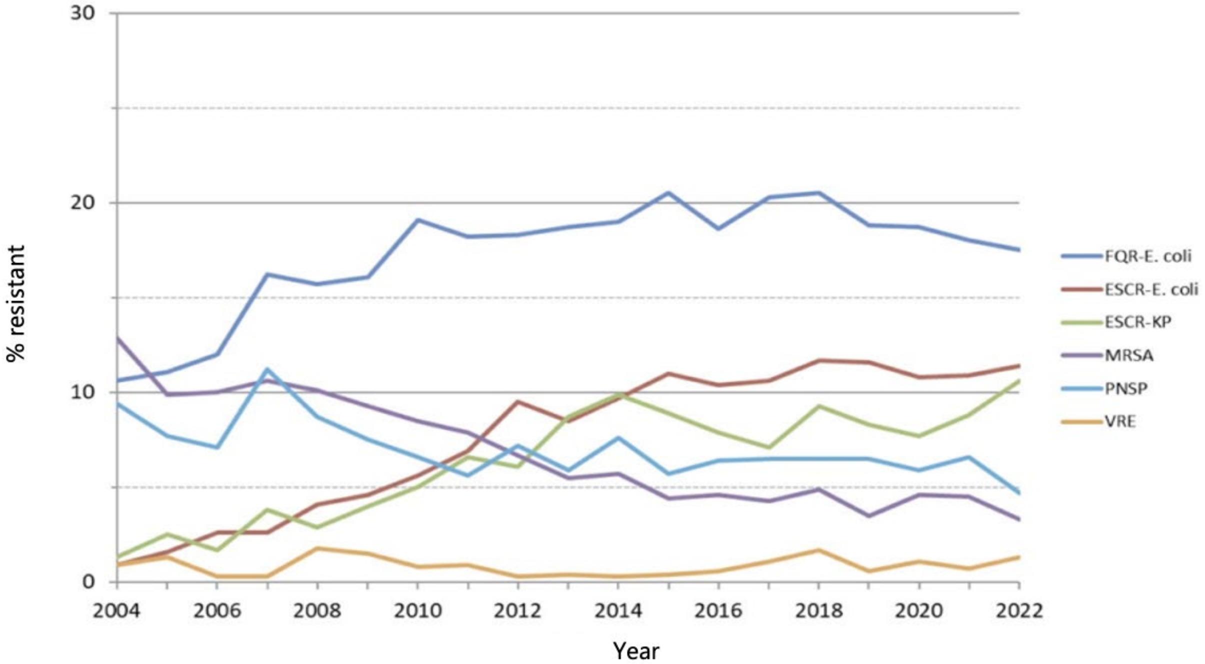
National data from the ANRESIS Swiss laboratory network

According to data from ANRESIS[5] (last update: 15 December 2022), the proportion of multidrug-resistant microorganisms detected in invasive isolates (inpatient and outpatient care)

[5] https://www.anresis.ch/antibiotic-resistance/methods/ and https://www.anresis.ch/shinyapps/Resistance/Coverage/barchart/

shows varying trends. For example, in the last few years, the proportions of fluoroquinolone-resistant *Escherichia coli,* penicillin-resistant pneumococci and methicillin-resistant *Staphylococcus aureus* have slightly decreased. However, a slight upward trend has been observed for extended-spectrum cephalosporin-resistant *E. coli* and vancomycin-resistant enterococci, while the proportion of extended-spectrum cephalosporin-resistant *Klebsiella pneumoniae* has been rapidly increasing (**Figure 15**).[6]

Figure 15 Epidemiology of MDROs in Switzerland since 2004. FQR-E. coli: fluoroquinolone-resistant *E. coli*; ESCR-E. coli: extended-spectrum cephalosporin-resistant *E. coli*; ESCR-KP: extended-spectrum cephalosporin-resistant *Klebsiella pneumoniae*; MRSA: methicillin-resistant *Staphylococcus aureus*; PNSP: penicillin-resistant *Streptococcus pneumoniae*; VRE: vancomycin-resistant enterococci. Source: ANRESIS

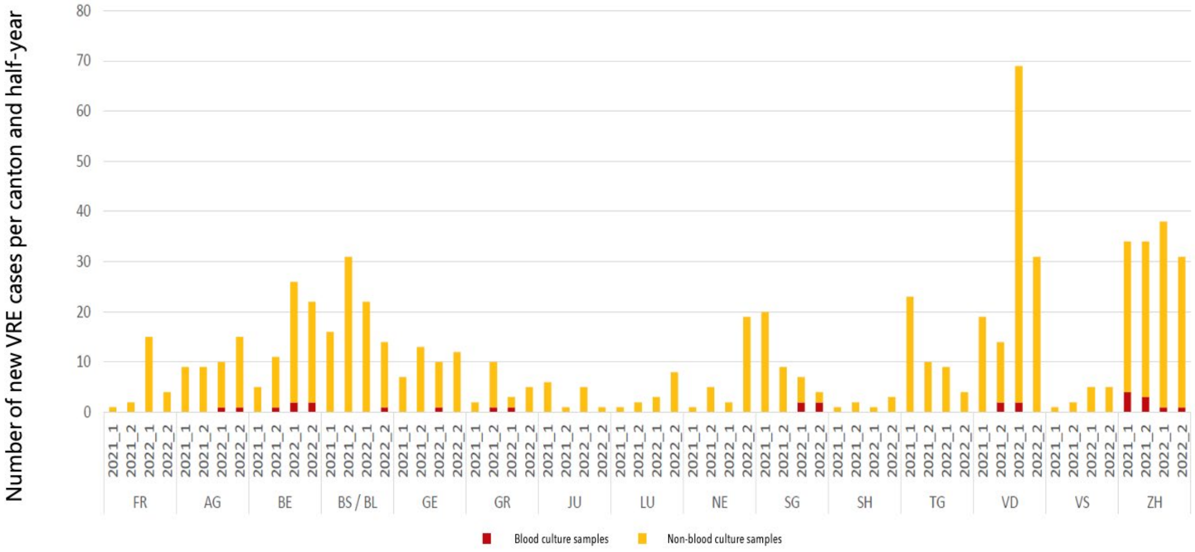


Epidemiology of vancomycin-resistant enterococci

Since 2018, Swissnoso has been closely monitoring the epidemiology of VRE (**Figure 16**). Data on new invasive and non-invasive isolates per canton is regularly reported on the Swissnoso website (courtesy of www.anresis.ch). Cantons can also comment on the data: for example, the increase in cases in the canton of Vaud in the first half of 2022 was due to a vanA vancomycin-resistant *Enterococcus faecium* ST80 outbreak in a regional hospital, which is currently under investigation. More precise information from other cantons with persistently high numbers or a sharp increase in non-invasive isolates was not available at the time this report was completed.

[6] Figure and more details can be found in the FOPH Bulletin 1+2/2023 www.bag.admin.ch/bag-bulletin

Figure 16 Half-yearly VRE surveillance results per canton from January 2021 to December 2022. *Yellow bars*: non-blood culture samples (screening or clinical specimens); *red bars*: blood culture samples. Cantons with no positive blood culture and less than five non-blood culture samples positive for VRE since the beginning of 2022 (SO, AI/AR, GL, OW/NW, SZ, TI, UR, ZG) are excluded for better readability. Source: ANRESIS



Epidemiology of carbapenemase-producing Enterobacterales

According to reports from ANRESIS,[7] the number of carbapenemase-producing Enterobacterales (CPE) has been increasing. These reports rely on data from the National Reference Centre for Emerging Antibiotic Resistance (NARA). Since the beginning of surveillance in 2013, 496 isolates have been characterised. Since January 2019, detailed analysis of resistance mechanisms at the NARA has been required for all CPE isolates. The genotypes most commonly identified are OXA-48 and NDM, with *Klebsiella pneumoniae* being the most frequently genotyped species. Concerning the regional distribution, the highest density of CPE has been observed in the Geneva area (12.7 isolates per 100,000 inhabitants), followed by western Switzerland.

4.2. *Candida auris*

This yeast has gained growing attention for its high transmissibility and persistence in healthcare facilities. Immunosuppressed and intensive care patients are most at risk for invasive and fatal *Candida auris* infections, not least due to high rates of antifungal resistance and, therefore, limited treatment options. Increasing numbers of nosocomial cases and outbreaks have been reported in several

[7] https://www.anresis.ch/antibiotic-resistance/methods/ and www.anresis.ch/shinyapps/Resistance/Coverage/barchart/

European countries. Switzerland detected the first case in 2018, and a few sporadic cases have since been reported in patients repatriated from abroad. Heightened alert, adherence to screening and IPC measures, and validated diagnostic methods are recommended to ensure rapid detection of cases and prevent onward transmission. Swissnoso has published national IPC recommendations for *Candida auris* [21].

4.3. Mpox (monkeypox)

Before the current epidemic, mpox was a zoonotic disease in rural areas of Africa, with only occasional transmission to humans. However, in May 2022, several countries began detecting cases linked to transmission events in Europe. Thousands of cases have been reported worldwide, including several hundred in the Swiss population. Transmission occurs through contact with skin lesions or bodily fluids and (rarely) with respiratory secretions or contaminated materials. Mpox has mainly (but not exclusively) affected men who have sex with men (MSM) and sex workers.

In May 2022, the first Swissnoso recommendations on mpox for acute care hospitals suggested that any centre with adequate facilities could admit suspected cases requiring hospitalisation, while mild cases could be isolated at home [22]. The document provides information on IPC measures, diagnostic aspects, post-exposure definition and management of individuals, and notification. The evidence so far suggests that the occupational risk of mpox for HCWs is extremely low in well-resourced settings [23]. In Switzerland, no cases of nosocomial transmission have been reported. Public health action focuses on awareness campaigns and vaccination (including ring vaccination) of at-risk populations.

Discussion and key points for IPC

There is an ongoing threat from multidrug-resistant bacteria and other organisms prone to nosocomial transmission and causing outbreaks, such as *Candida auris*.

- **The increasing detection of CPE and VRE warrants high-quality surveillance and effective communication to ensure early detection and rapid implementation of targeted IPC measures.**

swissnoso

5. HAI-relevant surveillance and IPC initiatives

5.1. Surveillance modules under development

Swissnoso and key stakeholders are developing additional surveillance modules under the NOSO strategy. A survey conducted in 2020 among Swiss acute care hospitals served as a basis for the development of surveillance modules in this connection [24]. Ninety-four hospitals completed the survey. The following three modules are designed for the surveillance of further important types of HAIs, and pilot studies are in preparation. Successful pilot studies lay the foundation for a potential nationwide semi-automated surveillance of the HAIs concerned. Nationwide nvHAP surveillance will raise awareness and provide information on appropriate IPC strategies. Substantial efforts are also ongoing to increase the level of automation for new and existing surveillance modules, so as to optimise data accuracy, timeliness, cost-effectiveness and connectivity.

CLABSI surveillance

Around 10% of all HAIs are bloodstream infections. Nosocomial bloodstream infections are less frequent than SSIs, but mortality is comparatively high (10–40%). At the same time, recent figures show that less than one-third of Swiss hospitals use surveillance systems for CLABSI (initiatives are primarily based on efforts at individual hospitals) [24]. In 2022, the Swissnoso working group for central line-associated bloodstream infections (CLABSIs) continued to advance the CLABSI surveillance module development. Based on systematic reviews and a meta-analysis of automated detection systems in the scientific literature, a detection algorithm has been established, which will be validated against manual surveillance.

The subsequent steps from 2023 onwards include a feasibility study in several large Swiss hospitals on central venous catheters (CVCs) in intensive care units (ICUs) and developing an automated surveillance module for non-CVCs in non-ICU settings. Based on the knowledge acquired during the pilot study, a national rollout will be started.

VAP surveillance

No national ventilator-associated pneumonia (VAP) surveillance program exists in Switzerland. Diagnostic criteria for VAP are ill defined, making this surveillance module a diagnostic challenge. Recent data on monitoring, prevention and control of HAIs in Swiss hospitals showed that only a minority of hospitals (16%) currently perform VAP surveillance [24]. There is a need for more consensus on the standard definitions of VAP to be used in hospitals conducting surveillance. Single-centre data from Bern University Hospital (using an adapted CDC protocol for automated retrospective detection of ventilator-associated events) showed a significant decrease in the yearly incidence over eight years [25].

In 2022, a VAP working group was established with members from Swissnoso and the Swiss Society of Intensive Care Medicine (SGI-SSMI). VAP surveillance definitions and a proposal for a pilot study have been drafted. The next steps for 2023 onwards include data and administrative agreements, identifying pilot ICUs, and defining a minimal dataset and surveillance protocol.

nvHAP surveillance

A single-centre type 2 hybrid effectiveness–implementation trial on the prevention of non-ventilator-associated hospital-acquired pneumonia (nvHAP) was performed at Zurich University Hospital (USZ) [26]. Traditionally, hospital IPC efforts focus on device- and procedure-related infections, but not on nvHAP – one of the most common HAIs, with mortality rates and costs similar to VAP [27]. NvHAP can affect virtually any hospitalised patient (except those currently on invasive respiratory devices), making continuous manual surveillance virtually impossible. Since 2017, the USZ has been conducting semi-automated nvHAP surveillance, using a computerised algorithm to select patients at risk for nvHAP, who are then manually screened [28]. Establishing a national nvHAP surveillance system would allow future initiatives to prevent nvHAP, one of the most common and important HAIs in larger and smaller hospitals.

In 2022, a team of experts from Swissnoso and the USZ was established, and a study protocol was drafted for a multi-hospital pilot implementation. The next steps for 2023 include the approval of the pilot study proposal, defining the participating hospitals and potentially starting the pilot study on semi-automated nvHAP surveillance in Swiss hospitals.

5.2. Competence centre for regional and national investigations of healthcare - associated infection outbreaks

In 2022, progress was made with activities aimed at the operation of a *Competence centre for regional and national investigations of healthcare-associated infection outbreaks*. Guidelines for MDRO prevention and control and the management of HAI outbreaks, as well as recommendations for *Candida auris* prevention and control measures, were published on the Swissnoso website and actively promoted among IPC professionals via the Swissnoso newsletter. The steps planned for 2023 onwards include an extended evaluation of compliance with MDRO guidelines at Swiss acute care hospitals (preparatory work started in 2022) and preparations for the development of an abridged online version of the MDRO guidelines and a database for HAI outbreaks.

5.3. Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals

The *Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals* [5] were developed within the framework of the NOSO strategy by a working group led by Swissnoso, with the involvement of the relevant professional societies (Swiss Society for Hospital Hygiene (SSHH), Swiss Society for Infectious Diseases, the infection-prevention nurses' groups SIPI and fibs). They are based on scientific evidence and ECDC and WHO recommendations. The first version of this document was published in January 2021. The FOPH, the Swiss Conference of Cantonal Health Directors (GDK) and the Association of Swiss Hospitals (H+) recognise the importance of these national minimum requirements and recommend their implementation by the cantons and hospitals. Following the first national symposium for representatives from cantonal health directorates and hospitals in August 2021, Swissnoso organised two workshops for IPC professionals in 2022. The focus was on political and regulatory frameworks, and on existing examples and potential tools for the local implementation of the minimum standards.

The next steps will involve further discussions between the actors involved (the FOPH, cantons, hospitals and professional societies) and representatives from the three key target groups – cantonal authorities, hospital management and hospital hygiene teams – on how binding the requirements should be, as well as the development of tools for delivering and evaluating the implementation of the minimum standards in acute care hospitals.

5.4. National Strategy on Antibiotic Resistance

In 2022, work continued for the StAR-2 project period (which began in 2019), as part of the National Strategy on Antibiotic Resistance (StAR) [6,29]. A working group with members of Swissnoso and key stakeholders, including ANRESIS and the Swiss Society of Infectious Diseases, advanced their subprojects on guideline development, antimicrobial stewardship programmes (ASPs) and *Clostridioides difficile* surveillance. Following reviews of the status of antimicrobial stewardship in Switzerland and other countries, the ASP subproject laid the groundwork for recommendations on implementing ASPs in Swiss acute care hospitals by publishing draft documents, expanding national antimicrobial consumption monitoring, and setting up multidisciplinary network activities for healthcare professionals responsible for the local implementation of ASPs in Switzerland.

The continuation project (StAR-3) on ASP implementation in Swiss acute care hospitals – developed jointly with the Swiss Society for Infectious Diseases, the SSM, ANRESIS, FMH, the SSHH, the Swiss Association of Hospital Pharmacists (GSASA), GDK and H+ – is due to start in summer 2023.

To effectively combat antimicrobial resistance, a comprehensive approach must be adopted, focusing on two key aspects: optimising antibiotic prescribing practices (i.e. antimicrobial stewardship) and implementing measures to prevent the transmission of MDROs or mobile genetic elements between patients (i.e. IPC measures).

5.5. Digitalisation and expansion of HAI surveillance

The Swissnoso Working Group for Digitalisation is tasked with developing and implementing the next generation of data handling, analysis and reporting for Swissnoso surveillance and intervention modules. The guiding principles are automation of data extraction and verification from hospital databases, near-real-time analysis, and actionable feedback targeting HAI prevention (user-centred dashboards).

Software delivered to Swiss hospitals is designed to reduce the daily workload for IPC teams. To create synergies, collaboration is sought with other initiatives and programmes in the field of digital health in Switzerland. Data standardisation at the source is key in developing this domain. In this connection, Swissnoso has already established an HL7 FHIR implementation guide for the CAUTI surveillance module.

The CLABSI and nvHAP surveillance modules will be the first to operate with the new data management system. Furthermore, collaboration with existing data collection efforts will help to streamline processes. A recent screening project [30] identified several registries with data relevant to HAIs (e.g. databases from the Swiss Federal Statistical Office, the Swiss transplant registry, and the Swiss implant registry).

Discussion and key points for IPC

- **The Covid-19 response showed the benefits of a national platform that can be activated for regular expert discussions, situation analysis and coordinated response to mitigate the impact of MDROs and other important nosocomial pathogens in acute care hospitals.**

- **Investing in digitalisation and automation improves the timeliness and accuracy of surveillance data that will inform the implementation of targeted IPC measures. In addition, staff can use the time no longer required for manual data entry to implement and operate IPC activities.**

- **The implementation of national minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals should leverage other national and local strategies to improve appropriate antimicrobial use, patient safety and the cost-effectiveness of healthcare in Swiss acute care hospitals.**

6. Conclusions and outlook

This report covers the epidemiology of HAIs in 2022 for a large proportion of the 182 Swiss acute care hospitals. Despite the ongoing Covid-19 pandemic during this period, the results provide important information on the status of HAIs in Switzerland. While the 2022 CH-PPS did not, per se, detect any change in HAI prevalence or antimicrobial use since the last national survey in 2017, a potential negative impact of the Covid-19 pandemic on hospital operations may have effectively nullified the effects of preventive efforts.

The survey showed that SSIs remain one of the most important types of HAI. SSI surveillance has shown positive trends for a variety of surgical procedures – e.g. through improved SSI rates over time and more timely administration of antibiotics – but also demonstrated the need for improvement in other procedures. Similarly, CAUTI surveillance results have provided valuable insights, highlighting areas requiring attention to improve indication-based urinary catheter use so as to decrease CAUTI rates.

As the Swiss healthcare system recovers from the strains of the Covid-19 pandemic, progress is being made with the implementation of *Minimum structural requirements for the prevention and control of HAIs in Swiss acute care hospitals*. To support the national prevention and control of HAIs, Swissnoso plans to provide additional semi-automated surveillance and intervention modules for use in acute care hospitals, as well as a new competence centre to detect, notify and manage outbreaks at a regional and national level.

Swissnoso continues to pursue its digitalisation strategy to fully exploit growing data connectivity. As hospitals are provided with IPC tools to simplify data collection processes, human resources will become available to implement and operate HAI prevention programs. Near-real-time data (dashboards) at the local hospital and national level will increase the effectiveness of HAI prevention and control strategies.

Swiss acute care hospitals need to exceed the established minimum standards for IPC. They need to pursue goal-oriented HAI reduction through surveillance and multimodal HAI prevention programmes – for example, by participating in the Swissnoso SSI, CAUTI, and future intervention modules. Results of the IPCAF self-assessment tool on the local status of IPC implementation in acute care hospitals – included in the CH-PPS for the first time – showed a need for improvement in the areas of multimodal prevention strategies, education and training, and audits and monitoring. There is a need to provide hospital staff with adequate IPC know-how and to provide feedback on adherence to infection prevention measures. At the same time, investment is required in critical IT interfaces between hospital databases and the future IPC software developed by Swissnoso.

In 2022, progress was made in developing structures and guidance for regional or national MDRO outbreaks. A national survey is being held to assess acute care hospitals' compliance with MDRO guidelines. Finally, Swissnoso has been providing input to the ongoing revision of the Epidemics Act.

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