Nationales Zentrum für Infektionsprävention
Centre national de prévention des infections
Centro nazionale per la prevenzione delle infezioni
National Center for Infection Control

Second national point prevalence survey of healthcare-associated infections and antimicrobial use in Swiss acute care hospitals (2022)

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Abbreviations

ANRESIS	Swiss Centre for Antibiotic Resistance
AU	Antimicrobial use
BSI	Bloodstream infection
CABSI	Catheter-associated bloodstream infection
CAUTI	Catheter-associated urinary tract infection
CDI	*Clostridioides difficile* infection
COVID	Coronavirus disease
CH	Switzerland
CI	Confidence interval
CLABSI	Central line-associated bloodstream infection
CDC	Centers for Disease Control and Prevention
CVC	Central venous catheter
ECDC	European Centre for Disease Prevention and Control
FOPH	Federal Office of Public Health
HAI	Healthcare-associated infection
HCW	Healthcare worker
ICU	Intensive care unit
IPC	Infection Prevention and Control
IPCAF	Infection Prevention and Control Assessment Framework at the Facility Level
IQR	Interquartile range
LRTI	Lower respiratory tract infection
MDRO	Multidrug-resistant organism
NEO	Neonatal infection
PPS	Point Prevalence Survey
PRIM	Primary care
PRIVFP	Private ownership, for-profit
PRIVNFP	Private ownership, not-for-profit
PUB	Public hospitals
PVC	Peripheral venous catheter
SEC	Secondary care
SPEC	Specialised care
SSI	Surgical site infection
SYS	Systemic infection
TERT	Tertiary care
USA	United States of America
UTI	Urinary tract infection
VAP	Ventilator-associated pneumonia
WHO	World Health Organization
95%CI	95% confidence interval

Executive Summary

After a COVID-related break in 2020, the Swiss point prevalence survey (CH-PPS) on healthcare-associated infections (HAI) and antimicrobial use restarted in 2021. In 2022, five years after the first national CH-PPS based on the ECDC protocol in 2017, a second national PPS was organised by Swissnoso in the framework of the strategy NOSO with the financial support of the Federal Office of Public Health (FOPH). Despite a number of challenges due to the pandemic, participation in the national CH-PPS 2022 exceeded expectations: 108 Swiss hospitals entered data into the CH-PPS database between April and June 2022, 12 more than 2017.

HAI

In 2022, data on 13,916 patients were collected. The prevalence of HAI was 5.9% (95% confidence interval: 5.5-6.3%), which is identical to 2017. Similarly, in the years between the two national surveys, no statistically significant differences were identified in the subset of hospitals performing yearly surveys at a local level.

Antimicrobial use (AU)

33% of the patients were taking at least one antimicrobial on the day of the survey. Although, the situation seems unchanged when compared over the years for all participating hospitals, AU was statistically higher in 2022 than in 2017 in the subset of hospitals participating in all surveys since 2017.

Both prevalence of HAI and AU have not changed over the past years. Unlike the United States, there are no signs that COVID-19 affected the prevalence of HAI in Switzerland, at least not in the short term, despite all limitations of the survey methodology to reach this conclusion.

There was particular interest in obtaining information on the implementation of the minimum standards in the organisation of IPC and the prevention of HAI in Swiss acute care hospitals. Hospitals were invited to complete the WHO IPCAF survey (Infection Prevention and Control Assessment Framework), as also advocated by the ECDC. The results showed Switzerland performing highly in hospital infrastructure and staffing, while room for improvement was detected in education and training, audits and monitoring, and multimodal HAI prevention strategies.

From a strategic perspective, the PPS has proven its applicability and relevance to Swiss hospitals over the past five years and has been integrated into routine surveillance activities of Swiss acute care hospitals. Around thirty institutions perform the PPS annually as part of the minimum standards in the organisation of IPC and the prevention of HAI.

Introduction

1. International situation in the context of the COVID-19 pandemic

The COVID-19 pandemic had a profound effect on health systems around the world, including the acute care setting. Hospitals had to demonstrate their resilience in terms of maintaining routine functioning while responding to extraordinary demands triggered by the pandemic. Emerging evidence shows that this extraordinary capacity overload in hospitals had multiple effects on patient safety. On the one hand, the awareness about infection prevention and control (IPC) measures and their systematic implementation increased in all settings. Despite these intensified measures, the evidence on their effectiveness in the acute care setting is mixed. The Centers for Disease Control and Infection (CDC) in the USA recently published data on an increasing trend of HAIs such as central-line associated bloodstream infection (CLABSI), catheter-associated urinary tract infection (CAUTI), ventilator-associated pneumonia (VAP) and bloodstream-infection (BSI) due to methicillin-resistant *Staphylococcus aureus*.[1] Data from the PPS 2022, does not suggest a similar trend in Switzerland.

2. Situation in Switzerland

In Switzerland, PPS has been progressively integrated into the IPC activity planning of many acute care hospitals over the past five years. Since 2017, five consecutive surveys have been conducted (except in 2020) in Swiss acute care hospitals. In 2017 and 2022, all Swiss hospitals were invited to participate in the national study, while the CH-PPS 2018, 2019 and 2021 were performed by a subset of acute care hospitals. Point prevalence surveys on HAI are part of the minimum standards for effective IPC, developed by Swissnoso and published in 2021 by the Swiss Conference of Cantonal Health Directors (CDS), the General Assembly of Swiss hospitals (H+ Hospitals Switzerland) and the Federal Office of Public Health (FOPH). The Swiss minimum standards are the result of a systematic literature review and cover seven areas, including IPC guidelines, access to appropriate protective equipment and material, staffing and organisation of the hospital hygiene teams, education and training, audits and monitoring, HAI surveillance, and multimodal prevention strategies.[2]

Figure 1: Minimum standards for IPC for Swiss acute care hospitals: development process

Survey methodology

1. Objectives

The objectives of the Swiss PPS 2022 are summarized as follows:

- To obtain representative data on HAI in acute care hospitals in Switzerland
- To obtain data on antimicrobial use in acute care hospitals in Switzerland
- To assess the implementation level of evidence-based IPC strategies in acute care hospitals in Switzerland
- To compare data on HAI and antimicrobial use with countries participating in the ECDC-PPS (2022/2023)

2. Methods and evolution of the Swiss PPS protocol

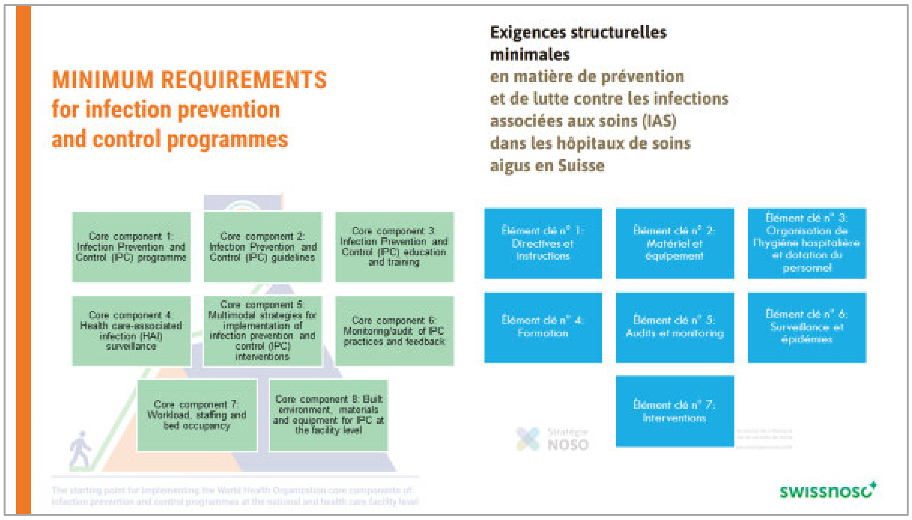
Swissnoso follows the PPS protocol of the European Centre for Disease Prevention and Control (ECDC) with the aim to benchmark with other European countries. Although originally planned for 2022, the ECDC PPS was postponed and will not be finished before 2023. The PPS protocol is based on the ECDC protocol version 5.3,[3] but takes into account the modifications of the present ECDC protocol, which was piloted in Austria and used in a number of European countries already in 2022.[4]

Hospital structural and process indicators

Hospital structural and process indicators were assessed using the WHO IPCAF questionnaire, a self-assessment framework of IPC activities based on the WHO core components and minimum standards. IPCAF allows hospitals to evaluate the quality of their IPC programmes and activities and to identify gaps and areas for improvement. In the context of the PPS, the IPCAF tool provides a unique opportunity to assess structure and process indicators on IPC and correlate them with key outcome indicators such as HAI and AU, .[5] The results can be used to benchmark with global and European data obtained in a recent global survey by the WHO.

The IPCAF tool includes 81 indicators divided into eight sections corresponding to the eight WHO core components of IPC: (1) IPC programme; (2) IPC guidelines; (3) IPC education and training; (4) HAI monitoring; (5) multimodal strategies; (6) monitoring and auditing of IPC practices and feedback, (7) workload, staffing and bed occupancy; and (8) structured environment, materials and equipment for IPC.[6] A maximum of 100 points can be obtained in each section, totaling 800 for the entire survey. Based on the overall score, four levels are distinguished: inadequate (0-200), basic (201-400), intermediate (401-600) and advanced (601-800).

Figure 2: Comparison of WHO minimum requirements for infection prevention and control programs and Swiss minimum standards for IPC in acute care hospitals (French version)



The IPCAF tool replaces the multimodal strategy indicators in the H3 form (2022 Swiss PPS protocol version).

Figure 3: PPS H3 hospital form (French version, April 2022)

Formulaire H3 – Fiche Établissement swissnoso

Code de l'établissement [__________] **Période d'enquête: du :__ / __ /____ au: __ / __ / ____**
jj/ mm / aaaa *jj/ mm / aaaa*

Veuillez remplir le questionnaire sous ce lien : [***https://fr.surveymonkey.com/r/CHPPS2022FR***](https://fr.surveymonkey.com/r/CHPPS2022FR)

Avez-vous rempli le questionnaire MEPCI (Modèle pour l'évaluation de la prévention et du contrôle des infections (PCI)?
O Oui O Non

The H1 form summarises the most important structural indicators at the hospital level. It collects information on the hospital's infrastructure and capacity, as well as on staffing Important changes were made to the H1 form to include indicators related to the COVID-19 pandemic, such as (1) COVID cases admitted to hospital in the previous year, (2) nosocomial COVID clusters in the previous year, (3) COVID cases admitted to the hospital at the time of PPS, (4) COVID cases admitted to intensive care unit (ICU) at the time of PPS, (5) COVID vaccination ratio among healthcare workers (HCW), and (6) influenza vaccination ratio among HCW. Hospital group variables were removed.

Figure 4: PPS H1 hospital form (French version, April 2022)

Formulaire H1 – Fiche Établissement swissnoso

Code de l'établissement [__________]

Période d'enquête: du :__ / __ /____ **au:** __ / __ / ____
jj/ mm / aaaa *jj/ mm / aaaa*

Nombre total de lits
Nombre de lits en soins aigus
Nombre de lits en soins intensifs

Y-a-t'il de services exclus de l'enquête?
☐ Non ☐ Oui, les services suivants ont été exclus:
____

Nombre des lits dans les services participants:
Nombre total des patients dans l'enquête:

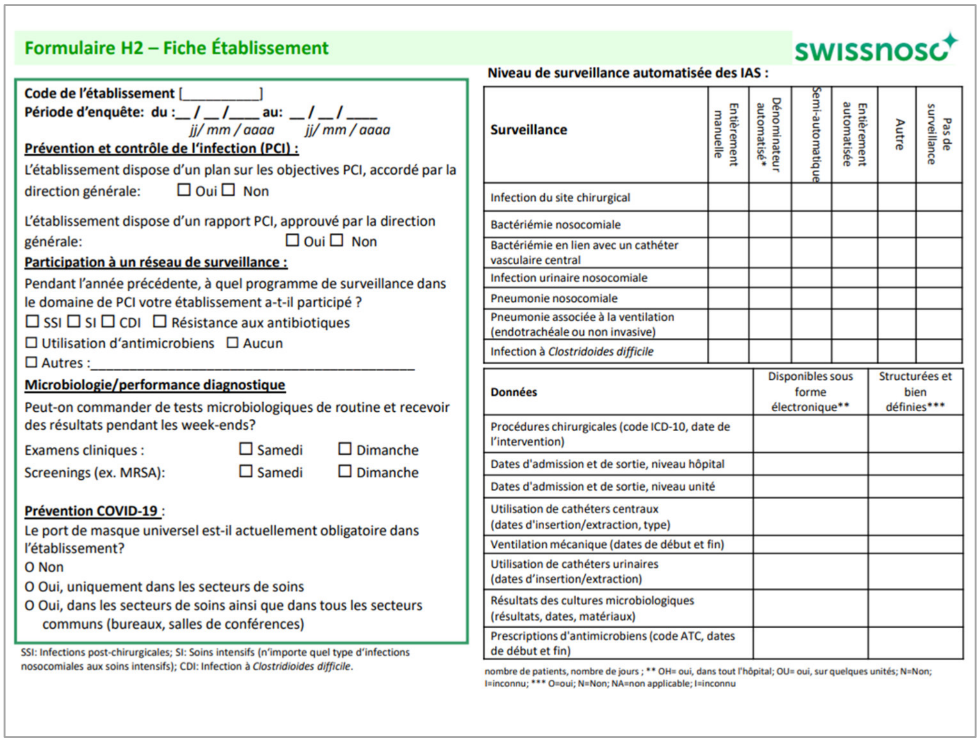
Secteur d'activité
☐ Primaire (1°) ☐ Secondaire (2°) ☐ Tertiaire (3°)
☐ Spécialisé: ______________________

☐ Publique ☐ Privé, à but non lucratif
☐ Privé, à but lucratif ☐ Autre/inconnu

	Nombre	An	Inc./ Total (1)
Nombre d'admissions/sorties par an			Inc Tot
Nombre de jours-patients par an			
Consommation de produit hydro-alcoolique (Litres/an)			Inc Tot
Nombre d'observations de l'hygiène des mains par an			Inc Tot
Nombre d'hémocultures (paires) par an			Inc Tot
Nombre d'analyses pour *C. difficile*			Inc Tot
Nombre d'infirmiers en équivalents plein temps (EPT) en PCI			
Nombre de médecins en EPT en PCI			Inc Tot
Nombre de soignants en EPT responsables de l'*antibiotic stewardship*			
Nombre de cas COVID à l'hôpital l'an dernier			
Nombre de clusters COVID nosocomiaux l'an dernier			
Nombre de cas actuels COVID à l'hôpital			
Nombre de cas actuels COVID aux SI			
Couverture vaccinale COVID des soignants en % (au 31.3.2022)			
Couverture vaccinale grippe ces soignants en %			
Nombre de chambres d'isolement aérosol			

The H2 form explores information on the level of automation of IPC surveillance: automated denominator collection, semi-automated surveillance, and fully automated surveillance stratified by HAI-type (surgical site infection (SSI), healthcare-associated bloodstream infection (HA-BSI), CLABSI, CAUTI, healthcare-associated pneumonia (HA-PN), VAP, *Clostridioides difficile* infections (CDI)) and denominator data (surgical procedures, admission and discharge dates, hospital level, admission and discharge dates, unit level, use of central lines: date of insertion and removal, type, use of mechanical ventilation or intubation, use of urinary catheters, microbiology culture results, antimicrobial prescriptions).

Figure 5: PPS H2 hospital form (French version, April 2022)



Formulaire H2 – Fiche Établissement

swissnoso

Code de l'établissement [__________]
Période d'enquête: du :__ / __ /____ **au:** __ / __ / ____
jj/ mm / aaaa *jj/ mm / aaaa*

Prévention et contrôle de l'infection (PCI) :

L'établissement dispose d'un plan sur les objectifs PCI, accordé par la direction générale: ☐ Oui ☐ Non

L'établissement dispose d'un rapport PCI, approuvé par la direction générale: ☐ Oui ☐ Non

Participation à un réseau de surveillance :

Pendant l'année précédente, à quel programme de surveillance dans le domaine de PCI votre établissement a-t-il participé ?
☐ SSI ☐ SI ☐ CDI ☐ Résistance aux antibiotiques
☐ Utilisation d'antimicrobiens ☐ Aucun
☐ Autres :_______________________________________

Microbiologie/performance diagnostique

Peut-on commander de tests microbiologiques de routine et recevoir des résultats pendant les week-ends?

Examens cliniques : ☐ Samedi ☐ Dimanche
Screenings (ex. MRSA): ☐ Samedi ☐ Dimanche

Prévention COVID-19 :

Le port de masque universel est-il actuellement obligatoire dans l'établissement?
O Non
O Oui, uniquement dans les secteurs de soins
O Oui, dans les secteurs de soins ainsi que dans tous les secteurs communs (bureaux, salles de conférences)

SSI: Infections post-chirurgicales; SI: Soins intensifs (n'importe quel type d'infections nosocomiales aux soins intensifs); CDI: Infection à *Clostridioides difficile*.

Niveau de surveillance automatisée des IAS :

Surveillance	Entièrement manuelle	Dénominateur automatisé*	Semi-automatique	Entièrement automatisée	Autre	Pas de surveillance
Infection du site chirurgical						
Bactériémie nosocomiale						
Bactériémie en lien avec un cathéter vasculaire central						
Infection urinaire nosocomiale						
Pneumonie nosocomiale						
Pneumonie associée à la ventilation (endotrachéale ou non invasive)						
Infection à *Clostridoides difficile*						

Données	Disponibles sous forme électronique**	Structurées et bien définies***
Procédures chirurgicales (code ICD-10, date de l'intervention)		
Dates d'admission et de sortie, niveau hôpital		
Dates d'admission et de sortie, niveau unité		
Utilisation de cathéters centraux (dates d'insertion/extraction, type)		
Ventilation mécanique (dates de début et fin)		
Utilisation de cathéters urinaires (dates d'insertion/extraction)		
Résultats des cultures microbiologiques (résultats, dates, matériaux)		
Prescriptions d'antimicrobiens (code ATC, dates de début et fin)		

nombre de patients, nombre de jours ; ** OH= oui, dans tout l'hôpital; OU= oui, sur quelques unités; N=Non; I=inconnu; *** O=oui; N=Non; NA=non applicable; I=inconnu

Figure 6: Overview of the Swissnoso PPS module webpage with useful material, including the IPCAF tool

Ward data

Of note, the question on single patient rooms with individual toilets and showers, previously included in the W form (ward form), was removed.

Antimicrobial use data

According to the amendments to the ECDC protocol, some information has been removed from the form: information on the antimicrobial treatment as a whole (start date of the first antimicrobial), as well as the dose, dosage, and units.

Patient data

As per changes in the ECDC protocol, the presence of a peripheral vascular catheter was removed, and the vaccination status of the patient against COVID was added.

HAI data

HAI codes for COVID and the microorganism code "VIRCOV" for SARS-CoV-2 were added, as well as criteria for healthcare-associated COVID-19. Vasopressor treatment for the consequences of HAI, as a marker for septic shock, was also included. Finally, the names of the antimicrobial susceptibility codes S and I were changed according to the European Committee on Antimicrobial Susceptibility Testing (EUCAST) definitions.

3. Inclusion and exclusion criteria for hospitals, wards, and patients

All acute care hospitals in Switzerland were eligible to participate in the PPS on a voluntary basis. All wards in acute-care hospitals, regardless of specialty were eligible, but hospitals were free to exclude wards (however, excluded wards had to be specified). Patients in the emergency room for more than 24 hours and patients hospitalized in psychiatry were excluded. Long-term rehabilitation and other long-term care facilities were included in the survey if they were an integral part of an acute-care hospital. All patients (including children and neonates) were eligible to be included if admitted to the ward before or at 8 a.m. and not discharged (either home or to a different ward) during the day of the survey.

Implementation

1. List of participating hospitals

One hundred and eight hospitals accepted to participate in the survey. The hospitals represented distinct hospital sites or hospital groups (Table 1).

Table 1: Participating hospitals by canton in alphabetic order

AG	Kantonsspital Aarau AG
	Kantonsspital Baden AG
	Spital Zofingen AG
	Asana Gruppe AG – Spital Menziken
	Asana Gruppe AG – Spital Leuggern
	Hirslanden Klinik Aarau
	Klinik Villa im Park
AR	Spitalverbund Appenzell Ausserrhoden - Herisau
	Hirslanden Klinik Am Rosenberg
BE	Insel Gruppe AG - Inselspital
	Insel Gruppe AG - Spital Tiefenau
	Insel Gruppe AG - Spital Riggisberg
	Insel Gruppe AG - Spital Aarberg
	Insel Gruppe AG - Spital Münsingen
	Spitalzentrum Biel AG
	Spital STS AG – Spital Thun
	Regionalspital Emmental AG – Spital Burgdorf
	Spital Region Oberaargau – Spital Langenthal
	Spitäler fmi ag - Unterseen
	Spitäler fmi ag - Frutigen
	Hôpital du Jura bernois SA – St-Imier
	Hôpital du Jura bernois SA - Moutier
	Hirslanden Bern AG, Beau-Site
	Hirslanden Bern AG, Salem Spital
	Hirslanden Bern AG, Klinik Permanence
	Lindenhofgruppe Bern, Lindenhofspital
	Lindenhofgruppe Bern, Sonnenhofspital
	Lindenhofgruppe Bern, Engeriedspital
	Insel Gruppe AG – Spital Belp
BL	Klinik Arlesheim AG
BS	Universitätsspital Basel
	St. Claraspital
	Universitäts-Kinderspital beider Basel UKBB

	Bethesda Spital AG
	Felix Platter-Spital
	Merian Iselin Klinik
	REHAB Basel
FR	Hôpital fribourgeois - Freiburger Spital
	Hôpital Daler – Daler Spital
	Clinique Générale Ste-Anne SA
GE	Hôpitaux universitaires de Genève
	Hôpital de La Tour
	Clinique Générale-Beaulieu
	Clinique de la Plaine
GR	Kantonsspital Graubünden
	Spital Oberengadin
	Flury Stiftung – Spital Schiers
	Ospidal d'Engiadina Bassa Akutabteilung, Scuol
	Klinik Gut Fläsch
JU	Hôpital du Jura - Delémont
LU	Luzerner Kantonsspital
	Hirslanden Klinik St. Anna AG - Luzern
	Hirslanden Klinik Meggen
OW	Kantonsspital Obwalden
SG	Kantonsspital St. Gallen
	Spitalregion Fürstenland Toggenburg – Spital Wil
	Spitalregion Rheintal Werdenberg Sarganserland – Spital Grabs
	Spitalregion Rheintal Werdenberg Sarganserland – Spital Allstätten
	Spital Linth
	Ostschweizer Kinderspital
	Hirslanden Klinik Stephanshorn
SO	Solothurner Spitäler AG – Bürgerspital Solothurn
	Solothurner Spitäler AG – Spital Olten
	Solothurner Spitäler AG – Spital Dornach
SZ	Spital Lachen AG
TG	Spital Thurgau AG - Münsterlingen
	Spital Thurgau AG – Spital Frauenfeld
	Klinik Seeschau
TI	EOC - Ospedale Regionale di Lugano Civico
	EOC - Ospedale Regionale Bellinzona e Valli
	EOC - Ospedale Regionale di Locarno
	EOC - Ospedeale Regionale di Mendrisio
	EOC - Ospedale Regionale di Lugano Italiano
	EOC - Istituto Cardio Centro Ticino
	Clinica Luganese SA

	Clinica S. Anna Sorengo
	Clinica Ars Medica Gravesano
UR	Kantonsspital Uri
VD	CHUV
	Etablissements Hospitaliers du Nord Vaudois – Site Yverdon-les-Bains
	Etablissements Hospitaliers du Nord Vaudois – Site St-Loup
	Ensemble Hospitalier de la Côte – Hôpital de Morges
	Hôpital Riviera-Chablais Rennaz
	Groupement Hospitalier de l'Ouest Lémanique – Hôpital de Nyon
	Hôpital intercantonal de La Broye HIB Payerne
	Hôpital du Pays-d'Enhaut Château-d'Oex
	Réseau Santé Balcon du Jura.vd Sainte-Croix
	Groupement Hospitalier de l'Ouest Lémanique – Hôpital de Rolle
	Clinique de La Source
	Clinique de Genolier
	Clinique CIC Riviera SA Clarens
	Pôle Santé Vallée de Joux
VS	Hôpital du Valais – Centre Hospitalier du Valais Romand
	Spital Wallis – Spitalzentrum Oberwallis
	Clinique médico-chirurgicale de Valère
	Clinique CIC Valais SA Saxon
ZG	Zuger Kantonsspital AG
	Hirslanden AndreasKlinik Cham Zug
ZH	UniversitätsSpital Zürich
	Universitätsklinik Balgrist
	Stadtspital Triemli
	Spital Uster
	Spitalverband Limmattal
	GZO AG - Spital Wetzikon
	Spital Bülach AG
	Spital Zollikerberg
	Kinderspital Zürich - Eleonorenstiftung
	Klinik Hirslanden Zürich

2. Material and train-the-trainer courses

The PPS Coordination Centre updated all relevant materials on the survey and made them available on the Swissnoso website. It also organised five interactive training courses for investigators: two for the German-speaking region, two for the French-speaking region and one for Ticino (in French). The courses offered a structured methodology that promoted a participatory, problem-solving approach through the discussion of clinical cases and the interactive use of the database. The duration was 4 hours, and participation was free of charge. In total, 141 health professionals participated in the courses.

3. Data management

Data collection took place from 1 April to 30 June 2022. Once the data was collected, hospitals were free to enter them into the database manually or automatically using the specifications provided by the coordination centre. Four large hospitals opted for automated import, which was facilitated this year by an option in the database that allowed hospitals to import data directly without an intermediary. The hospitals had the option to download their data (without benchmarking) in different formats (HTML, CSV, pdf). The data were analysed with STATA version 13 (STATA Corporation), R and R studio.

Results

1. Hospital characteristics and most relevant indicators

A total of 108 hospitals participated in the PPS, including 13’916 patients. Seventy-six were small-size, 24 medium-sized and eight large-size hospitals. All university hospitals were included. Regarding the type of hospitals, 53 primary, 36 secondary, ten tertiary and nine specialized hospitals participated in the survey.

According to the 2017 updated list of bed capacity in Swiss acute hospitals and the PPS hospital size categorisation, there were 148 small-size hospitals (less than 200 beds), 32 medium-sized hospitals (between 200 and 650 beds) and seven large hospitals (more than 650 beds) in Switzerland at that year. Of note, there have been changes in the meantime (e.g., the inclusion of another hospital in the large hospital category due to its capacity expansion), but by large the results of the PPS 2022 are representative of the Swiss hospital size distribution. While all large hospitals participated, about three out of four hospitals from both small and medium-sized categories were able to participate and conduct the PPS.

Table 2: Participating hospitals’ characteristics

	Hospitals, N	Patients, N
All	108	13916
Small size hospitals (<200 beds)	76	4416
Medium-size hospitals (200-650 beds)	24	4857
Large-size hospitals (>650 beds)	8	4643
University hospitals	5	3404
Primary hospitals	53	3633
Secondary hospitals	36	4794
Tertiary hospitals	10	4934
Specialized hospitals	9	555
Public hospitals	63	10834
Private non-for-profit hospitals	21	1793
Private for-profit hospitals	24	1289

In total, 95 and 99 hospitals provided information on COVID-19- and influenza vaccination coverage, respectively. Median (Interquartile range) COVID-19- and influenza vaccination coverages were 80% (70-86%) and 23% (15-33%), respectively. As mentioned above, questions on the level of automation of the most important surveillance modes were also asked. Although there are many differences between hospitals, especially with regard to hospital type and size, larger and tertiary hospitals tended to have the highest level of automation, at least for the most frequently performed surveillance activities in Switzerland.

Figure 7 : Level of automation of surveillance activities

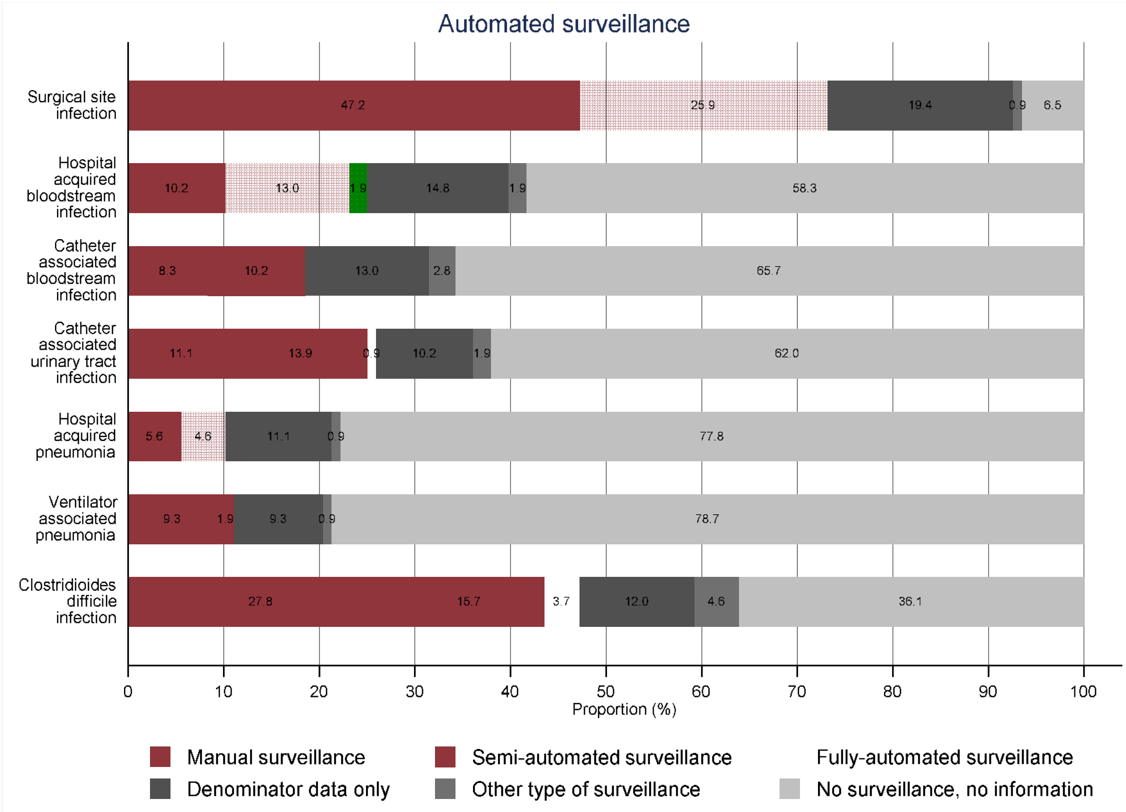
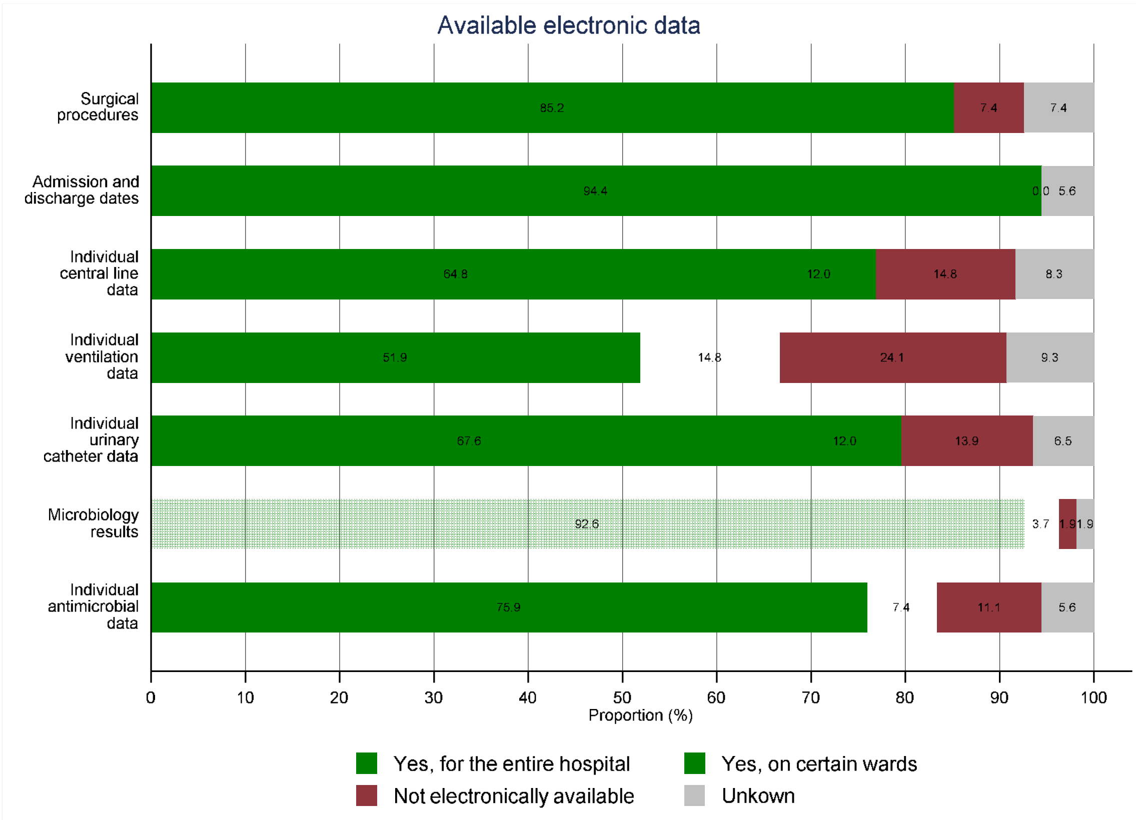


Figure 8: Electronically available denominator data

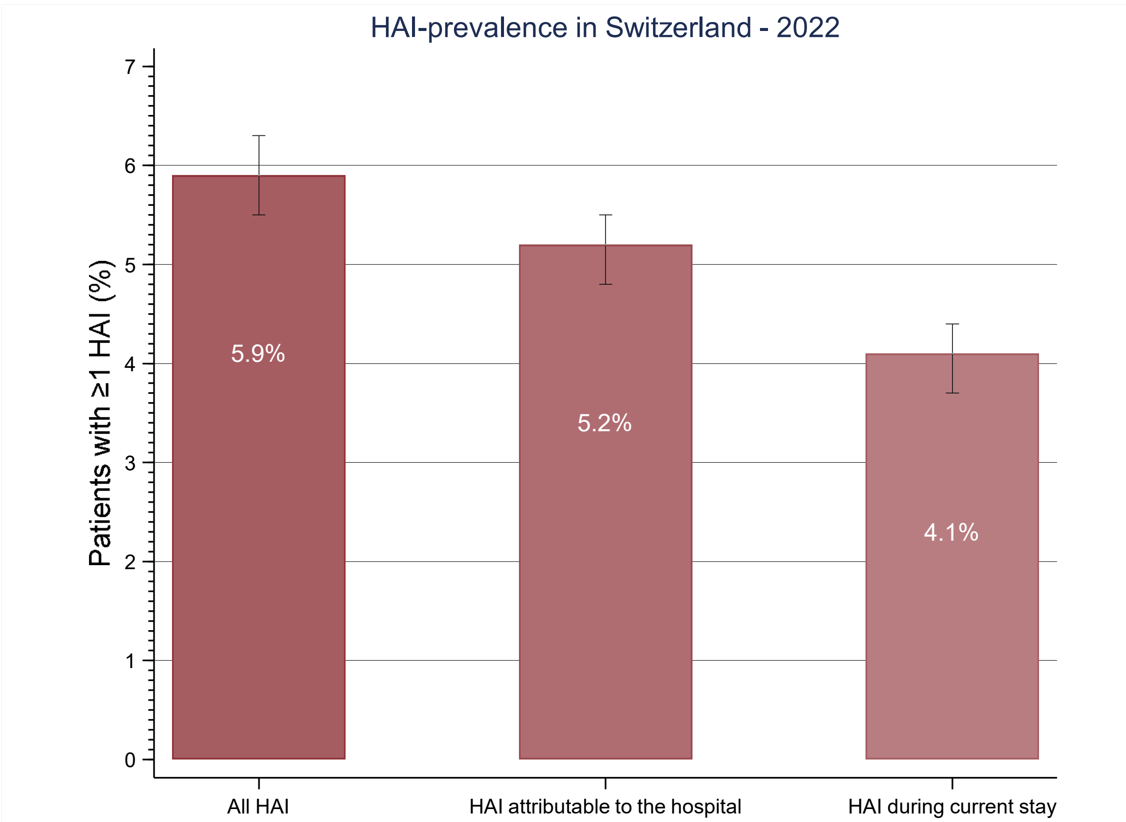


2. Healthcare-associated infections

HAIs are one of the most common adverse events during the hospital stay, resulting in substantial morbidity and mortality, an extension of the length of stay and increased readmission. According to the 2017 cost evaluation, HAIs entail considerable costs for Swiss hospitals, estimated at nearly 13,000 CHF per infection, or about 750 million CHF per year in Switzerland.[8] HAI prevalence is defined as the number of patients presenting one or more HAIs on the day of PPS compared to the total number of patients included in the survey.

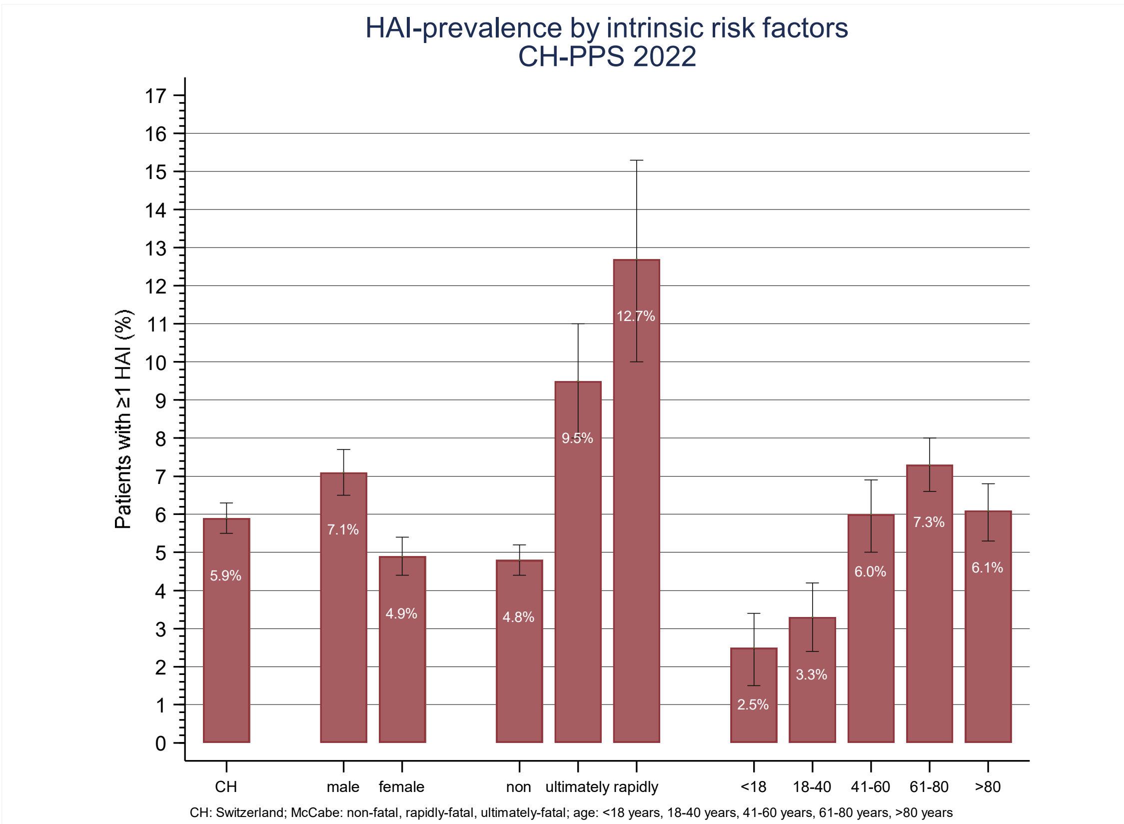
The prevalence of HAI is reported below in different formats: pooled and all-cause HAI from all participating hospitals, HAI without taking into account infections attributed to other hospitals, and all-cause HAI during the current stay. The following figure summarizes the different HAI prevalence formats.

Figure 9 : 2022 HAI prevalence in different formats (HAI prevalence in all participating hospitals and regardless of the origin of the infection, HAI prevalence attributable to the hospital reporting the HAI, and HAI prevalence contracted during the current stay of the reporting hospital)



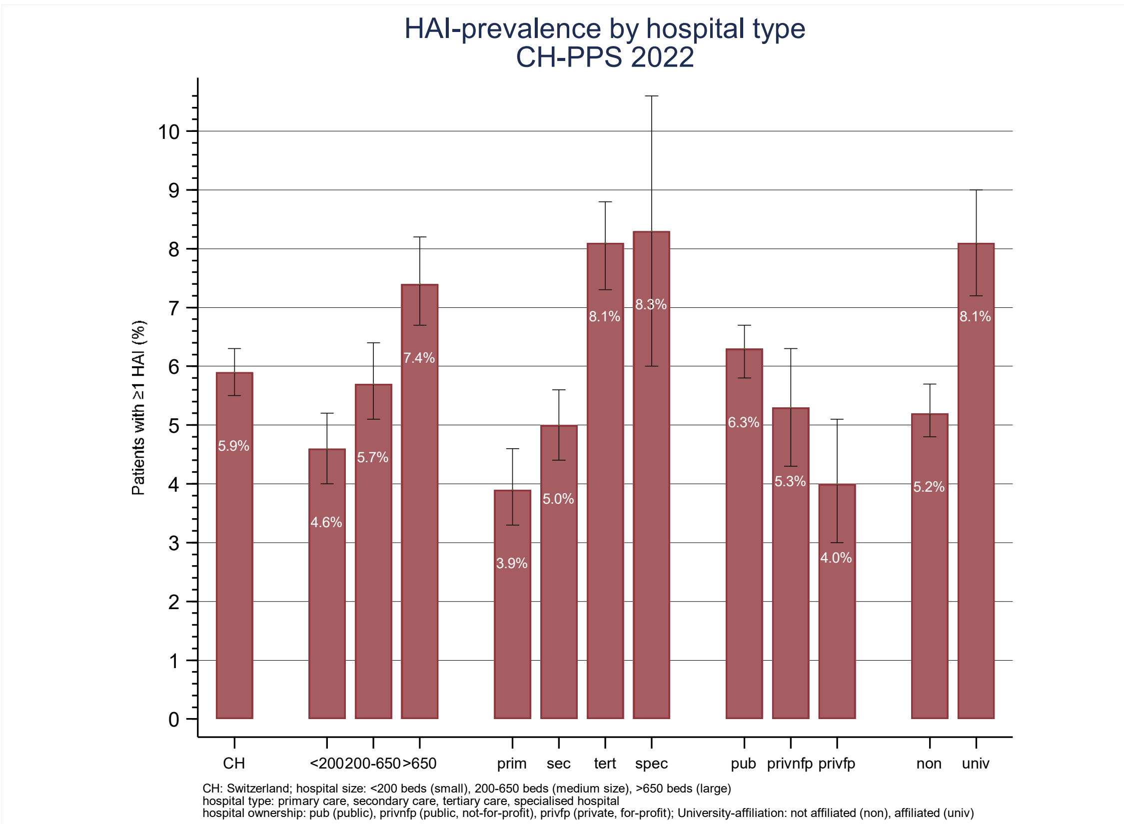
The prevalence of HAIs was also assessed according to the intrinsic risk factors of the included patients. Women tend to have a statistically significant lower HAI prevalence than men, which is mainly due to the fact that the prevalence is lower in obstetrics. The HAI prevalence is higher in patients with high fatality scores (McCabe score) and in older patients.

Figure 10 : HAI prevalence by intrinsic risk factors



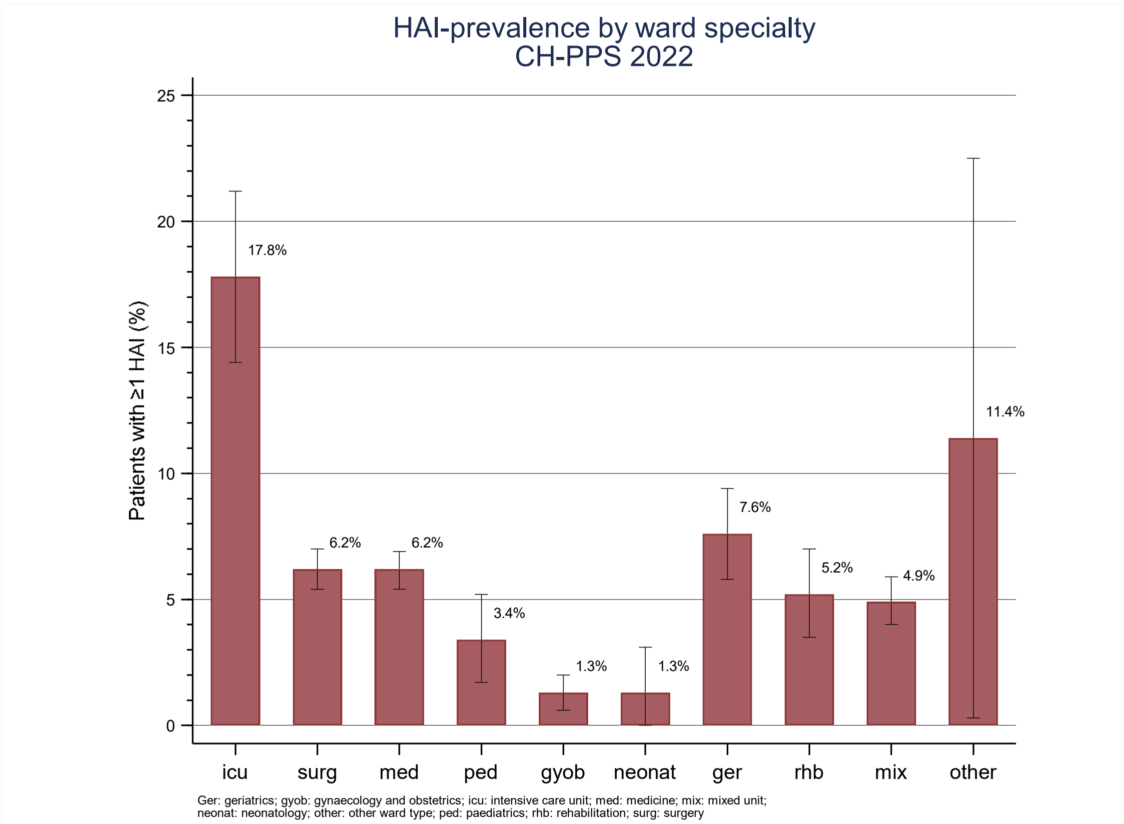
Analysis by hospital size (small: <200 beds, medium: 200-650 beds, large: >650 beds) and by hospital type (primary, secondary, tertiary, and specialized hospitals) shows that large and tertiary hospitals have a higher HAI prevalence than do small and primary care hospitals, which might be explained by the case mix and medical/surgical services offered by the first settings. Not surprisingly, the same finding was made when comparing university-affiliated and non-university hospitals.

Figure 11 : HAI prevalence by hospital type



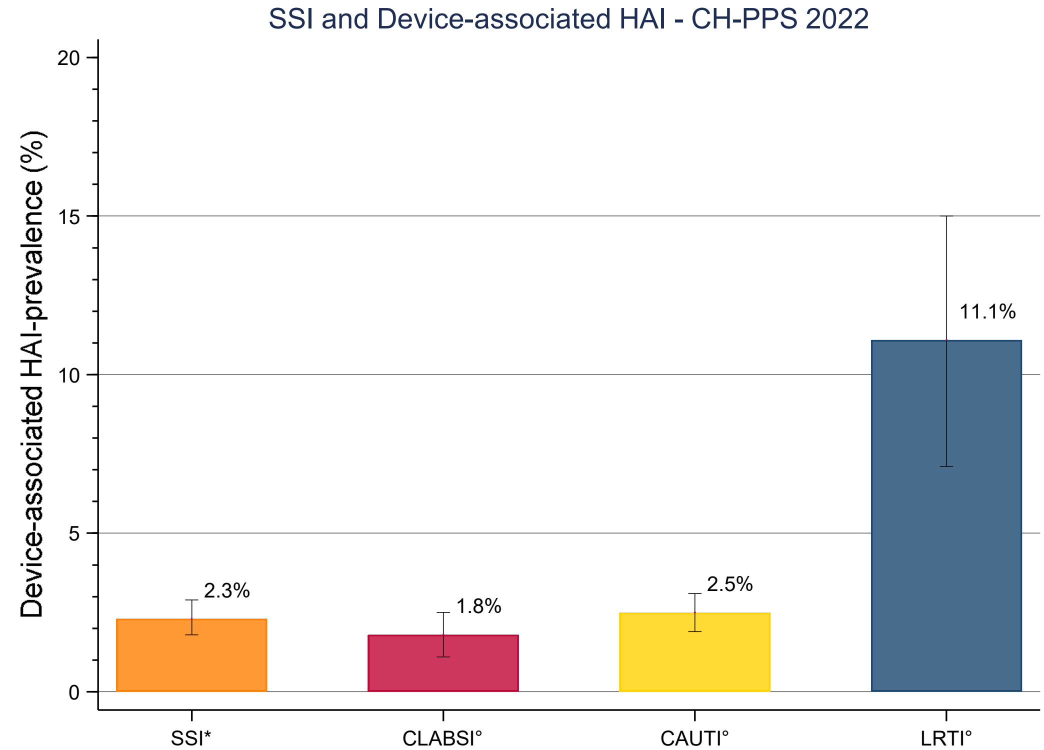
The highest HAI prevalence was identified in intensive care although only a small proportion of patients were hospitalized in intensive care units (ICUs).

Figure 12 : HAI prevalence by ward specialty



The following figure summarizes the prevalence of HAIs associated with surgery (SSIs) or the use of medical devices such as vascular catheters, urinary catheters and ventilation.

Figure 13 : **SSI and device-associated HAI prevalence in patients underwent surgery during or with devices during the current stay**



* Number of surgical site infections occurring during present hospital stay as per NHSN (national healthcare safety network) surgeries during current hospital stay
° Number of infections as per patients having a relevant medical device in place at survey
CAUTI: catheter-associated urinary tract infection; CLABSI: central line-associated (bloodstream) infection;
LRTI: lower-respiratory tract infection; SSI: surgical site infection

The figures below summarize the trend of HAI prevalence since 2017 in all participating hospitals.

Figure 14 : HAI prevalence in hospitals participating on both national PPS

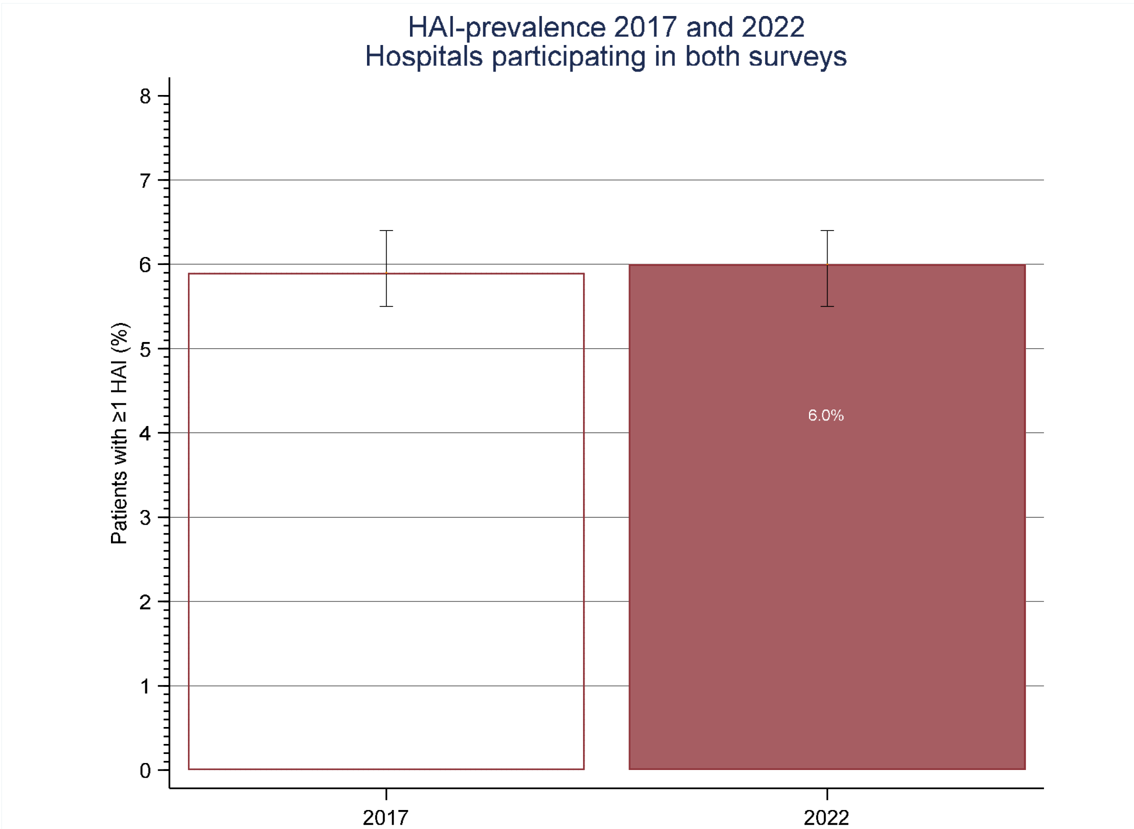
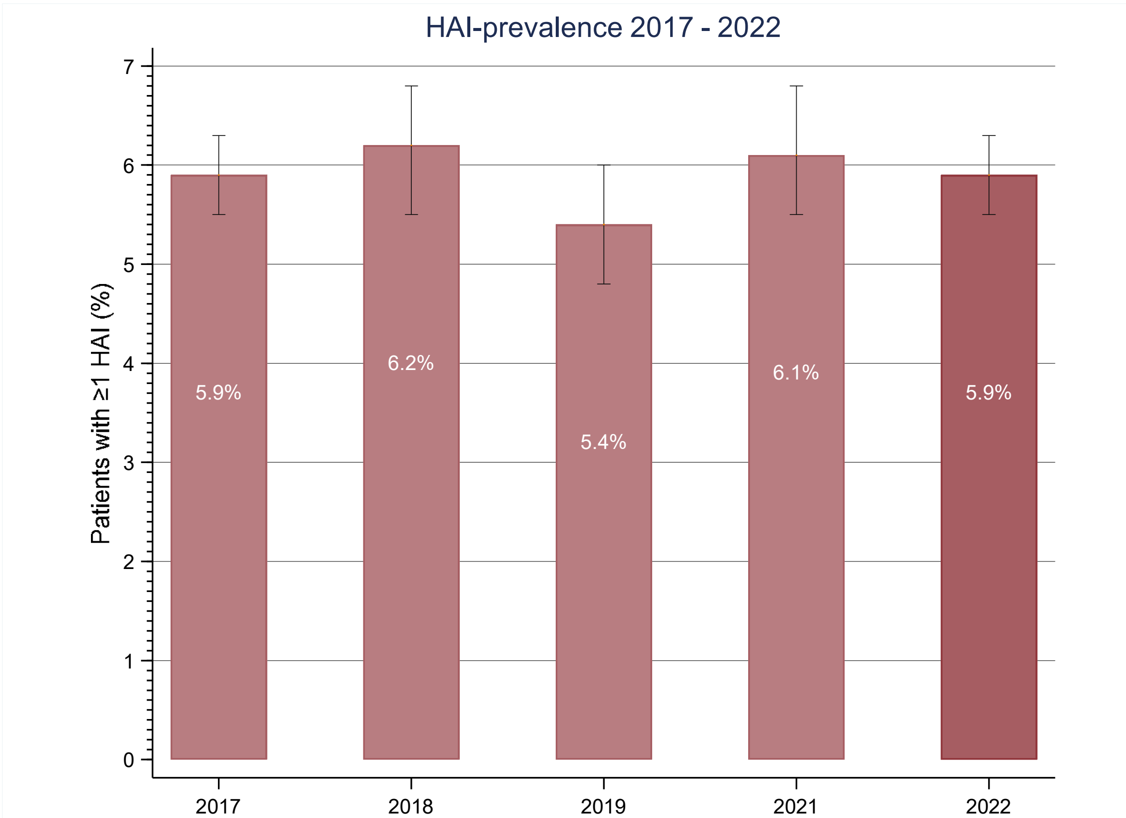


Figure 15 : HAI prevalence in all participating hospitals over time



Trends of HAI prevalence, as estimated considering all participating hospitals or only those that participated in all surveys, over the years are presented below in different formats: pooled all-cause HAI prevalence, HAI prevalence without taking into account infections attributed to other hospitals, all-cause HAI during the current stay. The following figures summarize the different HAI prevalence formats.

Figure 16 : HAI prevalence over time including all participating hospitals in three different formats: HAI prevalence in all participating hospitals and regardless of the origin of the infection, HAI prevalence attributable to the hospital reporting the HAI and HAI prevalence contracted during the current stay of the reporting hospital

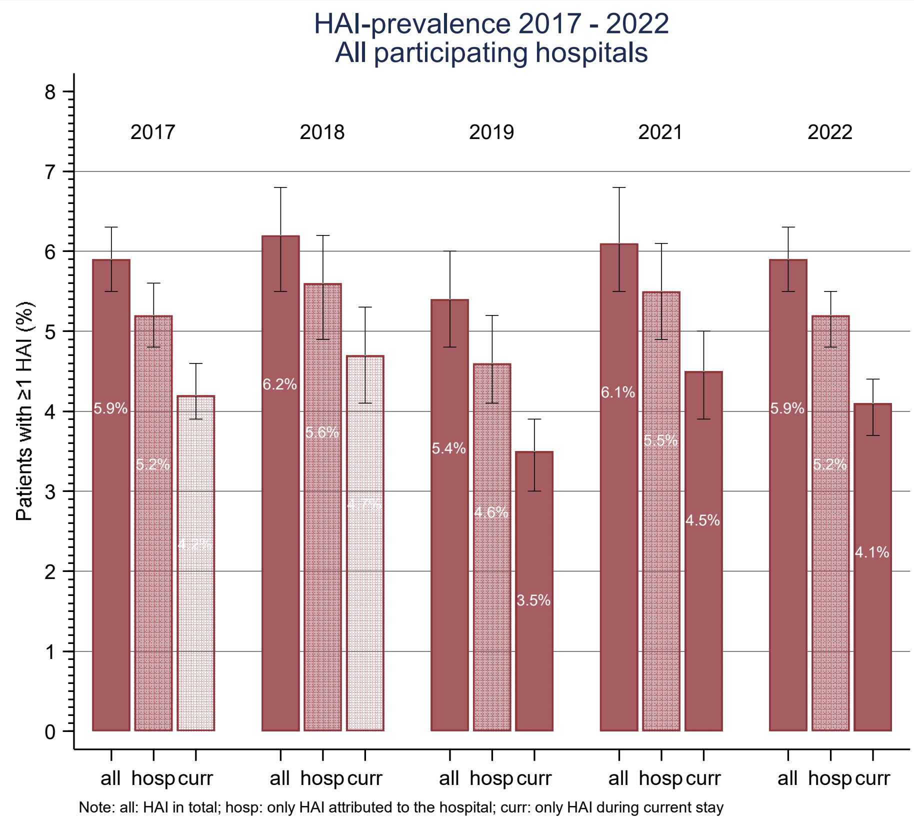
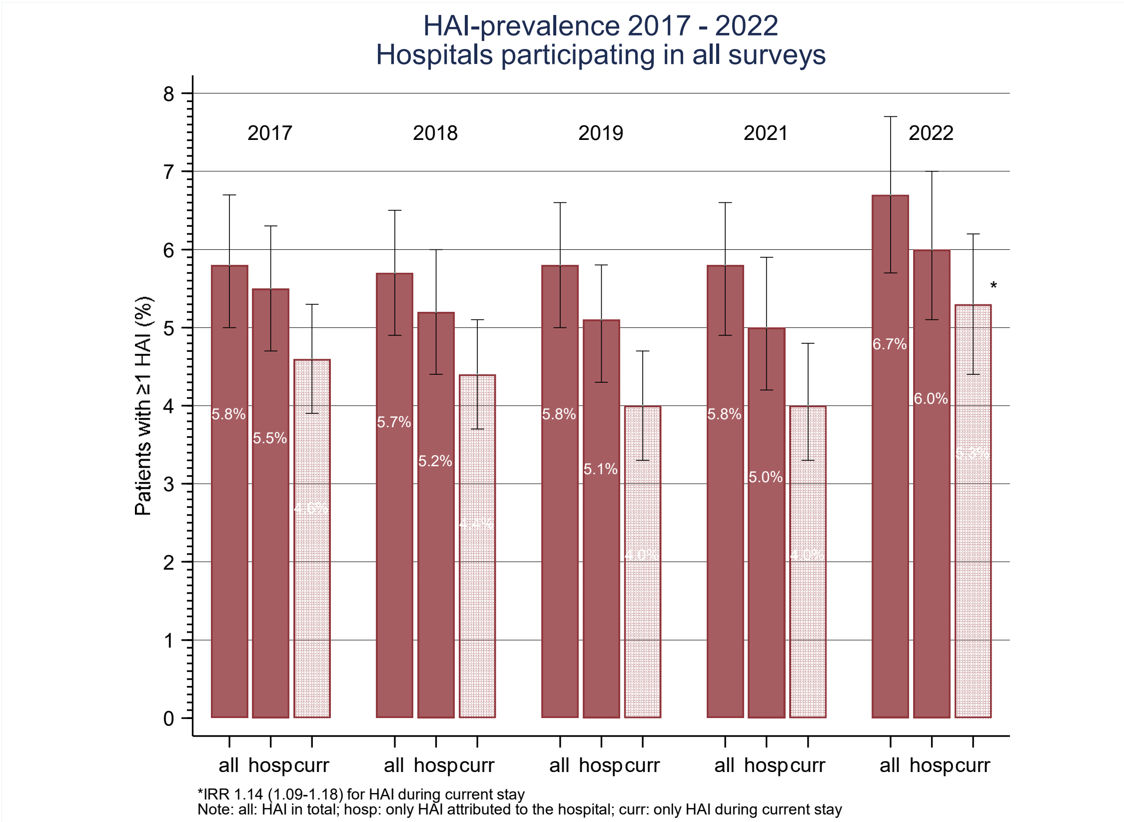
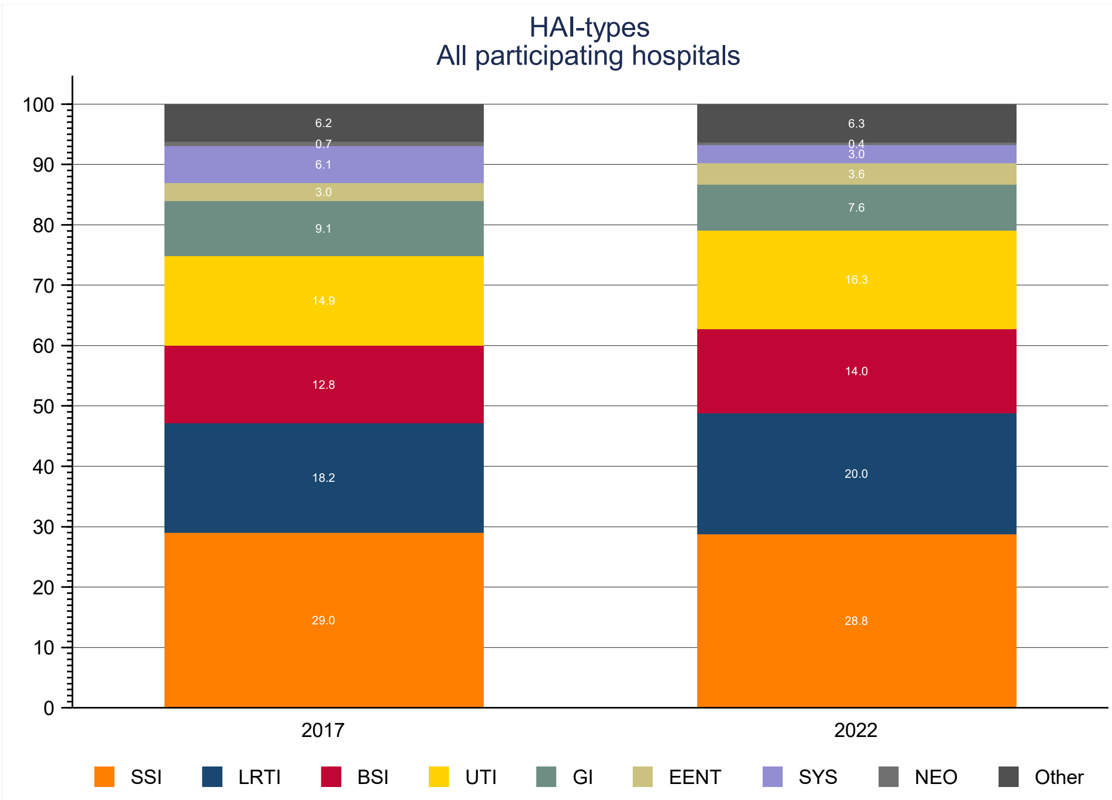


Figure 17 : HAI prevalence over time in hospitals participating in all surveys in three different formats: HAI prevalence in all participating hospitals and regardless of the origin of the infection, HAI prevalence attributable to the hospital reporting the HAI and HAI prevalence contracted during the current stay of the reporting hospital



In 2022 PPS, SSI were the most common infections, followed by LRTI, UTI, and BSI, similar to 2017.

Figure 18 : HAI types (proportions) in all participating hospitals in the two national PPS (SSI: surgical-site infection, LRTI: lower respiratory tract infection, BSI: bloodstream infection, UTI: urinary tract infection, GI: gastro-intestinal infection, EENT: eye, ear, nose, throat or mouth infection, SYS: systemic infection, NEO: neonatal infection, other: other infection)



The following figures (36-39) summarize HAI prevalence by HAI type in various formats: Device-associated and non-device-associated HAI types in all participating hospitals, in hospitals participating in all surveys, by hospital size and by hospital type. Differences are noted, but SSIs remain the most common HAI in all of these different presentations.

Figure 19 : Device and non-device-associated HAI types (proportions) in all participating hospitals in the two national PPS (SSI: surgical-site infection, LRTI: lower respiratory tract infection, VAP: ventilator-associated pneumonia, BSI: bloodstream infection, CABSI: catheter-associated bloodstream infection, UTI: urinary tract infection, CAUTI: catheter-associated urinary tract infection, GI: gastro-intestinal infection, EENT: eye, ear, nose, throat or mouth infection, SYS: systemic infection, NEO: neonatal infection, other: other infection)

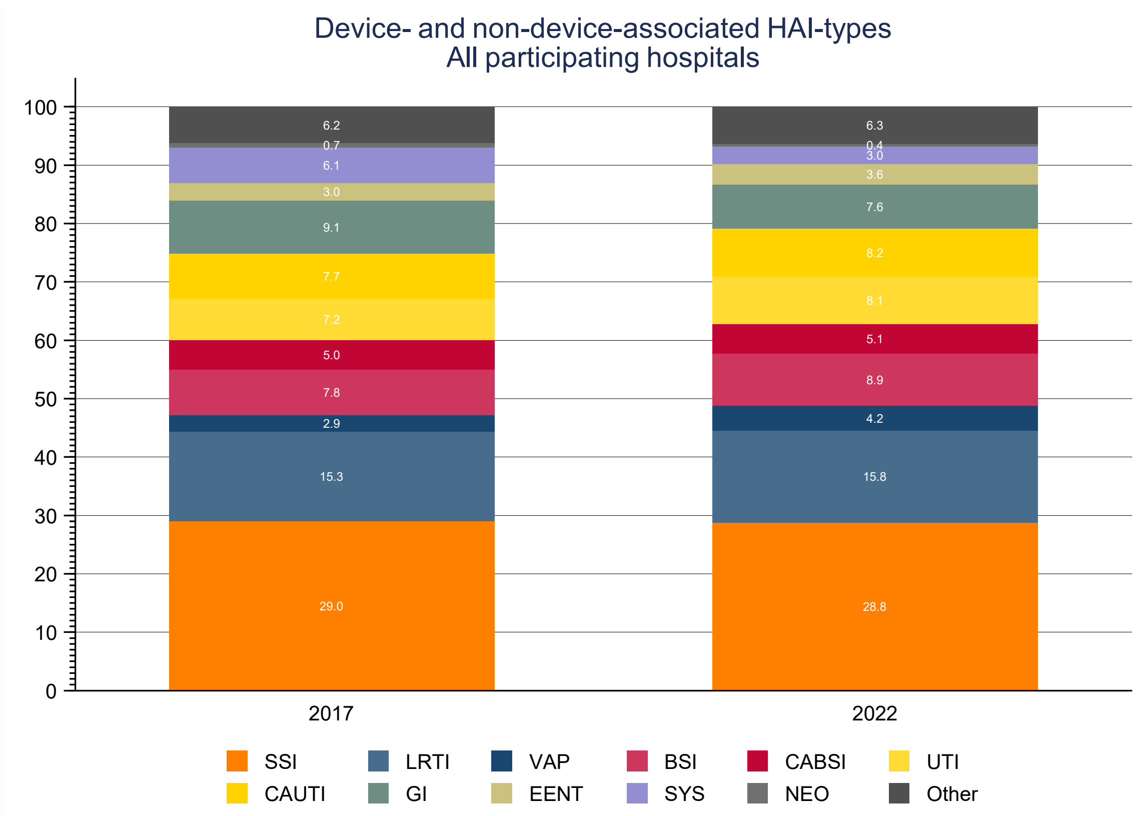


Figure 20 : Device and non-device-associated HAI types (proportions) in hospitals participating in all surveys (SSI: surgical-site infection, LRTI: lower respiratory tract infection, VAP: ventilator-associated pneumonia, BSI: bloodstream infection, CABSI: catheter-associated bloodstream infection, UTI: urinary tract infection, CAUTI: catheter-associated urinary tract infection, GI: gastro-intestinal infection, EENT: eye, ear, nose, throat or mouth infection, SYS: systemic infection, NEO: neonatal infection, other: other infection)

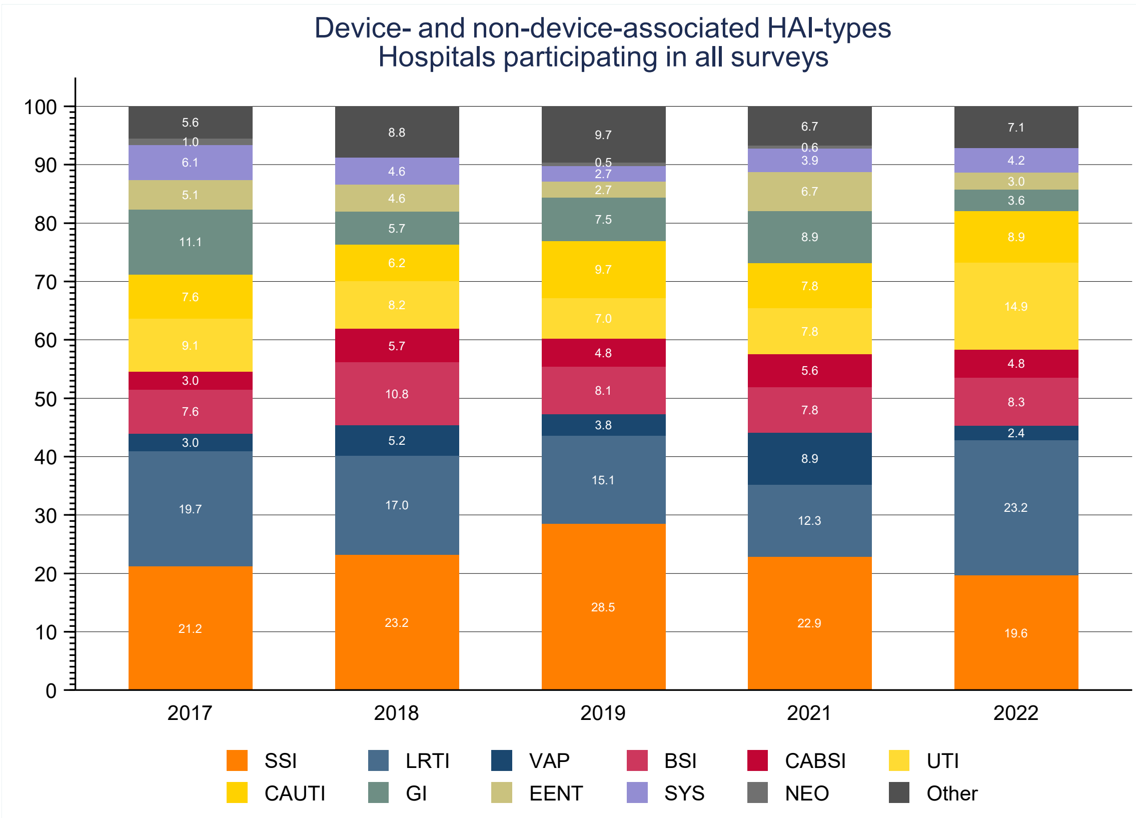
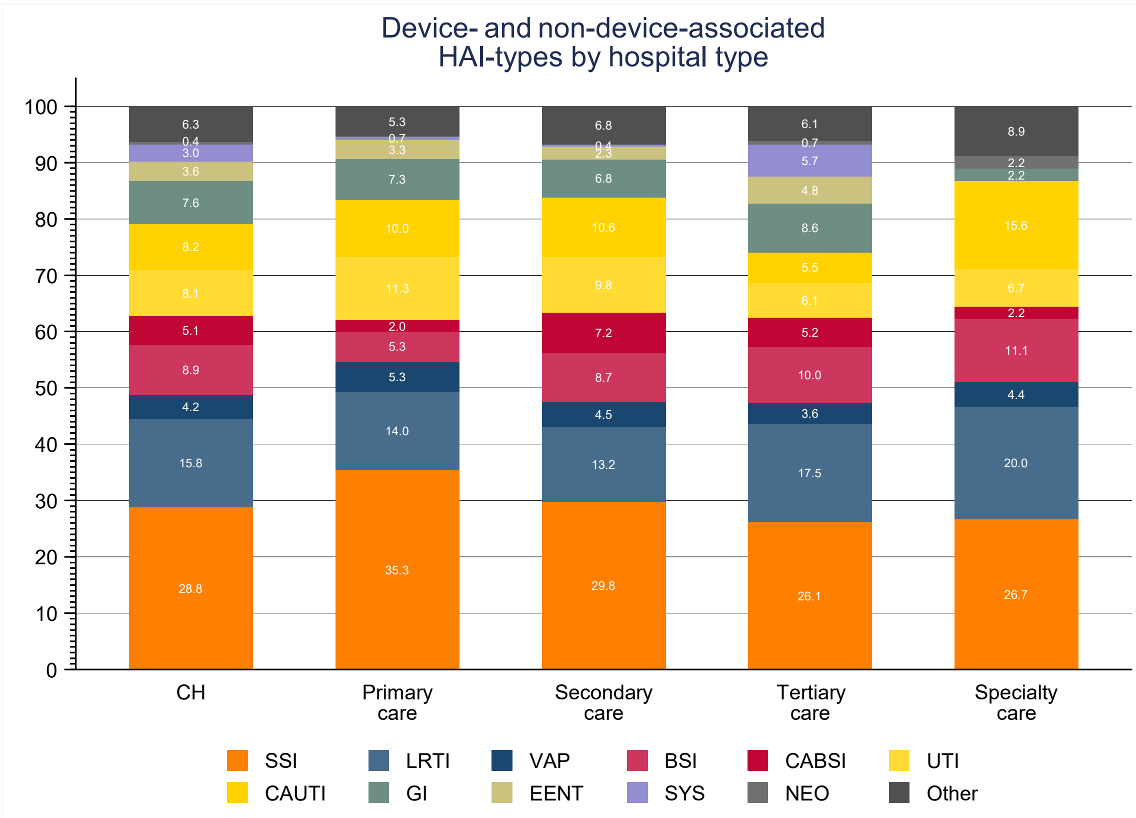


Figure 21: Device and non-device-associated HAI types (proportions) by hospital type (SSI: surgical-site infection, LRTI: lower respiratory tract infection, VAP: ventilator-associated pneumonia, BSI: bloodstream infection, CABSI: catheter-associated bloodstream infection, CABSI: catheter-associated bloodstream infection, UTI: urinary tract infection, CAUTI: catheter-associated urinary tract infection, GI: gastro-intestinal infection, EENT: eye, ear, nose, throat or mouth infection, SYS: systemic infection, NEO: neonatal infection, other: other infection)



When comparing the rates of microbiological testing of all HAIs and their culture positivity rate, no difference was found between the two national surveys in 2017 and 2022. The distribution of pathogens in 2022 is similar to 2017, although more virus-related infections were identified in 2022.

Figure 22 : Microbiological examination of all HAIs and positive microbiological results in 2017 and 2022 PPS

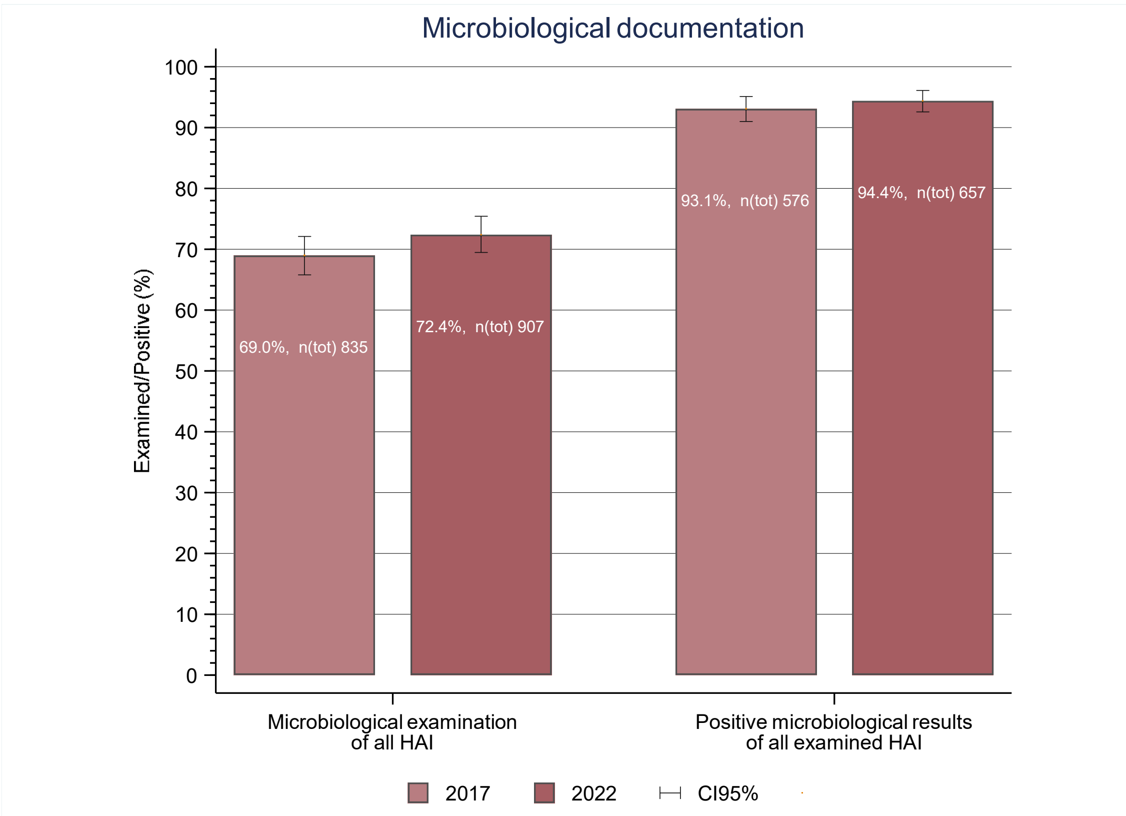
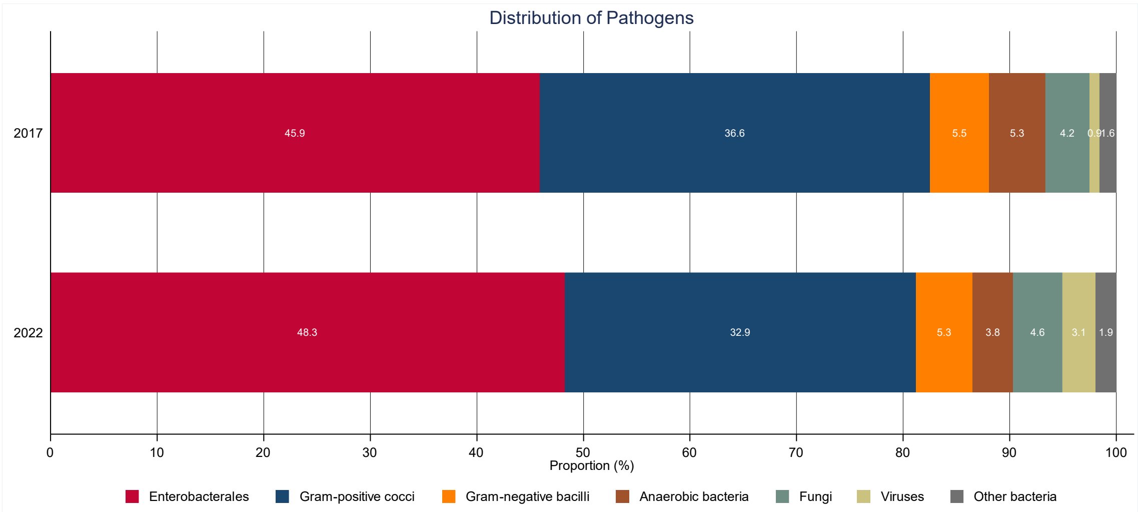
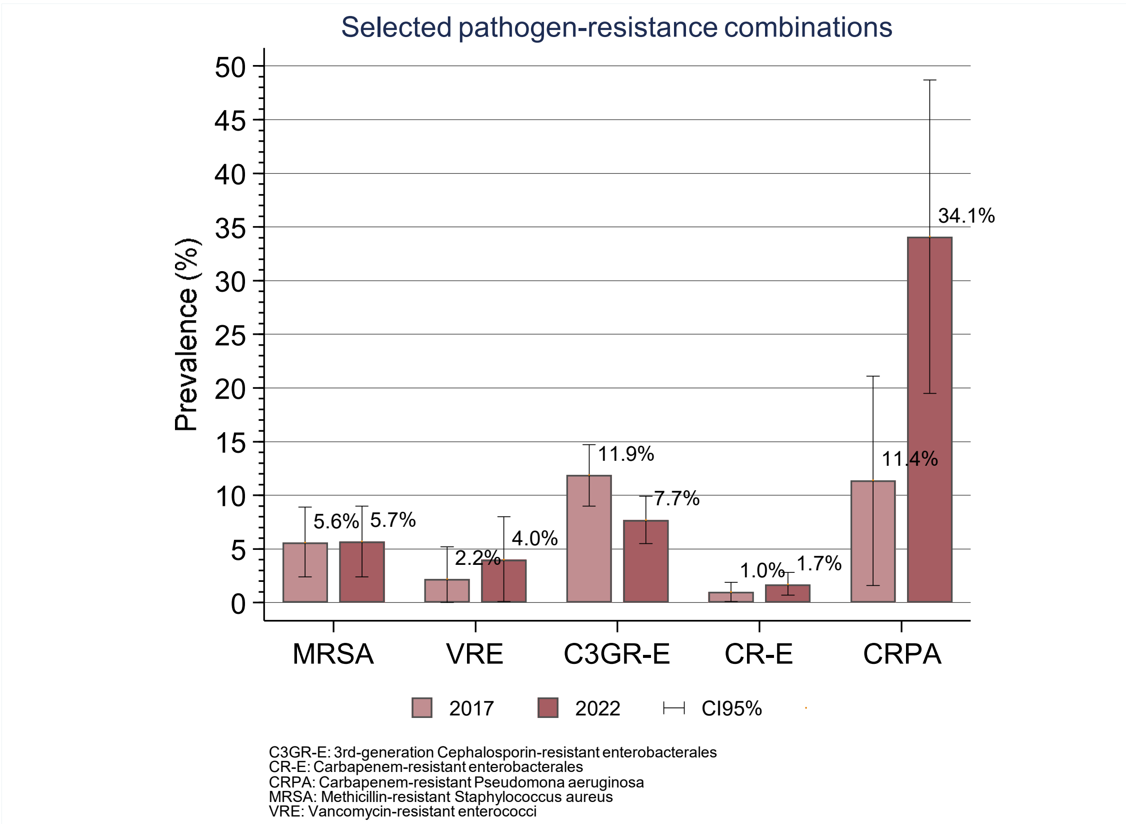


Figure 23 : Distribution of pathogens in 2017 and 2022 PPS



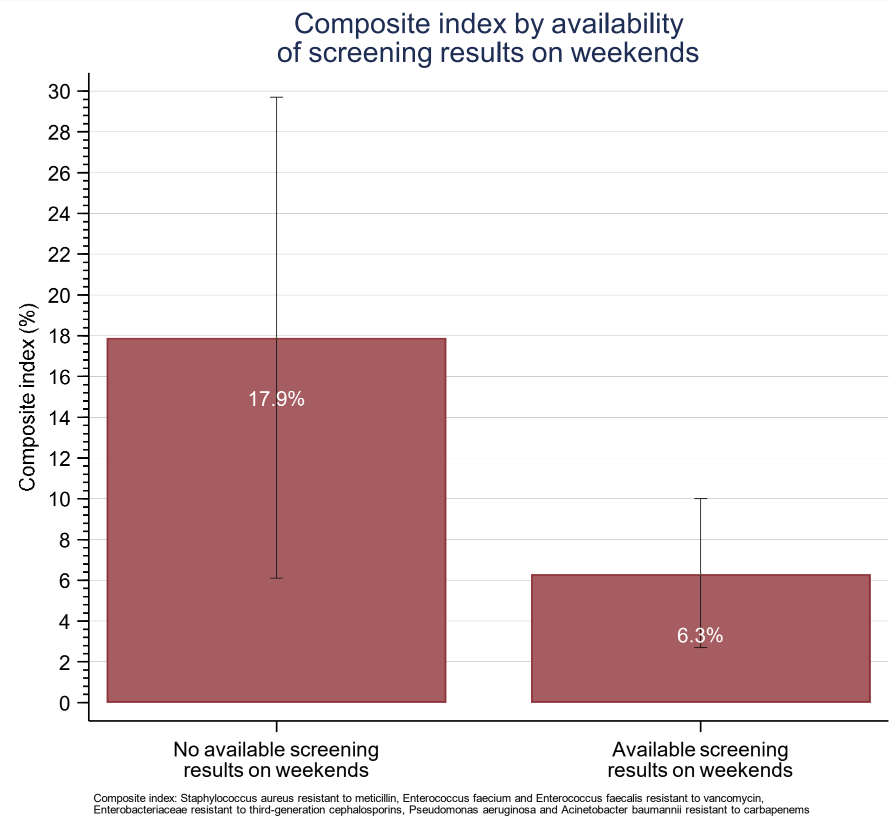
No statistically significant differences were found in selected microorganism-antibiotic combinations between 2017 and 2022; however, there is an increase in carbapenem resistance in *Pseudomonas aeruginosa.*

Figure 24 : Prevalence of selected resistant microorganisms in 2017 and 2022 PPS (MRSA: Methicillin-resistant *Staphylococcus aureus*; VRE: Vancomycin-resistant *Enterococcus*; C3GR-E: 3d generation Cephalosporin-resistant Enterobacteriaceae; CR-E: Carbapenem-resistant Enterobacteriaceae; CRPA: Carbapenem-resistant *Pseudomonas aeruginosa)*



In 2022, significantly fewer multidrug-resistant organisms were reported in hospitals where screening results were available on weekends.

Figure 25 : Composite index availability of screening results on weekends

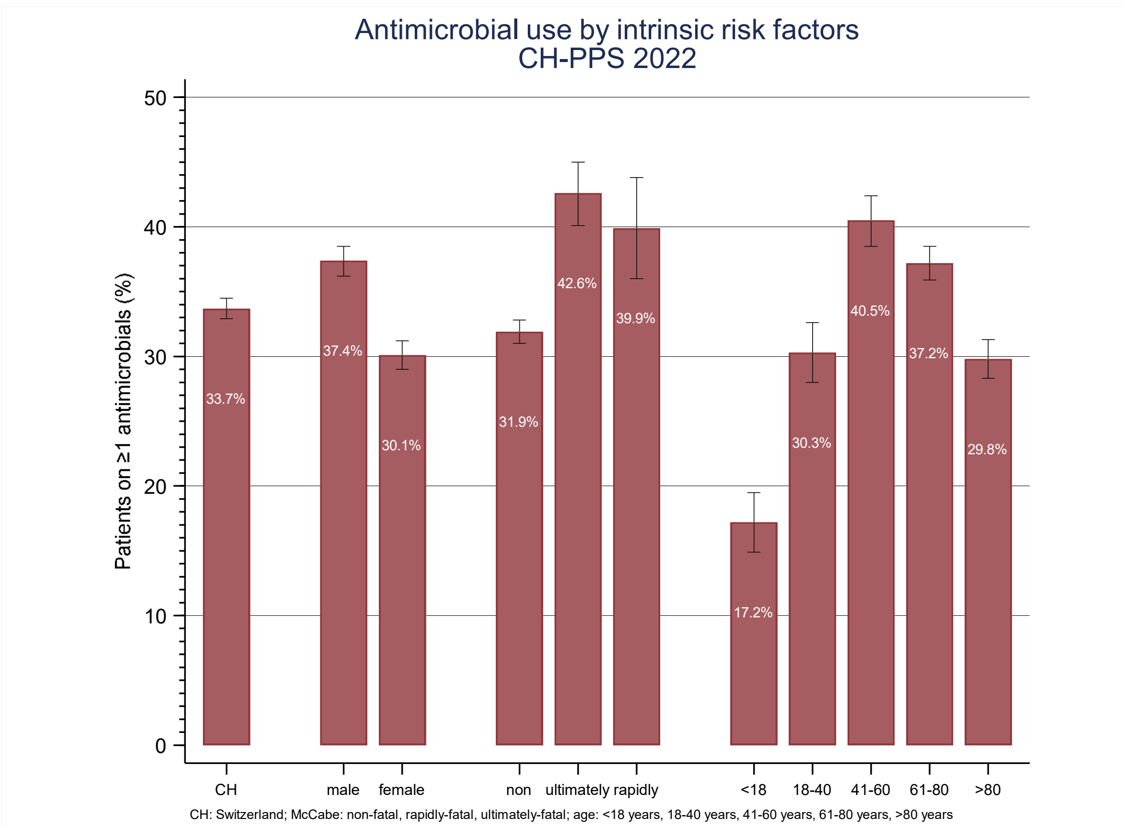


3. Antimicrobial use

Data on antimicrobial (AM) use in the CH-PPS offer comprehensive assessments of antimicrobial consumption in acute care hospitals. A recent study by the Swiss Centre for Antibiotic resistance (ANRESIS) showed that during the first year of the pandemic, total antibiotic consumption in acute care hospitals remained stable; however, a slight increase was detected in intensive care.[9]

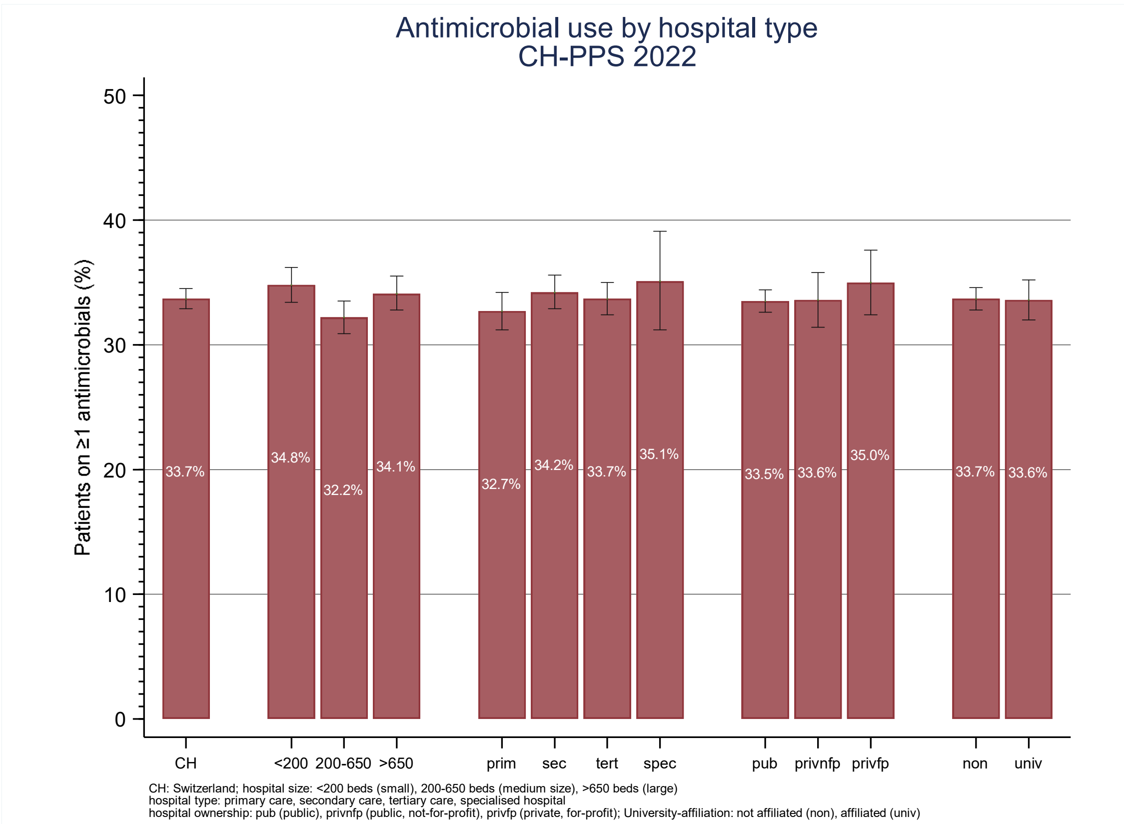
The following figure shows the prevalence of patients on one or more antimicrobials stratified by intrinsic risk factors. Similar to the findings on HAI, AU is significantly higher in men compared to women, as well as in older and more severely ill patients.

Figure 26 : AU prevalence by intrinsic risk factors



Analysis by hospital size (small: <200 beds, medium: 200-650 beds, large: >650 beds) and by hospital type (primary, secondary, tertiary, and specialized hospitals, public, private for-profit, private not-for-profit, university-affiliated), showed no differences. However, indications vary considerably between different size hospitals (see figure 27), with small hospitals using more antimicrobials for surgical prophylaxis compared to medium size or large hospitals.

Figure 27 : AU prevalence by hospital size (small: <200 beds, medium: 200-650 beds, large: >650 beds) and by hospital type (primary, secondary, tertiary, and specialized hospitals, public, private for-profit, private not-for-profit, university-affiliated)



No differences were noticed in AU prevalence in the hospitals over time, even when examining the different categories of indications (any use, therapeutic use, surgical prophylaxis, and medical prophylaxis).

Figure 28 : AU prevalence in all participating hospitals over time

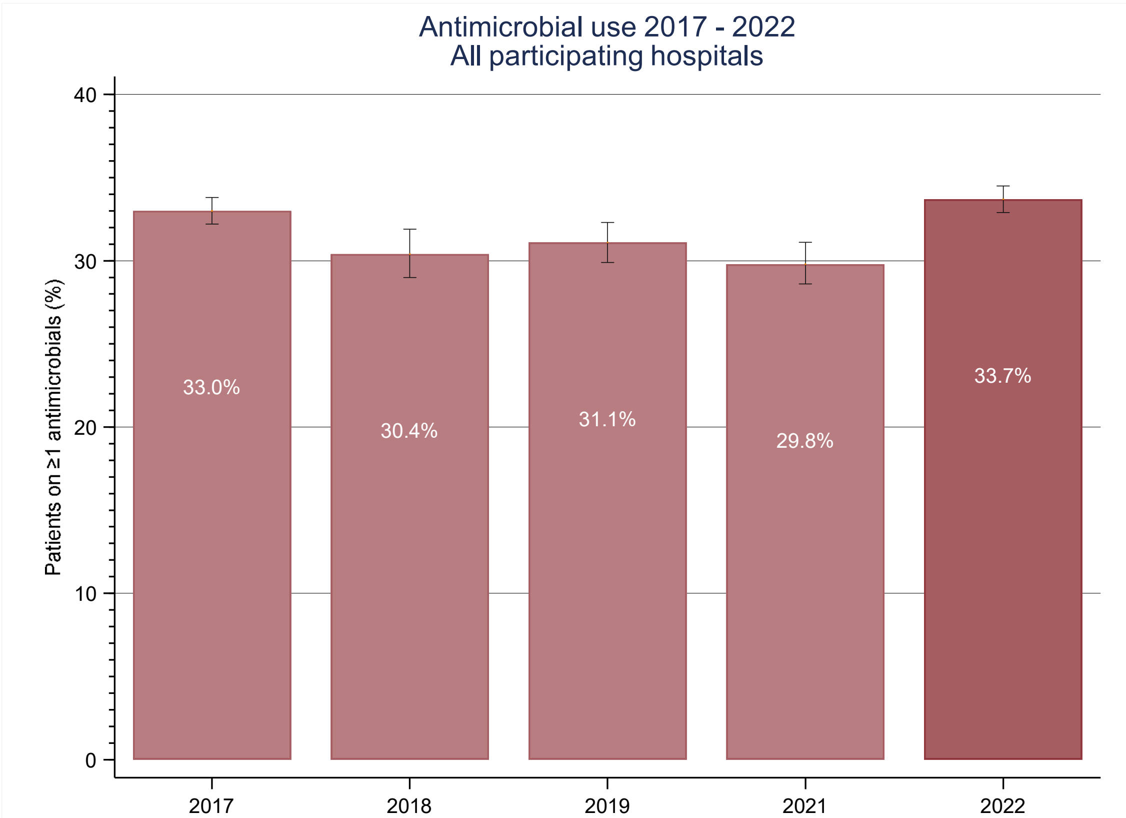
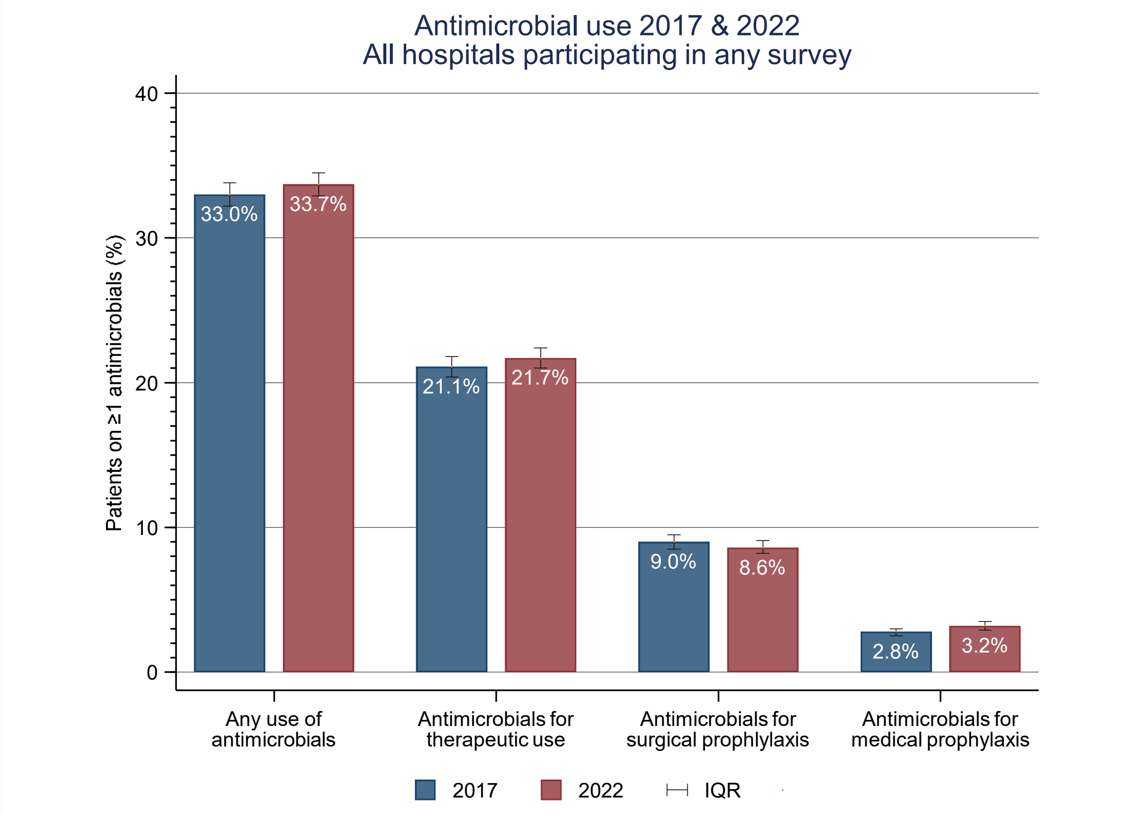


Figure 29 : AU prevalence in all participating hospitals by antimicrobial indication in 2017 and 2022 PPS



A statistically significant difference was found in the prevalence of AU in 2022 compared with 2017 when only hospitals participating in both surveys were included. Additional analysis shows a possible concentration effect due to the participation of a hospital in a different configuration that excluded wards with low AU prevalence. When AU prevalence in 2017 and 2022 was analyzed by antimicrobial indication, the statistically significant difference remained for all indications (therapeutic, medical or surgical prophylaxis). Results are summarized in figures 30and 31.

Figure 30 : AU prevalence in hospitals participating in all surveys over time

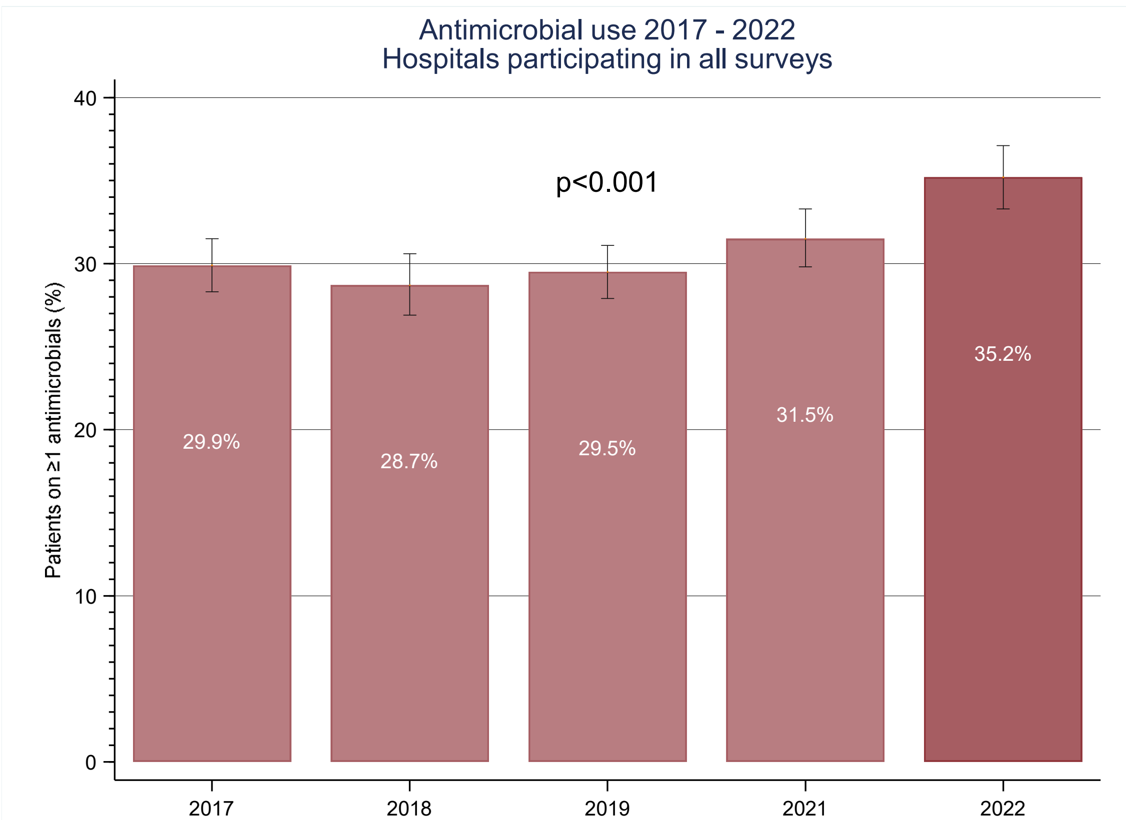
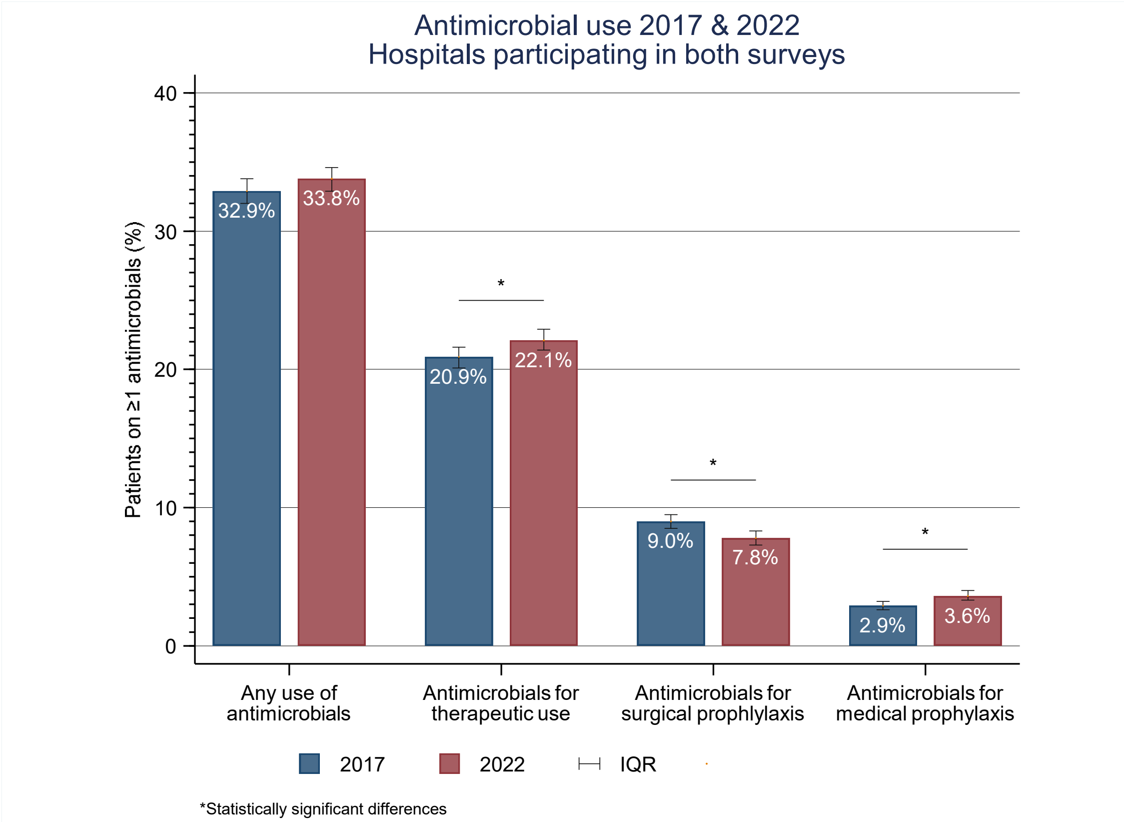


Figure 31 : AU prevalence in hospitals participating in both national surveys by indication



The trend in change of antimicrobials for therapeutic use is shown in Figures 32 and 33. Surprisingly, the absence of antimicrobial change increased significantly in PPS 2022 compared to 2017, as did the change from parenteral to oral use. While the former behaviour is difficult to interpret, the latter may be a good sign of de-escalation of therapy when possible.

Figure 32 : Change of antimicrobials for therapeutic use in both national PPS

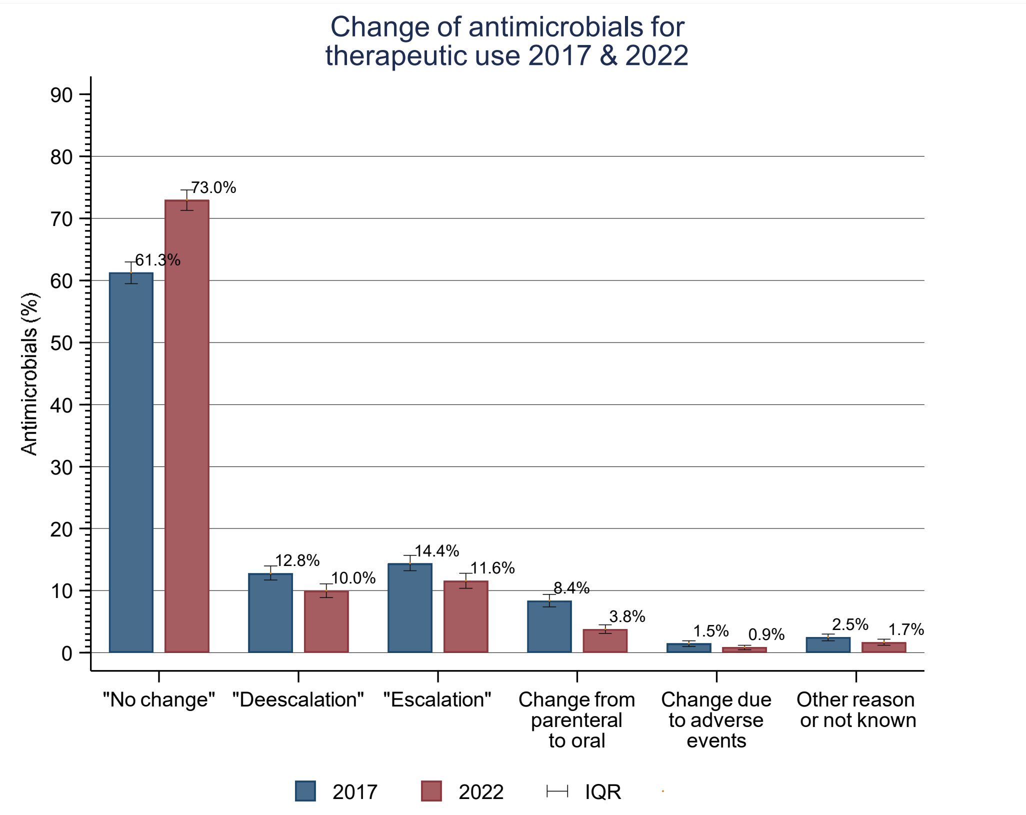
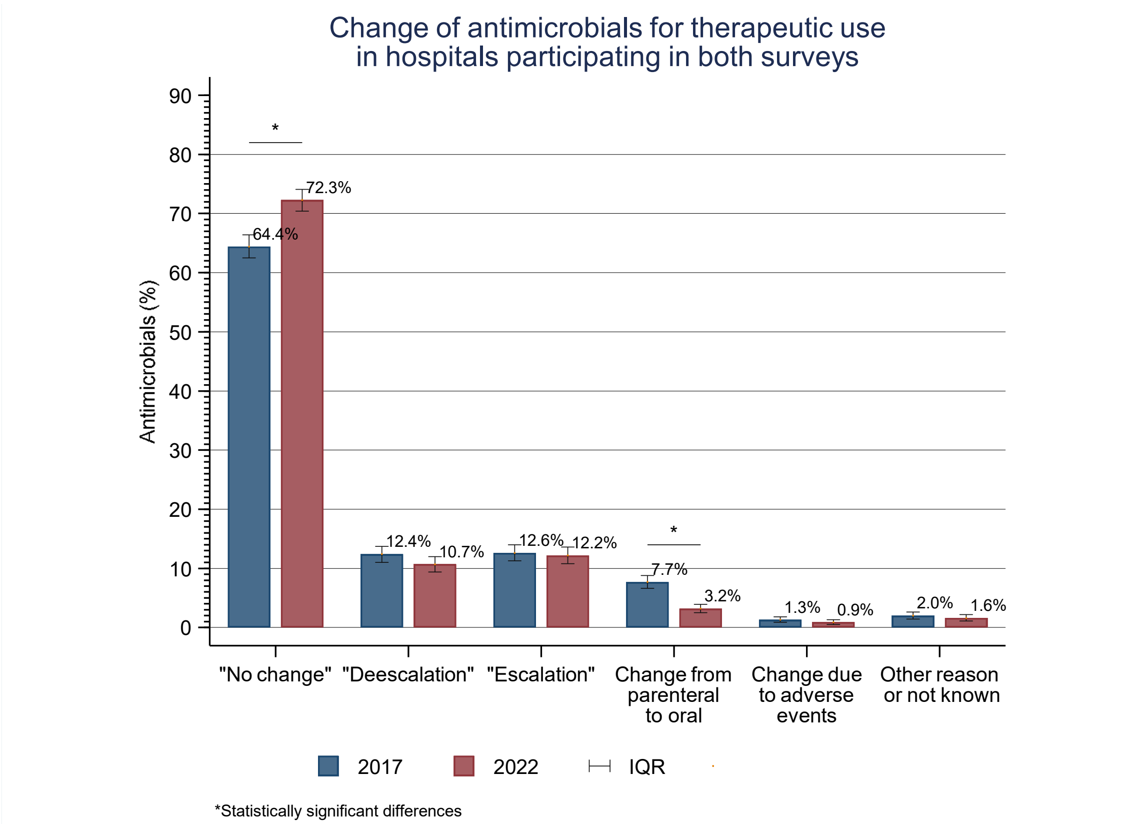


Figure 33 : Change of antimicrobials for therapeutic use in hospitals participating in both surveys in 2017 and 2022 PPS



Co-amoxicillin, cefuroxime, ceftriaxone, and piperacillin-tazobactam account for more than half of all antimicrobials used at the time of PPS for all indications. When considering only antimicrobials used for therapeutic purposes, co-amoxicillin, ceftriaxone, and piperacillin-tazobactam are the most frequently used antimicrobials. Subsequently, and fortunately, carbapenems are less commonly used. Results are summarized in figures 34 and 35.

Figure 34 : Most frequently used antimicrobials for all indications

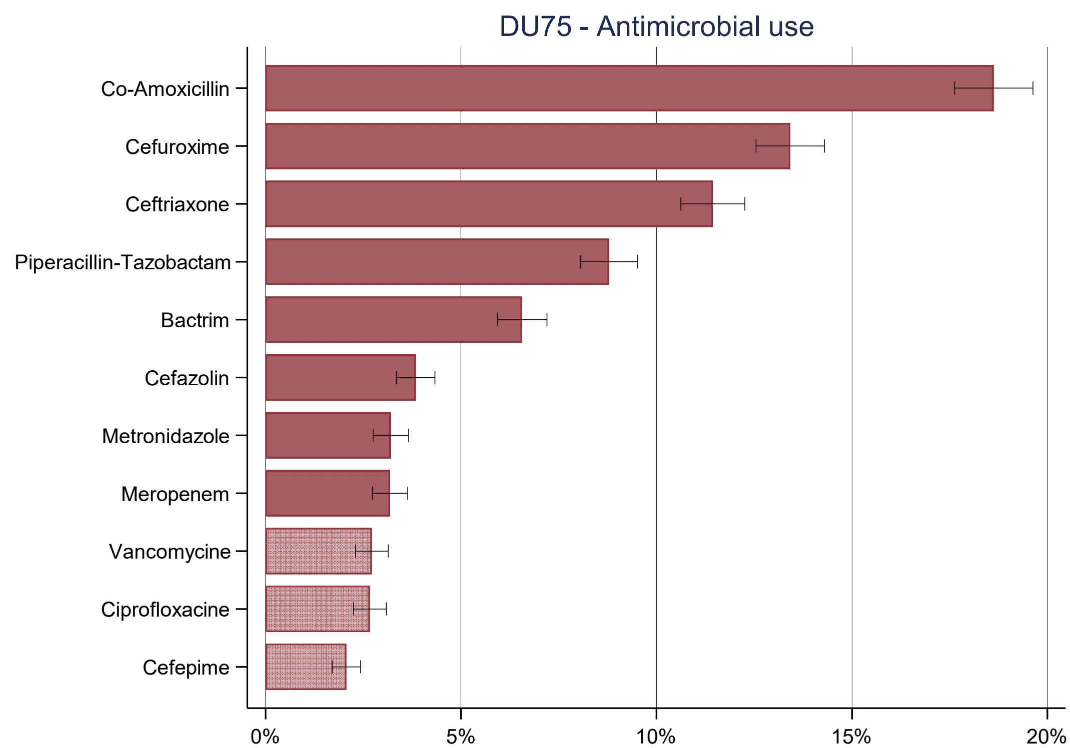


Figure 35 : Most frequently used antimicrobials for therapeutic use

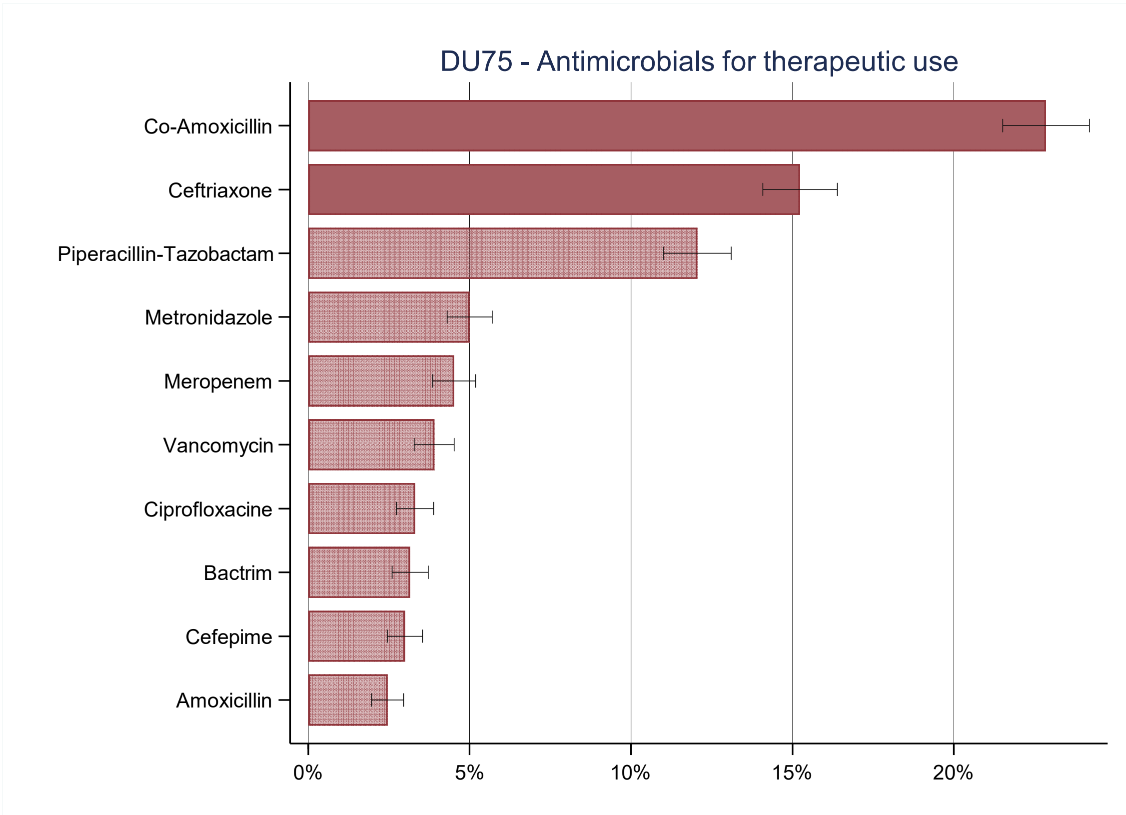


Figure 36 : Antimicrobial classes used by hospital size

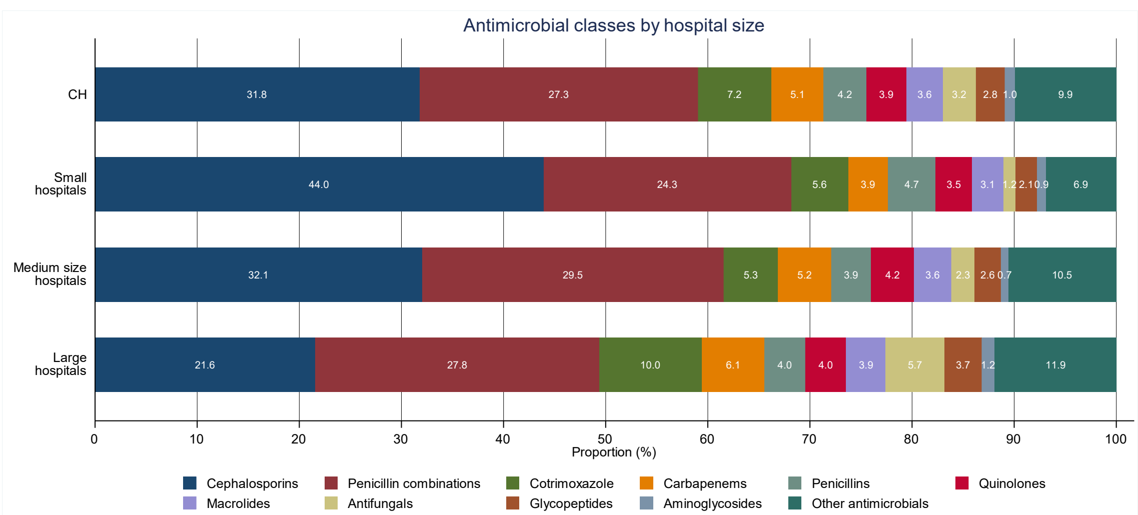
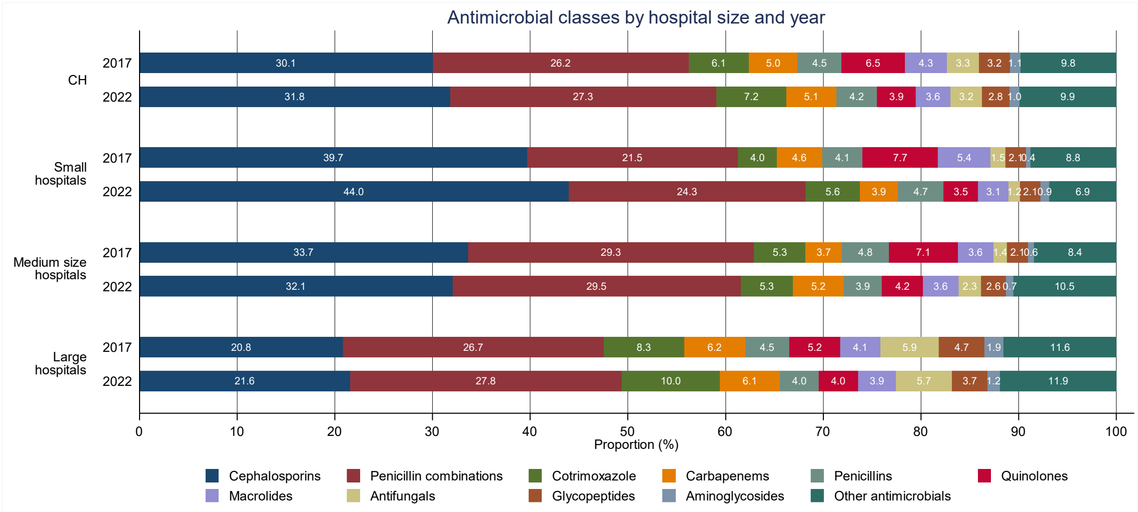
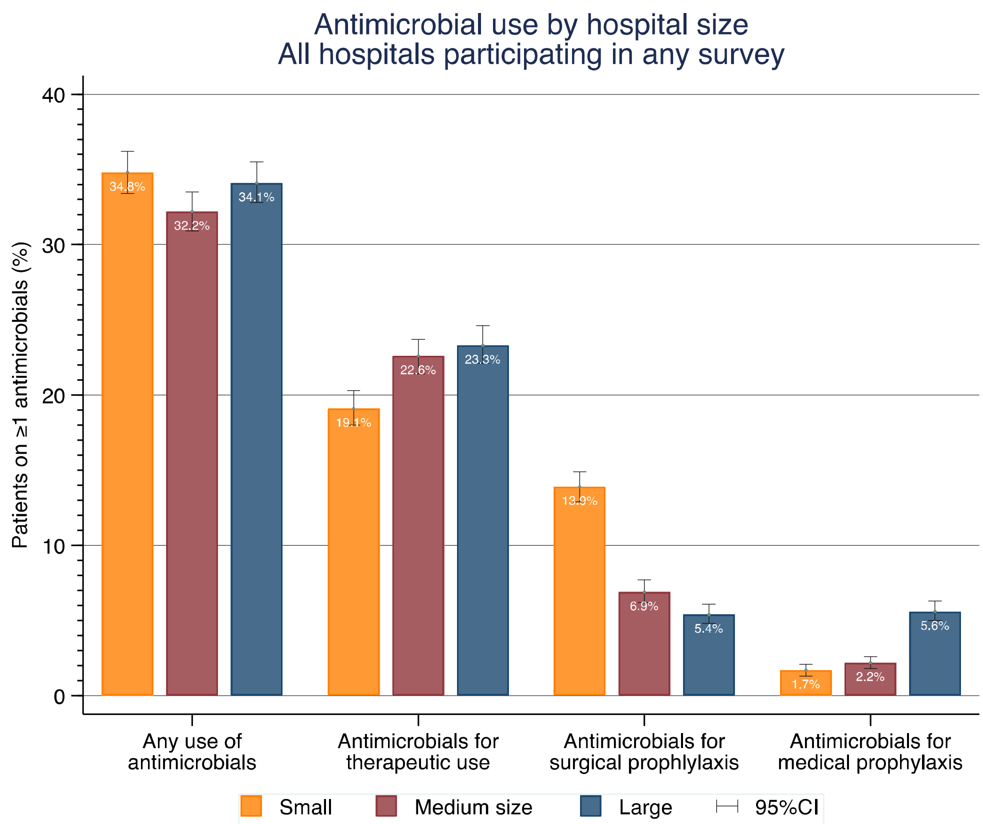


Figure 37 : Antimicrobial classes used by hospital size in both national surveys



Antimicrobial classes by hospital size and year
CH
Small hospitals
Medium size hospitals
Large hospitals
2017
2022
Proportion (%)
Cephalosporins
Penicillin combinations
Cotrimoxazole
Carbapenems
Penicillins
Quinolones
Macrolides
Antifungals
Glycopeptides
Aminoglycosides
Other antimicrobials

Figure 38 : Antimicrobial use by hospital size



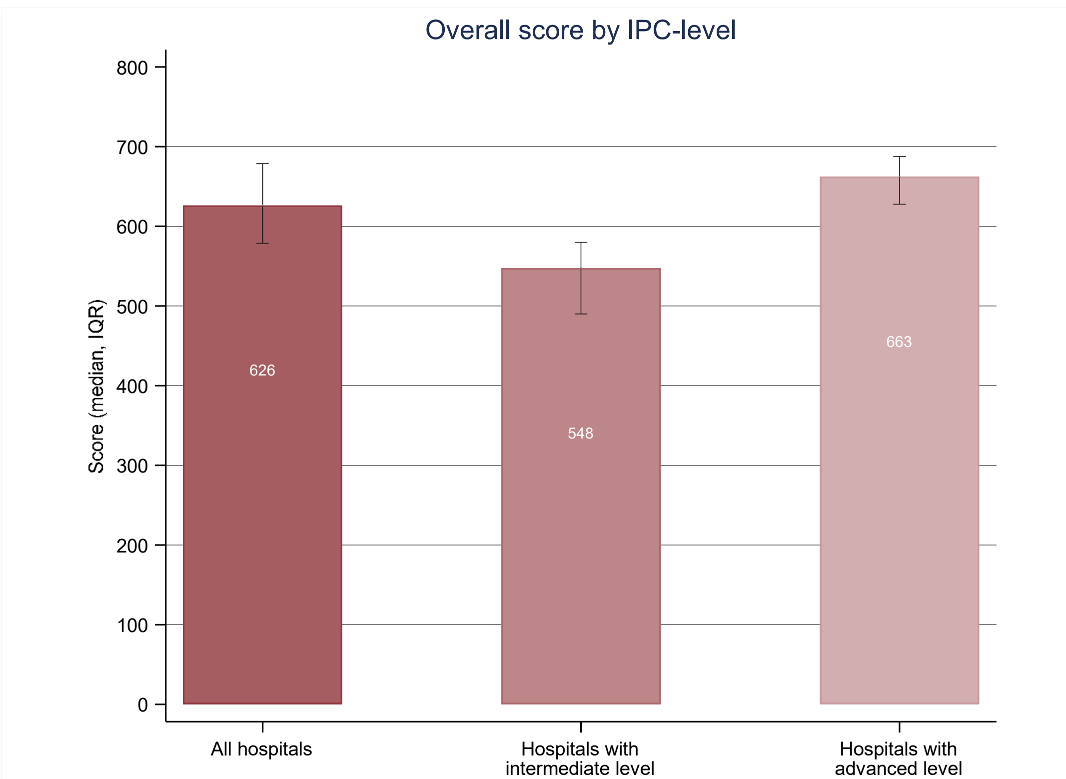
4. IPCAF results

The IPCAF questionnaire was distributed to the referent IPC expert of each participating hospital. Experts were strongly encouraged to complete it; for hospital groups where the IPC programme was applied to the whole group, it was advised to complete only one IPCAF for the whole group. Four of the 108 hospitals did not provide complete questionnaires. The other 104 hospitals completed the survey either as individual sites (73) or as part of a hospital network (31 hospitals in 11 networks).

The median (IQR) IPCAF score of the hospitals was 626 (579-679), which corresponds to an advanced level. However, 29 (34.5%) of the 84 hospitals or hospital networks submitting IPCAF data are at an intermediate level with a median score of 548 (490-580). Hospitals in the advanced category had a median score of 663 (628-688).

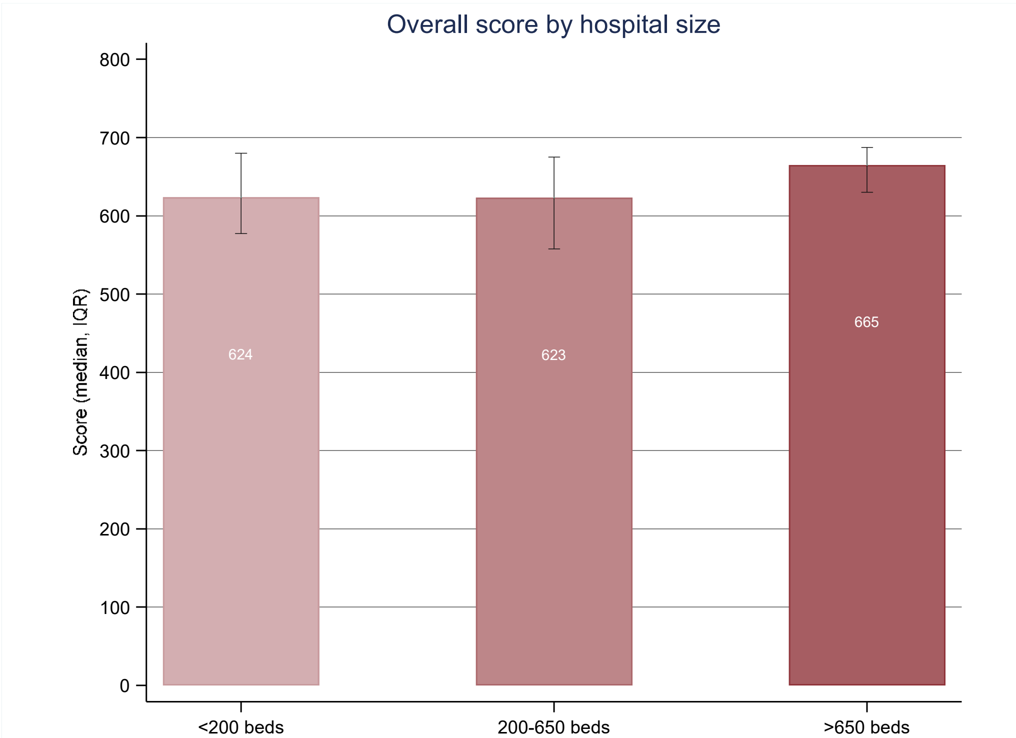
Except scores on materials and environment where no difference between intermediate and advanced hospitals was measured, intermediate hospitals had consistently lower levels in all other core components, and particularly in surveillance and multimodal HAI prevention strategies.

Figure 39 : Overall median IPCAF score by hospital IPC level



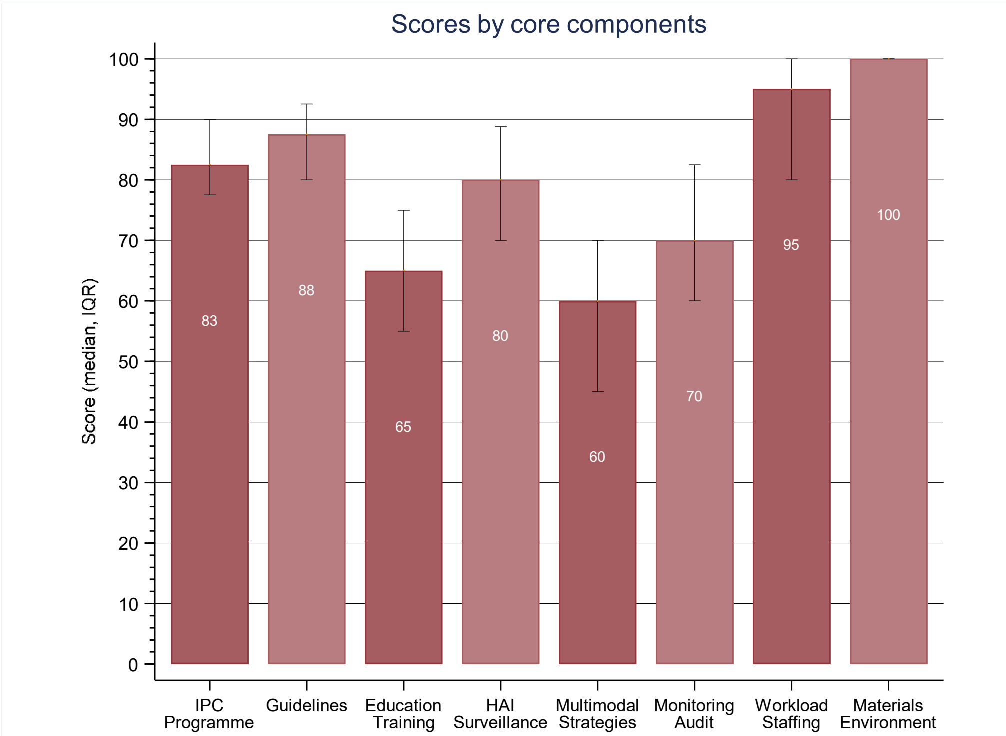
Regarding the overall IPC score by hospital size, no statistically significant difference was found.

Figure 40 : Overall median IPCAF score by hospital size (small-size: <200 beds, medium-size: 200-650 beds, large-size: >650 beds)



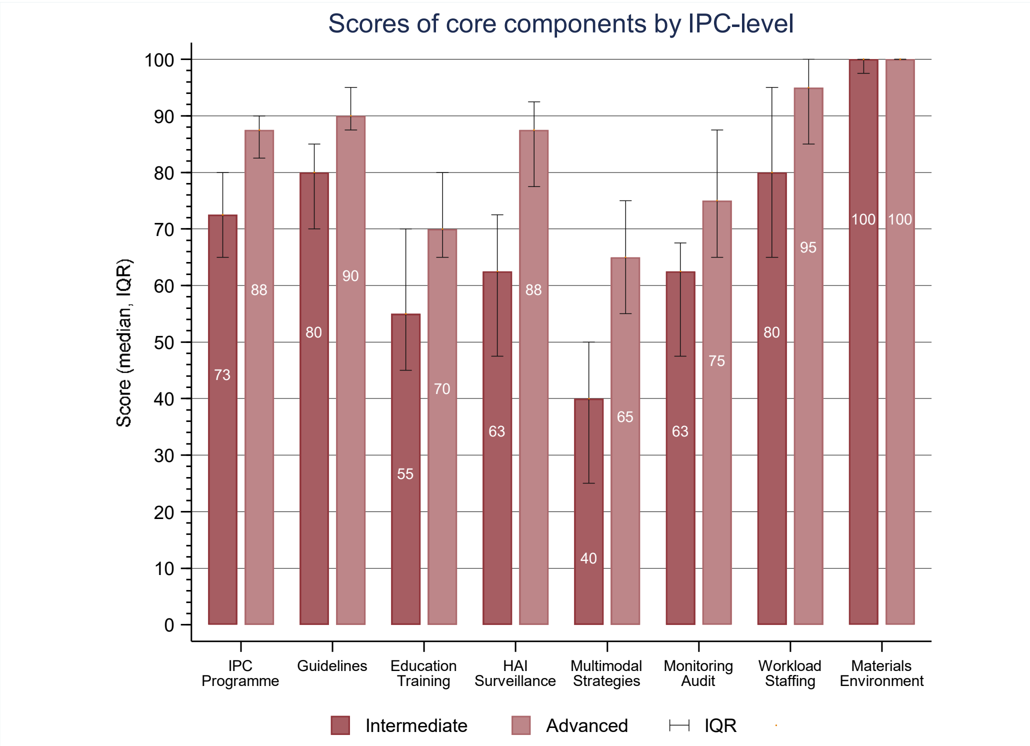
When the analysis was done by the core component, the lowest levels were identified for education and training, multimodal (prevention) strategies and monitoring and audits.

Figure 41 : Overall median IPCAF score by WHO IPC core component



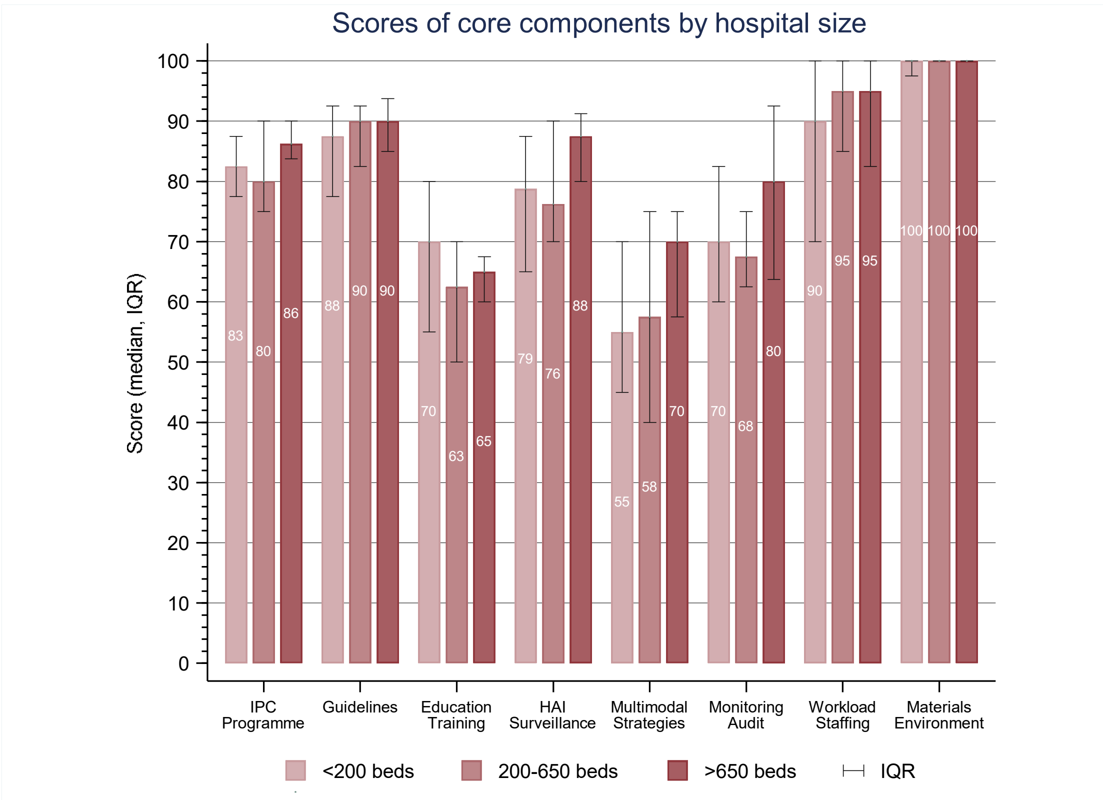
The difference by core component is more pronounced when results are stratified by the level of the overall IPCAF score (intermediate and advanced): differences are significant for core components 4 (HAI surveillance) and 5 (multimodal HAI prevention strategies), indicating that hospitals with lower IPCAF scores disproportionally perform lower in these two core components.

Figure 42 : IPCAF score by WHO IPC core component according to the IPC level achieved



Similarly, the lowest scores were obtained in core components 3 (education and training), 5 (multimodal HAI prevention strategies) and 6 (monitoring and audit) when results were stratified by hospital size.

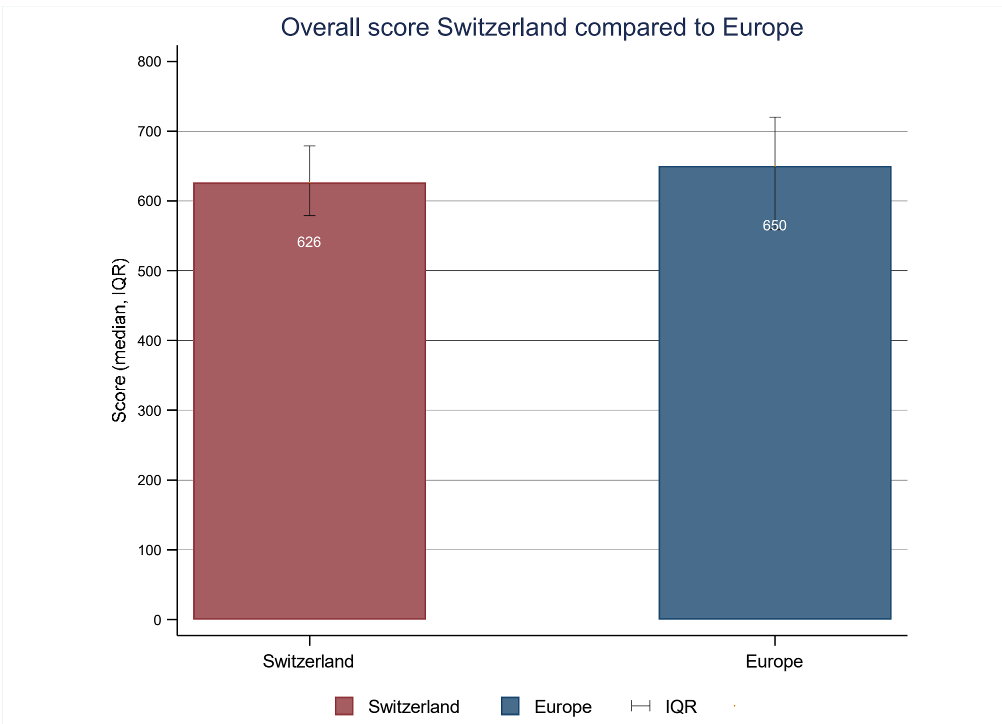
Figure 43 : Median IPCAF score by core component according to hospital size (small size: <200 beds; medium size: 200-650 beds; large size: >650 beds)



A recent Global survey of the IPCAF tool was published in January 2022.[7] The results were weighted towards the representativeness of regional data. From 16 January to 31 December 2019, 4440 questionnaires were received from 81 countries. A total of 23 out of 53 countries in the European region (43%) completed 1393 questionnaires for analysis.

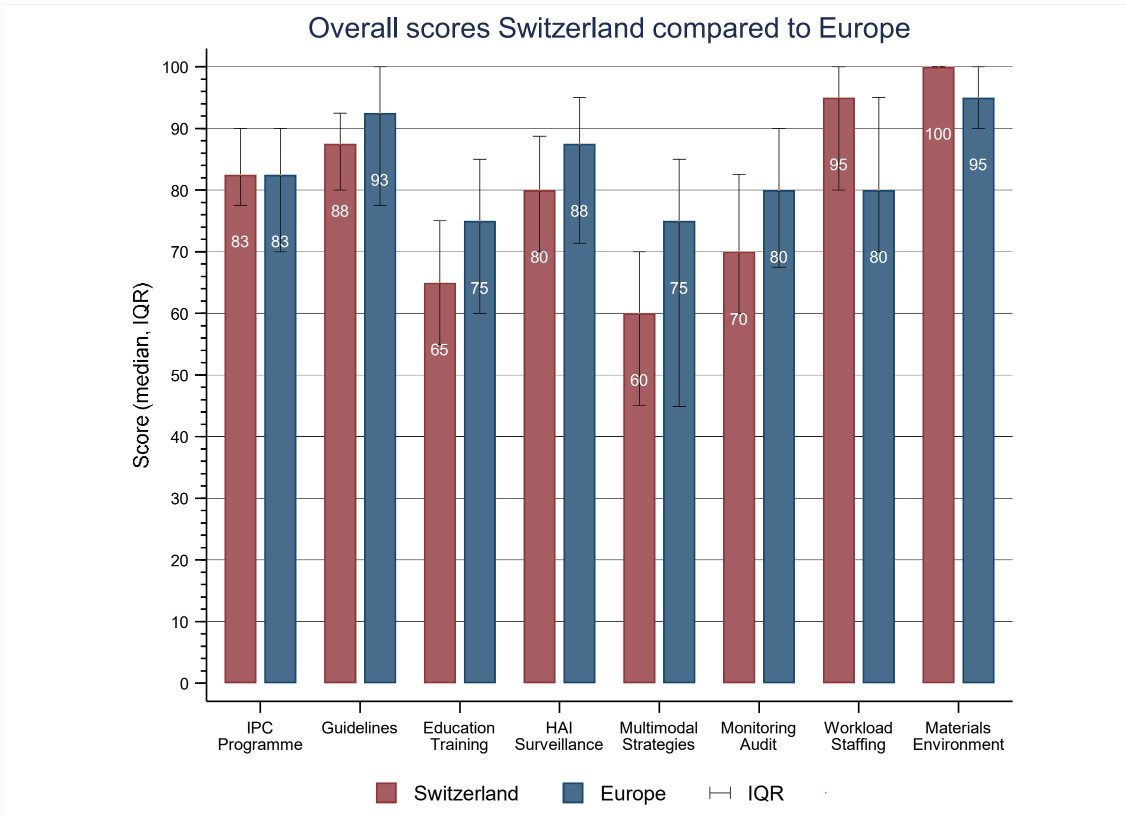
The Swiss data were compared with the median value of the IPCAF of the European countries as reported in the WHO survey. While considering all the limitations on the representativeness of the WHO survey for Europe (national data from Bulgaria, France, Germany, Italy, Serbia, Spain, and the United Kingdom – individual hospital data from a number of other European countries), Switzerland performs similarly to other European countries.

Figure 44 : Overall IPCAF score in Swiss hospitals compared to the European hospitals (source: *Tomczyk S Lancet Infect Dis 2022; 22:845*)



Stratifying median scores of Switzerland and European countries by core component, Switzerland scored higher in staffing and hospital infrastructure, while scores were non-significantly lower in education and training, monitoring and audits, as well as multimodal HAI prevention strategies.

Figure 45 : IPCAF score in Swiss hospitals and European hospitals by core component (source: *Tomczyk S Lancet Infect Dis 2022; 22:845*)



The following figures correspond to detailed scores achieved by the indicator of each core component.

Figure 46 : Score achieved for each of the eight indicators of the first core component- IPC programme (red: fully achieved; shades of pink: partially achieved; shades of blue: rather not achieved or not achieved)

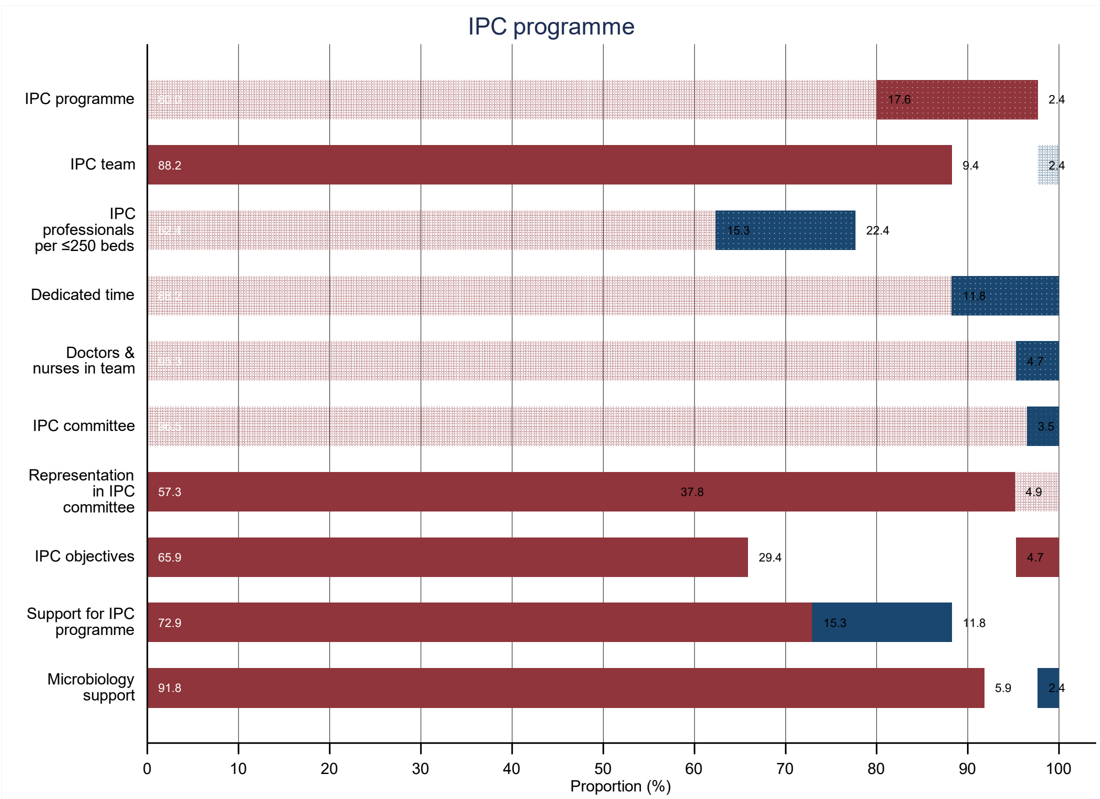


Figure 47 : Score achieved for each of the eight indicators of the second core component- Guidelines (red: fully achieved; shades of blue: rather not achieved or not achieved)

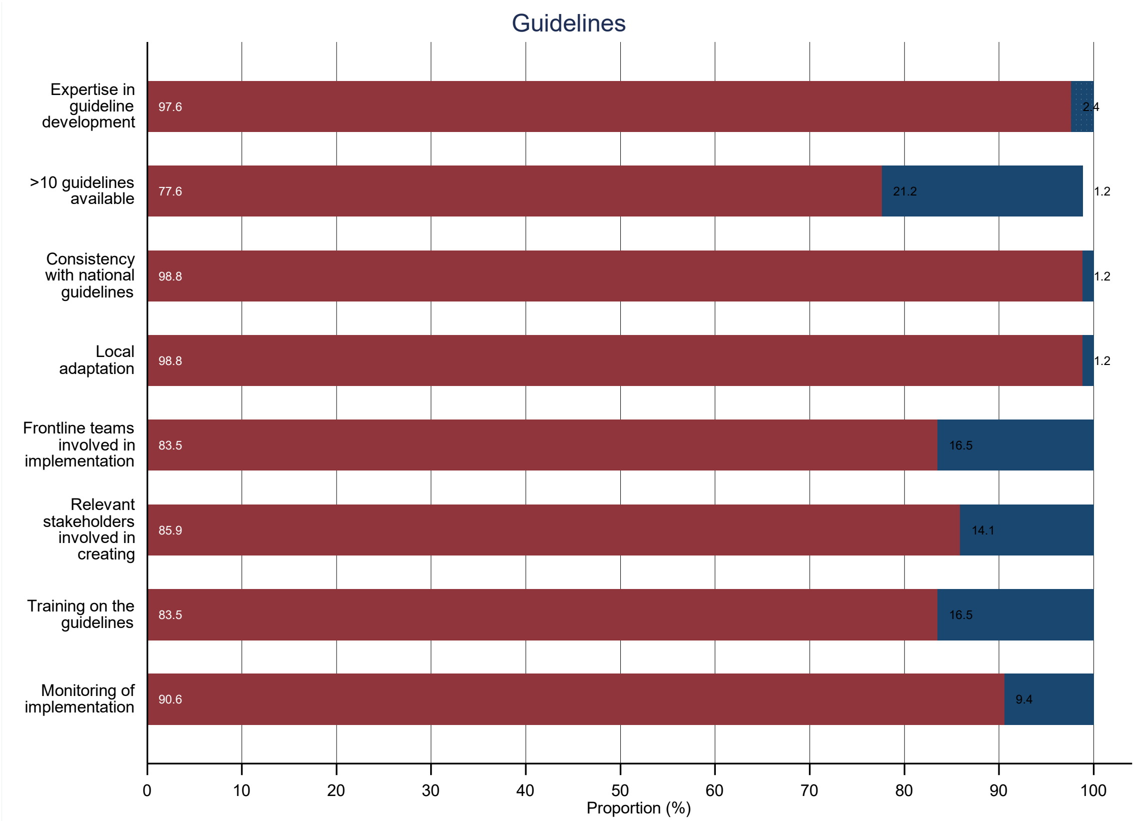


Figure 48 : Guidelines topics implemented in Swiss acute care hospitals (red: yes, blue: no)

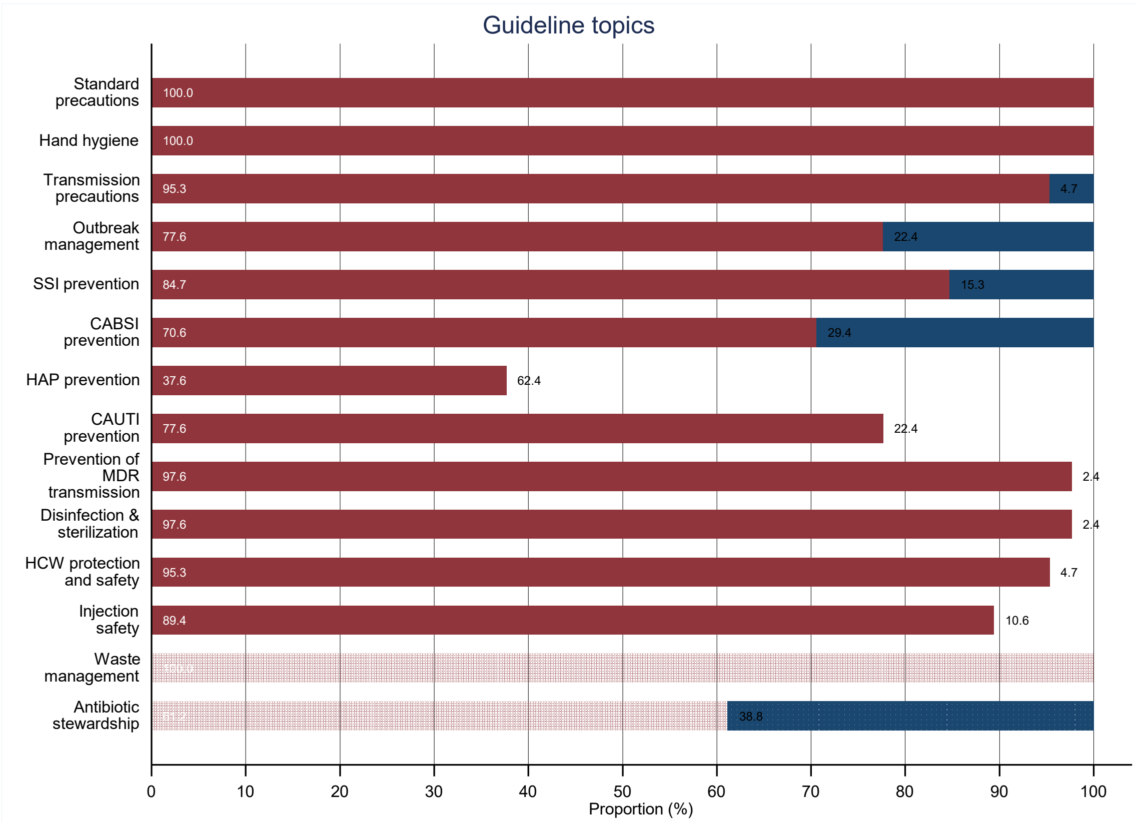


Figure 49 : Score achieved for each of the ten indicators of the third core component- Education and training (red: fully achieved; shades of pink: partially achieved; shades of blue: rather not achieved or not achieved)

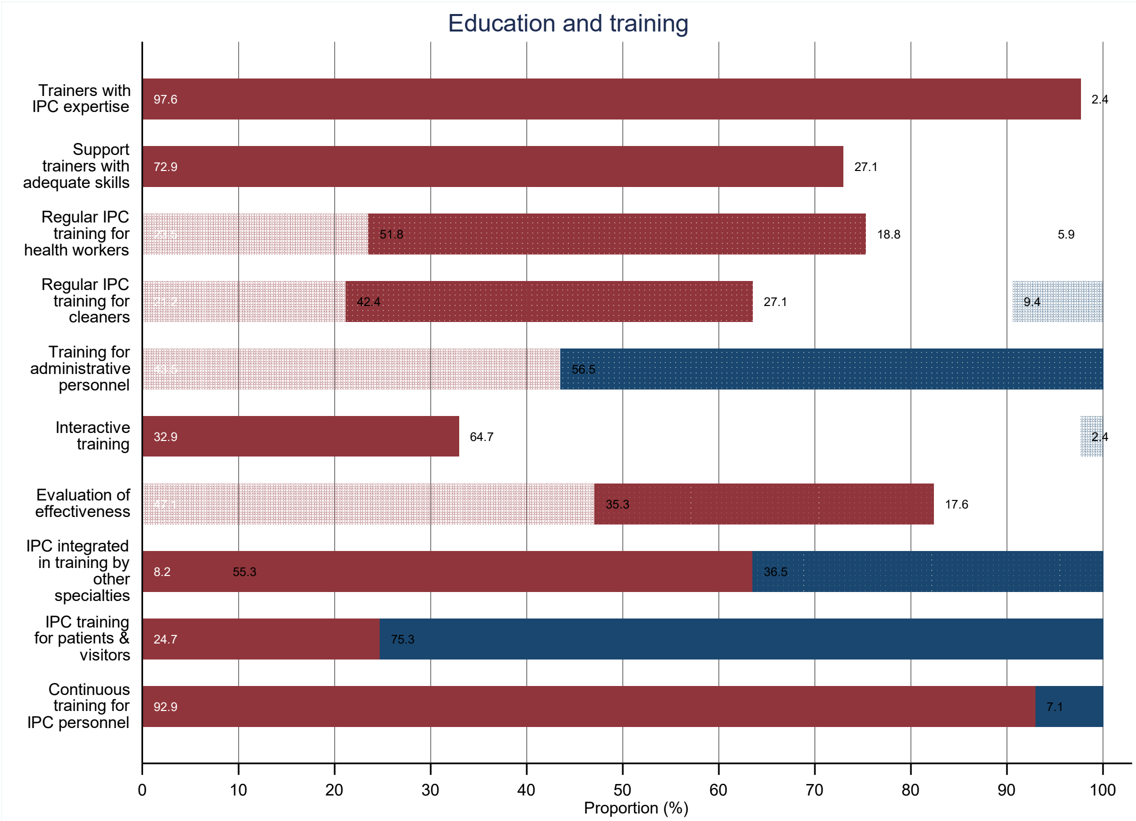


Figure 50 : Score achieved for each of the 15 indicators of the fourth core component- Surveillance (red: achieved; shades of blue: rather not achieved or not achieved)

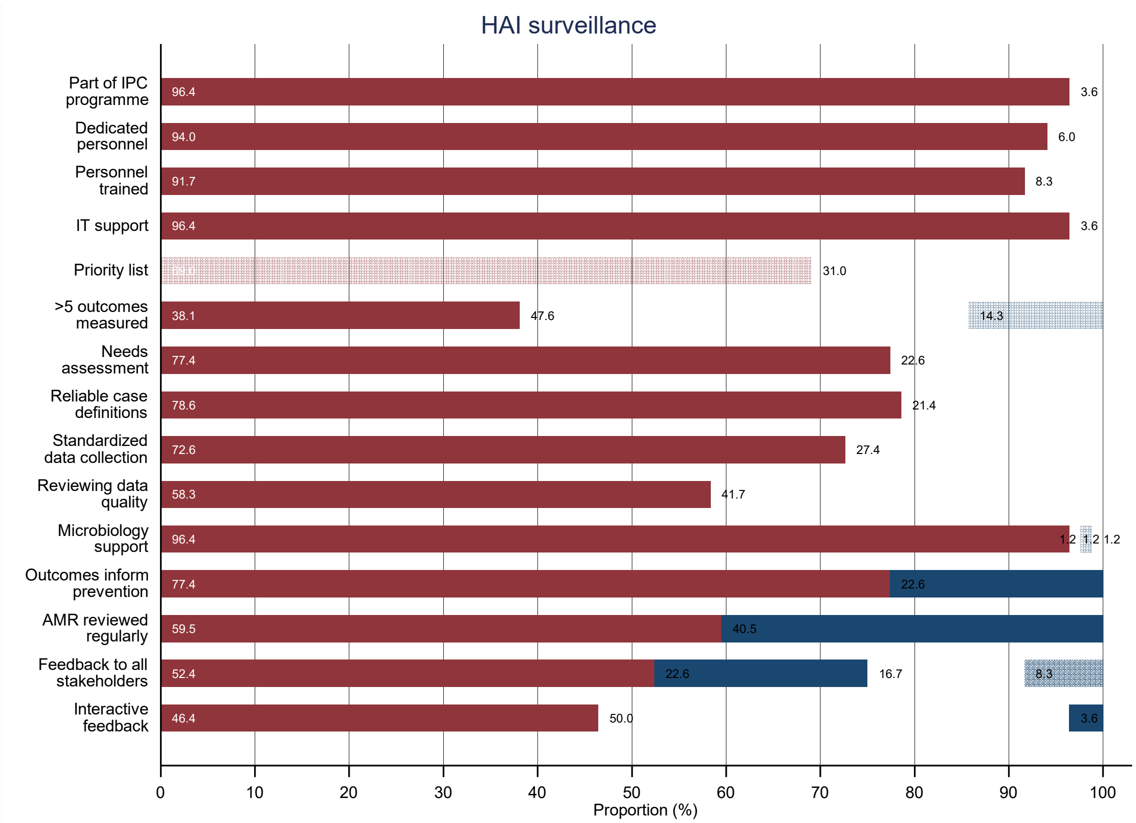


Figure 51: Surveillance topics implemented in Swiss acute care hospitals (red: yes, blue: no)

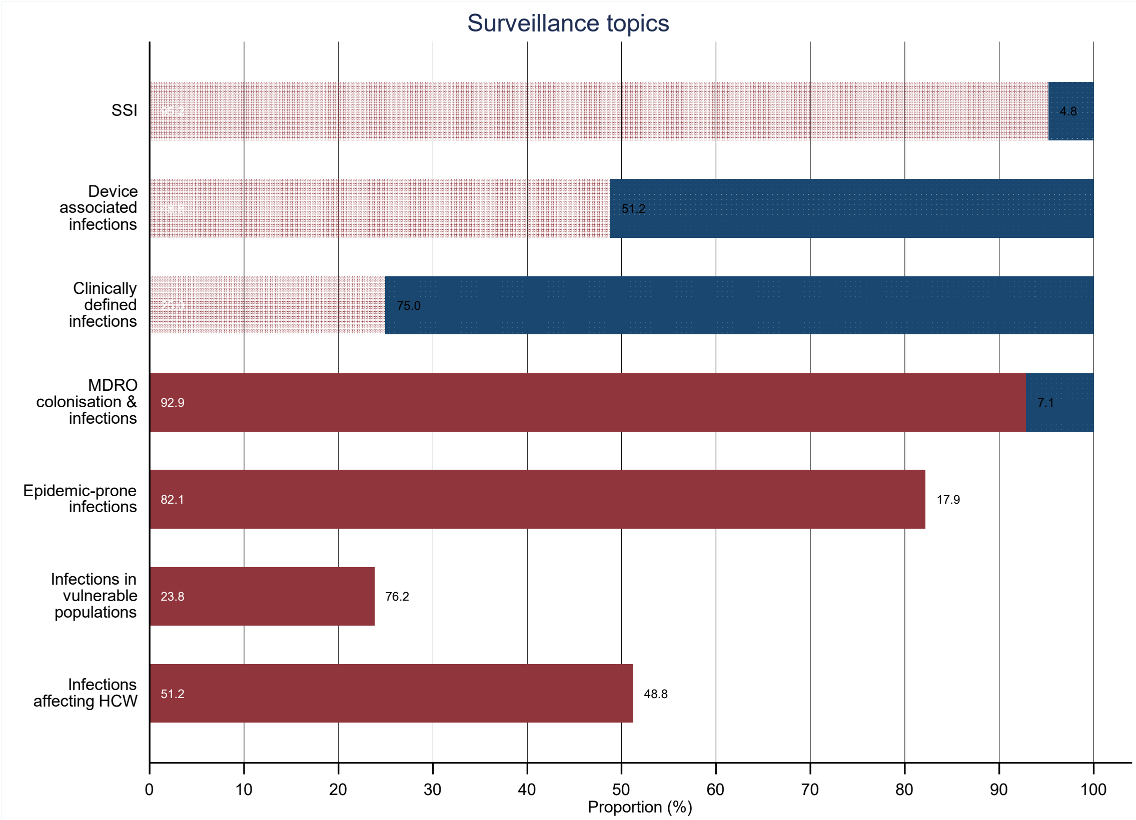


Figure 52 : Score achieved for each of the nine indicators of the fifth core component- Multimodal strategies (red: fully achieved; shades of pink: partially achieved; blue: not achieved)

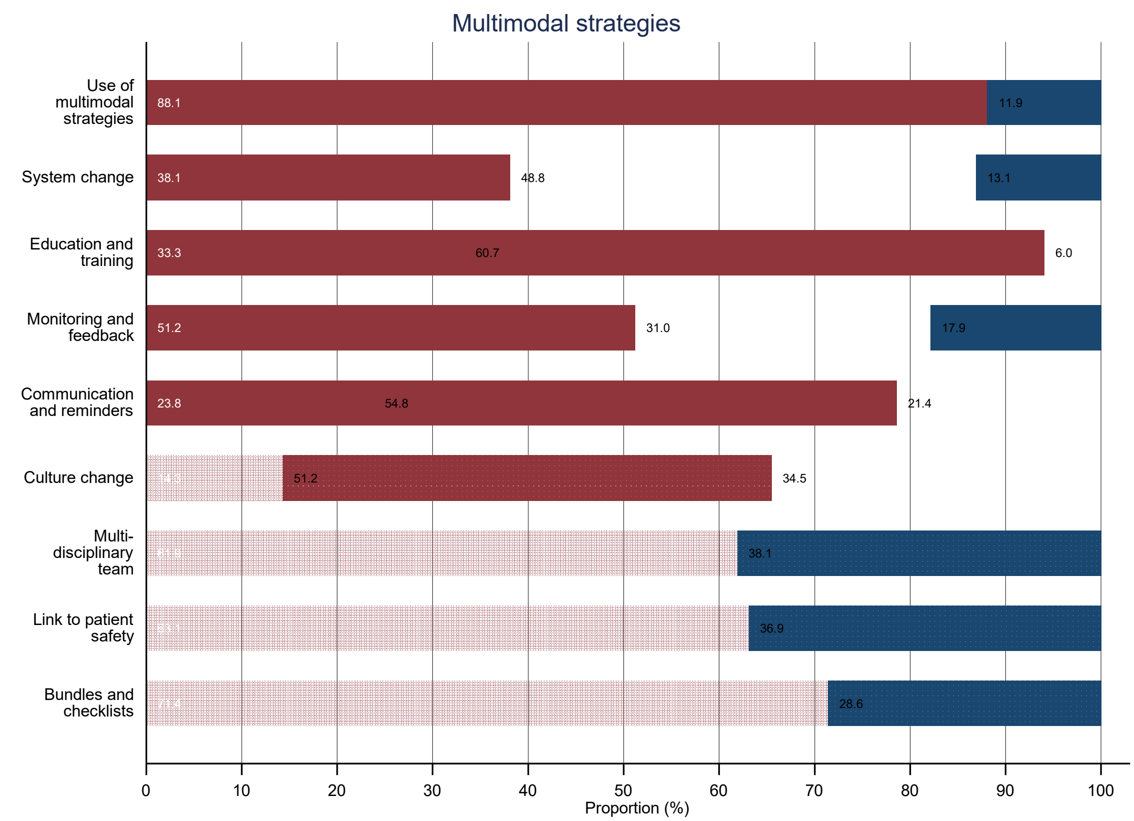


Figure 53 : Multimodal strategies elements implemented in Swiss acute care hospitals (red: fully achieved; shades of pink: partially achieved; blue: not achieved)

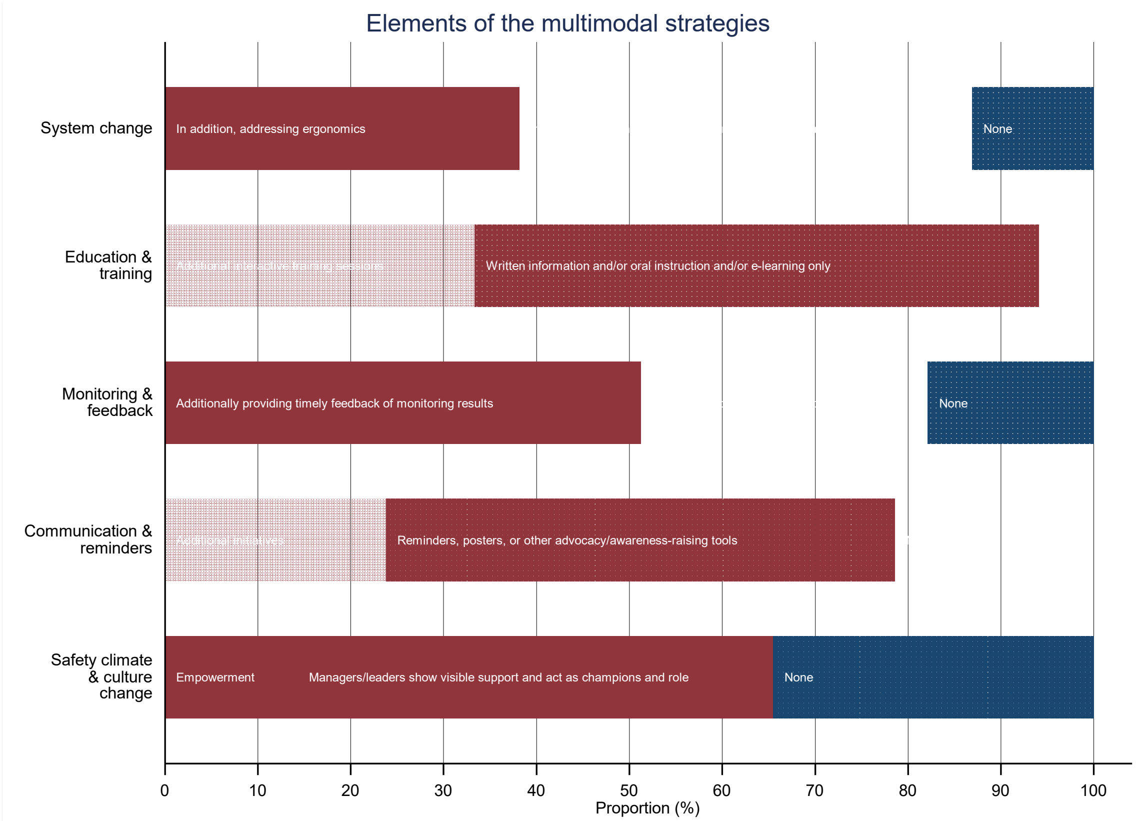


Figure 54 : Score achieved for each of the eight indicators of the sixth core component – Monitoring and feedback (red: fully achieved; shades of pink: partially achieved; blue: or not achieved)

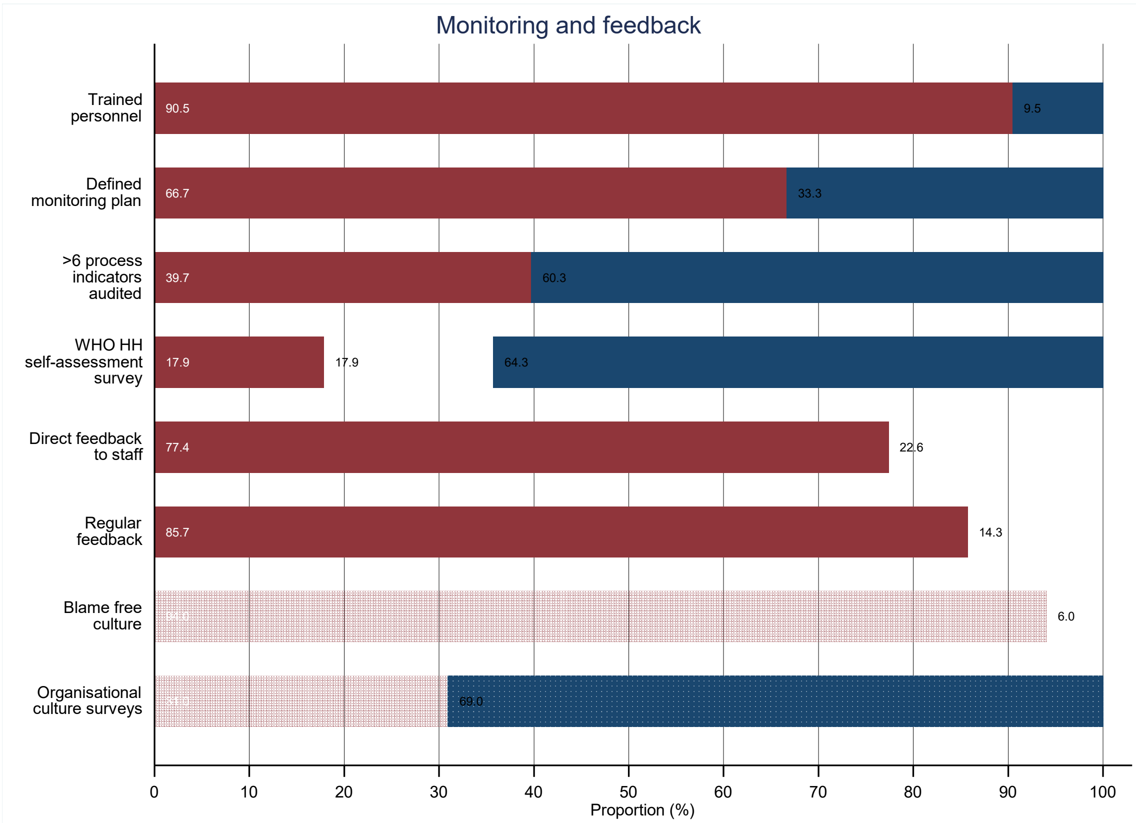


Figure 55 : Monitoring and audit topics implemented in Swiss acute care hospitals (red: yes, blue: no)

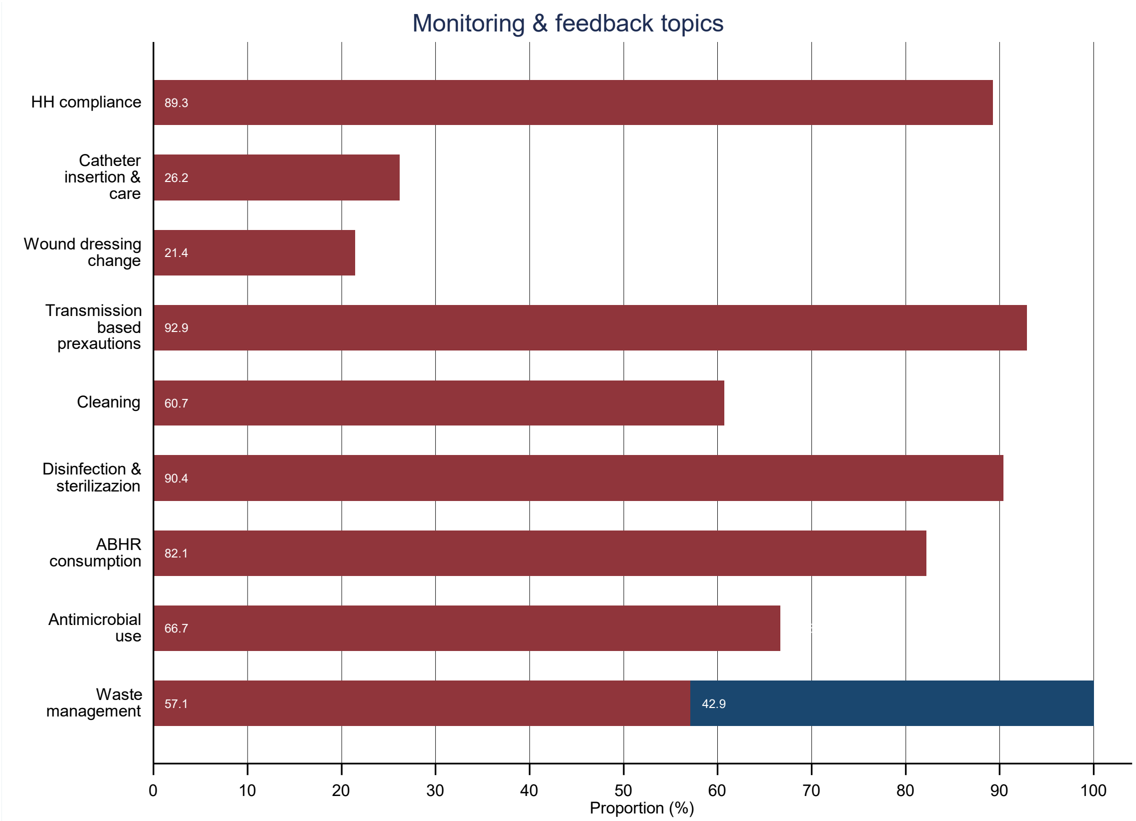


Figure 56 : Score achieved for each of the eight indicators of the seventh core component- Staffing and bed occupancy (red: fully achieved; shades of pink: partially achieved; shades of blue: rather not achieved or not achieved)

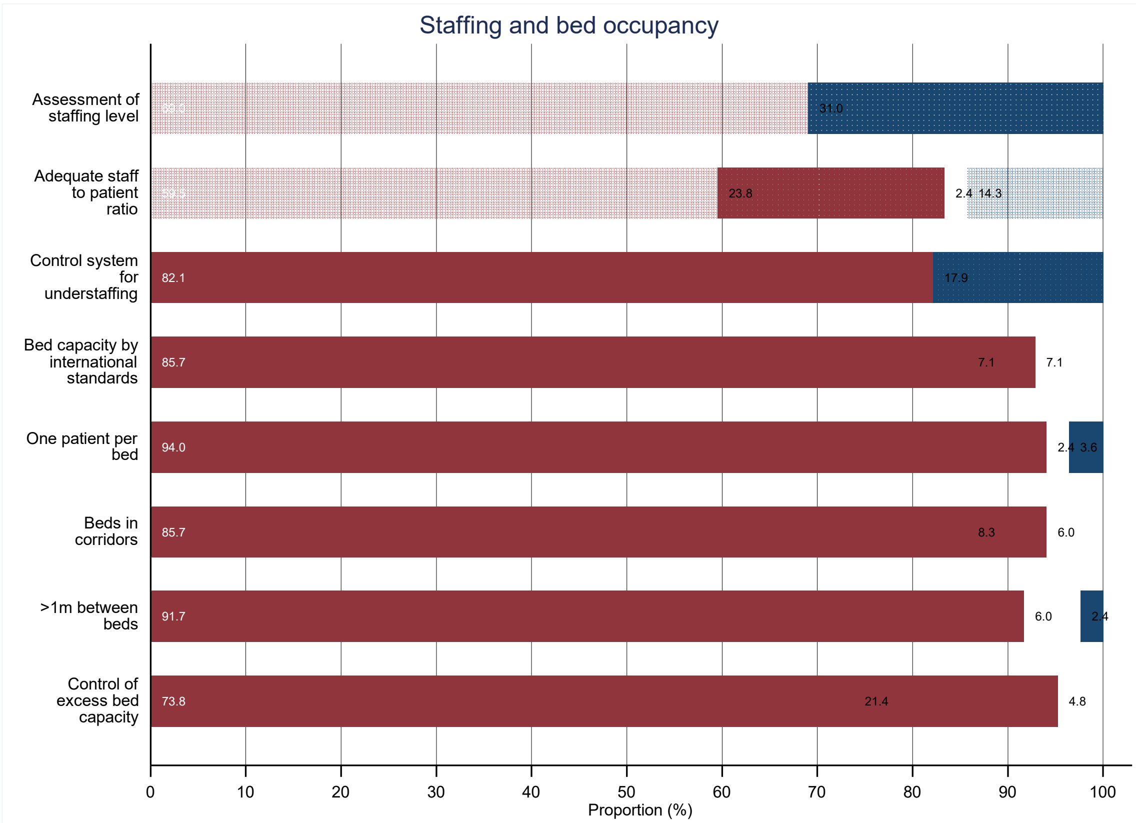
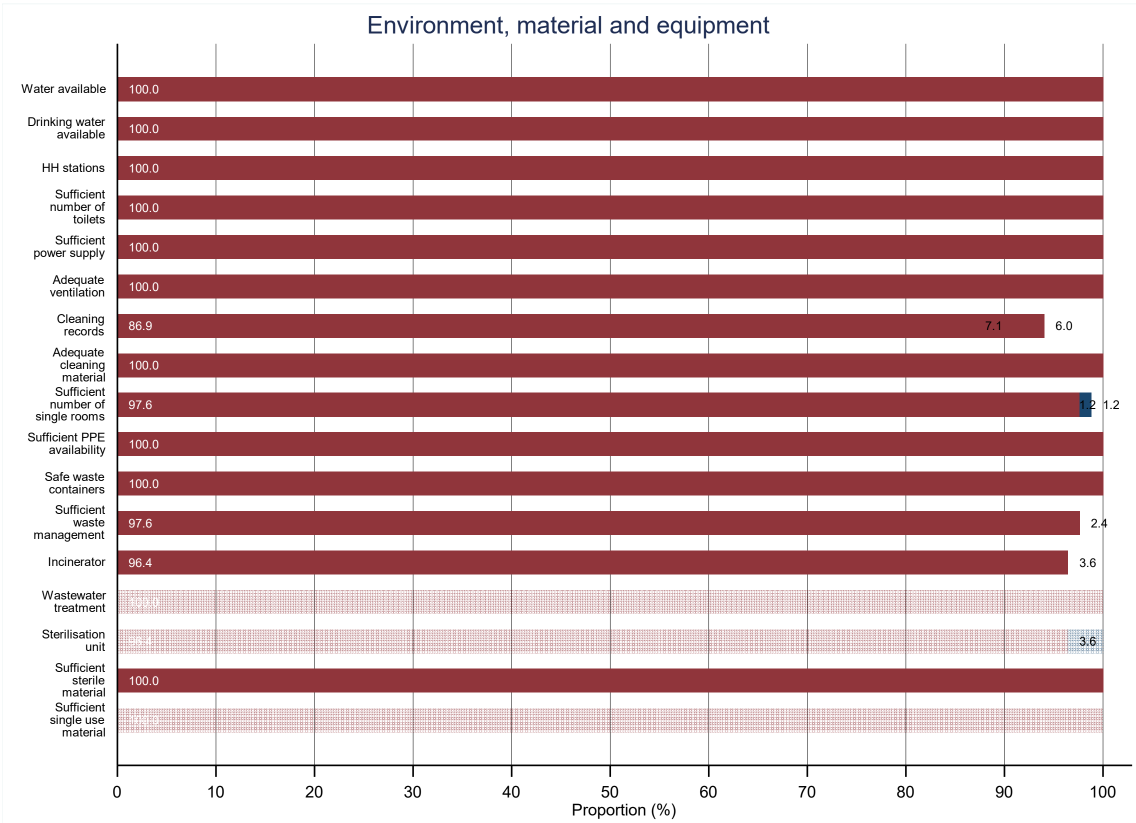


Figure 57 : Score achieved for each of the 17 indicators of the eight core component- Environment, material and equipment (red: fully achieved; shades of pink: partially achieved; shades of blue: rather not achieved or not achieved)



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