Hôpitaux Universitaires Genève

Swissnoso

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

Hôpitaux Universitaires de Genève

Point Prevalence Survey 2017 of healthcare-associated infections and antimicrobial use in Swiss acute care hospitals

Coordination Center Prevalence Study CH
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Abbreviations

ABHR	Alcohol-based hand rub
AU	Antimicrobial use
BSI	Bloodstream infection
CAUTI	Catheter-associated urinary tract infection
CDI	*Clostridium difficile* infection
CRF	Case Report Form
CH	Switzerland
CH-PPS	Swiss Point Prevalence Survey
CLABSI	Central line-associated bloodstream infection
CVC	Central venous catheter
ECDC	European Centre for Disease Prevention and Control
EU	European Union
FOPH	Federal Office of Public Health
HAI	Healthcare-associated infection
HCW	Healthcare worker
HH	Hand Hygiene
HUG	University Hospitals of Geneva (Hôpitaux Universitaires de Genève)
ICU	Intensive care
IPC	Infection Prevention and Control
IQR	Interquartile range
KISS	Krankenhaus Infektions Surveillance System
LRTI	Lower respiratory tract infection
MDRO	Multidrug-resistant organism
NHSN	National Healthcare Surveillance Network
PABSI	Peripheral line-associated bloodstream infection
PPS	Point Prevalence Survey
PRIM	Primary care
PRIVFP	Private ownership, for-profit
PRIVNFP	Private ownership, not-for-profit
PROHIBIT	Prevention of hospital infections by intervention and training
PUB	Public hospitals
PVC	Peripheral venous catheter
SEC	Secondary care
SENIC	Study on the Effectiveness of Nosocomial Infection Control
SPEC	Specialised care
SSI	Surgical site infection
TERT	Tertiary care
UC	Urinary catheter
US	United States
UTI	Urinary tract infection
VENT	Ventilator
WHO	World Health Organization
95%CI	95% confidence interval

Executive Summary

Between April and May 2017, 96 acute care hospitals in Switzerland performed a joint point prevalence survey on healthcare-associated infections (HAIs) and the use of antimicrobials. The average HAI-prevalence was 5.9% in 12'931 patients, and 33% received one or more antimicrobials on the day of survey. These numbers are similar to the past European Centre for Disease Prevention and Control (ECDC) point prevalence survey in 2011/2012. The most common healthcare-associated infections were surgical site infections (29%), lower respiratory tract infections (18%), urinary tract infections (15%), and bloodstream infections (13%). The highest proportions were identified in intensive care units (20.6%), in large hospitals (7.8%), in elderly patients (7.4%), in male patients (7.2%), and in patients with ultimately (9.3%) or rapidly (10.6%) fatal outcomes.

Most antimicrobials on the day of survey were administered to treat infections (62%). The remainders were used for prophylaxis either before surgery (77%) or for medical purposes (23%). More patients in intensive care were on antimicrobials (62%) compared to surgery (44%), internal medicine (32%), and paediatrics (31%). These findings are in mid-range compared to Europe. Two thirds of the hospitals have formalized antimicrobial stewardship, but only 9% perform post-prescription review of antimicrobials, one of the key actions of antimicrobial stewardship.

Only half of the hospitals (53%) had an annual plan for infection prevention and control (IPC), but two thirds (64%) produced an annual report summarizing IPC activities. Staffing of IPC nurses in Swiss hospitals was 1.5 per 250 hospital beds in 2017. This is higher compared to other European countries where average staffing is 1 per 250 hospital beds. Staffing for IPC doctors in Switzerland was 2.5 per 1000 hospital beds in 2017. Average consumption of alcohol-based handrub was 53 mL per patient-day. Although there is room for improvement, this was far more than the 21 mL per patient-day identified in past European surveys.

The survey in 2017 was part of the priority given on HAI-prevention by the strategy “Gesundheit 2020/Santé 2020” of the Swiss Confederation. The survey was organised by Swissnoso with financial support by the Federal Office of Public Health. The last survey on HAI in Switzerland was performed in 2004. Although the methodologies between the two surveys in 2004 and 2017 were different and comparison of the results difficult, healthcare-associated infections are likely to have decreased since. The protocol of the survey in 2017 followed the ECDC methodology, which was developed jointly by different stakeholders, and which was used concurrently in surveys on HAI and antimicrobial use in other European countries. This will allow benchmarking with countries in Europe as soon as ECDC will publish the results by the end of 2018.

Introduction

1. The impact of Healthcare-associated infections on healthcare

Healthcare-associated infections (HAIs), also known as “nosocomial” or “hospital-acquired infections” are infections acquired in healthcare settings, which neither are present nor incubating at the time of hospital admission. They are associated with attributable mortality, and have a negative impact on clinical outcome, length of stay, and hospital costs. Healthcare-associated infections are accepted to have a major impact on patient safety, and today, a growing number of countries address HAIs as a priority patient safety topic.

The overall HAI burden remains high, albeit much effort has been devoted to their prevention. According to the World Health Organization (WHO), 7% of patients in developed countries and 10% in developing countries will acquire at least one HAI at any one time, with attributable mortality estimated at 10%.[1]

2. Prevalence surveys as a means to assess the burden of healthcare-associated infections

Prevalence surveys have a long tradition in the field of infection prevention and control (IPC). In the early 70's, the Center for Disease Control and Prevention (CDC) Study on the Effectiveness of Nosocomial Infection Control (SENIC) in the United States used repeated point prevalence surveys (PPSs) to measure the effectiveness of infection prevention and control programmes on a number of HAI outcomes such as surgical site infections (SSIs), bloodstream infections (BSIs), urinary tract infections (UTIs), and lower respiratory tract infections (LRTIs) in more than 300 US hospitals.[2] Already in 1981, WHO experts recommended performing national PPSs as a tool to estimate the burden of HAI at reasonable cost.[3] Although the response to this call was moderate at that time, a growing number of countries have conducted national surveys in subsequent years. In the 90’s and at the turn of the millennium, PPSs have gradually fallen into oblivion until the European Centre for Disease Prevention and Control (ECDC), and the US Center for Disease Control (CDC) performed large-scale, surveys in 2011/2012. The prevalence in the US and in the European Union (EU) was 4% and 6%, respectively.[4-6] Between 2016 and 2017, ECDC performed its second PPS on HAI and antimicrobial use in the European Union, the European Economic Area, and EU candidate countries.

3. The situation in Switzerland

In Switzerland, a series of national HAI prevalence surveys had been carried out by Swissnoso in the past, the last in 2004.[7-14] In contrast to most other countries using the point prevalence methodology, Switzerland used the period prevalence methodology, which did not allow benchmarking, neither to other surveys nor to the present CH-PPS. The period prevalence methodology inflates the number of identified HAI by providing a more appropriate distribution of HAI-types.[15]

In January 2013, the Swiss Federal Council approved the ‘Health 2020' plan, setting priorities in public health over the upcoming years. Within this plan, HAI prevention was given high priority, and as a consequence, the federal office of public health (FOPH) together with a large number of stakeholders from health delivery, defined the “Strategy NOSO”, which was validated by the Swiss Federal Council in 2016.[16] The objective of the strategy is the reduction of HAIs and prevention of emerging resistance in Swiss acute-care health facilities. In order to get data on the burden of HAI in Switzerland, the FOPH encouraged and supported Swissnoso to perform a national PPS. Swissnoso on its part engaged the University of Geneva Hospitals (HUG) to coordinate the task. Given that ECDC was about performing its second PPS, Switzerland should provide comparable data still in 2017.

4. Funding

This survey was organized by Swissnoso in collaboration with the University of Geneva Hospitals. Swissnoso received financial support by the Swiss Federal Office of Public Health to conduct this study.

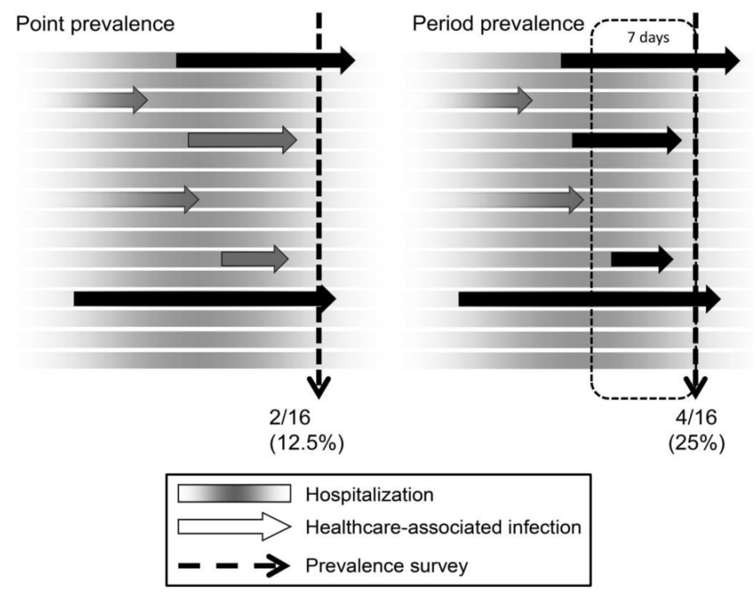
Survey design and methodology

1. Method and development of the Swiss PPS protocol

The applied method follows a **classic point prevalence protocol.** Compared to the period prevalence methodology used in the past, data are collected on one day only (snapshot), instead of looking at a time window of 7 days. While the period prevalence method captures more HAIs, particularly those of short duration, it is a mix between the concepts of "prevalence" and "incidence" and inflates the overall burden of HAI.[15] Furthermore, it is also more time-consuming than PPS.

The Swiss-PPS used the standard version of the second ECDC-PPS as described in the *ECDC Protocol version 5.3 for the ECDC-PPS II.*[17] In addition to previous surveys, the second ECDC-PPS addressed hospital indicator data based on ten key components, identified by a large ECDC-initiated systematic review and expert consensus.[18] The protocol was translated into the three official Swiss languages (German, French and Italian) by the coordinators and the IPC team at Lugano Civico Hospital. A few minor modifications were applied to adapt the protocol to the situation in Switzerland (particularly in the section about hospital indicators). The protocol, as well as the code lists for HAIs, microorganisms, and antimicrobials, can be downloaded from the CH-PPS website www.swissnoso.ch/prevalence. The protocol addresses four areas of interest: 1) hospital indicator data; 2) patients' demographics, characteristics, and risk factors; 3) HAIs, and 4) antimicrobial use.

Figure 1: Differences between point and periodic prevalence survey methods



Adapted from Zingg and colleagues [15]

2. Objectives

The CH-PPS has the following objectives:

- 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 establish a hospital network for future surveys in Switzerland
- To benchmark data on HAI and antimicrobial consumption with the concurrently performed ECDC-PPS (once the data are officially available)

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

Hospitals

All acute care hospitals in Switzerland (and the Liechtenstein national hospital) were eligible to participate in the PPS on a voluntary basis. All 187 acute care hospitals were sent an invitation letter in December 2016. Concomitantly, local IPC professionals were informed via Email. Reminders were sent mid-January.

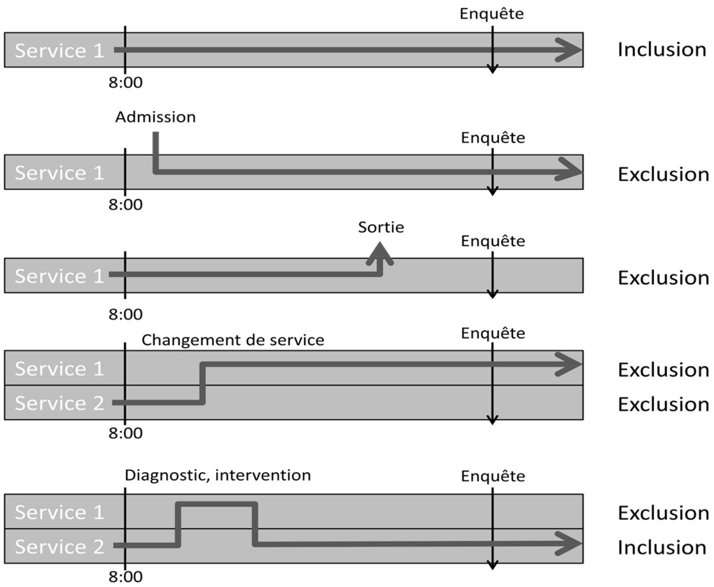
Wards

All wards in n 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.

Patients

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.

Figure 2: Examples to include and exclude patients



4. Representative sample for comparison with the European countries participating in the ECDC-PPS

In order to obtain a representative sample to be benchmarked with the ECDC-PPS, a randomization process was performed based on the list of invited hospitals. The hospitals were allocated to three categories (<200 beds, 200-650 beds, >650 beds). Based on the final data of eligible hospitals and applying the methodology by ECDC (Design effect of 4.7; precision of +/- 1%; pooled HAI prevalence of 5.9; 95% confidence interval), a total of 8606 in 56 hospitals had to be included in the randomized sample. A list of each category was created in descending (bed size) order. Six randomised sequences were generated for each category (www.randomizer.org), and one of the sequences again was selected randomly. Two (out of 7 [7]), 10 (out of 26 [32]), and 44 (out of 63 [148]) hospitals were selected for large size, medium size, and small size hospitals, respectively. The distribution of the selected hospitals among hospital categories was similar to the invited hospitals. However, while all large size hospitals participated in the CH-PPS, only 26 of 32 (81.3%) medium size hospitals, and 63 of 148 (42.6%) small size hospitals contributed data to the CH-PPS.

5. Validation survey

In order to assess the sensitivity and specificity of the survey, a validation survey was performed in a limited number of participating hospitals in parallel. Six hospitals representing different categories were contacted and voluntarily accepted to participate in the validation survey: 1 university-affiliated hospital, two public medium size hospitals, two public small size hospitals, and one private hospital. Three investigators from the CH-PPS coordination center performed validation in 50 patients of each hospital, prioritizing high-prevalence areas such as intensive care units (ICUs).

Implementation

1. List of participating hospitals

Ninety-six 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
	Spital Muri
	Asana Gruppe – Spital Menziken
	Asana Gruppe – Spital Leuggern
AI	Kantonales Spital und Pflegezentrum Appenzell
AR	Spitalverbund Ausserrhoden – Spital Herisau
BE	Inselspital-Gruppe – Inselspital Bern
	Spitalzentrum Biel AG
	Spital STS AG – Spital Thun
	Spital STS AG – Spital Zweisimmen
BE	Regionalspital Emmental AG – Burgdorf
	SRO AG – Spital Langenthal
	Hôpital du Jura Bernois SA – Hôpital St. Imier
	Hôpital du Jura Bernois SA – Hôpital Moutier
	Lindenhofgruppe - Lindenhofspital
	Lindenhofgruppe - Sonnenhofspital
	Lindenhofgruppe - Engeriedspital
BL	KSBL – Spital Bruderholz
	KSBL – Spital Liestal
	KSBL – Spital Laufen
BS	Universitätsspital Basel
	Claraspital
	UKBB
	Felix-Platter Spital
	Merian Iselin Klinik
FR	HFR Fribourg – Hôpital Cantonal
	Hôpital Daler
GE	Hôpitaux Universitaires de Genève
	La Tour – Hôpital de la Tour
	La Tour – Clinique de Carouge
	Clinique Générale Beaulieu
GR	Kantonsspital Graubünden
	Spital Oberengadin
	Regionalspital Surselva AG
JU	Hôpital du Jura – Hôpital Delémont
LI	Liechtensteinisches Landesspital
LU	Schweizer Paraplegiker-Zentrum, Nottwil

NE	Hôpital neuchâtelois – Neuchâtel
	Hôpital neuchâtelois – La Chaux-de-Fonds
SG	Kantonsspital St. Gallen – St. Gallen
	Kantonsspital St. Gallen – Flawil
	Kantonsspital St. Gallen – Rorschach
	SRFT – Spital Wil
	SRFT – Spital Wattwil
	SRWS – Spital Grabs
	SRWS – Spital Walenstadt
	SRWS – Spital Altstätten
	Ostschweizer Kinderspital
	Hirslanden Gruppe – Klinik Stephanshorn
SO	Solothurner Spitäler AG – Burgerspital Solothurn
	Solothurner Spitäler AG – Kantonsspital Olten
	Solothurner Spitäler AG – Spital Dornach
	Privatklinik Obach
SZ	Spital Lachen
TG	Spital Thurgau AG – Kantonsspital Münsterlingen
	Spital Thurgau AG – Kantonsspital Frauenfeld
	Klinik Seeschau
TI	EOC – Ospedale Civico di Lugano
	EOC – Ospedale Regionale Bellinzona e Valli
	EOC – Ospedale Regionale di Locarno
	EOC – Ospedale Regionale di Mendrisio
	EOC – Ospedale Regionale di Lugano Italiano
	Fondazione Cardiocentro Ticino
	Clinica Luganese Moncucco
VD	CHUV
	Hôpital ophtalmique Jules-Gonin
	eHnv – Hôpital de Yverdon-les-Bains
	eHnv – Hôpital Saint-Loup
	EHC – Hôpital Morges
	HRC – Hôpital Samaritain
	HRC – Hôpital Aigle
	HRC – Hôpital Vevey Providence
	HRC – Hôpital Montreux
	GHOL – Hôpital de Nyon
	GHOL – Hôpital de Rolle
	Hôpital intercantonal de la Broye
	Hôpital du Pays-d'Enhaut, Château d'Œx
	RSBJ – Sainte-Croix
	Clinique de La Source
	Hirslanden-Gruppe – Clinique Bois-Cerf
	Hirslanden-Gruppe – Clinique Cecil
VS	Centre Hospitalier du Valais Romand
	Spitalzentrum Oberwallis
	HRC – Hôpital Monthey
	Clinique de Valère
ZG	Kantonsspital Zug

ZH	Universitätsspital Zürich Stadtspital Waid Spital Uster Spital Limmattal GZO – Spital Wetzikon Spital Bülach Universitäts-Kinderspital Zürich Spital Affoltern Hirslanden Gruppe – Klinik Hirslanden Klinik Susenberg

2. Swiss PPS website

The CH-PPS website was created as an information platform destined to participating hospitals, and to anyone interested in knowing more about this survey. Information, documents, protocols, codelists as well as a "Frequently Asked Questions" were regularly updated. In addition, dates for training courses and the link to the database for data entering were provided: https://www.swissnoso.ch/forschung-entwicklung/punktpraevalenz-erhebung-2017/ueber-die-punktpraevalenz-erhebung/ (accessed 14 December 2017).

3. Training-the trainor courses

The CH-PPS coordination center organized seven interactive training courses for hospital investigators: four in the German-speaking region (three in German, one in French), two in the French-speaking region, and one in Ticino (in French). The courses offered a structured methodology, encouraging a participative, problem-solving approach by discussing clinical cases, and interactive use of the database. The duration was 4 hours and participation was free of charge. Study material, beverages and lunch were provided. A total of 174 healthcare professionals attended the courses. In addition, regional courses were organized in the cantons Vaud and St. Gallen.

Table 2: Training-the trainor courses schedule

Date	Place	Language
14.03.2017	Clinique romande de réadaptation, Sion	FR
16.03.2017	Swiss Alcohol Board (SAB), Bern	DE
21.03.2017	Inselspital, Bern	FR
23.03.2017	Universitätsspital Zürich, Zürich	DE
04.04.2017	Hôpitaux Universitaires de Genève, Geneva	FR
06.04.2017	Allresto GmbH, Bern	DE
27.04.2017	Ospedale Regionale di Lugano, Lugano	FR

4. Data collection

Data collection was conducted **from 1st April to 30 June 2017.** Participating hospitals were free to choose a suitable date or time frame (of maximal 2 weeks) within this period.

5. Data management

After data collection by case report forms (CRFs), data were entered into the electronic CH-PPS database. Hospitals were free to enter data directly into the database without formally using paper CRFs. Data had to be entered on 31 July 2017. A data cleaning process was established, in which hospitals were contacted if necessary; the database was closed on 27 September 2017 for data entry. Hospitals had the option to download their own data (without benchmarking) in different formats (html, csv, pdf). Data were analyzed using STATA version 13 (STATA Corporation); validated PPS-data were provided by Carl Suetens from ECDC, applying the identical methodology used in the ECDC-PPS.

Results

1. Hospital-level data

Hospital indicator data were selected based on an ECDC-initiated systematic review on Hospital organization, management, and structure for the prevention of healthcare-associated infections (SIGHT), coordinated by the University of Geneva Hospitals (HUG).[18] The systematic review identified ten key components for successful HAI-prevention: 1) organisation of infection control at the hospital level; 2) bed occupancy, staffing, workload, and employment of pool or agency nurses; 3) availability of and ease of access to materials and equipment and optimum ergonomics; 4) appropriate use of guidelines; 5) education and training; 6) auditing; 7) surveillance and feedback; 8) multimodal and multidisciplinary prevention programmes that include behavioural change; 9) engagement of champions; and 10) positive organisational culture. An expert committee agreed on a number of indicators to be allocated to the key components for surveillance purposes. In a multistep consultation process by the authors, the ECDC ARHAI (antibiotic resistance and healthcare-associated infection) coordinators, and EU/EEA national focal points on IPC, a number of indicators were selected to be addressed by the ECDC-PPS. The CH-PPS adopted these indicators in the protocol in order to benchmark the Swiss data to the ECDC data.

A. Hospital characteristics

A total of 96 hospitals participated in the CH-PPS in 2017 (Tables 1, 3, 4). Median (Interquartile range [IQR]) duration of data collection was 2 (1-5) days, with three hospitals using more than 14 days. All adult and mixed university-affiliated hospitals participated in the CH-PPS. However, only two of three free-standing children's hospitals participated, and one mixed university hospital did not collect data on children.

Most hospitals (68/96, 70.8%) were public, 14 (14.6%) were private-not-for-profit, and another 14 (14.6%) private-for-profit hospitals.

Table 3: Hospital size and number of patients included in the CH-PPS

	Participating hospitals (N)	Eligible hospitals (N)	Size (beds) (N, mean [95%CI])	Patients in PPS (N, mean [95%CI])
Hospital size				
<200 beds	63	[1]148	98 (86-111)	56 (47-65)
200-650 beds	26	32	289 (256-322)	168 (142-195)
>650 beds	7	7	1102 (670-1535)	719 (422-1016)
Hospital category[2]				
Primary	38	ND	135 (106-164)	71 (52-90)
Secondary	40	ND	182 (136-228)	108 (81-135)
Tertiary	11	ND	762 (374-1150)	504 (246-763)
Specialised care	7	ND	91 (8-173)	52 (11-92)
Ownership				
Public	68	ND	253 (174-332)	147 (96-198)
Private not for profit	14	ND	195 (62-328)	149 (37-261)
Private for profit	14	ND	106 (55-157)	60 (25-95)
All hospitals	96	187	223 (164-283)	135 (95-174)

[1] The proportion of hospitals with less than 200 beds in the survey was relatively low compared with middle-size hospitals (200-650 beds) or big-size hospitals (>650 beds). This low proportion concerns especially very small-size acute-care settings (<100 beds). From the 187 acute-care hospitals, 101 have less than 100 beds. From the 86 hospitals with equal or more than 100 beds, 68 (79.1%) participated in the survey. All 5 university-affiliated hospitals also participated in the survey, including the two freestanding university-affiliated children's hospitals.

[2] The protocol did provide a definition for hospital category. The analysis is based on self-reporting by the hospitals.

ND: not determined; data on ownership and hospital category were defined as provided by the participating hospitals.

The 96 hospitals participating in the survey provided data on 12’931 patients (Table 4).

Table 4: Number of available beds and patients included in the CH-PPS

	Hospitals (N)	Total beds (N)	Total patients in PPS (N)
Hospital size			
<200 beds	63	6194	3516
200-650 beds	26	7514	4380
>650 beds	7	7717	5035
Hospital category			
Primary	38	5132	2694
Secondary	40	7279	4325
Tertiary	11	8378	5549
Specialised care	7	636	363
Ownership			
Public	68	17215	10009
Private not for profit	14	2728	2082
Private for profit	14	1482	840
All hospitals	96	21425	12931

The numbers of patients included in the PPS is lower compared to the number of total beds due to bed occupation, and the specific inclusion/exclusion criteria for patients (e.g. patients to be discharged during the day, or new admissions after 8.00 were excluded). The proportion of included patients to total beds is in line with the experience of the CH-PPS coordinating centre with previous local PPSs.

Tables 5 and 6 summarize indicator data on the participating hospitals, stratified by hospital size, hospital category, and ownership.

Table 5: Hospital discharges in a given year

		Results median (IQR)	***Data source** (N)
Hospital size			
	<200 beds	3999 (2338-6568)	62
	200-650 beds	11828 (10506-14486)	26
	>650 beds	40349 (28701-47522)	7
Hospital category			
	Primary	5125 (2432-7993)	37
	Secondary	7608 (3547-11470)	40
	Tertiary	27750 (17564-47522)	11
	Specialised care	1271 (798-2874)	7
Ownership			
	Public	7039 (3073-11871)	67
	Private not for profit	6304 (4106-7902)	14
	Private for profit	4042 (2000-7350)	14
Total CH		6455 (2950-11360)	95

*Data source: number of hospitals contributing to the results

Median length of stay of participating patients (as defined as days to CH-PPS) was higher in specialized care hospitals compared to the other hospital categories (Table 6).

Table 6: Length of stay (days)

		Results median (IQR)	***Data source** (N)
Hospital size			
	<200 beds	6 (5-7)	62
	200-650 beds	6 (5-7)	26
	>650 beds	7 (6-10)	7
Hospital category			
	Primary	6 (5-7)	37
	Secondary	6 (5-7)	40
	Tertiary	7 (6-8)	11
	Specialised care	9 (5-18)	7
Ownership			
	Public	6 (5-7)	67
	Private not for profit	6 (5-7)	14
	Private for profit	5 (4-6)	14
Total CH		6 (5-7)	95

*Data source: number of hospitals contributing to the results

B. Isolation capacity

Tables 7 to 10 summarize the isolation capacity of hospitals, stratified by hospital size, hospital category, and ownership. Data on the number of hospital rooms and single rooms were provided only by 40 and 41 hospitals, respectively. This limits generalisability for Switzerland.

Table 7: Hospital rooms

		Results mean (95%CI)	*Data source (N)
Hospital size			
	<200 beds	52 (41-64)	26
	200-650 beds	157 (101-212)	12
	>650 beds	412 (NA)	2
Hospital category			
	Primary	60 (40-81)	15
	Secondary	111 (63-159)	16
	Tertiary	246 (24-467)	5
	Specialised care	39 (7-70)	4
Ownership			
	Public	124 (70-179)	23
	Private not for profit	76 (39-112)	10
	Private for profit	64 (27-101)	7
Total CH		102 (69-135)	40

*Data source: number of hospitals contributing to the results

Table 8: Beds per hospital room

		Results mean (95%CI)	*Data source (N)
Hospital size			
	<200 beds	1.9 (1.5-2.4)	24
	200-650 beds	2.5 (1.1-3.8)	11
	>650 beds	2 (NA)	1
Hospital category			
	Primary	2.5 (1.4-3.7)	13
	Secondary	1.6 (1.3-1.9)	15
	Tertiary	2 (NA)	4
	Specialised care	2.5 (0-6.3)	4
Ownership			
	Public	2.5 (1.7-3.3)	20
	Private not for profit	1.7 (1.3-2.1)	9
	Private for profit	1.4 (0.9-1.9)	7
Total CH	Total CH	2.1 (1.6-2.6)	36

*Data source: number of hospitals contributing to the results

Data on beds per patient room could be calculated only for 36 hospitals due to lack of data on hospital rooms or differences (year, data on the entire hospital or the proportion of participating wards) between numerator (total beds) and denominator (number of hospital rooms). In Switzerland, hospital rooms host 2.1 beds on average without significant differences across hospital size or hospital category. However, the average number of beds per room is much lower in private-for-profit hospitals (Table 8).

Table 9: Proportion of single rooms (among all rooms)

		Results mean % (95%CI)	*Data source (N)
Hospital size			
	<200 beds	36.8 (29.5-44.1)	26
	200-650 beds	32.7 (24.8-40.6)	12
	>650 beds	34.4 (NA)	2
Hospital category			
	Primary	35.3 (23.5-47.2)	15
	Secondary	36.3 (28.9-43.8)	16
	Tertiary	32.3 (21.6-43.0)	5
	Specialised care	36.4 (17.2-55.6)	4
Ownership			
	Public	30.2 (25.1-35.2)	23
	Private not for profit	33.9 (25.9-41.8)	10
	Private for profit	55.0 (35.3-74.7)	7
Total CH		35.5 (30.3-40.6)	40

*Data source: number of hospitals contributing to the results

The proportion of single rooms in Switzerland with an average of 35.5% of all hospital rooms is relatively high. Interestingly, there are not many differences across hospital sizes and hospital categories. However, the proportion in private-for-profit hospitals was significantly higher compared to public hospitals (Table 9).

Table 10: Proportion of single rooms with toilet and shower (among single rooms)

		Results mean % (95%CI)	*Data source (N)
Hospital size			
	<200 beds	83.9 (74.4-93.4)	27
	200-650 beds	86.6 (75.5-97.7)	12
	>650 beds	90.5 (NA)	2
Hospital category			
	Primary	87.3 (76.4-98.1)	16
	Secondary	83.8 (75.0-92.5)	16
	Tertiary	75.5 (22.7-100.0)	5
	Specialised care	92.9 (79.7-100.0)	4
Ownership			
	Public	80.5 (69.5-91.5)	23
	Private not for profit	87.7 (78.1-97.3)	10
	Private for profit	94.6 (82.8-100.0)	8
Total CH		85.0 (78.2-91.8)	41

*Data source: number of hospitals contributing to the results

Most single rooms in Switzerland are equipped with toilet and shower. Even in public hospitals, this proportion is around 80%; in private-for-profit hospitals, almost all single rooms are equipped with individual toilet and shower.

C. Staffing, workload, bed occupation

Staffing (at the frontline) adapted to the acuity of care has been shown to be associated with fewer HAIs. High bed occupation was shown to have a negative impact on the transmission of multidrug-resistant organisms (MDROs).[18]

Tables 11 to 14 summarize nurse-to-bed ratio for the entire hospital and the ICU both for registered nurses and nursing assistants. The data are stratified by hospital size, hospital type, and ownership.

Table 11: Nurses per 100 hospital beds

		Results mean (95%CI)	***Data source** (N)
Hospital size			
	<200 beds	95.4 (84.0-106.8)	60
	200-650 beds	113.7 (88.0-139.4)	22
	>650 beds	132.8 (86.1-179.6)	6
Hospital category			
	Primary	93.3 (76.2-110.3)	36
	Secondary	102.7 (88.8-116.6)	36
	Tertiary	142.3 (110.1-174.5)	10
	Specialised care	90.7 (22.8-158.5)	6
Ownership			
	Public	105.6 (92.7-118.6)	63
	Private not for profit	96.5 (75.5-117.4)	11
	Private for profit	93.3 (65.3-121.3)	14
Total CH		102.5 (92.2-112.8)	88

*Data source: number of hospitals contributing to the results

Large size and tertiary care hospitals show the most favorable nurse-to-bed ratio. Interestingly, private-for-profit hospitals have (non-significant) lower ratios for registered nurses, but higher ratios for nursing assistants (Table 12).

Table 12: Nursing assistants per 100 hospital beds

		Results mean (95%CI)	*Data source (N)
Hospital size			
	<200 beds	24.8 (19.8-29.7)	58
	200-650 beds	18.2 (10.7-25.6)	20
	>650 beds	24.5 (7.6-41.4)	6
Hospital category			
	Primary	23.8 (17.0-30.6)	33
	Secondary	22.3 (17.1-27.5)	35
	Tertiary	19.2 (7.5-30.9)	10
	Specialised care	31.3 (0.0-63.5)	6
Ownership			
	Public	22.0 (17.5-26.5)	59
	Private not for profit	23.1 (9.9-36.3)	11
	Private for profit	28.1 (16.0-40.3)	14
Total CH		23.2 (19.2-27.1)	84

*Data source: number of hospitals contributing to the results

Table 13: ICU nurses per ICU bed

		Results mean (95%CI)	*Data source (N)
Hospital size			
	<200 beds	3.1 (2.9-3.4)	26
	200-650 beds	3.5 (2.8-4.2)	20
	>650 beds	4.6 (2.6-6.7)	6
Hospital category			
	Primary	3.1 (2.6-3.5)	16
	Secondary	3.6 (3.0-4.1)	24
	Tertiary	3.9 (2.6-5.2)	10
	Specialised care	3.2 (0.0-11.4)	2
Ownership			
	Public	3.6 (3.1-4.0)	40
	Private not for profit	2.9 (2.4-3.4)	7
	Private for profit	3.3 (2.6-4.1)	5
Total CH		3.5 (3.1-3.8)	52

*Data source: number of hospitals contributing to the results

Large size and tertiary care hospitals show the most favorable nurse-to-bed ratio in the ICU. Employment of nursing assistants in this area is low and there are only a few differences.

Table 14: ICU nursing assistant per ICU bed

		Results mean (95%CI)	*Data source (N)
Hospital size			
	<200 beds	0.4 (0.3-0.5)	26
	200-650 beds	0.3 (0.2-0.4)	17
	>650 beds	0.7 (0.2-1.2)	6
Hospital category			
	Primary	0.4 (0.2-0.5)	14
	Secondary	0.4 (0.3-0.5)	24
	Tertiary	0.5 (0.1-0.9)	9
	Specialised care	0.7 (NA)	2
Ownership			
	Public	0.4 (0.3-0.5)	38
	Private not for profit	0.4 (0.2-0.6)	6
	Private for profit	0.4 (0.2-0.6)	5
Total CH		0.4 (0.3-.05)	49

*Data source: number of hospitals contributing to the results

Table 15: Ward occupation at midnight

		Results mean % (95%CI)	***Data source** (N)
Hospital size			
	<200 beds	81.7 (74.1-89.4)	25
	200-650 beds	86.6 (77.4-95.7)	10
	>650 beds	91.7 (NA)	2
Hospital category			
	Primary	76.2 (64.8-87.6)	14
	Secondary	89.8 (83.3-96.3)	14
	Tertiary	85.8 (68.8-100)	5
	Specialised care	84.7 (49.9-100)	4
Ownership			
	Public	82.7 (74.8-90.5)	7
	Private not for profit	82.2 (69.8-94.6)	9
	Private for profit	88.1 (71.0-100)	21
Total CH		83.6 (78.0-89.2)	37

*Data source: number of hospitals contributing to the results

Ward occupation corresponds to the number of hospital beds occupied at midnight on the day of survey (or any day during data collection if longer than one day). This variable was collected separately due to the criteria to include or exclude patients in the survey. Data are available only for a third of participating hospitals. Occupation is highest in large size and in private-for-profit hospitals.

D. Hand hygiene

Hand hygiene (HH) is considered the most important action in HAI prevention. As an isolated measure, its association has been shown only in a small number of studies. However, HH is part of all bundle or multimodal prevention programmes, and thus, contributes to the overall effectiveness of such strategies. HH can be measured by direct observation or by calculating consumption of alcohol-based handrub (ABHR). The European FP7 project PROHIBIT (Prevention of hospital infections by intervention and training, https://plone.unige.ch/prohibit/) found a median hospital-wide handrub consumption of 21 mL per patient-day in 232 European hospitals.[19] The first ECDC-PPS found an average of 19 ml per patient-day. The purpose of the CH-PPS was to obtain both data on hand rubbing (ABHR consumption), and data on investing in HH promotion (number of observed HH opportunities) per year.

Table 16: Alcohol-based handrub consumption

		Results mean liters/1000 patient-days (95%CI)	***Data source** (N)
Hospital size			
	<200 beds	48.9 (39.6-58.3)	55
	200-650 beds	60.2 (47.9-72.6)	23
	>650 beds	57.6 (14.6-100.0)	5
Hospital category			
	Primary	44.3 (37.5-51.1)	33
	Secondary	49.4 (41.6-57.2)	35
	Tertiary	82.0 (57.4-106.6)	9
	Specialised care	72.5 (0-165.4)	6
Ownership			
	Public	51.8 (45.3-58.3)	60
	Private not for profit	44.7 (26.9-62.6)	11
	Private for profit	63.6 (23.7-103.5)	12
Total CH		52.6 (45.3-59.8)	83

*Data source: number of hospitals contributing to the results

Data on ABHR consumption were obtained by 83 hospitals, most frequently based on pharmacy data, either ordered or delivered. Formally, we asked for Liters per 1000 patient-days; however, this ratio is identical to mL per patient-day (as reported by PROHIBIT and the ECDC-PPS). Tertiary care hospitals consume more ABHR than other hospitals, as do private-for-profit hospitals compared to other hospitals.

Table 17: Alcohol-based handrub (dispensers) at the point of care

	Results mean % (95%CI)	**Results** median % (IQR)	***Data source** (N)
Hospital size			
<200 beds	46.3 (26.6-66.0)	53.6 (0.0-100.0)	21
200-650 beds	54.4 (21.7-87.1)	44.4 (17.8-98.2)	9
>650 beds	58.5 (NA)	16.9 & 100.0	2
Hospital category			
Primary	64.7 (40.4-89.1)	64.9 (53.6-100.0)	13
Secondary	44.2 (14.6-73.8)	35.5 (0.0-100.0)	11
Tertiary	49.3 (0-100)	22.8 (17.8-89.0)	5
Specialised care	1.6 (0-8.7)	0.0 (0.0-4.9)	3
Ownership			
Public	54.9(36.1-73.7)	55.9 (17.8-100.0)	18
Private not for profit	47.5 (5.8-89.2)	45.5 (0.0-100.0)	8
Private for profit	35.3 (0-88.1)	5.8 (0.0-100.0)	6
Total CH	49.4 (34.0-64.7)	49 (4.7-100.0)	32

*Data source: number of hospitals contributing to the results

ABHR provision is not effective if not available at the point of care. As defined by the World Health Organization, “point of care” is the place where three elements come together: the patient, the healthcare worker (HCWs) and care or treatment involving contact with the patient or his/her surroundings. Table 17 reports means and medians because variation among the hospitals was quite important.

Many hospitals have invested on individual pocket bottles of ABHR carried directly by the HCW. This policy explains partially why data on ABHR at the point of care were not reported by some hospitals.

Table 18: Observed hand hygiene opportunities per year and hospital

	Results mean % (95%CI)	Results median (IQR)	*Data source (N)
Hospital size			
<200 beds	1279 (0-2619)	328 (155-800)	45
200-650 beds	1024 (630-1417)	752 (341-1441)	22
>650 beds	3125 (342-5907)	2923 (1883-4415)	5
Hospital category			
Primary	1827 (0-4169)	446 (200-1169)	26
Secondary	848 (512-1183)	530 (263-1068)	34
Tertiary	2234 (374-4093)	1882 (300-2923)	8
Specialised care	375 (40-709)	326 (241-410)	4
Ownership			
Public	1594 (486-2702)	617 (250-1441)	55
Private not for profit	940 (0-2304)	541 (410-657)	5
Private for profit	275 (129-420)	255 (80-382)	12
Total CH	1329 (478-2180)	505 (223-1123)	72

*Data source: number of hospitals contributing to the results

E. Microbiological laboratory performance

The more microbiological tests are performed the more likely infections can be identified. Because some definitions for HAI-surveillance require microbiological confirmation, the rate of performing blood cultures and stool testing for *Clostridium difficile*, impacts directly on the measured HAI prevalence.

Table 19: Blood culture sets per 1000 patient-days

		Results median (IQR)	***Data source** (N)
Hospital size			
	<200 beds	28.9 (12.5-55.1)	50
	200-650 beds	49.4 (40.2-69.7)	22
	>650 beds	48.8 (46.9-49)	5
Hospital category			
	Primary	33.0 (19.3-48.1)	33
	Secondary	52.3 (2934-69.7)	30
	Tertiary	50.7 (48.8-73.7)	8
	Specialised care	6.0 (0.4-12.5)	6
Ownership			
	Public	48.9 (32.8-68.2)	52
	Private not for profit	22.6 (3.2-42.0)	11
	Private for profit	12.4 (4.0-31.4)	14
Total CH		41.6 (21.8-55.6)	77

*Data source: number of hospitals contributing to the results

Most hospitals have a high rate of blood culture sampling. Only small size, primary care and private-for-profit hospitals perform fewer blood cultures. The rate of private-for-profit hospitals is significantly lower compared public hospitals.

Table 20: Stool tests for identifying *Clostridium difficile* infections per 1000 patient-days

	Results median (IQR)	***Data source** (N)
Hospital size		
<200 beds	4.7 (1.8-6.4)	48
200-650 beds	5.3 (3.6-5.8)	22
>650 beds	4.8 (4.6-8.5)	5
Hospital category		
Primary	4.7 (2.6-6.1)	32
Secondary	5.5 (3.9-6.4)	30
Tertiary	5.3 (4.6-7.5)	8
Specialised care	2.6 (2-2.6)	5
Ownership		
Public	5.5 (4.3-6.4)	52
Private not for profit	2.3 (0.6-3.2)	11
Private for profit	1.3 (0.5-5.4)	12
Total CH	5 (2.3-6.2)	75

*Data source: number of hospitals contributing to the results

There is no difference in school testing for *Clostridium difficile* among hospital sizes and hospital types. Only private-for-profit hospitals perform less testing.

Availability of microbiological service also on weekends is important to manage isolation precaution measures. If screening tests are not reported, patients remain too long in isolation or may not be isolated at first place.

Table 21: Microbiological tests on weekends

	Clinical tests	**Screening tests**
Saturday	87/96 (90.6%)	84/96 (87.5%)
Sunday	76/96 (79.2%)	72/96 (75.0%)
Saturday and Sunday	76/96 (79.2%)	72/96 (75.0%)

All hospitals provided information to this question. There is no difference between clinical tests and screening tests; however, reporting is less common on Sundays than on Saturdays.

F. Post-prescription review of antimicrobials

Nine of the 96 hospitals (9.4%) have post-prescription review at 72 hours either in the entire hospital (3), in the ICU (3), or elsewhere (3). The *Ostschweizer Kinderspital* is the only tertiary care hospital with a post-prescription review of antimicrobials. No other tertiary care or large size hospital reported to have such review formally established. The nine hospitals with the post-prescription review are primary and secondary care, small size and medium size hospitals.

G. Organisation of infection prevention and control

Annual plans in IPC help to set priorities and targets both to improve quality and to save resources. In order to be effective, an annual plan should be produced by the IPC but approved by the hospital management.

Table 22: Infection Prevention and Control – Annual plan

		Results mean % (95%CI)	***Data source** (N)
Hospital size			
	<200 beds	52.4 (39.7-65.1)	63
	200-650 beds	46.2 (25.6-66.7)	26
	>650 beds	85.750.8-100.0)	7
Hospital category			
	Primary	47.4 (30.7-64.0)	38
	Secondary	57.541.5-73.5)	40
	Tertiary	45.5 (10.4-80.5)	11
	Specialised care	71.426.3-100.0)	7
Ownership			
	Public	57.4 (45.3-69.4)	68
	Private not for profit	35.7 (7.0-64.4)	14
	Private for profit	50.0 (20.0-80.0)	14
Total CH		53.1 (43.0-63.3)	96

*Data source: number of hospitals contributing to the results

Annual plans for IPC are produced predominantly in large size hospitals.

An Infection Prevention and Control annual report is the minimal standard of providing feedback to the hospital and frontline HCWs. It should be authorized by the hospital management.

Table 23: Infection Prevention and Control – Annual report

		Results mean % (95%CI)	***Data source** (N)
Hospital size			
	<200 beds	61.9 (49.6-74.2)	63
	200-650 beds	61.5 (41.5-81.6)	26
	>650 beds	100.0 (NA)	6
Hospital category			
	Primary	60.5 (44.2-76.8)	38
	Secondary	65.0 (49.6-80.4)	40
	Tertiary	60.0 (23.1-96.9)	10
	Specialised care	85.7 (50.8-100.0)	7
Ownership			
	Public	68.7 (57.3-80.1)	67
	Private not for profit	42.9 (13.2-72.5)	14
	Private for profit	64.3 (35.6-93.0)	14
Total CH		64.2 (54.4-74.0)	95

*Data source: number of hospitals contributing to the results

Still today, staffing of IPC-nurses for effective IPC is based on the findings of the SENIC study in the 1970's. No formal testing has been performed since. The ratio was defined as 1 IPC-nurse per 250 hospital beds,[2] but expert consensus today suggests to employ one IPC-nurse per ICU, and ratios in acute care in the order of one nurse per 100-150 beds.[20]

Table 24: Infection Prevention and Control nurse – Full time equivalent per 250 beds

		Results mean (95%CI)	*Data source (N)
Hospital size			
	<200 beds	1.6 (1.1-2.0)	63
	200-650 beds	1.3 (1.0-1.6)	26
	>650 beds	1.3 (0.8-1.7)	7
Hospital category			
	Primary	1.2 (0.9-1.5)	38
	Secondary	1.5 (1.2-1.8)	40
	Tertiary	1.4 (0.9-1.8)	11
	Specialised care	3.0 (0.0-7.1)	7
Ownership			
	Public	1.3 (1.1-1.5)	68
	Private not for profit	1.6 (1.1-2.2)	14
	Private for profit	2.3 (0.5-4.1)	14
Total CH	Total CH	1.5 (1.2-1.8)	96

*Data source: number of hospitals contributing to the results
FTE: full-time equivalent

With 1.5 IPC nurse per 250 beds, Switzerland has a more favorable ratio than identified in the TRICE (Training in infection control) surveillance by the ECDC that found an average of 1 IPC nurse per 250 beds in Europe.[21, 22]

There is no consensus about the ratio of IPC doctors per hospital beds. While the original SENIC study suggested that a hospital should have at least one doctor with some IPC training, there is some agreement that 1 doctor per 1000 beds is preferred.

Table 25: Infection Prevention and Control doctor – Full time equivalent per 1000 beds

		Results mean (95%CI)	***Data source** (N)
Hospital size			
	<200 beds	1.2 (0.6-1.8)	63
	200-650 beds	5.7 (0.0-13.0)	26
	>650 beds	2.3 (1.3-3.3)	7
Hospital category			
	Primary	4.0 (0.0-8.9)	38
	Secondary	1.2 (0.7-1.7)	40
	Tertiary	3.5 (0.6-6.3)	11
	Specialised care	0.4 (0.0-1.5)	7
Ownership			
	Public	2.8 (0.1-5.5)	68
	Private not for profit	2.9 (0.4-5.5)	14
	Private for profit	0.4 (0.1-0.8)	14
Total CH		2.5 (0.6-4.4)	96

*Data source: number of hospitals contributing to the results
FTE: full-time equivalent

Hospitals providing specialized care and private-for-profit hospitals have lower IPC doctor to hospital bed ratios compared to other hospitals.

Table 26: Antimicrobial stewardship – Full time equivalent per hospital

		Results mean (95%CI)	*Data source (N)
Hospital size			
	<200 beds	0.1 (0.1-0.2)	63
	200-650 beds	1.7 (0.0-3.9)	26
	>650 beds	2.6 (1.1-4.1)	7
Hospital category			
	Primary	1.1 (0.0-2.6)	38
	Secondary	0.2 (0.1-0.2)	40
	Tertiary	2.0 (1.0-3.1)	11
	**Specialised care	0.0 (0.0-0.0)	7
Ownership			
	Public	0.9 (0.1-1.8)	68
	Private not for profit	0.7 (0-1.3)	14
	Private for profit	0.1 (0.0-0.1)	14
Total CH		0.8 (0.2-1.3)	96

*Data source: number of hospitals contributing to the results
**One hospital with 0.1 FTE antibiotic stewardship

FTE: full-time equivalent

In a time of emerging microbiological resistance, judicious use of antimicrobials is key to offer effective antimicrobial treatment in the future. Antimicrobial prescription in hospitals must be rational and based on best practice. Given that antimicrobials are prescribed by most doctors seeing patients, their use must be monitored and inappropriate use minimised. This task should formally be allocated to an *antimicrobial stewardship* consultant for optimal results. In the CH-PPS we were interested to know about such formal employment of *antimicrobial stewardship* consultants.

Table 27: Surveillance activities

	CH	Hospital size			Hospital type			
Outcome	*All %	<200 %	200-650 %	>650 %	PRIM %	SEC %	TERT %	SPEC %
SSI	94.8	93.7	96.2	100.0	94.7	97.5	100.0	71.4
HAI in ICU	4.2	3.2	7.7	0.0	7.9	2.5	0.0	0.0
CDI	10.4	7.9	7.7	42.9	10.5	7.5	27.3	0.0
AMR	59.4	57.1	57.7	85.7	57.9	60.0	81.8	28.6
AM-use	44.8	36.5	50.0	100.0	36.8	52.5	72.7	0.0

*Data from all 96 hospitals

AM-use: consumption of antimicrobials; AMR: antimicrobial resistance; CDI: *Clostridium difficile* infection; HAI: healthcare-associated infection; PRIM: primary care; SEC: secondary care; SPEC: special care; SSI: surgical site infection; TERT: tertiary care

This table presents the percentage of hospitals participating in the aforementioned surveillance activities, either these activities are organized in a local or wider/national level.

Some hospitals specified other surveillance activities:

- 12 hospitals in SG and TI: *CleanHands*
- 18 hospitals in VD; 2 hospitals in NE; and 1 hospital in JU: cantonal surveillance of AMR, BSI, HAI-prevalence
- 2 Hospitals in VS: Swissnoso intervention module

Surveillance (with timely feedback and as part of a surveillance network) has been shown to be effective in HAI prevention.[18] The coordination of outcome surveillance usually is done by the IPC team. In Switzerland, a number of national and international surveillance networks are available for hospitals: Swissnoso SSI-surveillance, ICU-HAI surveillance in the German KISS (Krankenhaus Infektions Surveillance System), AMR (antimicrobial resistance) with anresis, AM-use (Consumption of antimicrobials) with anresis and global antibiotic use networks, CDI-surveillance with KISS.[23, 24] In the CH-PPS we addressed surveillance as part of a network. Hospitals still may have established local surveillance activities with prospective benchmarking rather than comparing the results with other hospitals.

H. Organisation of infection prevention and control

Multimodal strategies are a combination of technology and best practice, which are delivered by different "modes" such as lectures, visual reminders, simulation training, bedside teaching, knowledge tests, or any other original and imaginable idea to change the behaviour of healthcare professionals. Multimodal strategies have been found one of the ten key components in effective organization and structure of IPC.[18] The concept of multimodality leaves room for innovation and adaptation to local concepts. In order to obtain more tangible and comparable results on how multimodal strategies are implemented, the main elements of multimodal strategies were detached and addressed separately. As a proxy, the more elements are combined the more likely a strategy is "multimodal" and thus, effective. The following tables summarize the use of multimodal elements in the ICU and outside the ICU, both as the proportion of how many hospitals have established a single element for HAI prevention and antimicrobial stewardship (ABS) and as the proportion of how many hospitals have combined elements of multimodal strategies for HAI prevention and ABS.

Table 28: Multimodal strategies in intensive care: single elements

	Guidelines %	Bundles %	Training %	Checklist %	Audits %	Surveillance %	Feedback %
VAP	52.5%	43.6%	23.4%	16.9%	6.5%	17.1%	17.1%
BSI	51.9%	40.5%	26.0%	26.7%	10.5%	34.2%	33.3%
UTI	57.5%	41.8%	21.8%	16.7%	19.2%	20.8%	23.4%
ABS	63.7%	36.7%	27.3%	14.1%	10.3%	41.6%	36.4%

ABS: antimicrobial stewardship; BSI: bloodstream infection; UTI: urinary tract infection; VAP: ventilator-associated pneumonia

Table 29: Multimodal strategies in intensive care: combination of elements

Elements combined (N)	VAP N/N (%)	BSI N/N (%)	UTI N/N (%)	ABS N/N (%)
0	33/83 (39.8%)	33/83 (39.8%)	33/83 (39.8%)	27/83 (32.5%)
1	17/83 (20.5%)	9/83 (10.8%)	14/83 (16.9%)	14/83 (16.9%)
2	11/83 (13.3%)	11/83 (13.3%)	9/83 (10.8%)	9/83 (10.8%)
3	6/83 (7.2%)	6/83 (7.2%)	7/83 (8.4%)	4/83 (4.8%)
4	7/83 (8.4%)	12/83 (14.5%)	7/83 (8.4%)	17/83 (20.5%)
5	3/83 (3.6%)	2/83 (2.4%)	6/83 (7.2%)	7/83 (8.4%)
6	4/83 (4.8%)	5/83 (6.0%)	2/83 (2.4%)	2/83 (2.4%)
7	2/83 (2.4%)	5/83 (6.0%)	5/83 (6.0%)	3/83 (3.6%)

ABS: antimicrobial stewardship; BSI: bloodstream infection; UTI: urinary tract infection; VAP: ventilator-associated pneumonia

Table 30: Multimodal strategies outside intensive care: single elements

	Guidelines %	Bundles %	Training %	Checklist %	Audits %	Surveillance %	Feedback %
PN	37.9%	23.3%	14.0%	4.5%	4.3%	5.5%	6.5%
BSI	49.5%	33.3%	20.4%	13.6%	9.8%	30.8%	30.8%
SSI	71.3%	68.8%	27.7%	32.3%	40.4%	88.2%	83.0%
UTI	63.4%	47.3%	29.3%	21.1%	21.5%	22.8%	24.2%
ABS	70.5%	37.2%	30.8%	15.2%	10.8%	41.3%	38.2%

ABS: antimicrobial stewardship; BSI: bloodstream infection; PN: pneumonia; SSI: surgical site infection; UTI: urinary tract infection

Table 31: Multimodal strategies outside intensive care: combination of elements

EC (N)	PN N/N (%)	BSI N/N (%)	SSI N/N (%)	UTI N/N (%)	ABS N/N (%)
0	45/95 (47.4%)	30/95 (31.6%)	7/95 (7.4%)	26/95 (27.4%)	21/95 (22.1%)
1	27/95 (28.4%)	22/95 (23.2%)	4/95 (4.2%)	23/95 (24.2%)	20/95 (21.1%)
2	13/95 (13.7%)	12/95 (12.6%)	10/95 (10.5%)	11/95 (11.6%)	14/95 (14.7%)
3	6/95 (6.3%)	13/95 (13.7%)	11/95 (11.6%)	6/95 (6.3%)	8/95 (8.4%)
4	3/95 (3.2%)	9/95 (9.5%)	21/95 (22.1%)	9/95 (9.5%)	17/95 (17.9%)
5	0/95 (0.0%)	4/95 (4.2%)	22/95 (23.2%)	12/95 (12.6%)	7/95 (7.4%)
6	1/95 (1.1%)	3/95 (3.2%)	6/95 (6.3%)	3/95 (3.2%)	5/95 (5.3%)
7	0/95 (0.0%)	2/95 (2.1%)	14/95 (14.7%)	5/95 (5.3%)	3/95 (3.2%)

ABS: antimicrobial stewardship; BSI: bloodstream infection; EC: number of combined elements; PN: pneumonia; SSI: surgical site infection; UTI: urinary tract infection

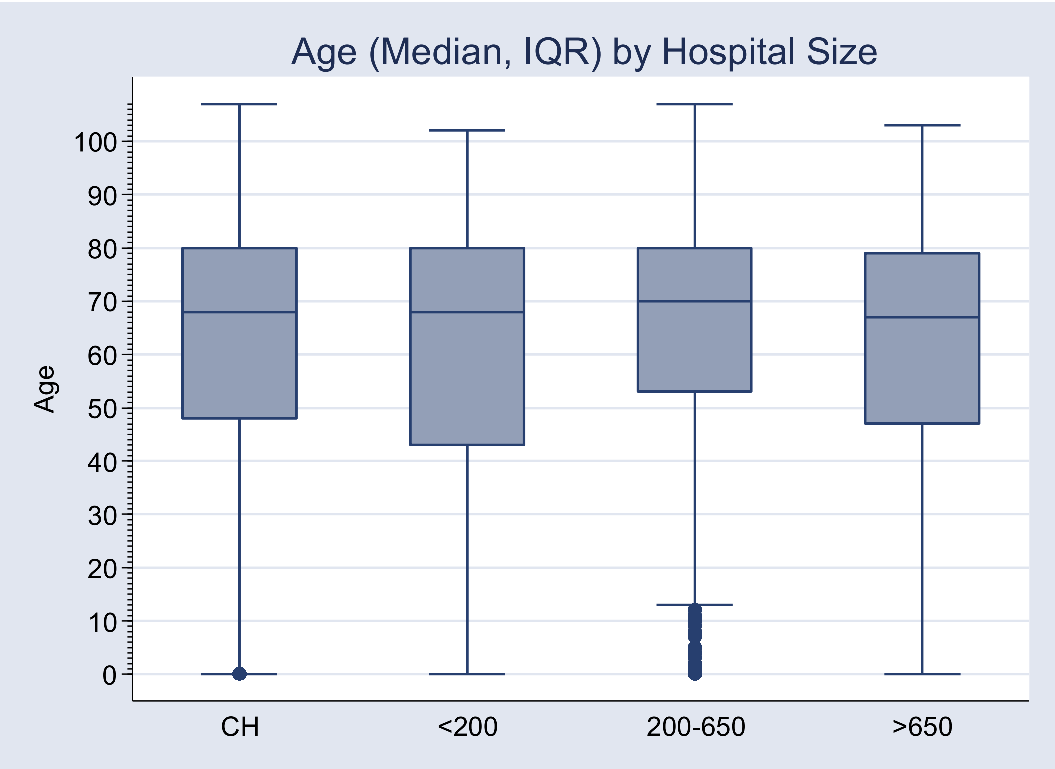
2. Patient level data

A. Patient characteristics

A total of 12'931 patients were included by the 96 hospitals participating in the CH-PPS. Patient data were collected using an individual patient form (ECDC standard protocol) that includes demographic information, data on risk factors for HAI, data on AU, HAI, and microbiology.

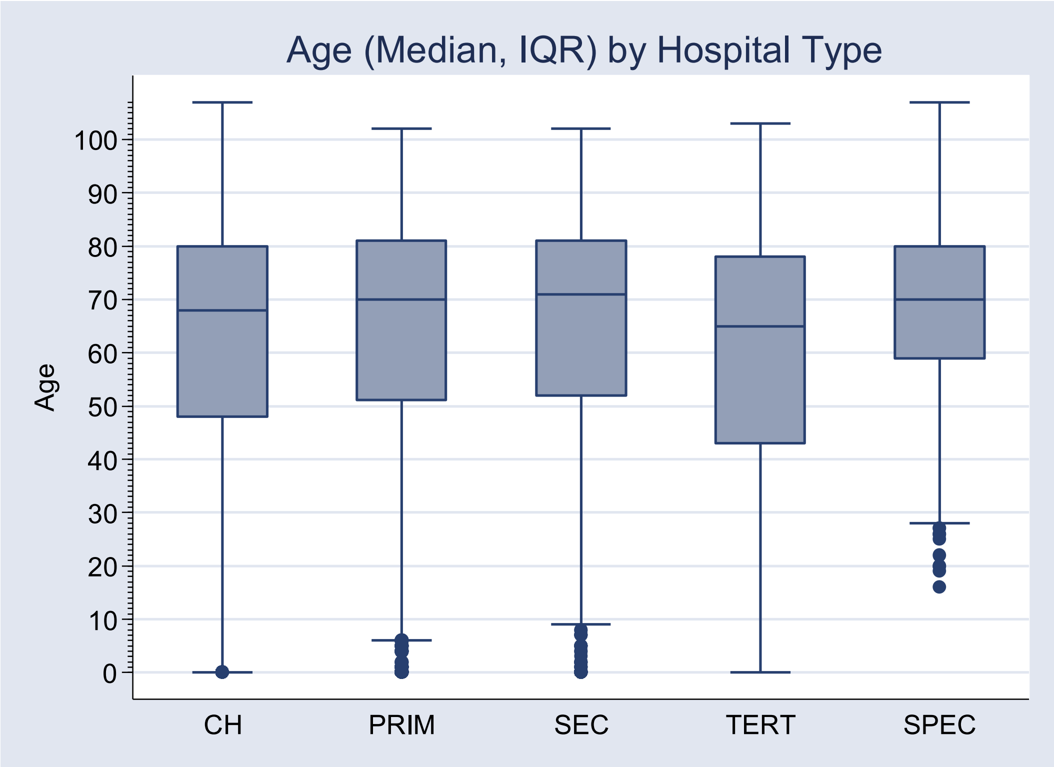
The following figures summarize patient indicators such as age, gender, McCabe score, length of stay (defined as days from admission to CH-PPS), ward speciality, and patient speciality.

Figure 3: Patient age by hospital size



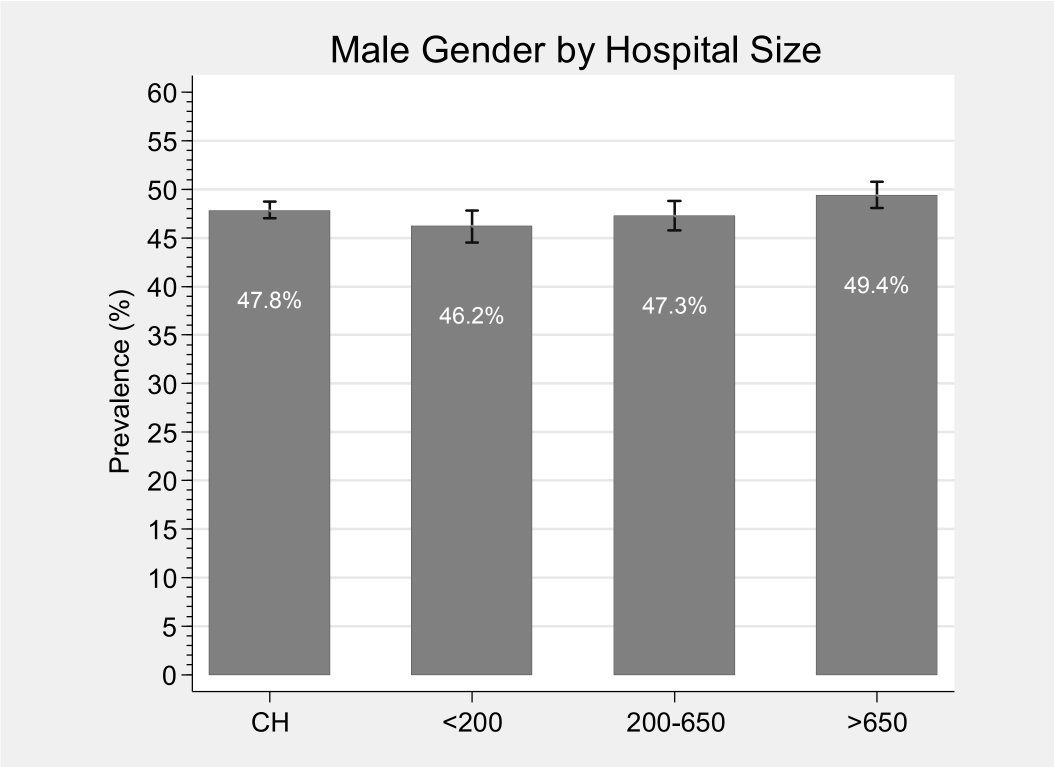
CH: Switzerland; IQR: interquartile range

Figure 4: Patient by hospital type



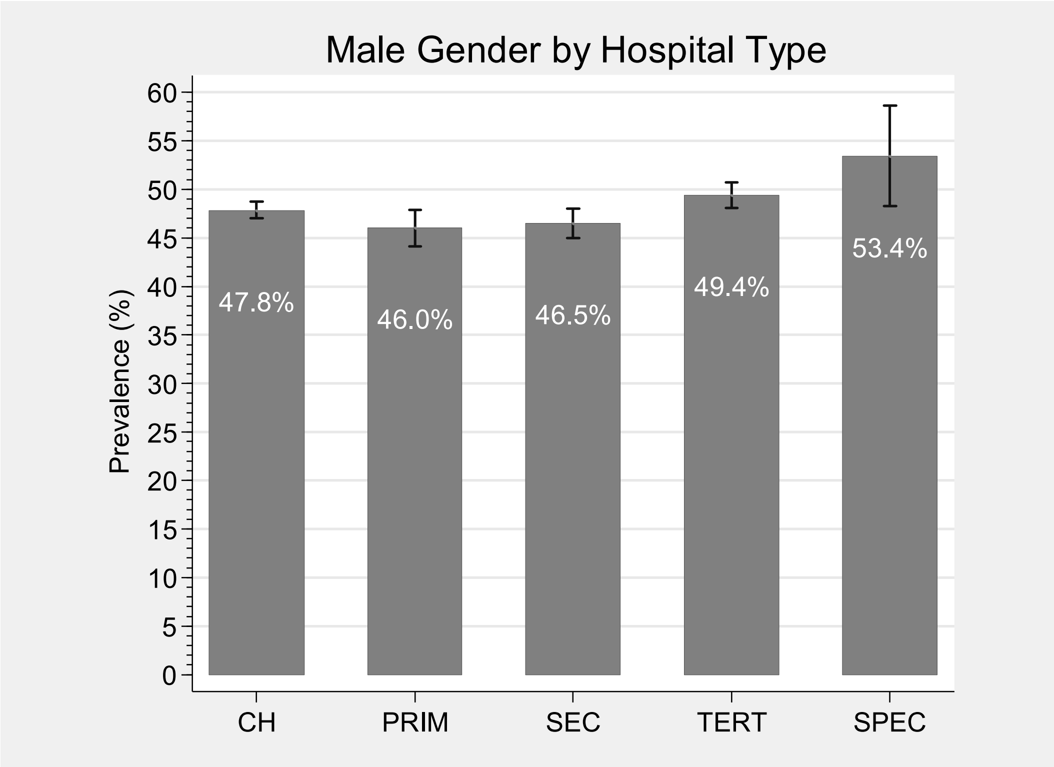
CH: Switzerland; IQR: interquartile range; PRIM: primary care; SEC: secondary care; TERT: tertiary care; SPEC: specialized care

Figure 5: Prevalence of male gender by hospital size



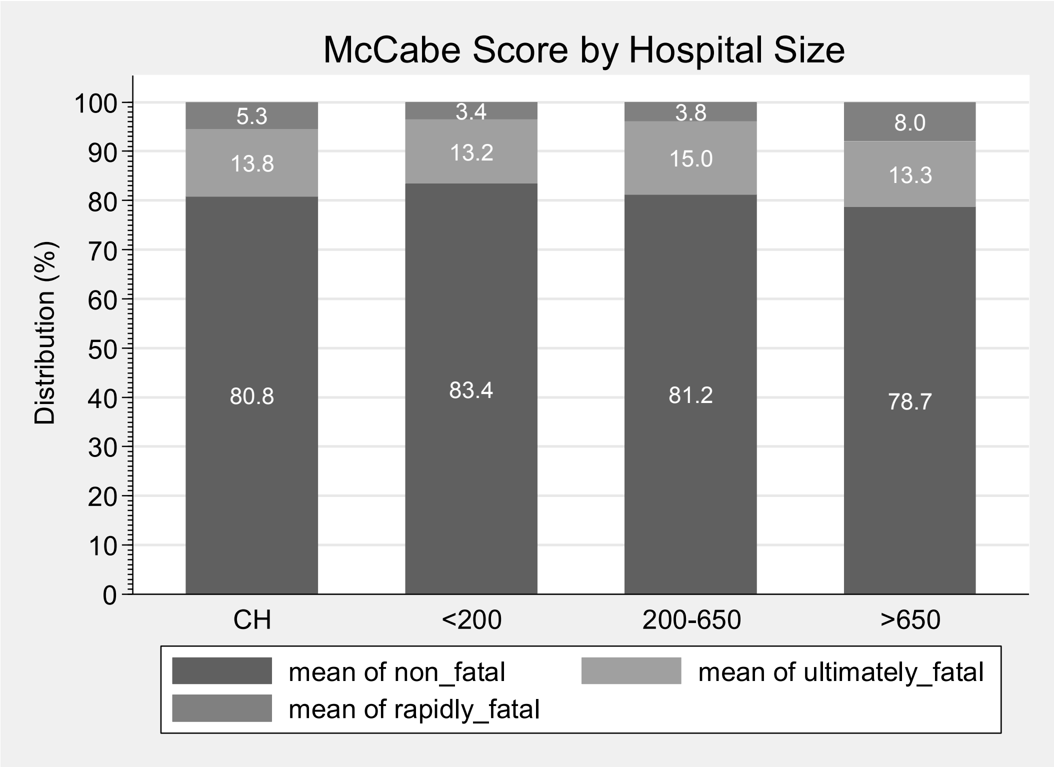
CH: Switzerland

Figure 6: Prevalence of male gender by hospital type



CH: Switzerland; PRIM: primary care; SEC: secondary care; TERT: tertiary care; SPEC: specialized care

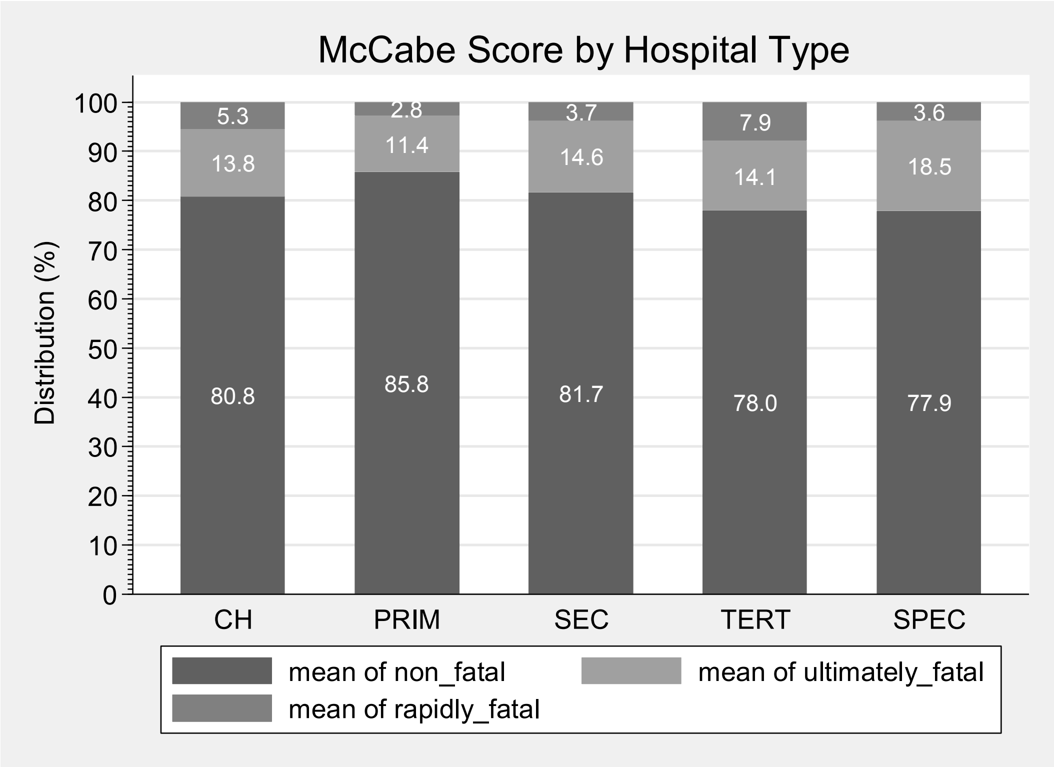
Figure 7: Patient McCabe score by hospital size



CH: Switzerland; McCabe score categories: rapidly fatal (grey): <1 year; ultimately fatal (light grey): 1-4 years; non-fatal (dark grey): >5 years

Large size hospitals (>650 beds) had more patients with rapidly fatal disease than medium size or small size hospitals.

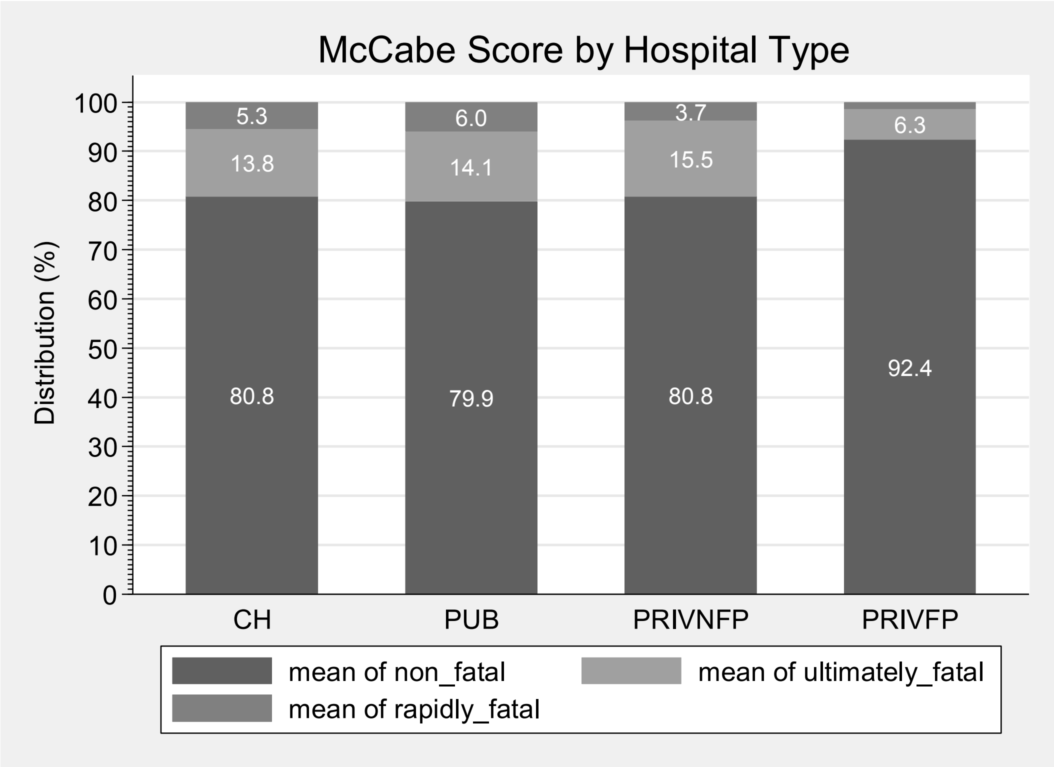
Figure 8: Patient McCabe score by hospital type



CH: Switzerland; PRIM: primary care; SEC: secondary care; TERT: tertiary care; SPEC: specialized care; McCabe score categories: rapidly fatal (grey): <1 year; ultimately fatal (light grey): 1-4 years; non-fatal (dark grey): >5 years

Tertiary care hospitals had more patients with rapidly fatal disease than primary care, secondary care or specialized care hospitals.

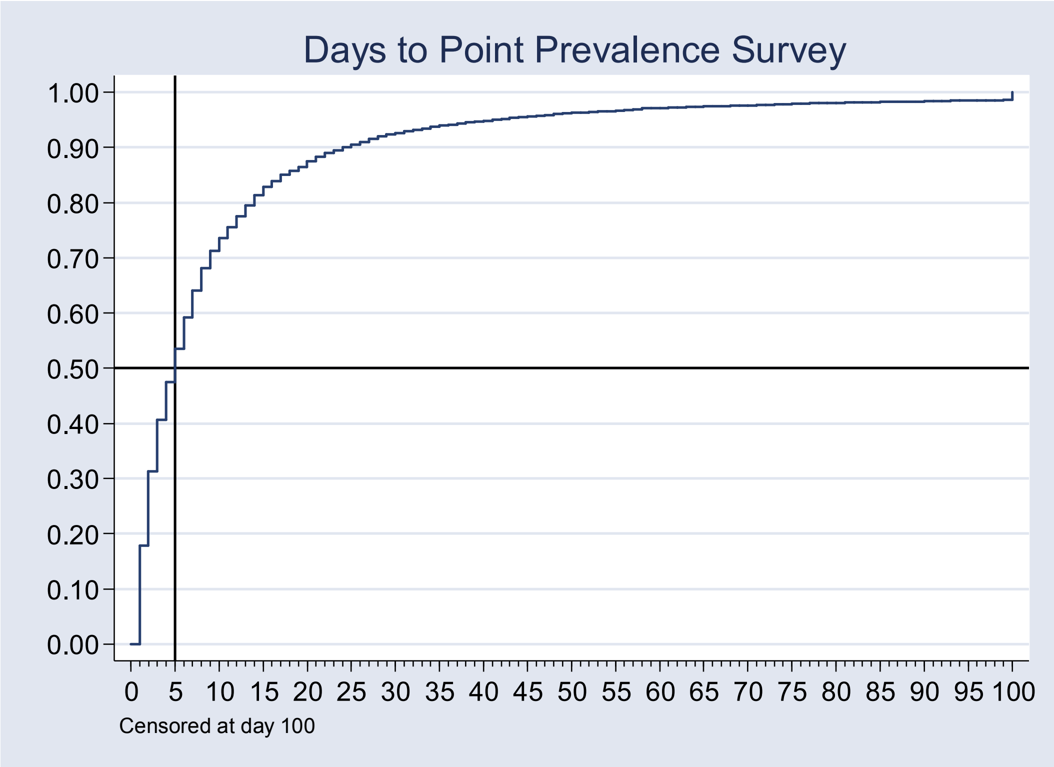
Figure 9: Patient McCabe score by hospital ownership



CH: Switzerland; McCabe score categories: rapidly fatal (grey): <1 year; ultimately fatal (light grey): 1-4 years; non-fatal (dark grey): >5 years; PUB: public hospitals; PRIVFP: private-for-profit hospitals; PRIVNFP: private non-for-profit hospitals

Private-for-profit hospitals had less patients with fatal (both rapidly fatal and ultimately fatal) McCabe scores.

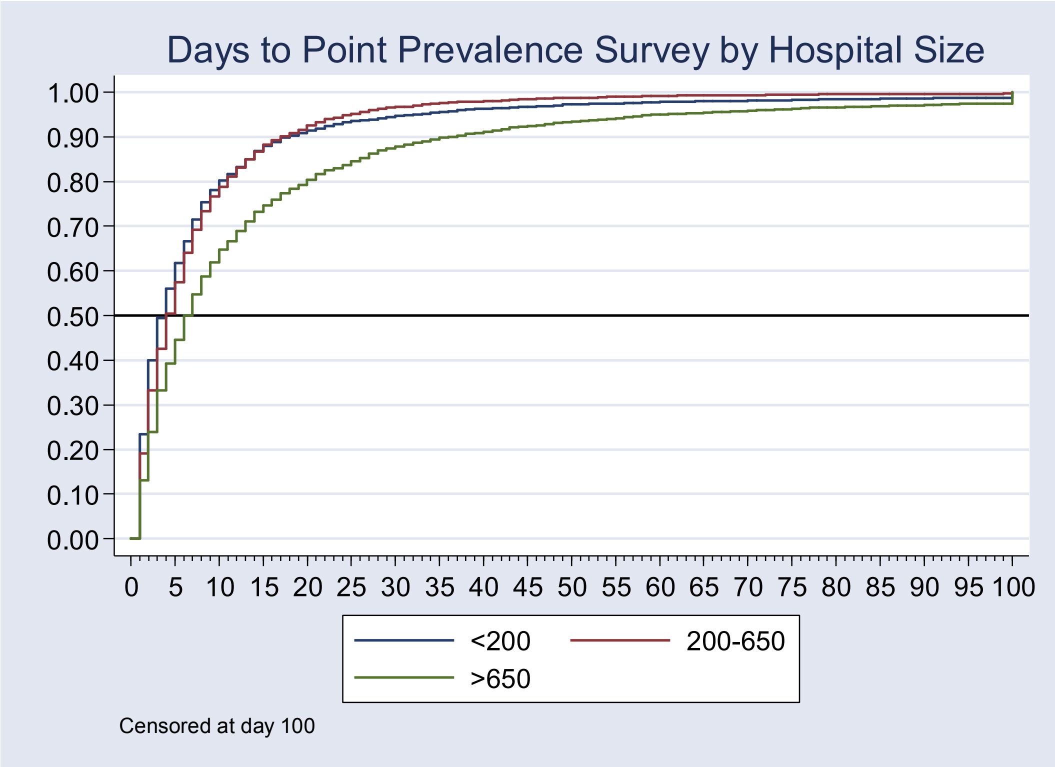
Figure 10: Length of stay to survey day



0.50: median quantile, censoring at 100 days

The median length of stay (median quantile) of patients before PPS day was 5 days.

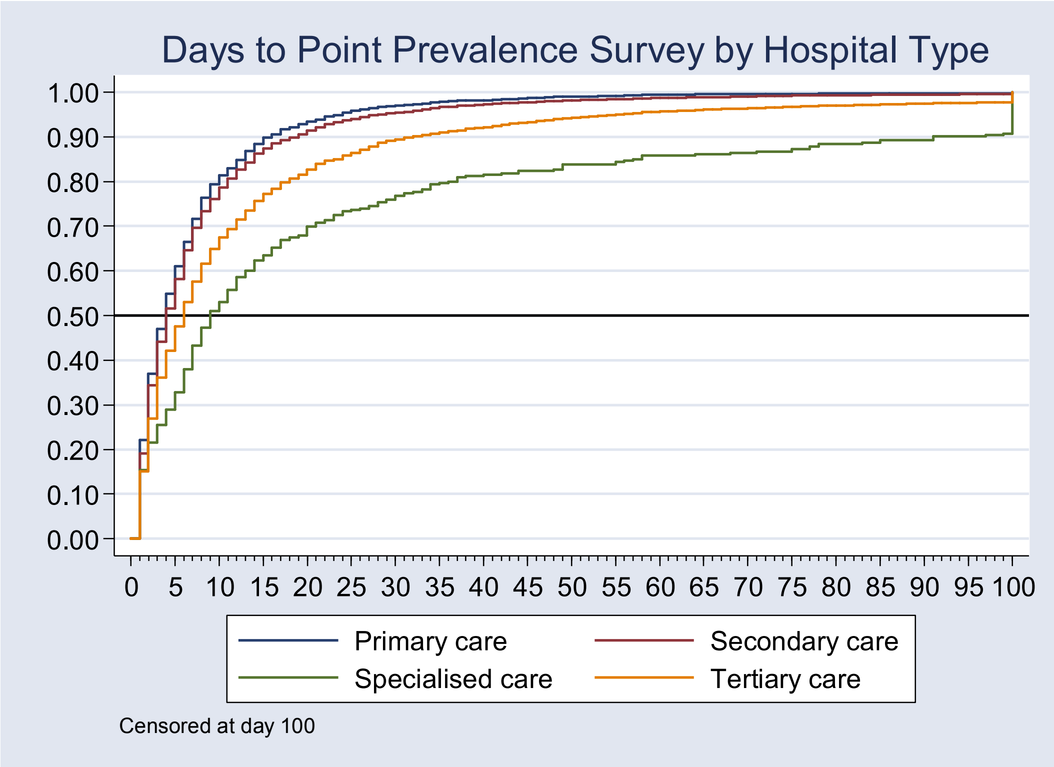
Figure 11: Length of stay to survey day by hospital size



0.50: median quantile, censored at 100 days

Patients hospitalized in large size hospitals (>650 beds) had longer stay (6.5 days) before PPS than patients in medium size or small size hospitals (3.5 days and 4 days, respectively).

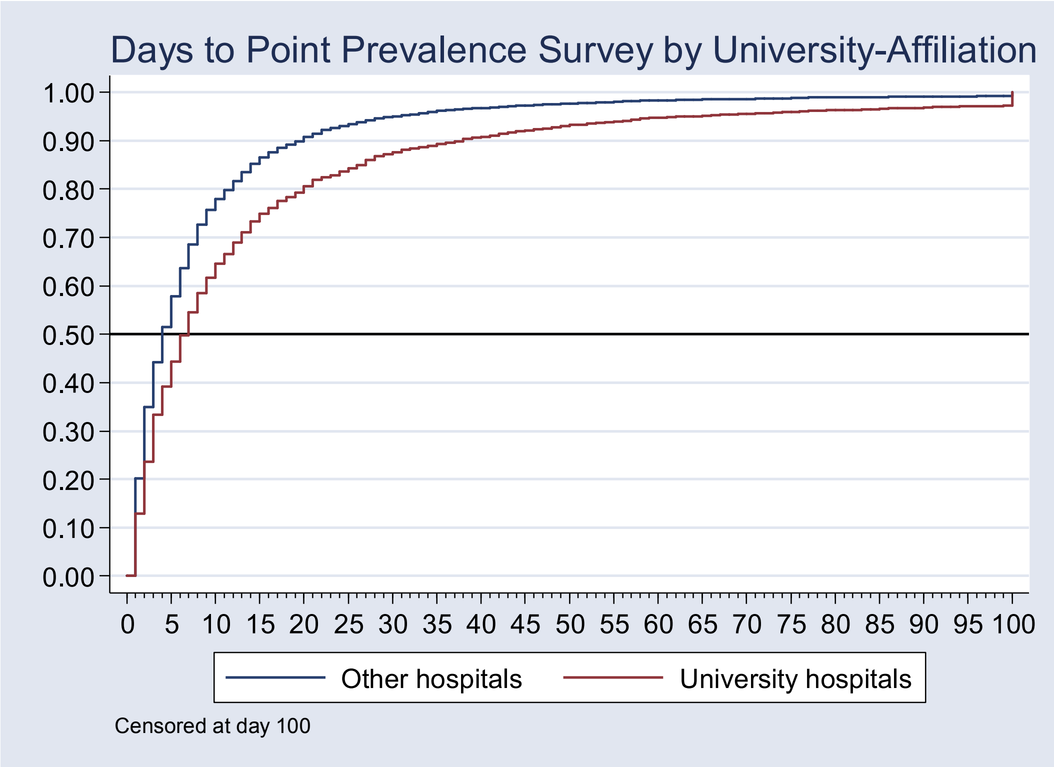
Figure 12: Length of stay to survey day by hospital type



0.50: median quantile, censored at 100 days
PRIM: primary care; SEC: secondary care; TERT: tertiary care; SPEC: specialized care

Patients in hospitals offering specialized care had longer stay before PPS (9 days) than patients in tertiary care (6 days) and primary/secondary care (4 days) hospitals.

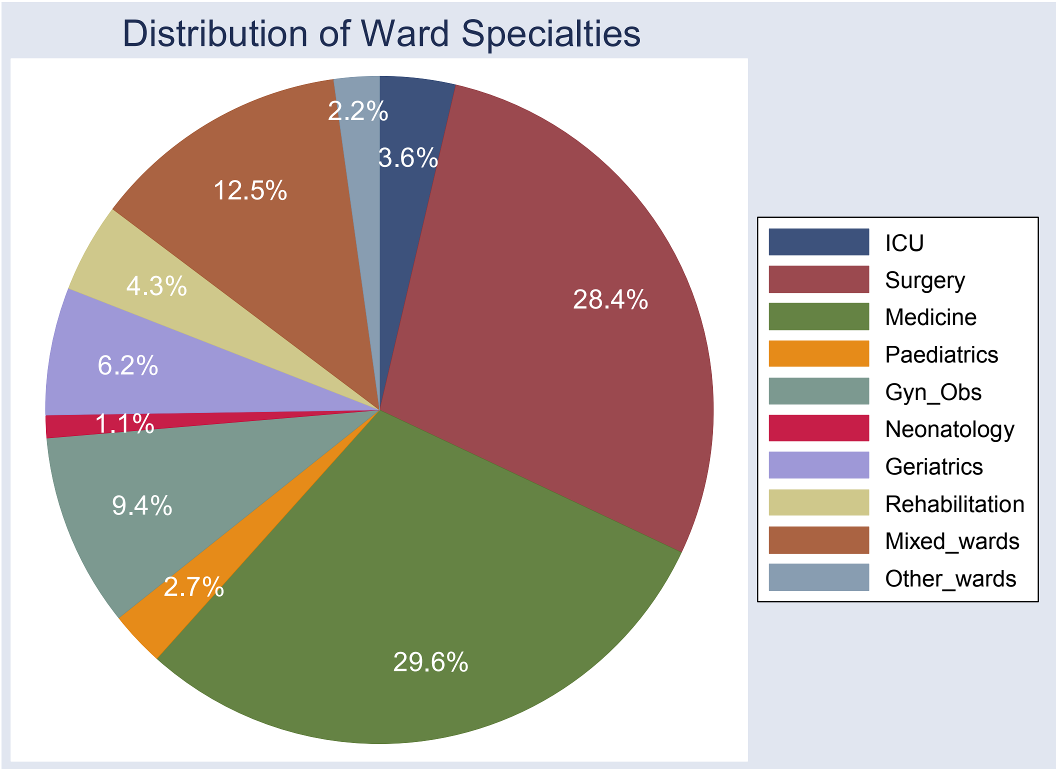
Figure 13: Length of stay to survey day by University-Affiliation



0.50 = median quantile, censored at 100 days
CH: Switzerland, PRIM: primary, SEC: secondary, TERT: tertiary, SPEC: specialized

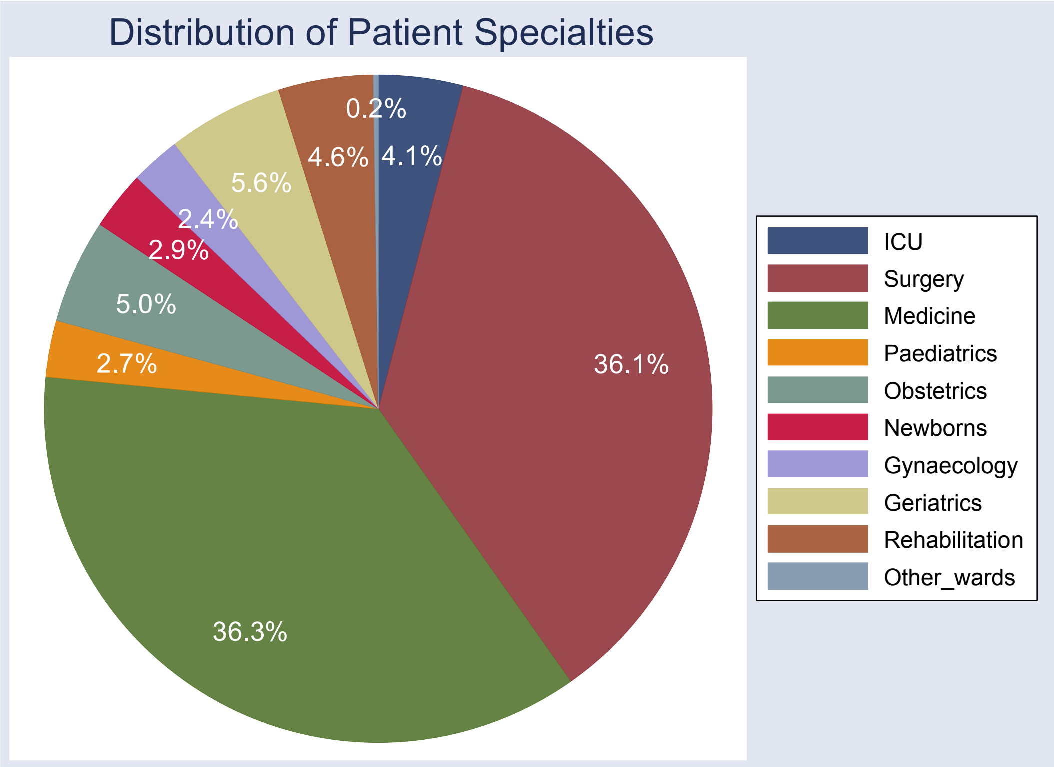
Patients in university-affiliated hospitals had longer stay before PPS (6.5 days) than patients in other hospitals (4 days). University-affiliation was used for all five Swiss University-affiliated hospitals with a mixed patient population.

Figure 14: Distribution of ward specialties



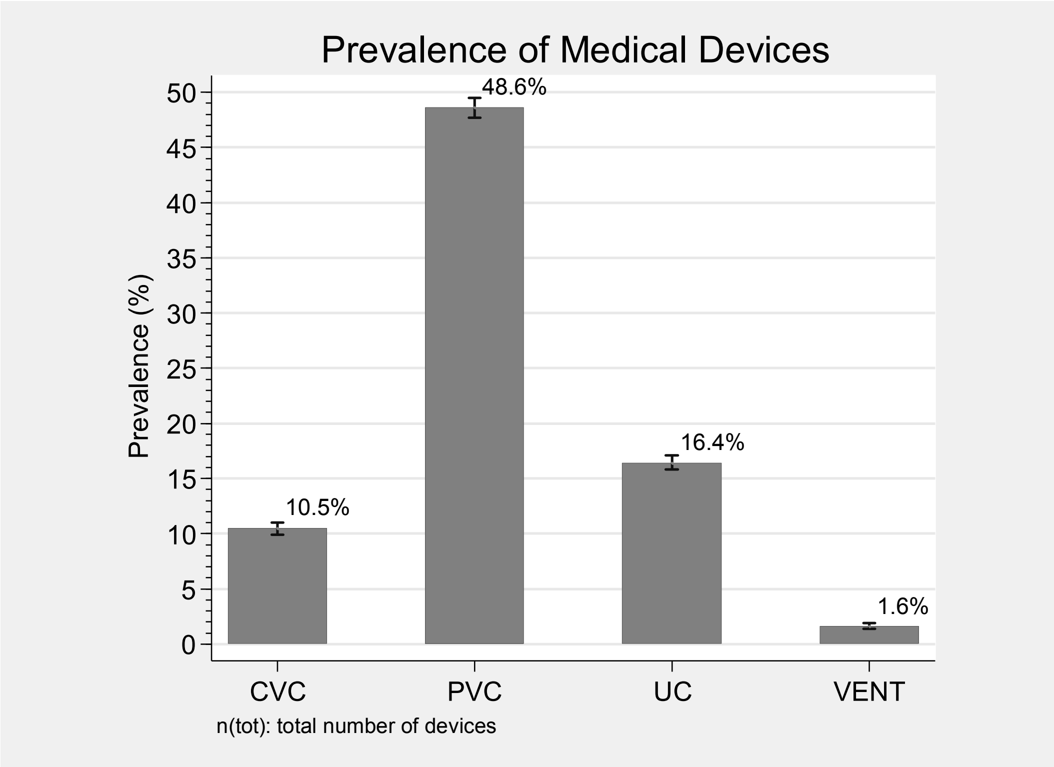
Medical and surgical wards contributed to more than a half of total participating wards in the PPS.

Figure 15: Distribution of patient specialties



Most patients were medical or surgical, accumulating to almost ¾ of the entire population.

Figure 16: Use of medical devices



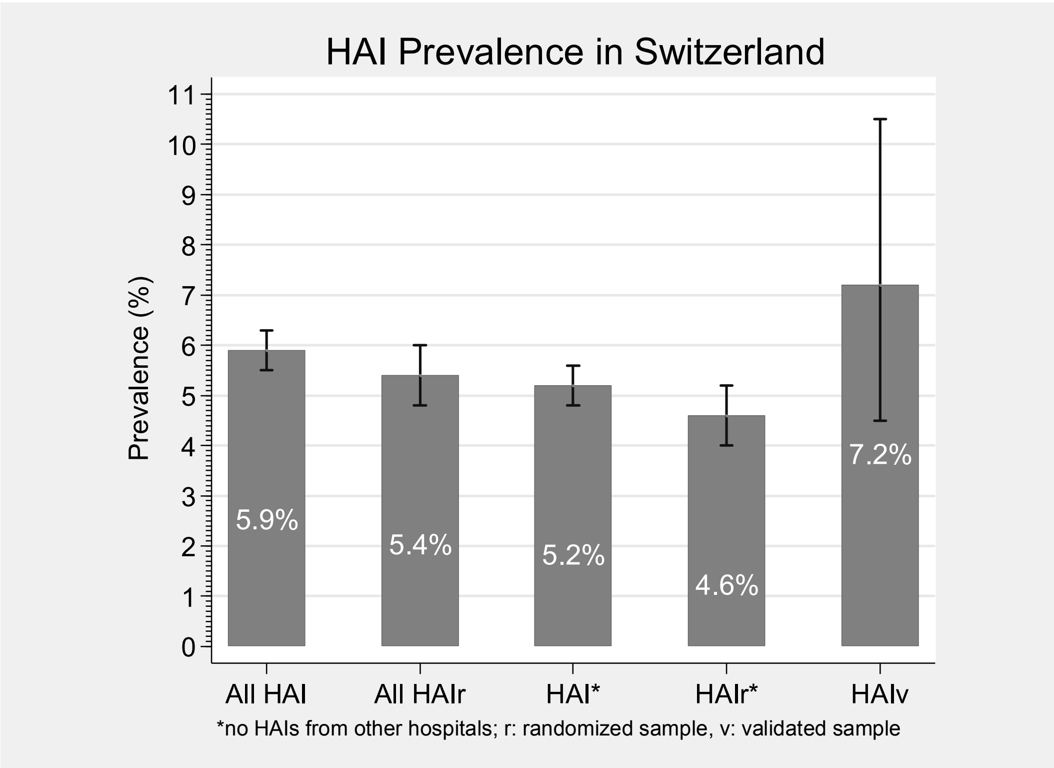
CVC: central venous catheter, PVC: peripheral venous catheter, UC: urinary catheter, VENT: ventilator

Almost half of the patients had a peripheral venous catheter in place on the day of PPS.

B. Healthcare-associated infections

Healthcare-associated infections (HAIs) are one of the most common adverse events during hospital stay, resulting in substantial morbidity and mortality. 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 in different formats: pooled all-cause HAI from all participating hospitals (96), HAI without taking into account infections attributed to other hospitals, all-cause HAI from a randomized subsample of participating hospitals (56), and validated HAI prevalence, taking into account the results of validation and case-mix. Table 17 summarizes the different HAI prevalence formats.

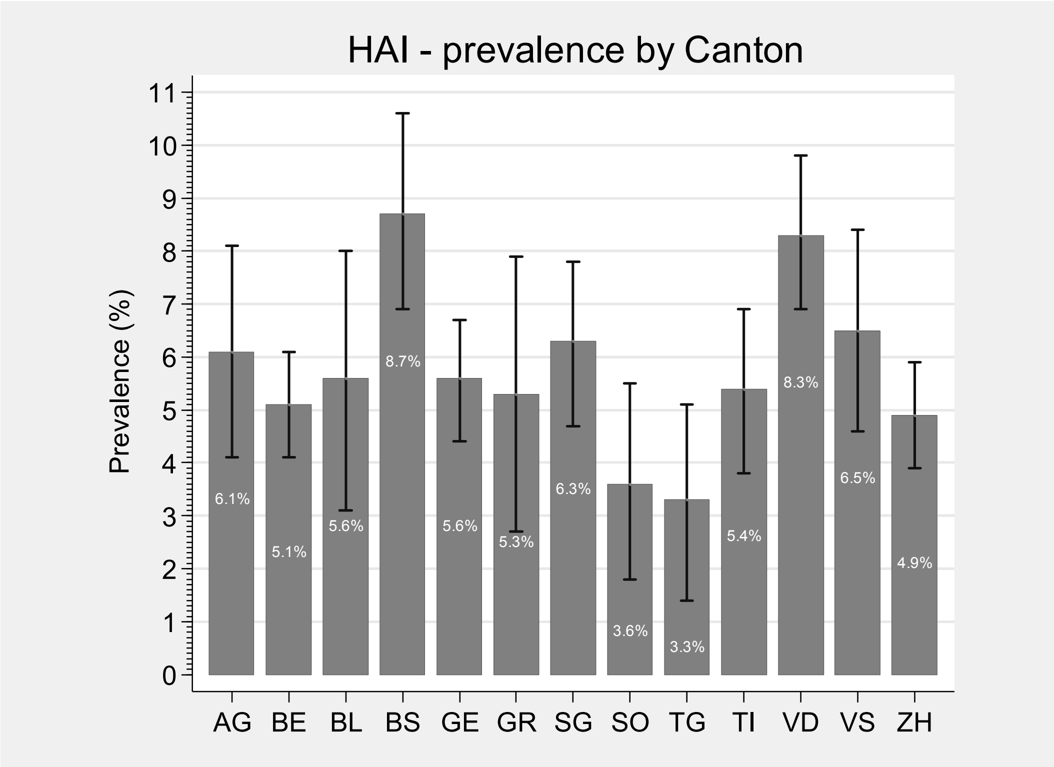
Figure 17: HAI prevalence in Switzerland (with randomized and validated sample)



The figure reports the different HAI formats:

- All participating hospitals and patients (All HAI)
- Randomized sample of hospitals and patients (All HAIr)
- All participating hospitals and patients but excluding HAI attributed to other hospitals (HAI*)
- Randomized sample of hospitals and patients but excluding HAI attributed to other hospitals (HAIr*)
- Validated and adjusted HAI of all participating hospitals and patients (HAIv)

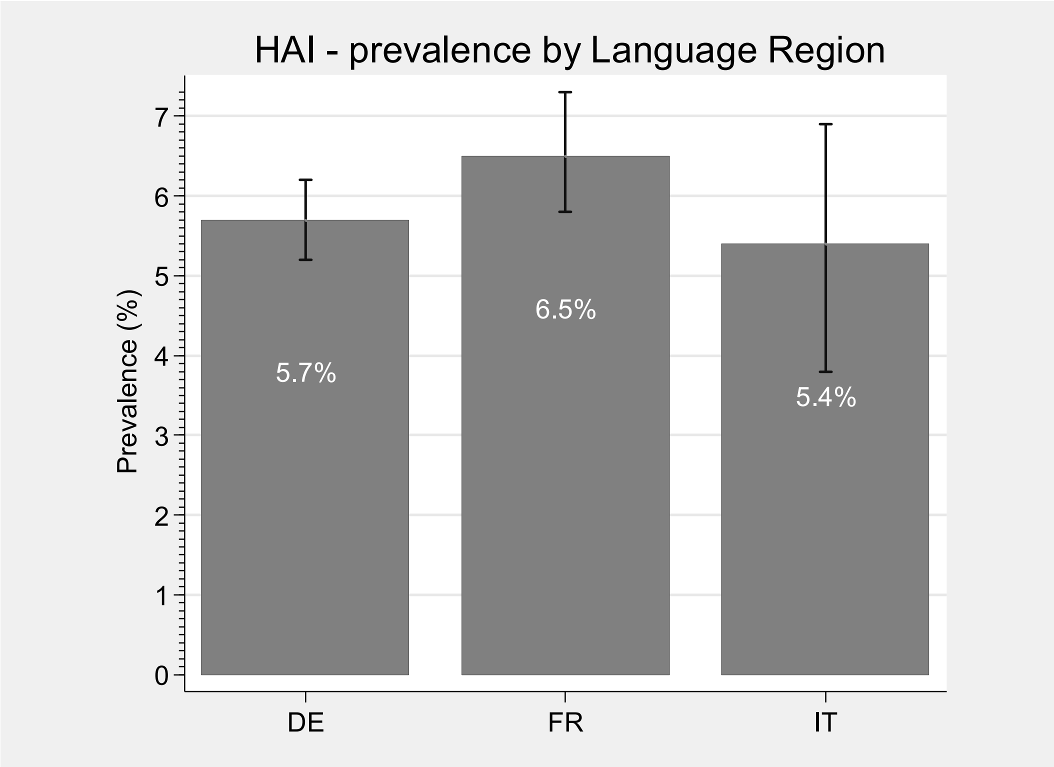
Figure 18: HAI prevalence by Canton



AG: Aargau; BE: Bern; BL: Basel-Landschaft; BS: Basel-Stadt; GE: Geneva; GR: Grisons; SG: St. Gallen; SO: Solothurn; TG: Thurgau; VD: Vaud; VS: Valais; ZH: Zürich

This table reports HAI prevalence by cantons participating with three or more hospitals. Cantons with fewer hospitals are not included in this figure.

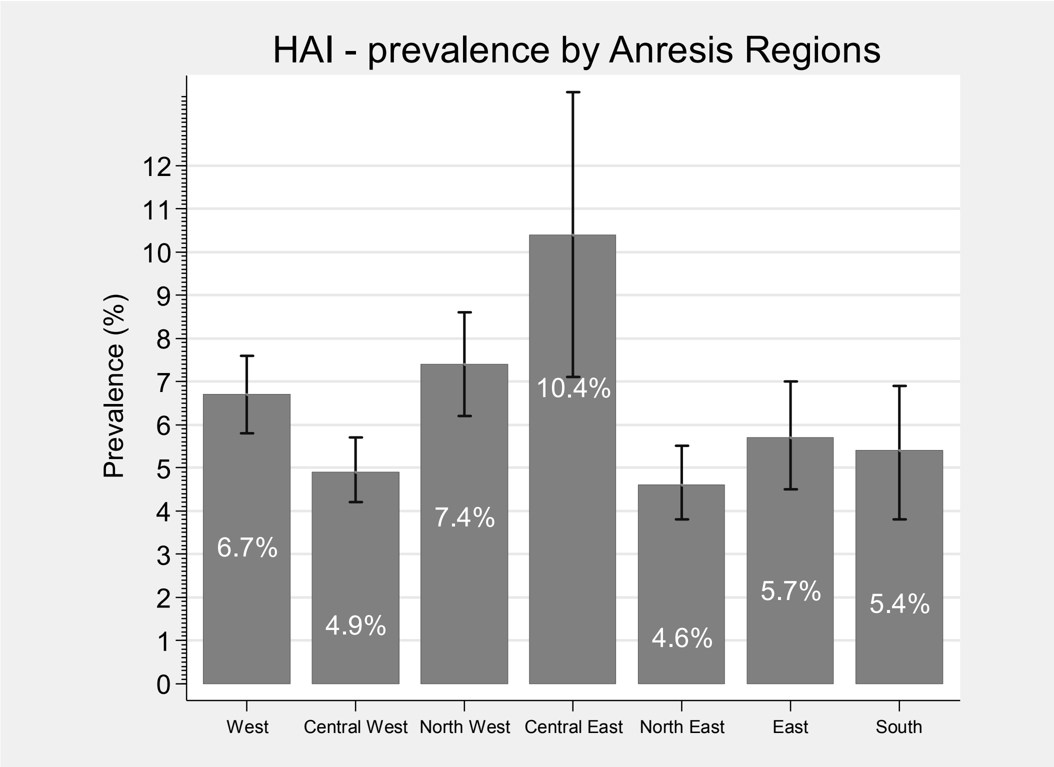
Figure 19: HAI prevalence by linguistic region



DE: German; FR: French; IT: Italian; HAI: healthcare-associated infection

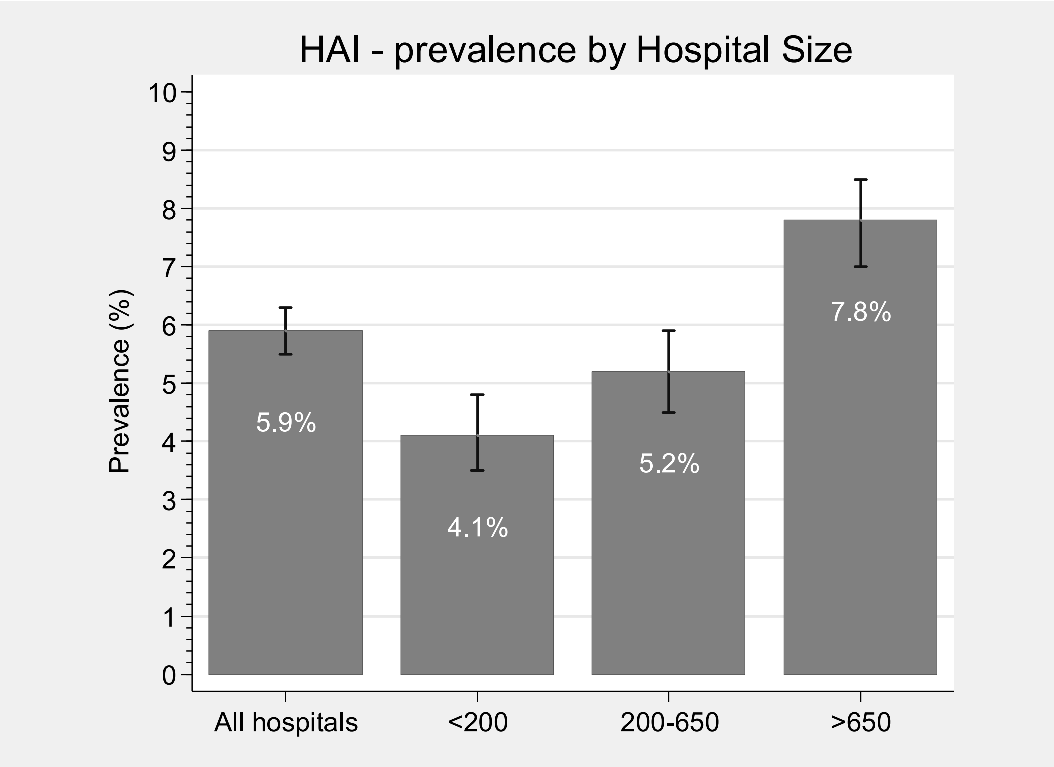
This figure summarizes patients with one or more HAI on the day of survey, stratified by language regions (Deutschschweiz, Romandie, Ticino).

Figure 20: HAI prevalence by Anresis Region



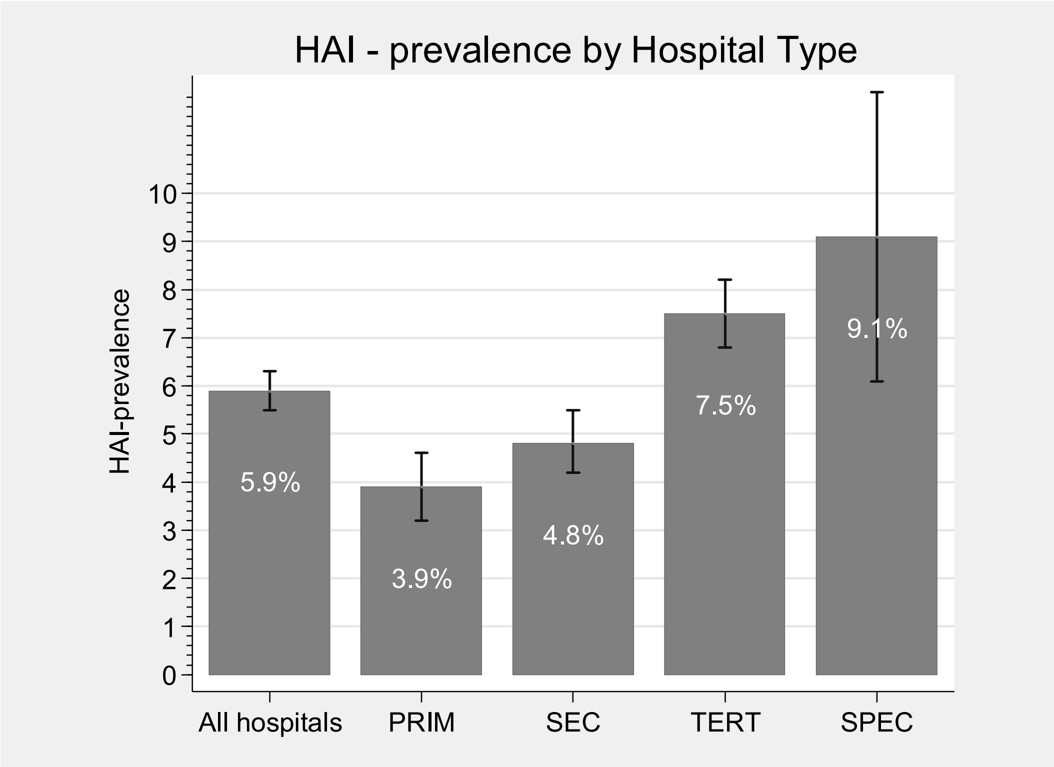
Geographical subdivision of Switzerland as presented in the Swiss Center of Antimicrobial Resistance (anresis): http://www.anresis.ch (Geneva is integrated into the "West" region)

Figure 21: HAI prevalence by hospital size



Large size hospitals (>650 beds) had a significantly higher HAI prevalence compared to other hospital sizes.

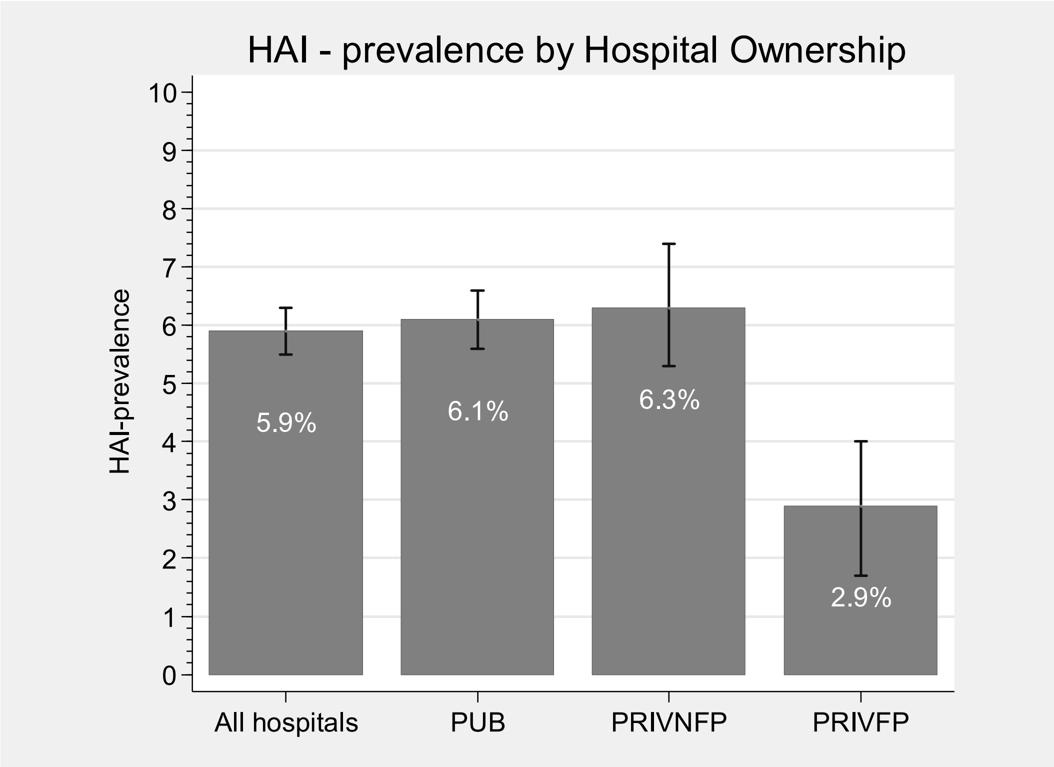
Figure 22: HAI prevalence by hospital type



HAI: healthcare-associated infection; PRIM: primary care; SEC: secondary care; TERT: tertiary care; SPEC: specialized care

Tertiary care hospitals have a significantly higher HAI prevalence compared to other hospital types.

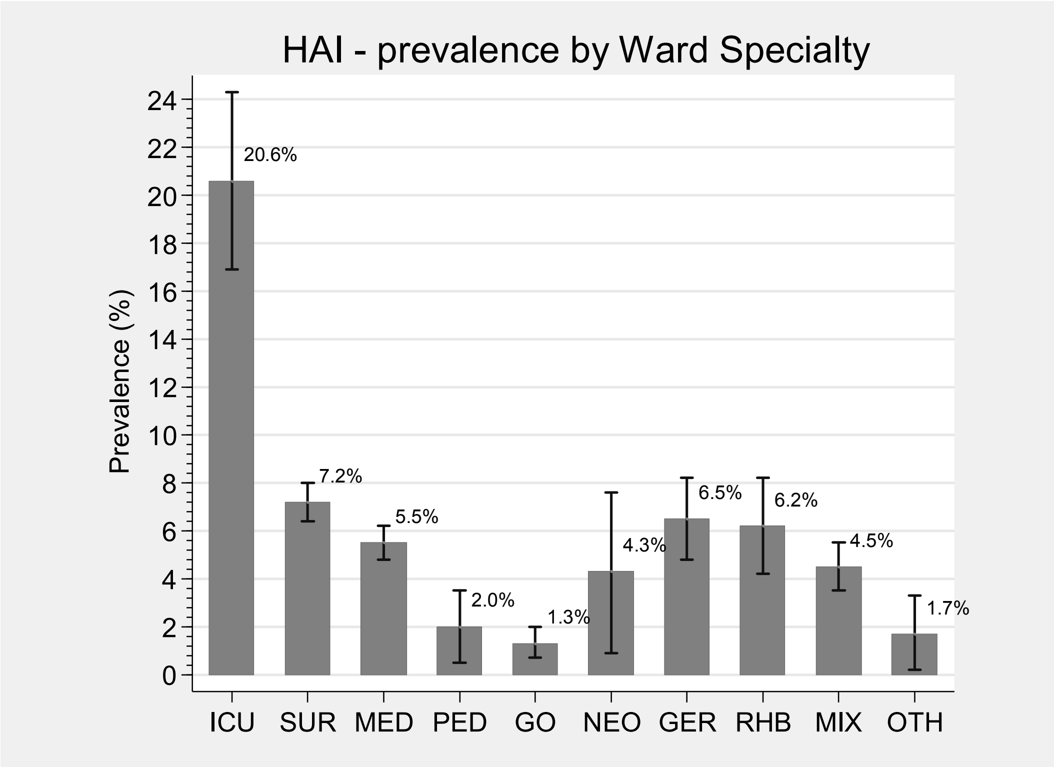
Figure 23: HAI prevalence by hospital ownership



HAI: healthcare-associated infection; PUB: public hospitals; PRIVNFP: private ownership, non-for-profit; PRIVFP: private ownership, for-profit

Private-for-profit hospitals have a significantly lower HAI prevalence compared to other hospitals. This difference does not hold in multivariable analysis (Table 32).

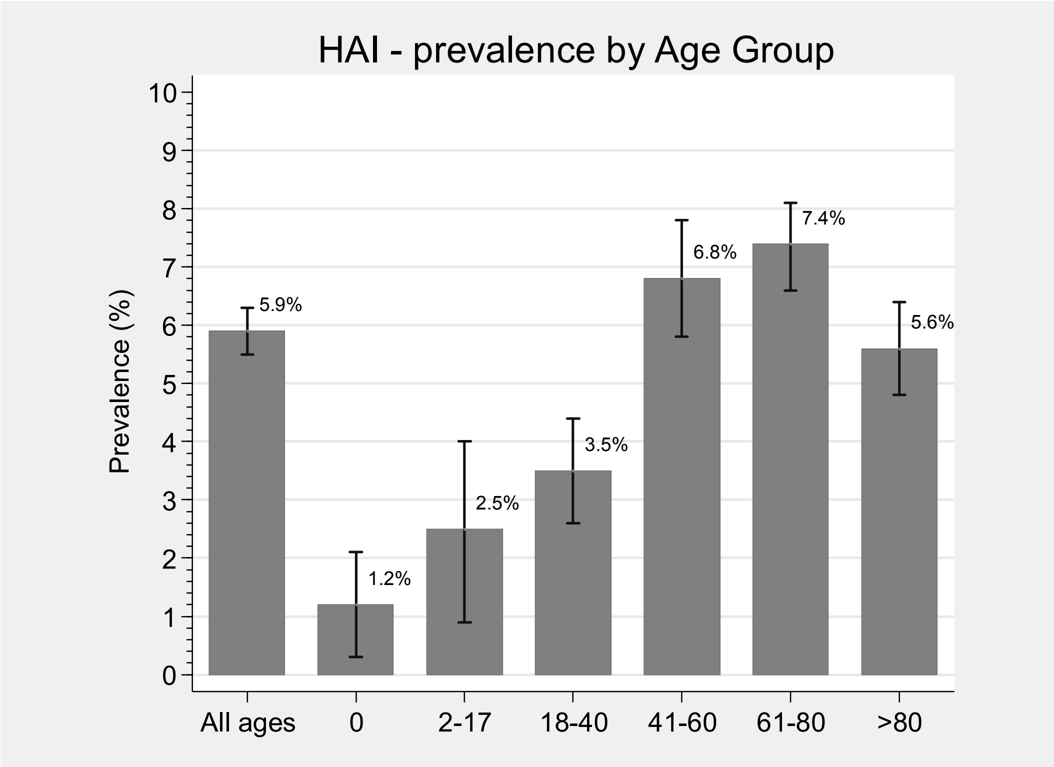
Figure 24: HAI prevalence by ward specialty



ICU: Intensive care unit; SUR: surgery; MED: medicine; PED: pediatrics; GO: gynecology/obstetrics; NEO: neonatology; GER: geriatrics; RHB: rehabilitation; MIX: mixed specialties; OTH: other specialties

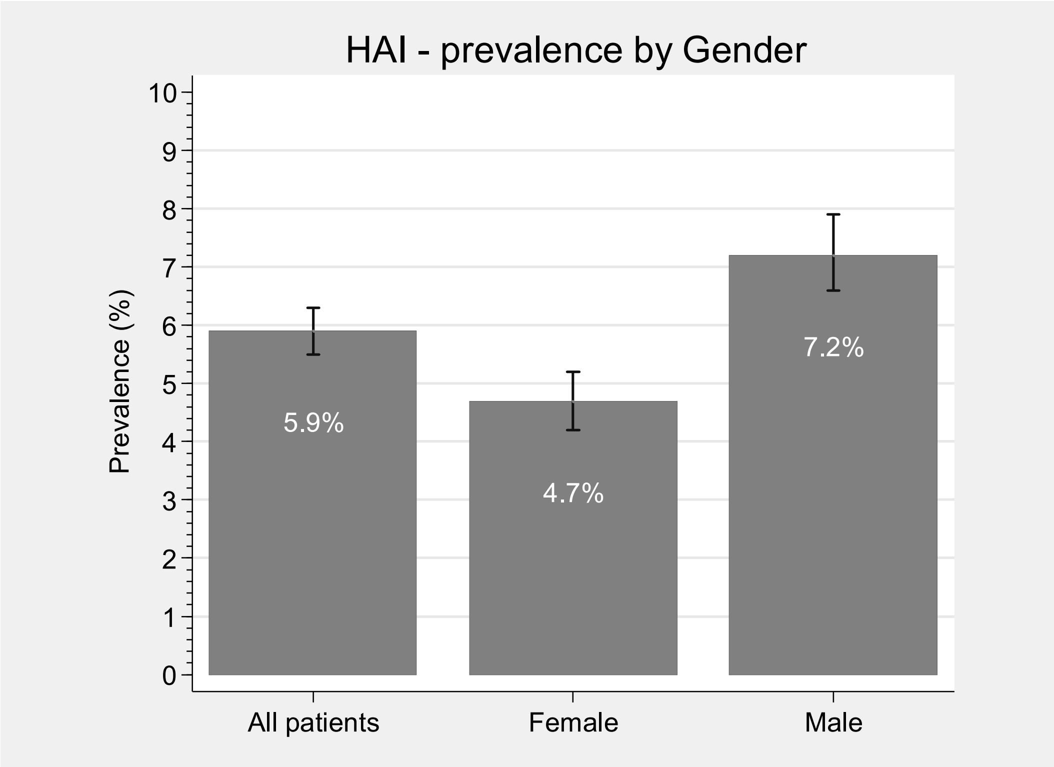
The highest prevalence was found in the ICU, followed by surgery, geriatrics, rehabilitation, and medicine. The difference compared to other ward specialties is significant (Table 32).

Figure 25: HAI prevalence by age group



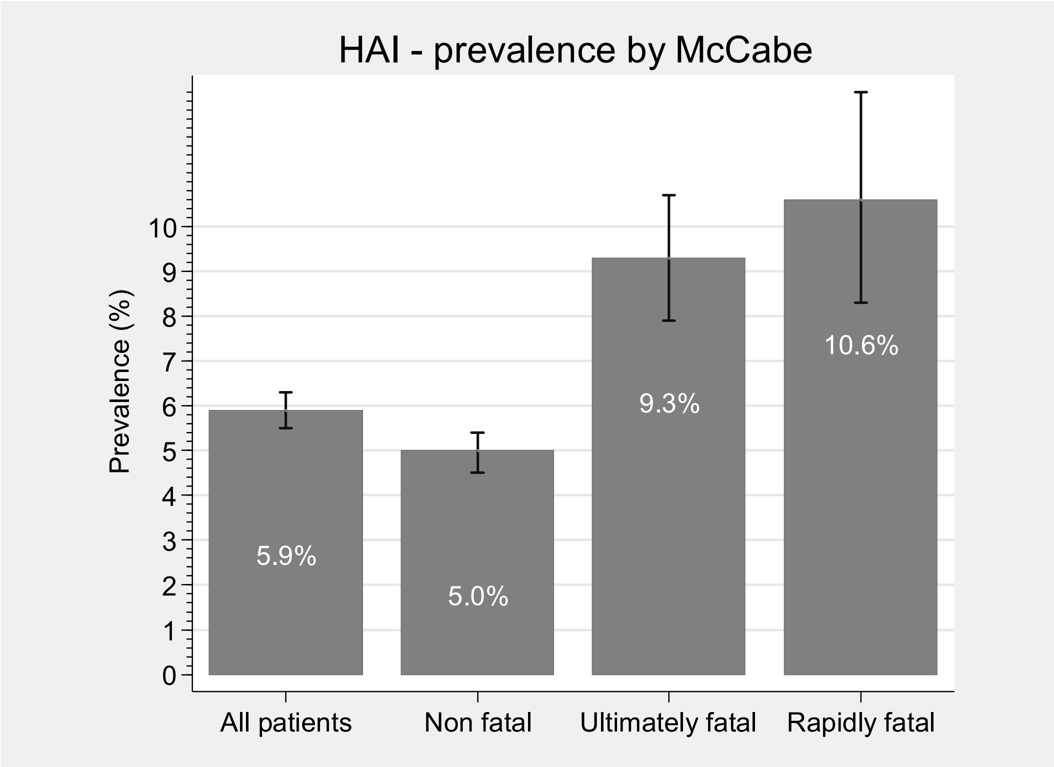
The highest prevalence was found in patients above 40 years of age. Higher age is significantly associated with HAI (Table 32).

Figure 26: HAI prevalence by gender



Male gender is a significant risk factor HAI (Table 32).

Figure 27: HAI prevalence by McCabe score



Ultimately and rapidly fatal McCabe scores significantly predict HAI (Table 32)

As shown in figures 21-27, the HAI prevalence depends on a number of variables. Table 32 summarizes formal uni- and multivariable testing using logistic regression analysis with the outcome HAI (1/0). The following variables were tested in uni- and multivariable regression analysis (on patient level), clustered on the hospital level. A two-sided p-value <0.05 was considered statistically significant.

Table 32: Univariable and multivariable analysis of risk factors for HAI

Variable	**Univariable analysis**			**Multivariable analysis**		
	OR	(95%CI)	P-value	OR	(95%CI)	P-value
Large hospitals[1]	1.70	(1.27-2.28)	<0.001	1.33	(1.07-1.66)	0.011
Tertiary care	1.65	(1.24-2.20)	0.001	1.23	(1.00-1.52)	0.045
Private-for-profit[2]	0.45	(0.29-0.70)	<0.001	*0.63*	*(0.39-1.02)*	*0.059*
Intensive care unit	4.58	(3.53-5.93)	<0.001	4.17	(3.13-5.55)	<0.001
Fatal McCabe score[3]	2.01	(1.66-2.43)	<0.001	1.68	(1.40-2.03)	<0.001
Male gender	1.58	(1.38-1.81)	<0.001	1.45	(1.29-1.64)	<0.001
Age group[4]	1.20	(1.14-1.26)	<0.001	1.18	(1.10-1.24)	<0.001

[1]Large hospitals: hospitals >650 beds

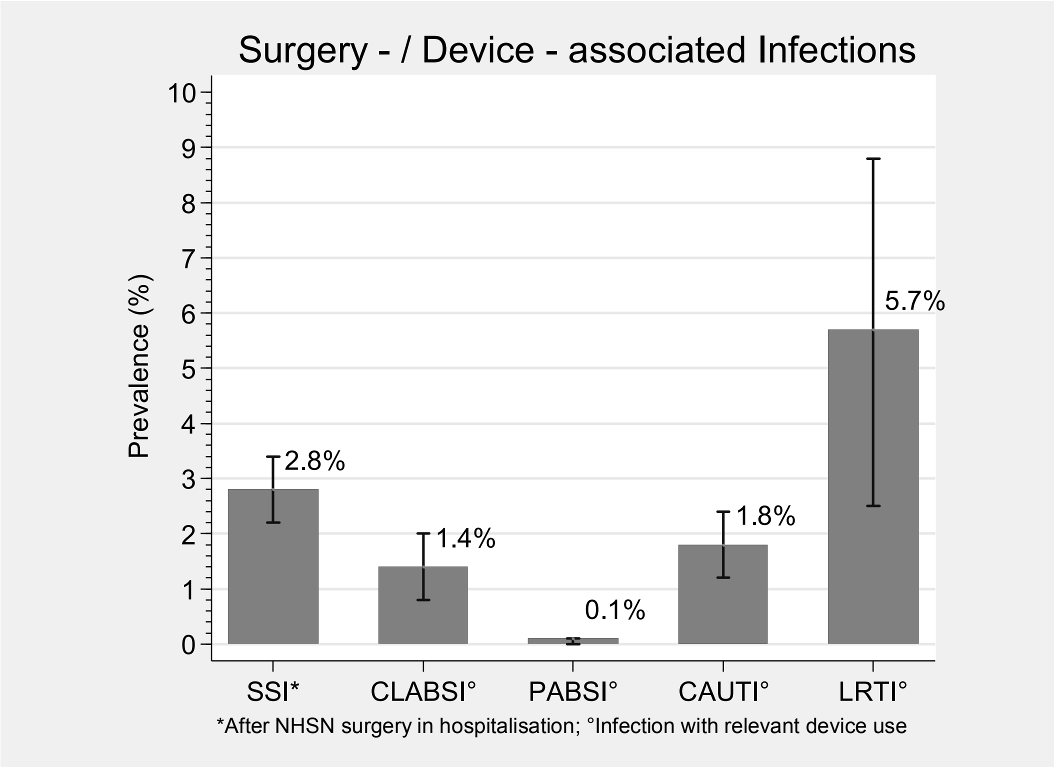
[2]Private-for-profit: private-for-profit hospitals compared to other hospital ownerships (public, private-non-for-profit)

[3]Fatal McCabe score: ultimately and rapidly fatal McCabe score combined

[4]Age groups: 0 years, 2-17 years, 18-40 years, 41-60 years, 61-80 years, >80 years

All predictive variables for HAI were also significant in the multivariable analysis, except private-for-profit ownership. This is due to a more favourable case-mix of patients in private-for-profit hospitals: fewer patients with ultimately or rapidly fatal McCabe score (7.50% vs. 19.32%; p<0.001 [Chi^2-test]); lower median age (64 years vs. 68 years; p<0.001 [ranksum test]); there were no significant differences for number of ICU-patients and male gender.

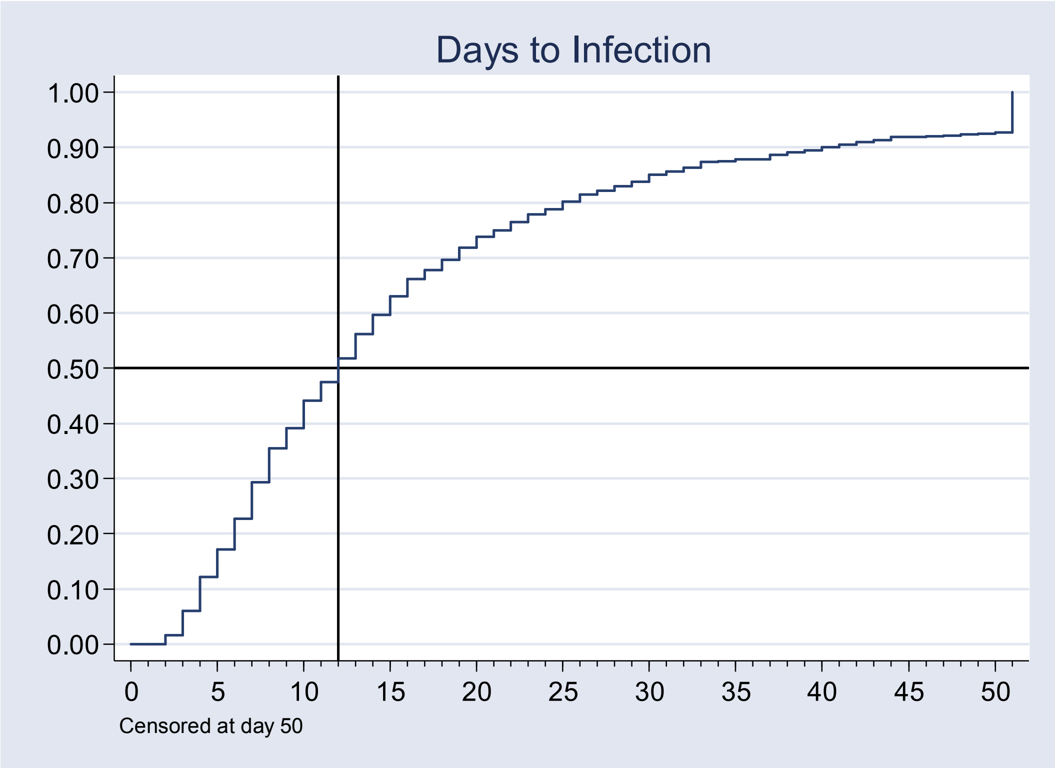
Figure 28: Prevalence of surgical site and device-associated infections



SSI: surgical site infection; CLABSI: central line-associated bloodstream infection; PABSI: peripheral line-associated bloodstream infection; CAUTI: catheter-associated urinary tract infection; LRTI: lower respiratory tract infection

This figure reports specific HAI-types, potentially associated with surgery or the use of medical devices. SSI was analyzed for all in-hospital SSI in patients undergoing NHSN (National Healthcare Surveillance Network) class surgery before PPS. All other HAI types were analyzed in patients with a relevant medical device in place at PPS.

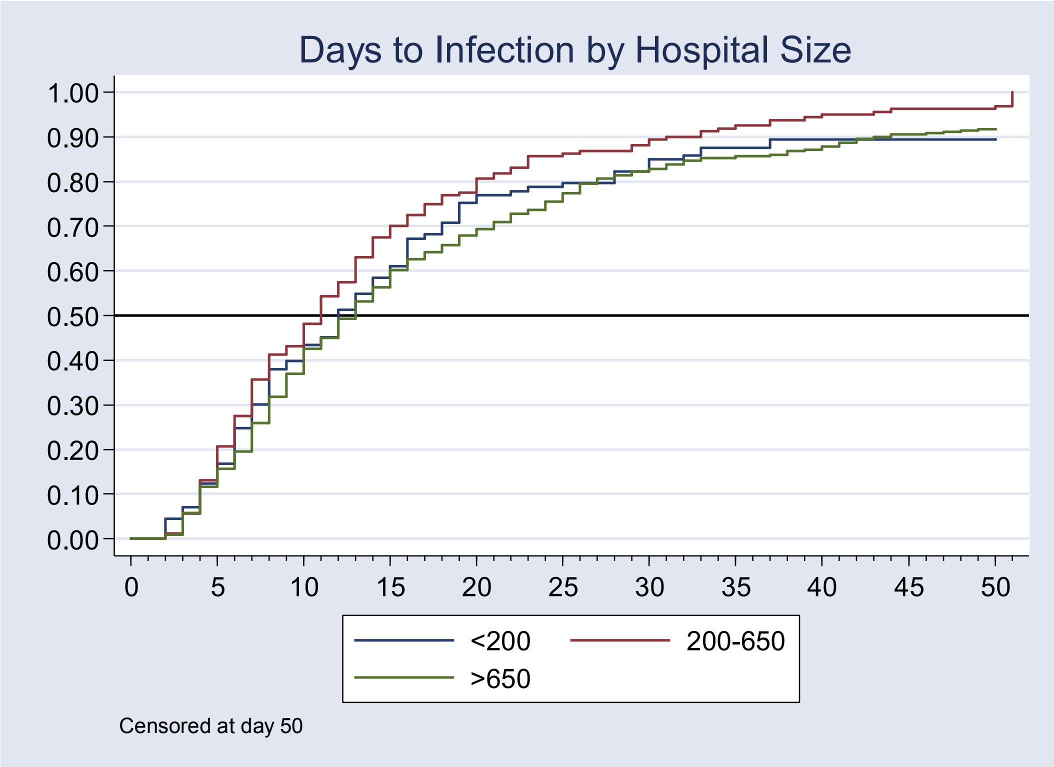
Figure 29: Days to healthcare-associated infection



0.50: median quantile, censored at 50 days

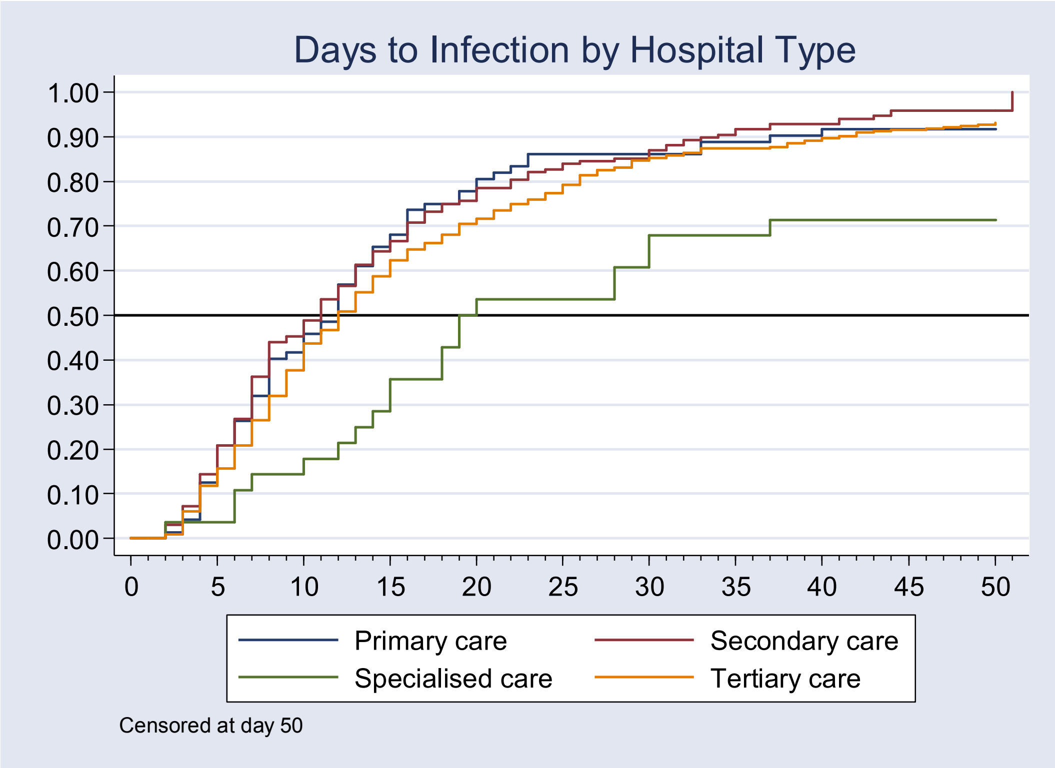
The median time to HAI from admission was 12 days.

Figure 30: Days to HAI by hospital size



0.50: median quantile, censored at 50 days

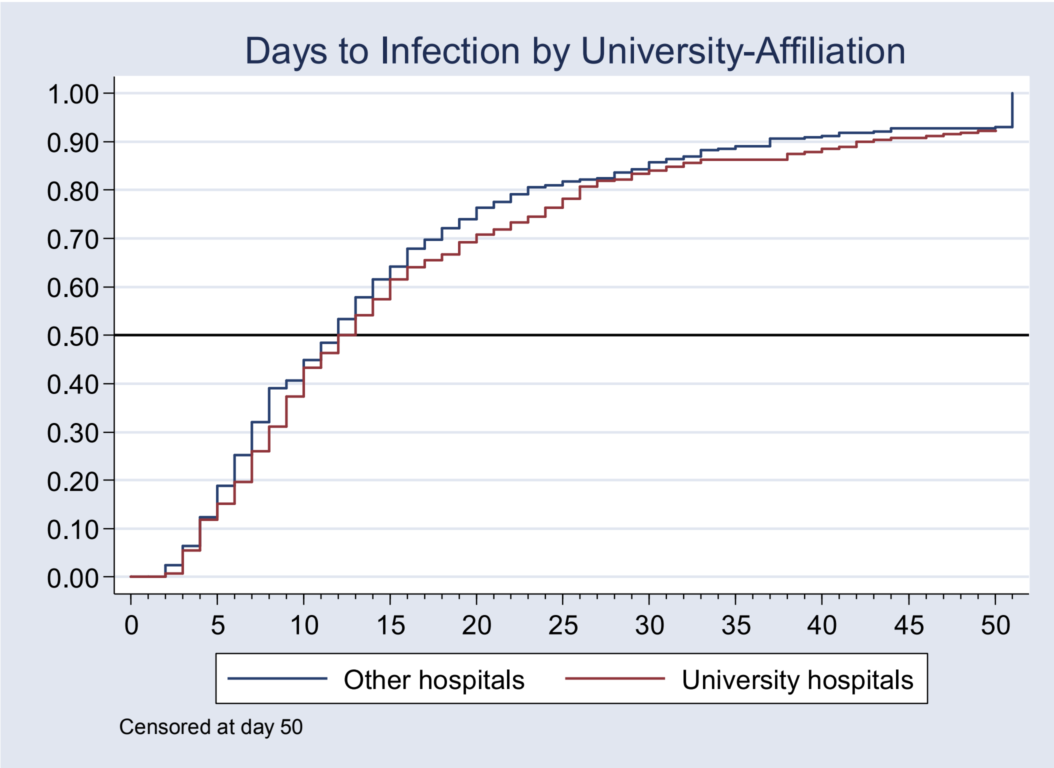
Figure 31: Days to HAI by hospital type



0.50: median quantile, censored at 50 days

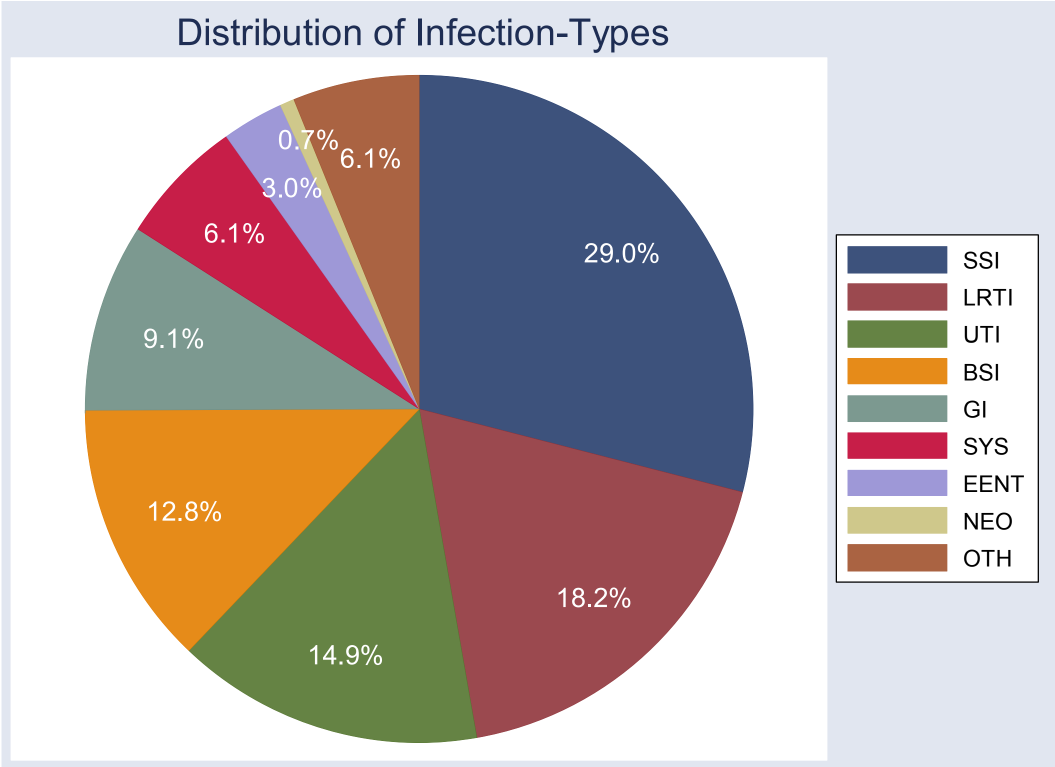
Patients in specialized hospitals had a longer stay when an HAI occurred than in other type hospitals.

Figure 32: Days to HAI by University-affiliation



0.50: median quantile, censored at 50 days

Figure 33: Distribution of HAI types (835 HAIs)

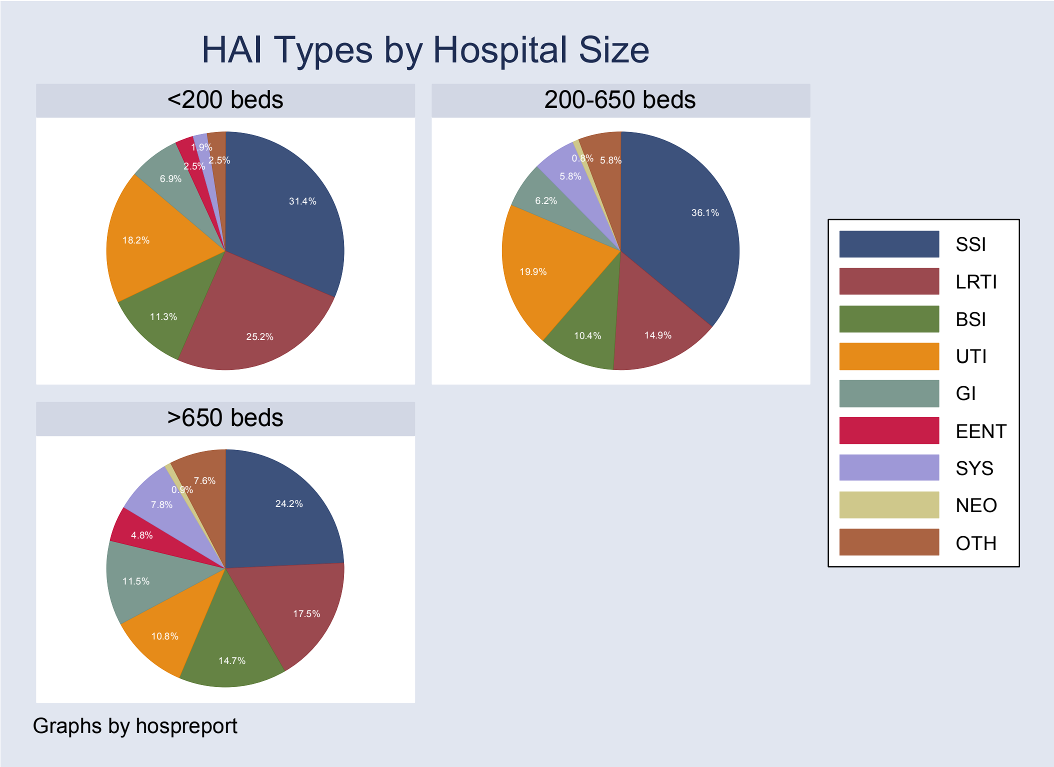


SSI: surgical site infection; LRTI: lower respiratory tract infection; UTI: urinary tract infection; BSI: bloodstream infection; GI: gastrointestinal infection; SYS: systemic infection; EENT: eye; ear; nose; throat; or mouth infection; NEO: specific neonatal case definitions; OTH: other infection

SSI was the most frequent HAI type, corresponding to more than a quarter of all HAI cases, followed by LRTI (18.2%), UTI (14.9%) and BSI (12.8%). Together, the four most common HAI-types accounted for approximately ¾ of all HAI.

Of the 76 gastrointestinal infections (GI), 36 (47.4%) were due to *Clostridium difficile*. *Clostridium difficile* infections (CDIs) contributed to 4.3% (36/835) of all HAIs, and an overall prevalence of 0.28% (36/12'931).

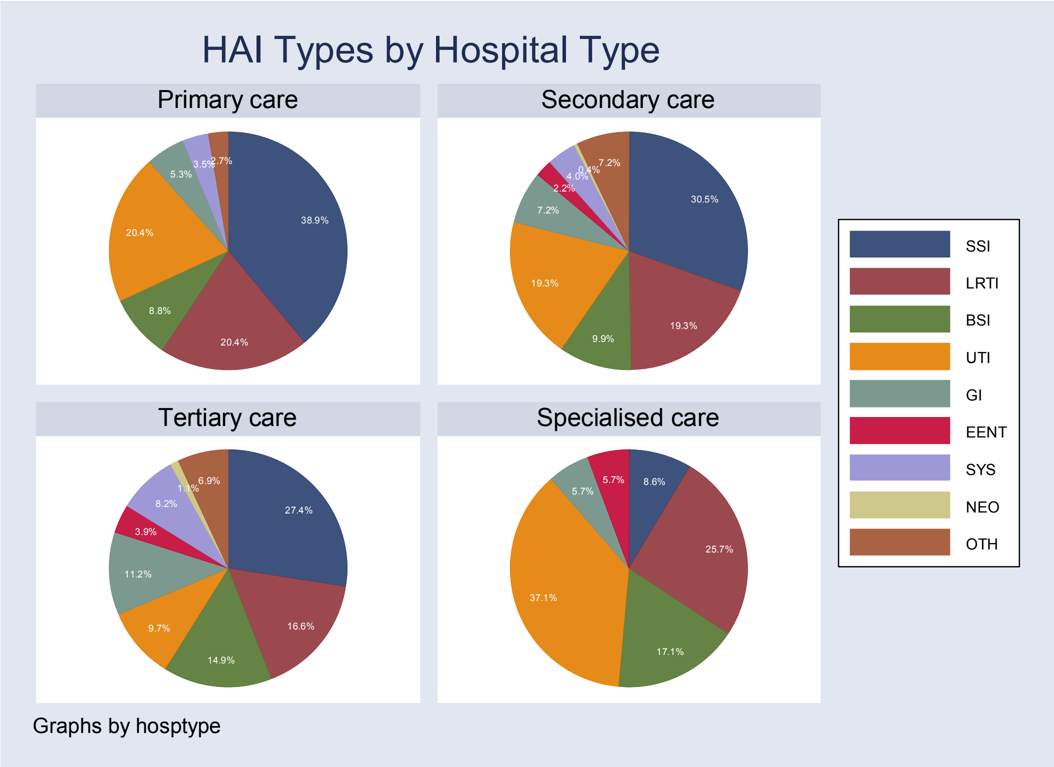
Figure 34: Distribution of HAI types by hospital size



SSI: surgical site infection; LRTI: lower respiratory tract infection; UTI: urinary tract infection; BSI: bloodstream infection; GI: gastrointestinal infection; SYS: systemic infection; EENT: eye; ear; nose; throat; or mouth infection; NEO: specific neonatal case definitions; OTH: other infection

SSI was the most frequent HAI type in all hospital types.

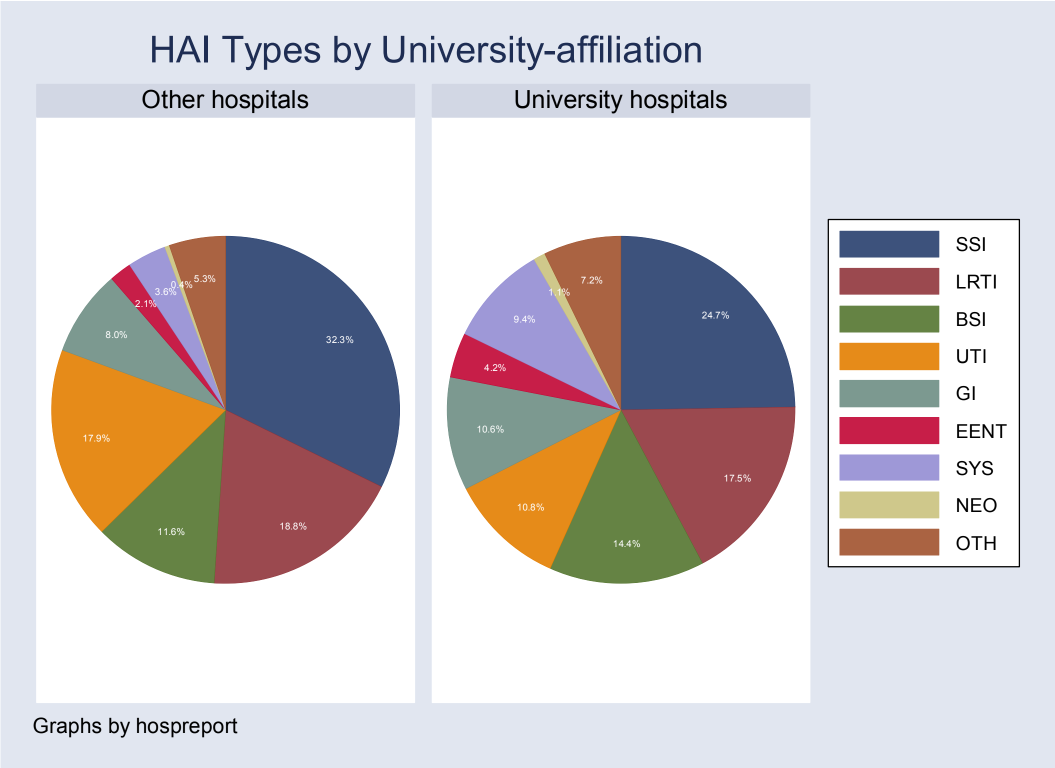
Figure 35: Distribution of HAI types by hospital type



SSI: surgical site infection; LRTI: lower respiratory tract infection; UTI: urinary tract infection; BSI: bloodstream infection; GI: gastrointestinal infection; SYS: systemic infection; EENT: eye; ear; nose; throat; or mouth infection; NEO: specific neonatal case definitions; OTH: other infection

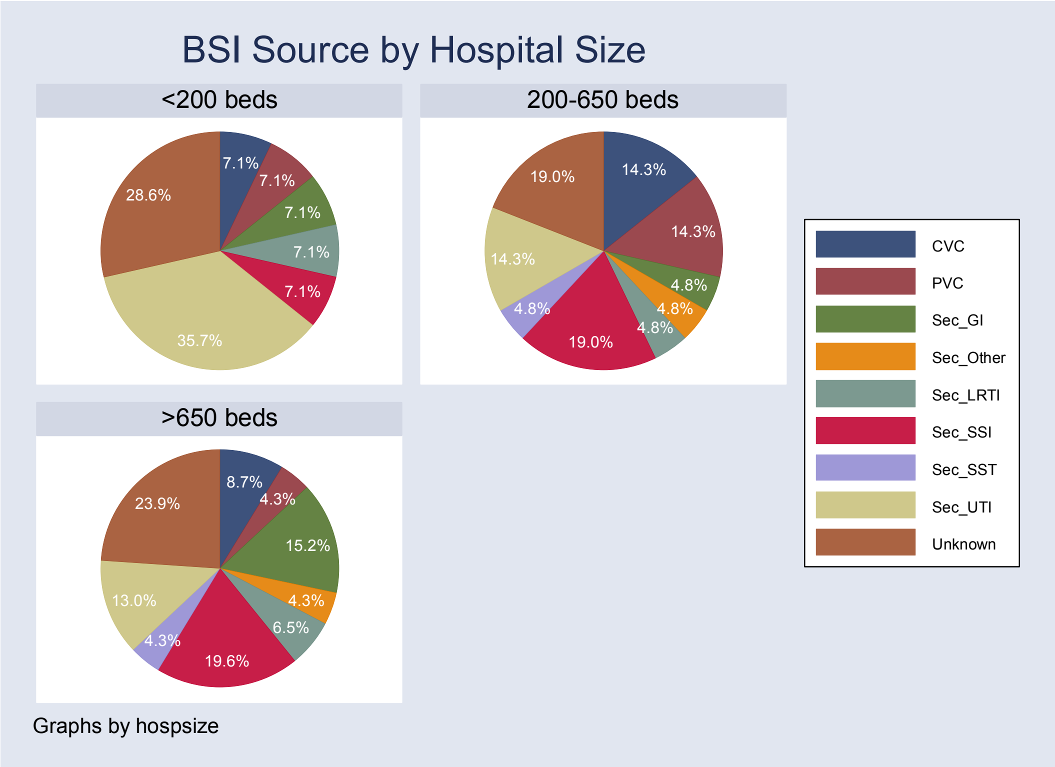
While SSI was the dominant HAI-type in primary, secondary and tertiary care hospitals, it was less frequently in hospitals with specialized care, where UTI represented more than a third of all HAI cases.

Figure 36: Distribution of HAI types by University-affiliation



SSI: surgical site infection; LRTI: lower respiratory tract infection; UTI: urinary tract infection; BSI: bloodstream infection; GI: gastrointestinal infection; SYS: systemic infection; EENT: eye; ear; nose; throat; or mouth infection; NEO: specific neonatal case definitions; OTH: other infection

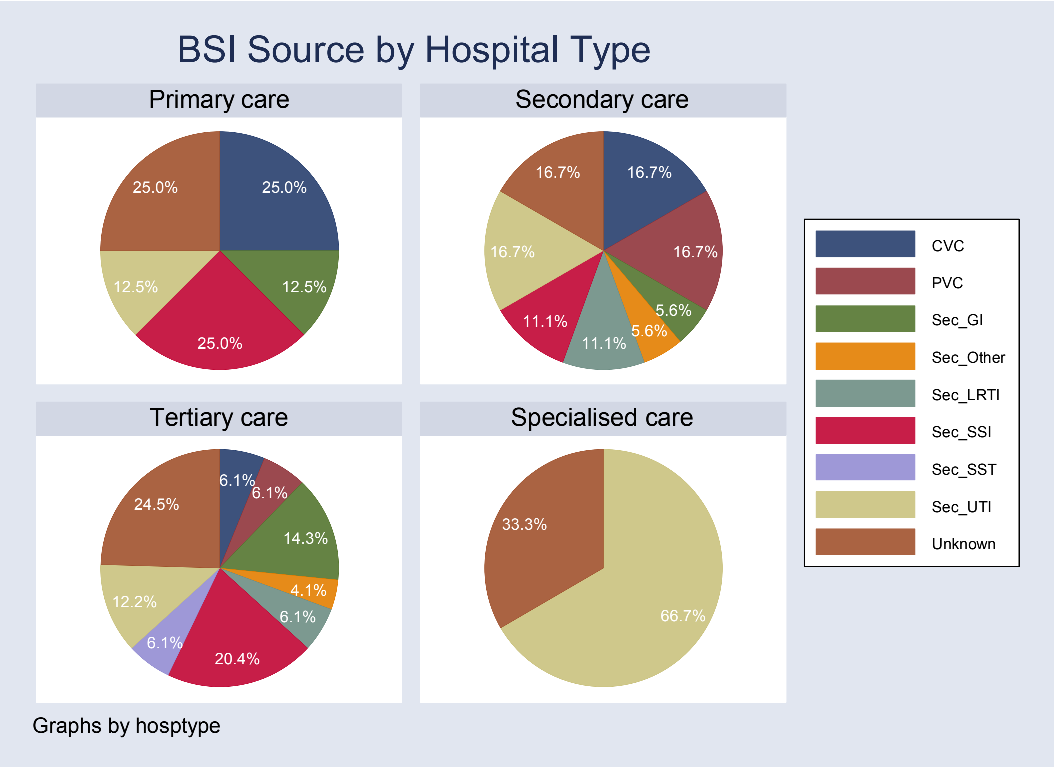
Figure 37: Source for bloodstream infections by hospital size



CVC: central venous catheter; PVC: peripheral venous catheter; Sec_GI: secondary to gastrointestinal infection; Sec_LRTI: secondary to lower respiratory tract infection; Sec_SST_ secondary to skin and soft tissue infection; Sec_SSI: secondary to surgical site infection; Sec_UTI: secondary to urinary tract infection; Sec_Other: secondary to other infection

A mixed pattern was also observed in BSI sources by hospital size.

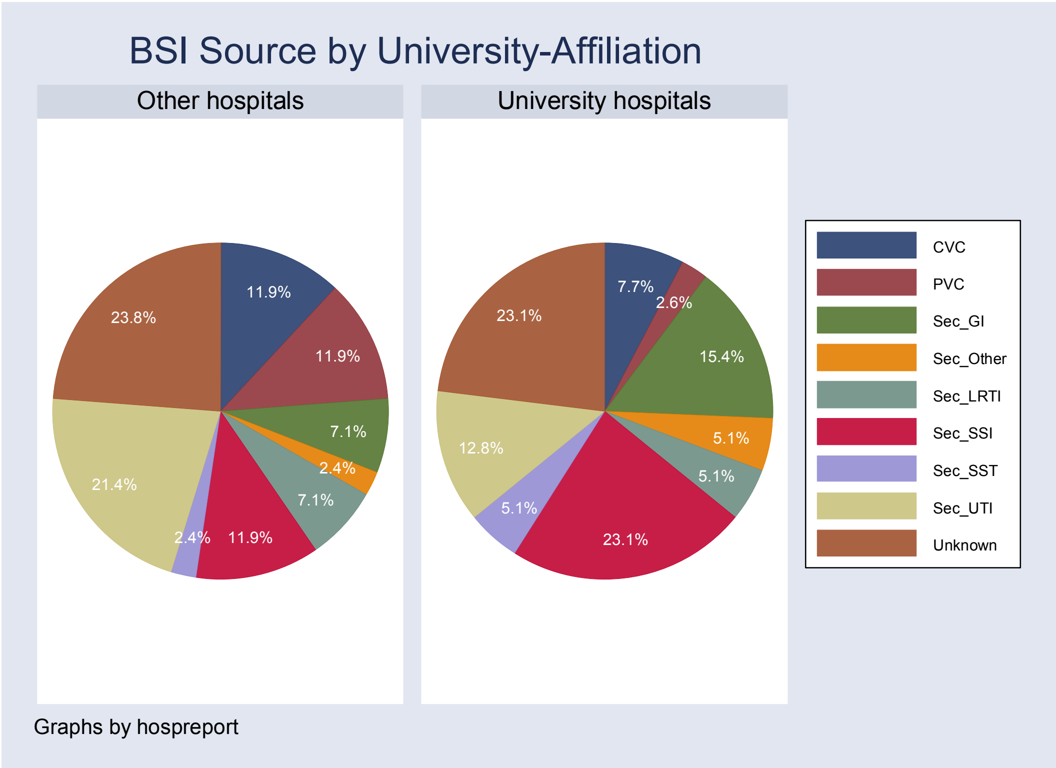
Figure 38: Source for bloodstream infections by hospital type



CVC: central venous catheter; PVC: peripheral venous catheter; Sec_GI: secondary to gastrointestinal infection; Sec_LRTI: secondary to lower respiratory tract infection; Sec_SST_ secondary to skin and soft tissue infection; Sec_SSI: secondary to surgical site infection; Sec_UTI: secondary to urinary tract infection; Sec_Other: secondary to other infection

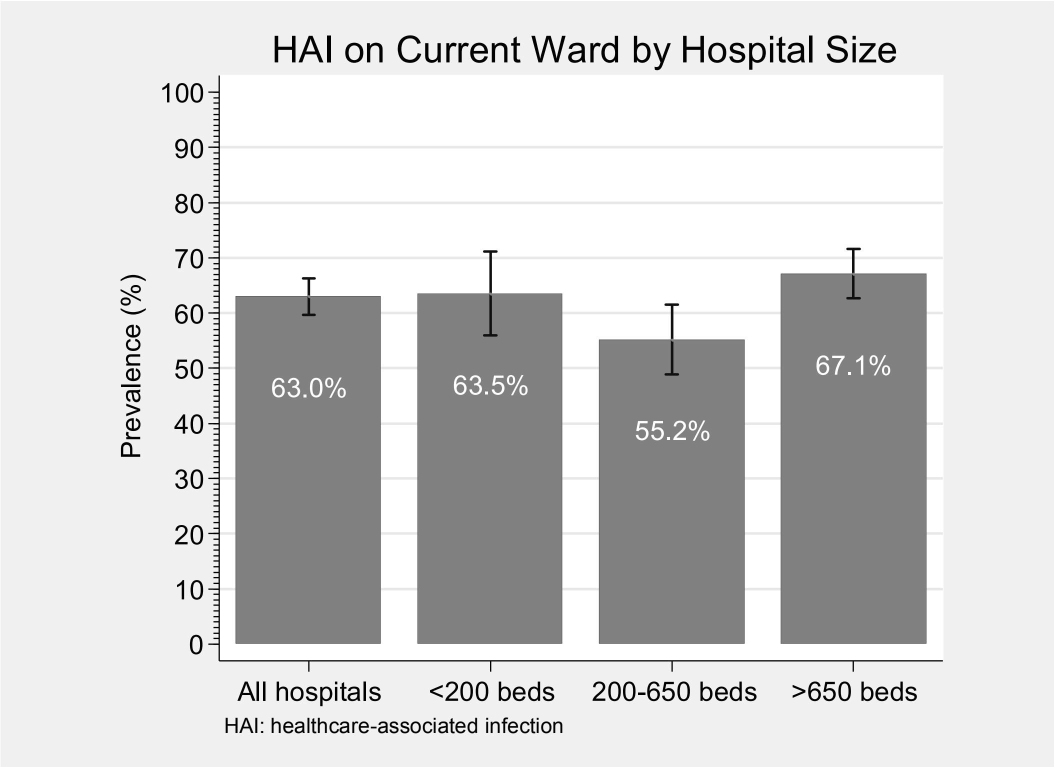
Tertiary hospitals had a lower prevalence of BSIs caused by CVC when compared with primary and secondary hospitals; while they appeared to have a similar prevalence of PVC-related BSIs when compared with primary settings.

Figure 39: Source for bloodstream infections by University-affiliation



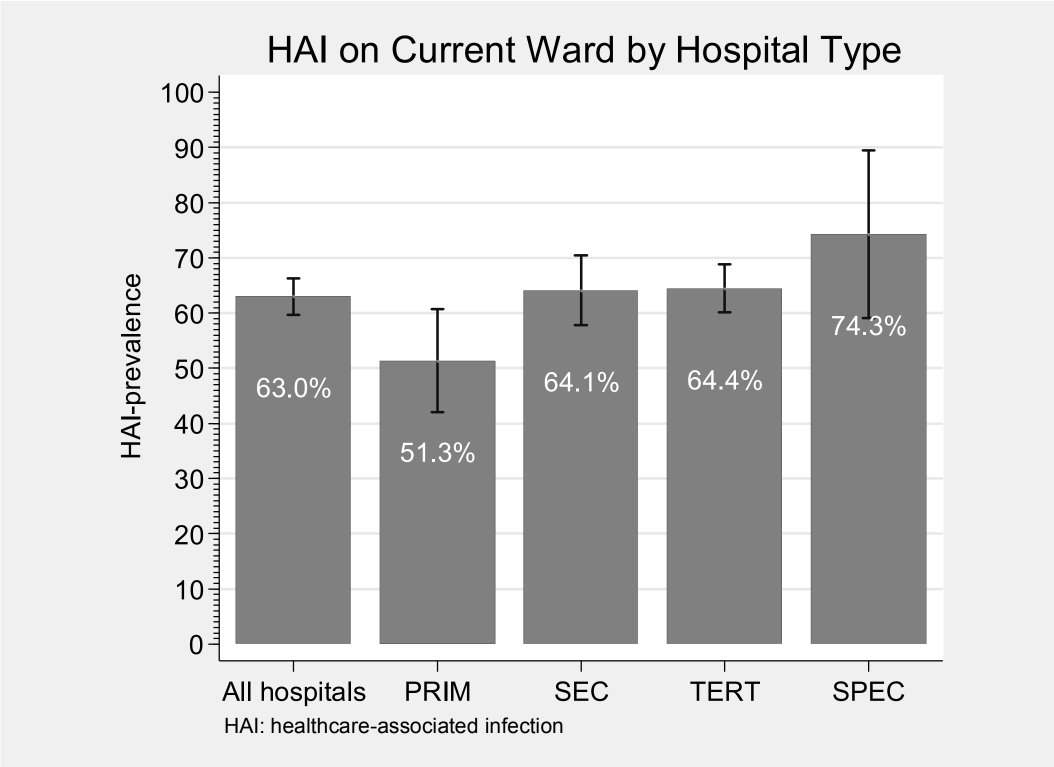
CVC: central venous catheter; PVC: peripheral venous catheter; Sec_GI: secondary to gastrointestinal infection; Sec_LRTI: secondary to lower respiratory tract infection; Sec_SST_ secondary to skin and soft tissue infection; Sec_SSI: secondary to surgical site infection; Sec_UTI: secondary to urinary tract infection; Sec_Other: secondary to other infection

Figure 40: HAI prevalence attributed to the current ward by hospital size



This figure summarizes the proportion of HAI attributed to the current ward a patient was hospitalised on the day of survey.

Figure 41: HAI prevalence attributed to the current ward by hospital type

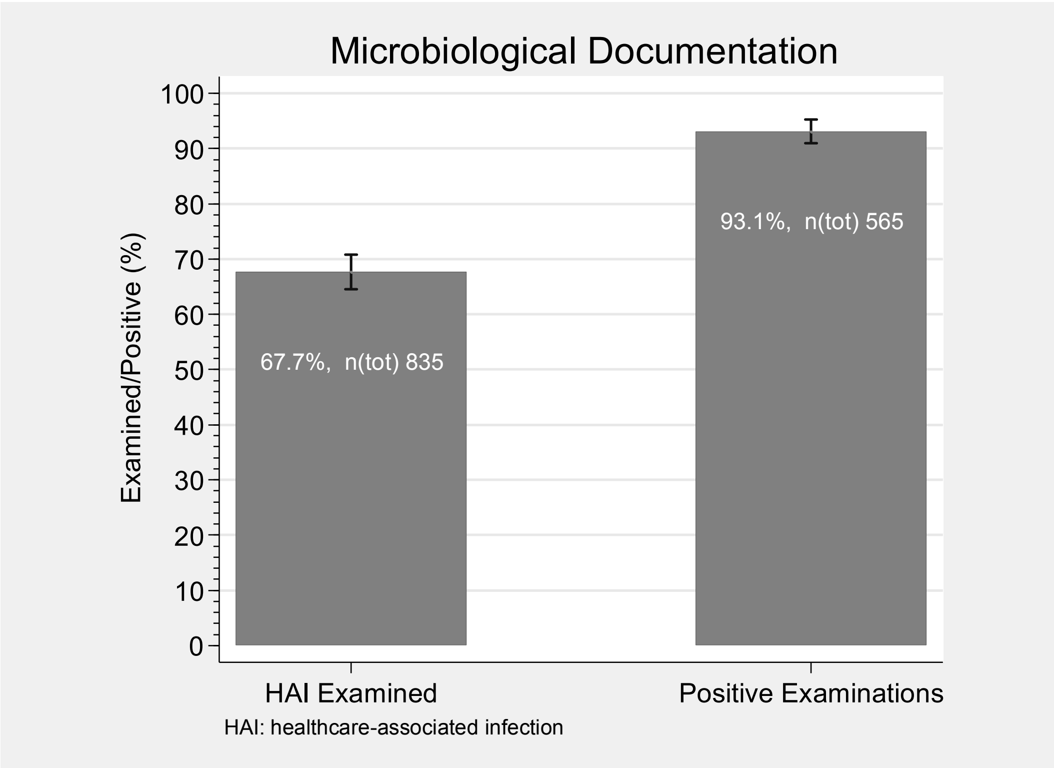


PRIM: primary care; SEC: secondary care; TERT: tertiary care; SPEC: specialized care

Microorganisms

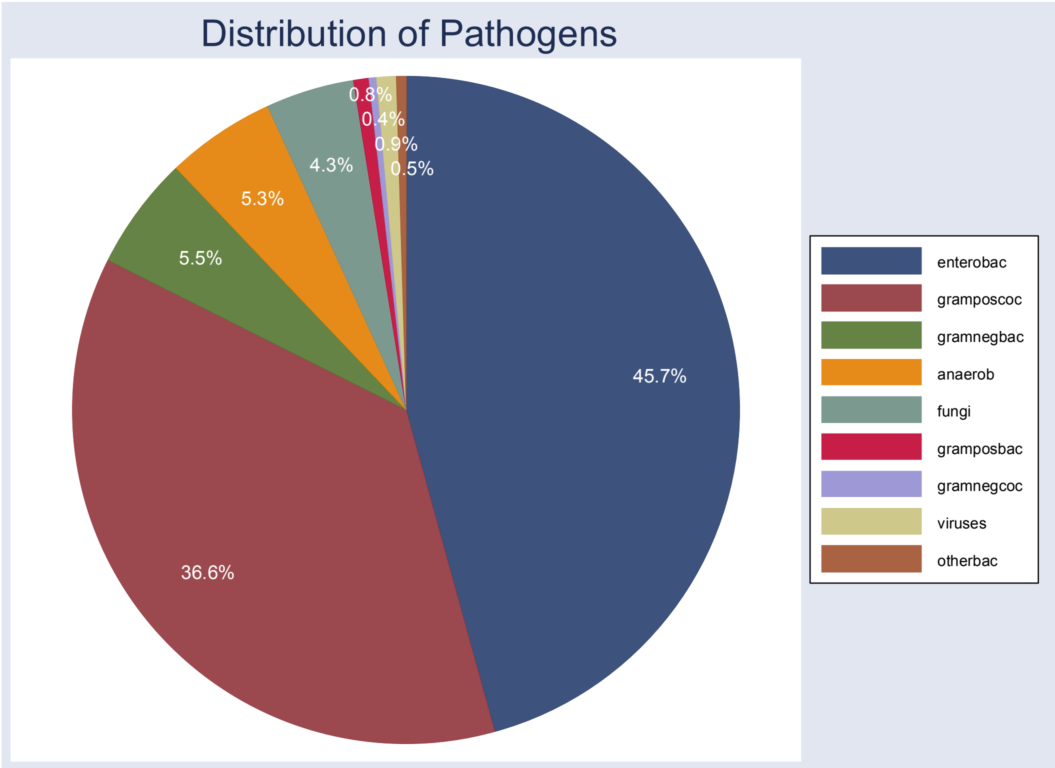
Microbiology including antibiotic susceptibility for selected antibiotics was collected for all HAI.

Figure 42: Proportion of HAIs for which microbiological tests were ordered on total number of HAIs, and proportion of microbiologically documented HAIs



This figure summarizes how many HAIs were investigated (left hand side) and among the microbiological tests, how many were positive (right hand side).

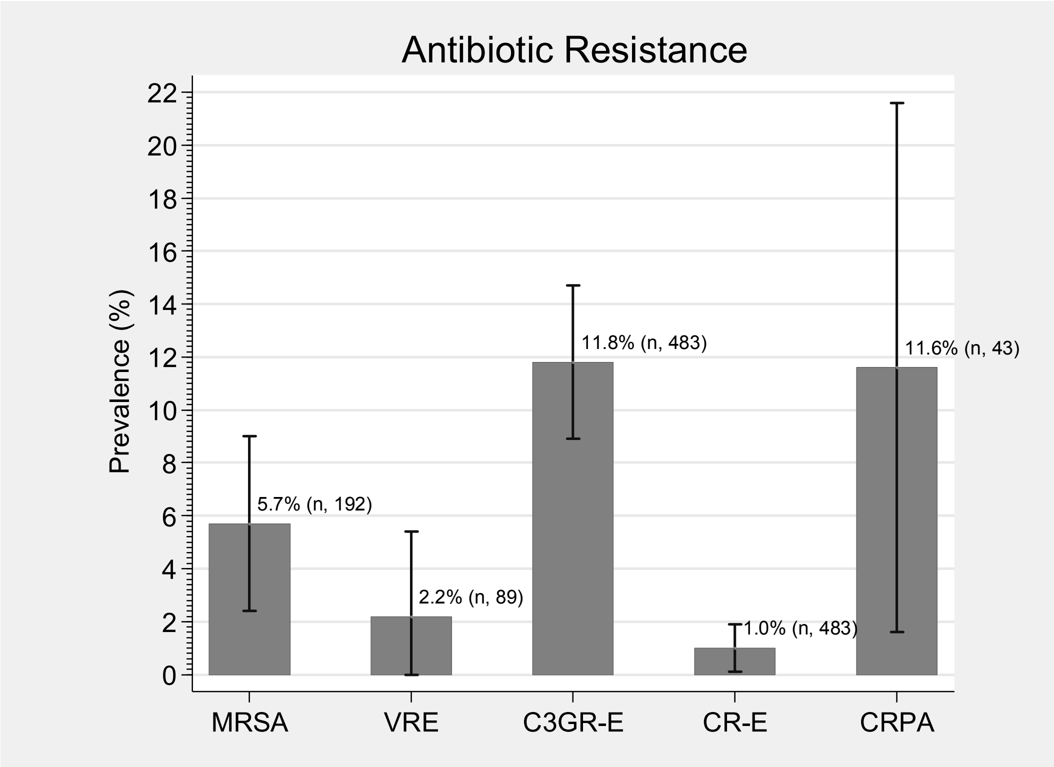
Figure 43: Distribution of isolated microorganisms (by family name)



Enterobac: Enterobacteriaceae; gramposcoc: Gram positive cocci; gramnegbac: Gram negative bacteria; anaerobic bacteria; gramposbac: Gram positive bacteria; gramnegcoc: Gram negative cocci; otherbac: other bacteria

Gram-negative bacteria and Gram-positive cocci represented more than 80% of isolated microorganisms.

Figure 44: Drug-resistant microorganisms among isolated microorganisms



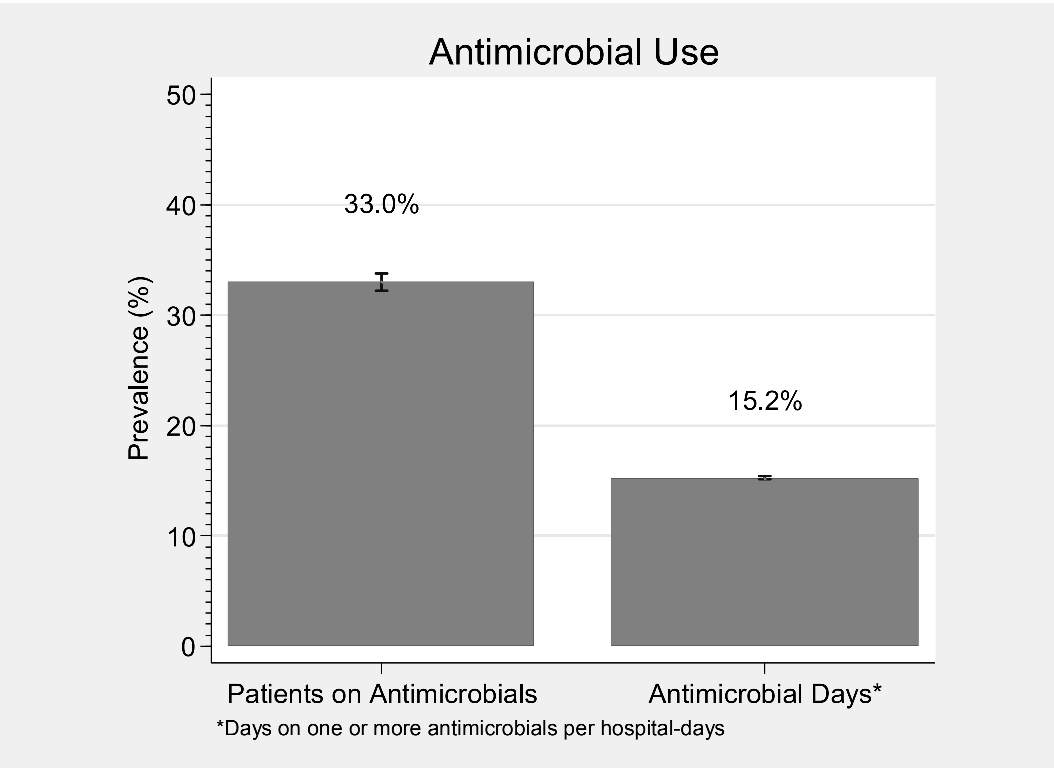
MRSA: Methicillin-resistant *Staphylococcus aureus*; VRE: Vancomycin-resistant *Enterococcus*; C3GR-E: 3d generation Cephalosporin-resistant Enterobacteriaceae; CR-E: Carbapenem-resistant Enterobacteriaceae; CRPA: Carbapenem-resistant *Pseudomonas aeruginosa*

Approximately, 10% of isolated Enterobacteriaceae and *Pseudomonas aeruginosa* were respectively resistant to 3d generation cephalosporins and carbapenems.

C. Antimicrobial use

Antimicrobial use (AU) data consists of a numerator of substantial interest as it allows assessing their overall use and understanding the indications and reasons of change of treatment. The sequential pattern of AU report was conceived in a way that the treatment choice (name of antimicrobial) follows the clinical decision of frontline physicians (indication, diagnosis, reason for change, dosage).

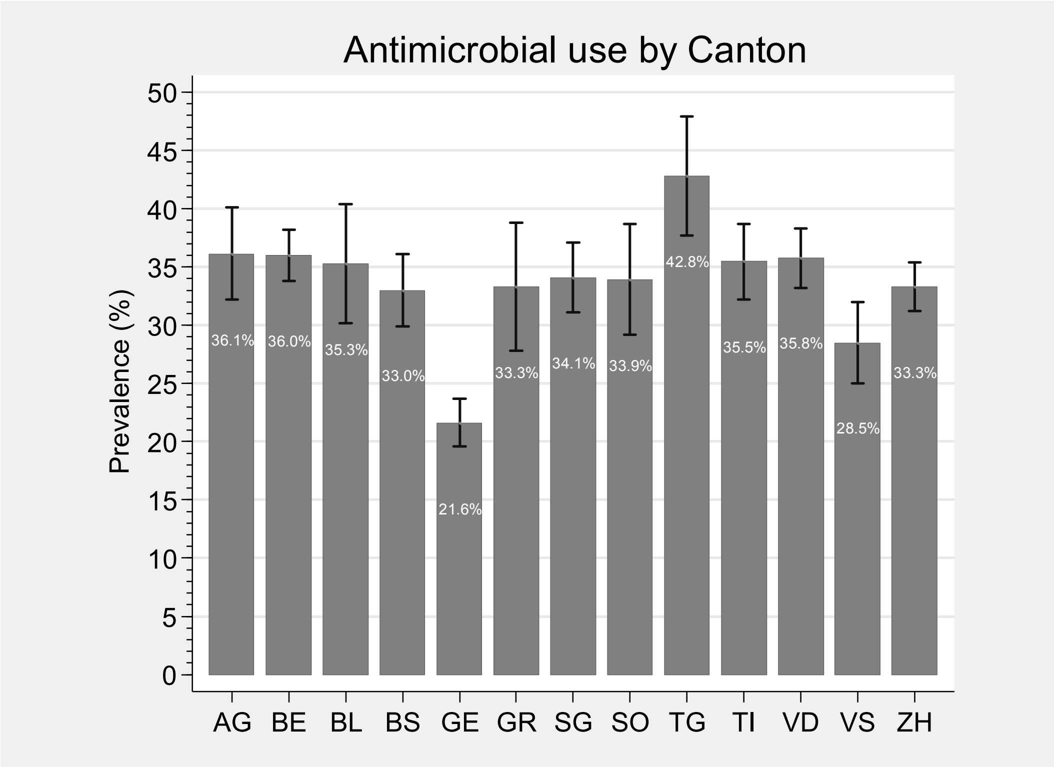
Figure 45: Antimicrobial use, total and antimicrobial days



This figure summarizes how many patients received one or more antimicrobials on the day of survey (left-hand side), and how many days on one or more antimicrobials accumulated between admission and day of survey (right-hand side).

Overall, 1 out of three hospitalized patients included in the survey was under at least one antimicrobial.

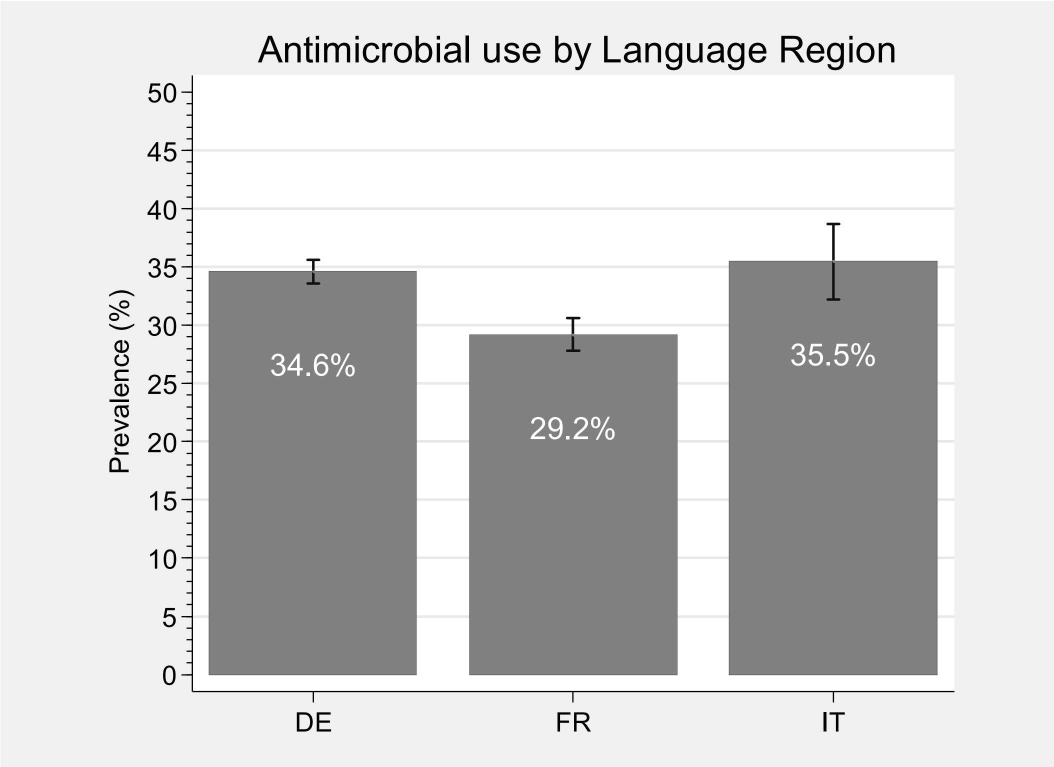
Figure 46: Antimicrobial use by canton



AG: Aargau, BE: Bern, BL: Basel-Landschaft, BS: Basel-Stadt, GE: Geneva, GR: Graubünden, SG: St.Gallen, SO: Solothurn, TG: Thurgau, VD: Vaud, VS: Valais, ZH: Zürich

This table reports antimicrobial use by cantons participating with three or more hospitals. Cantons with fewer hospitals are not included in this figure.

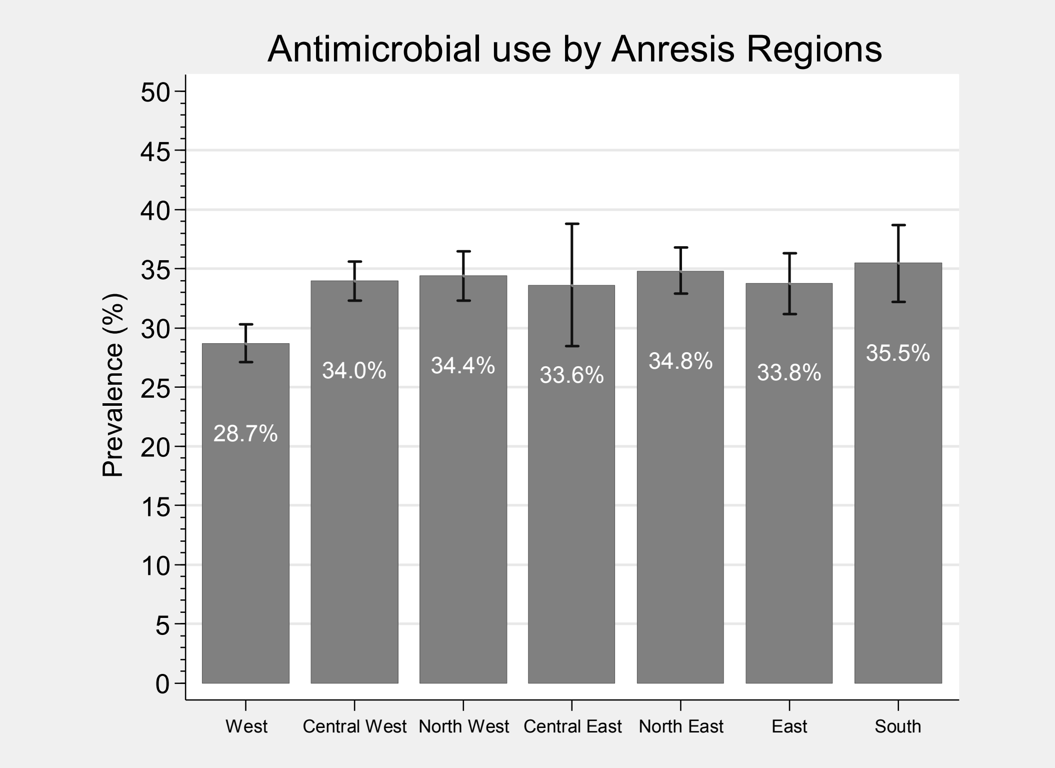
Figure 47: Antimicrobial use by linguistic regions



DE: German, FR: French, IT: Italian

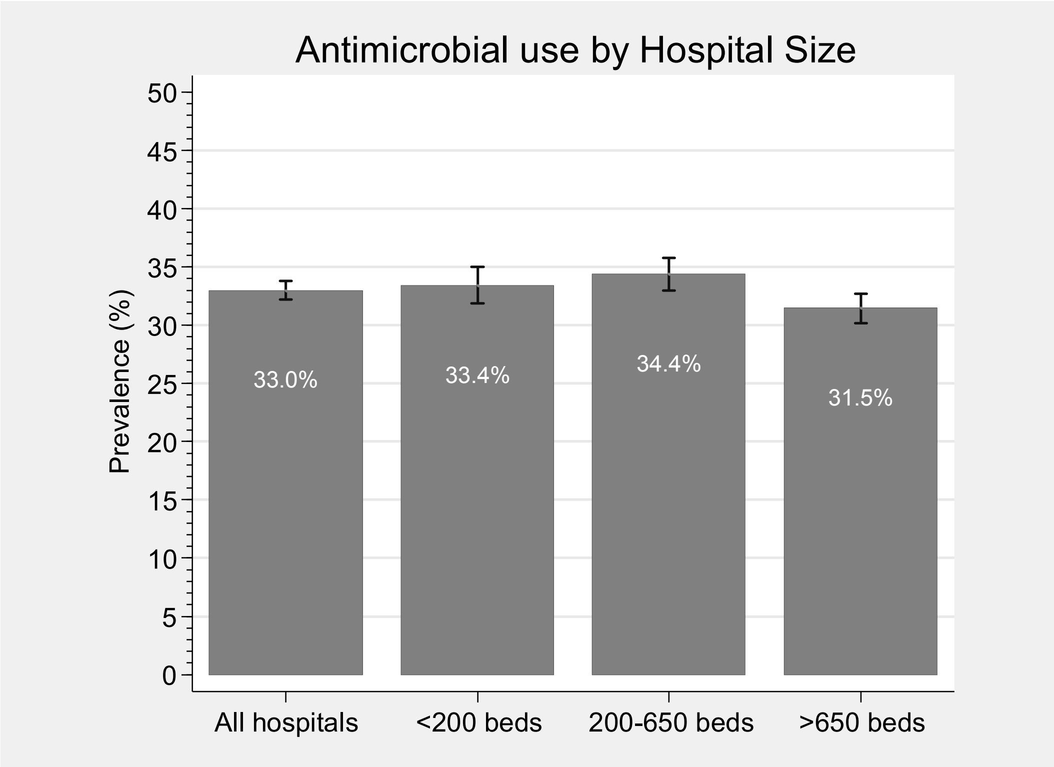
This figure summarized patients receiving one or more antimicrobials, stratified by language regions (Deutschweiz, Romandie, Ticino).

Figure 48: Antimicrobial use by Anresis regions



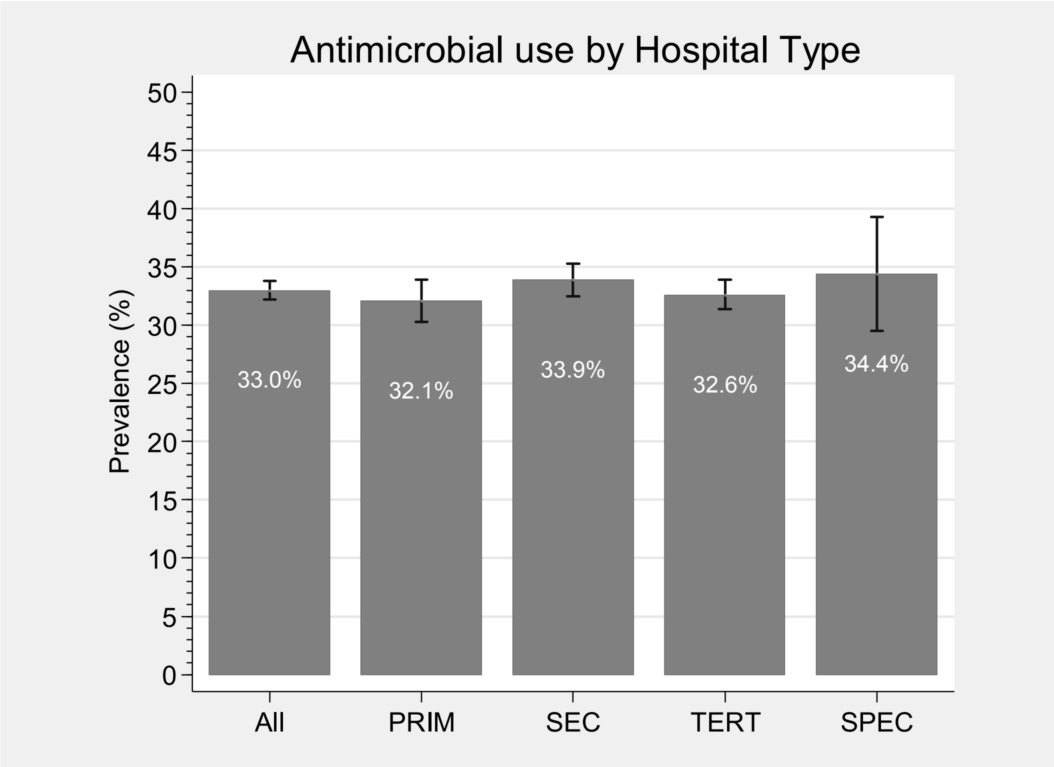
Geographical subdivision of Switzerland as presented in the Swiss Center of Antimicrobial Resistance (anresis): http://www.anresis.ch (Geneva is integrated into the "West" region)

Figure 49: Antimicrobial use by hospital size



This figure summarizes how many patients were on one or more antimicrobial substances, stratified by hospital size. There were no differences between the categories.

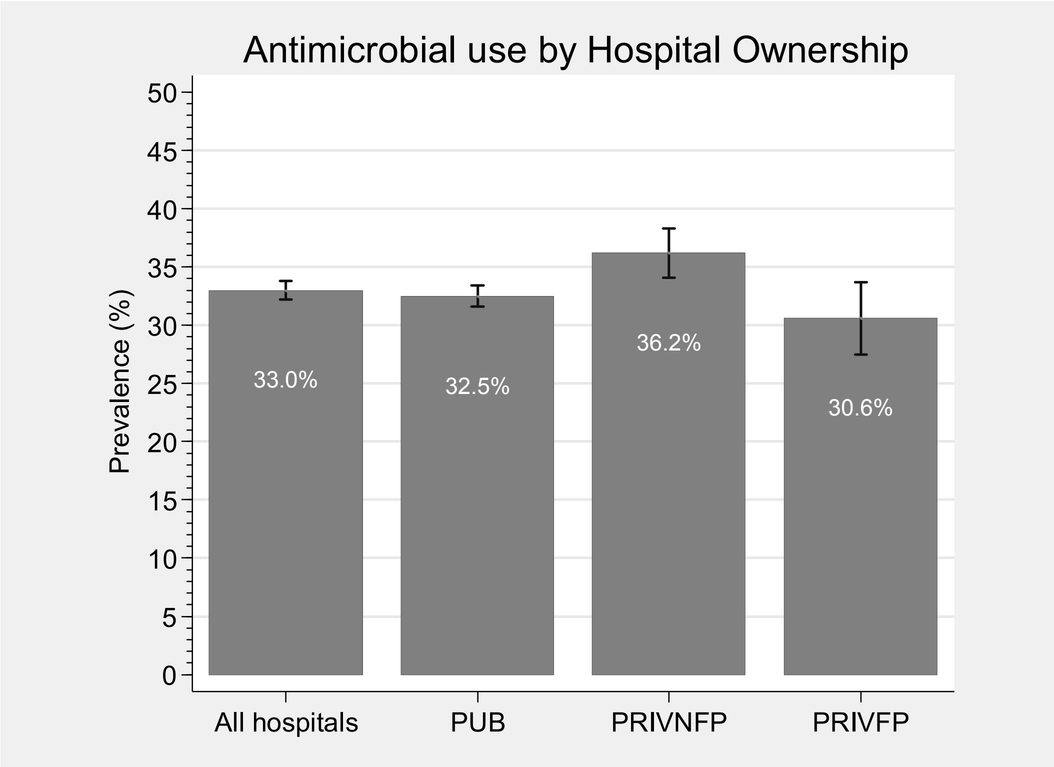
Figure 50: Antimicrobial use by hospital type



PRIM: primary care; SEC: secondary care; TERT: tertiary care; SPEC: specialized care

This figure summarizes how many patients were on one or more antimicrobial substances, stratified by hospital type. There were no differences between the categories.

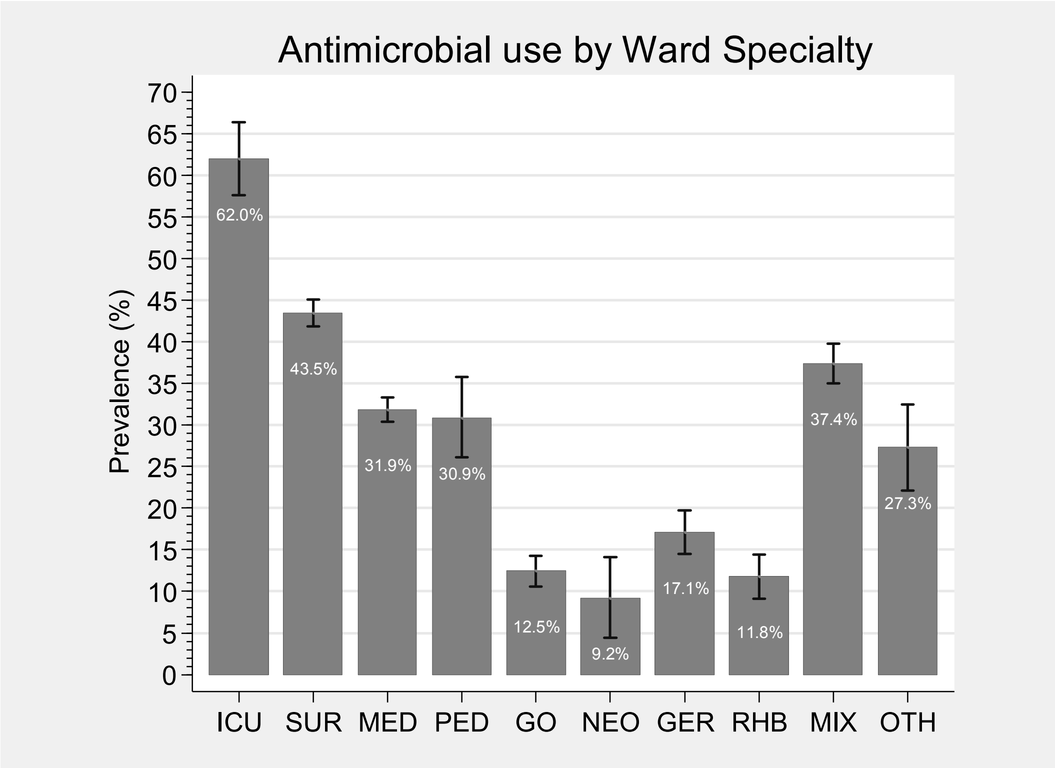
Figure 51: Antimicrobial use by hospital ownership



PUB: public hospitals; PRIVFP: private-for-profit hospitals; PRIVNFP: private-non-for-profit hospitals

This figure summarizes how many patients were on one or more antimicrobial substances, stratified by hospital ownership. More patients in private-non-for-profit hospitals received antimicrobials compared to other hospitals; this difference was not significant.

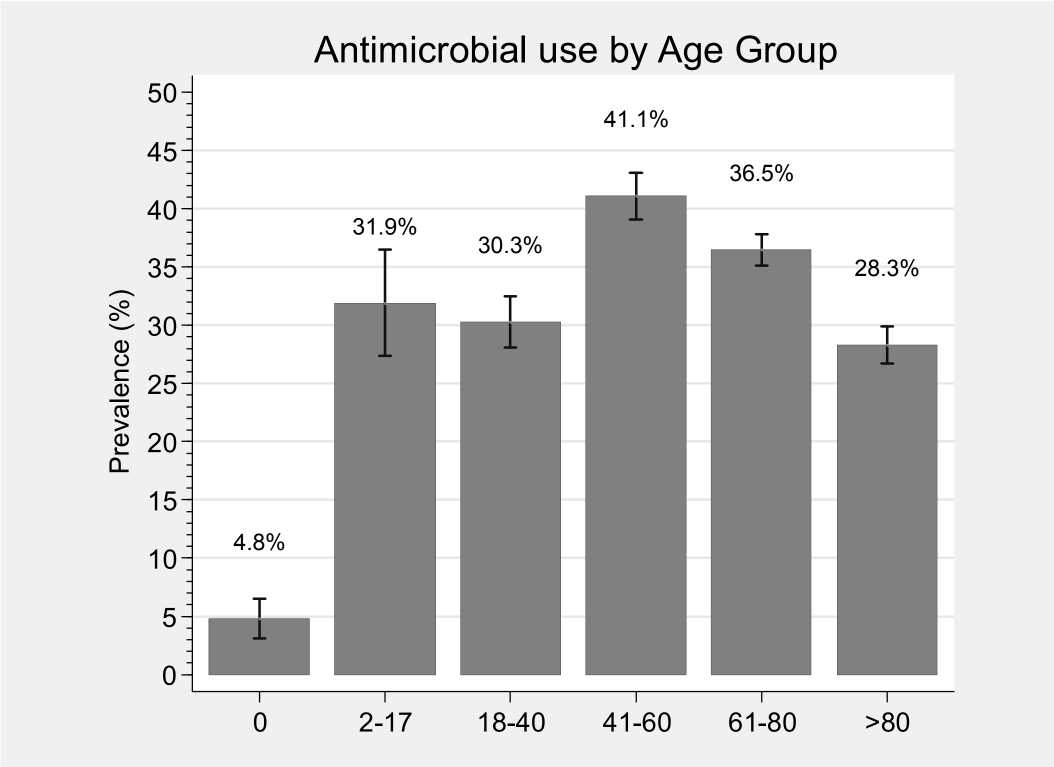
Figure 52: Antimicrobial use by ward specialty



ICU: Intensive care unit, SUR: surgery, MED: medicine, PED: pediatrics, GO: gynecology/ obstetrics, NEO: neonatology, GER: geriatrics, RHB: rehabilitation, MIX: mix, OTH: other

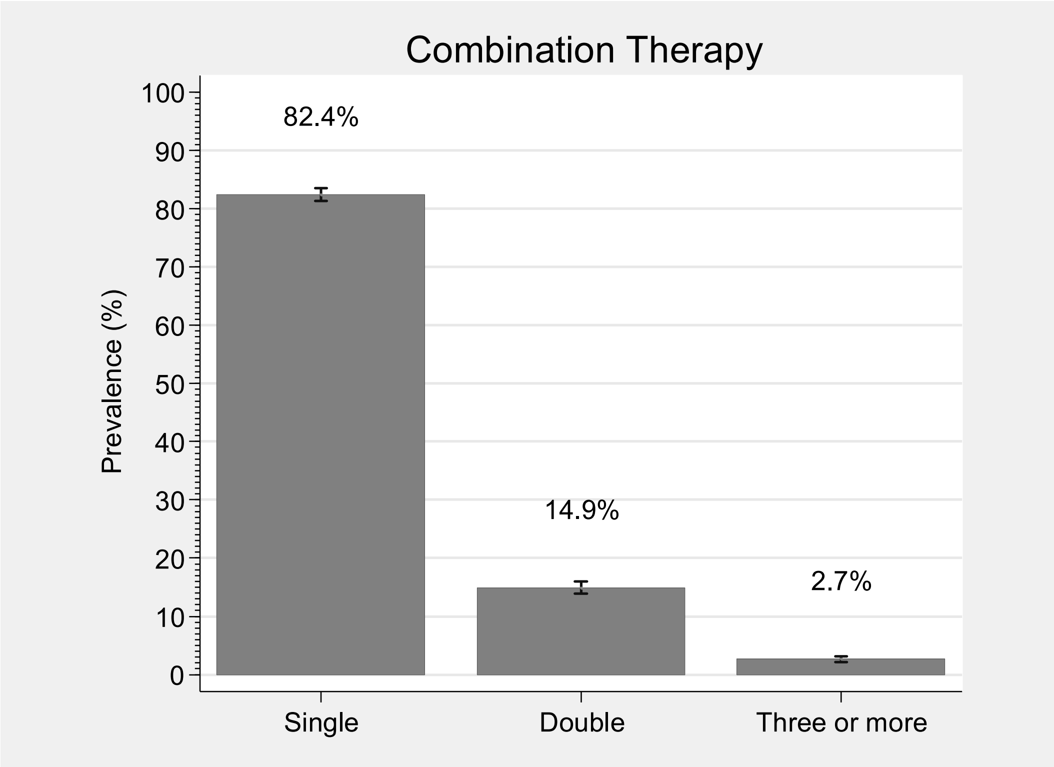
Antimicrobials were more frequently used in ICU, followed by surgical, mix, medical and pediatric units.

Figure 53: Antimicrobial use by age group



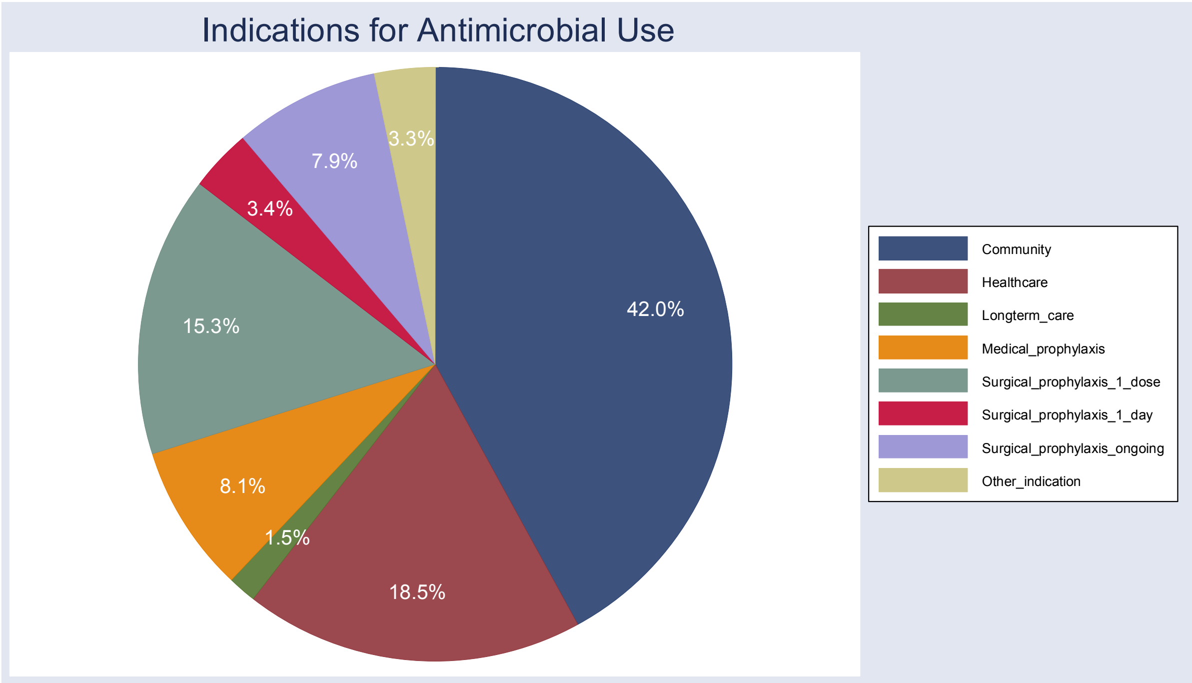
Patients belonging to the age range between 41 and 60 years received more antimicrobials than in the other age groups (medical and surgical prophylaxis included).

Figure 54: Patient on single antimicrobial or combination therapy



This figure summarizes how many patients being treated with antimicrobials received one, two or more antimicrobial substances.

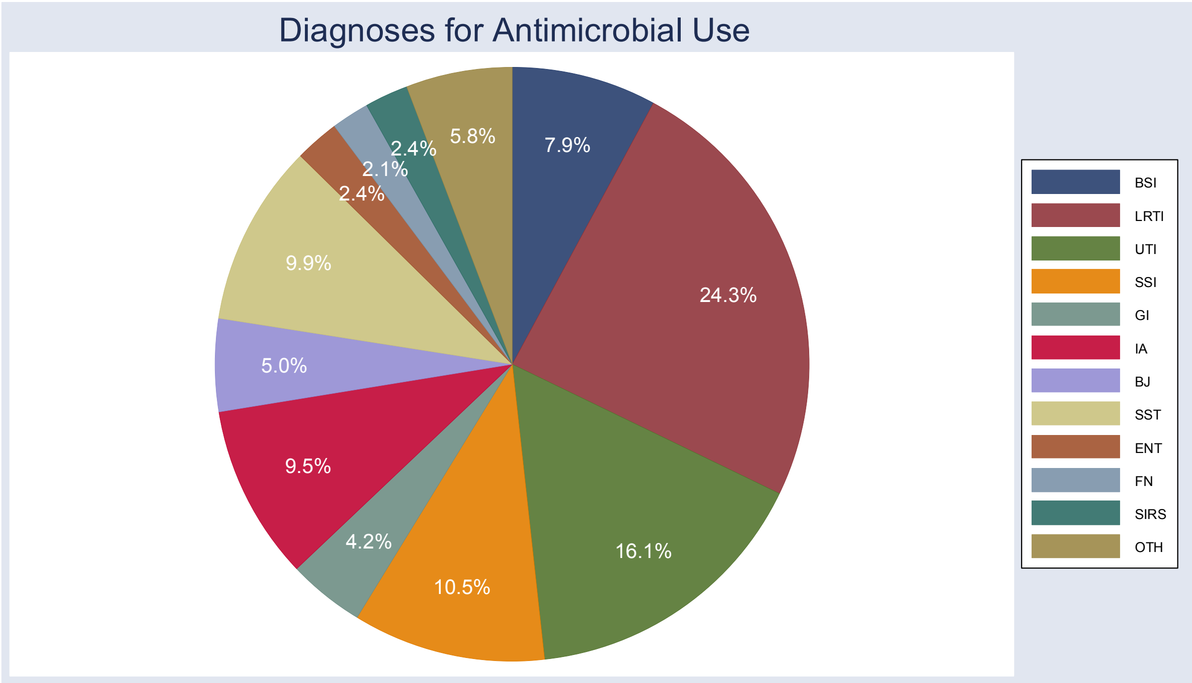
Figure 55: Distribution of antimicrobials by indication



Community: community-acquired infection; Healthcare: Healthcare-acquired infection; Longterm_care: Long-term care-acquired infection; Surgical_prophylaxis_1_dose: Surgical prophylaxis (single dose administration); Surgical_prophylaxis_1_day: Surgical prophylaxis (one day administration); Surgical_prophylaxis_ongoing: Surgical prophylaxis (more than one day administration)

The most frequent reason for AU is a community-acquired infection (42%).

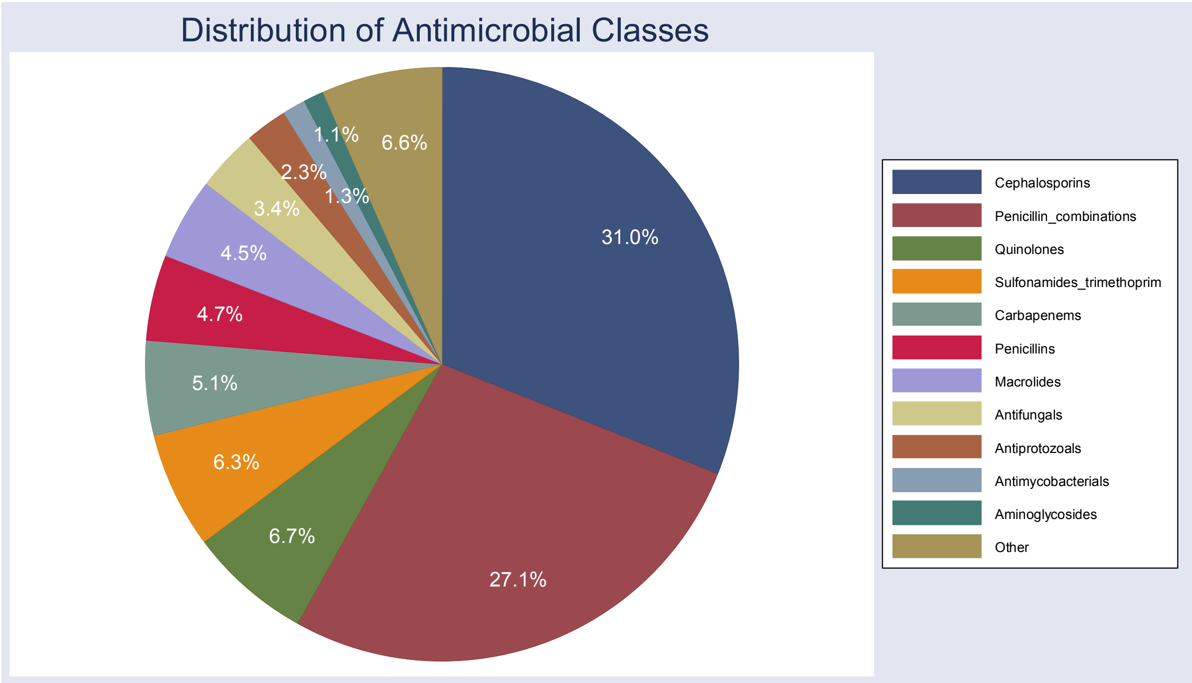
Figure 56: Distribution of antimicrobials by medical diagnosis



BSI: bloodstream infection; LRTI: lower respiratory tract infection; UTI: Urinary tract infection; SSI: Surgical site infection; GI: Gastrointestinal infection; IA: intra-abdominal infection; BJ: bone and joint infection; SST: skin and soft tissue infection; ENT: eye; ear; nose; throat or mouth infection; FN: febrile neutropenia or other form of manifestation of infection in immunocompromised host (e.g. HIV; chemotherapy; etc.) with no clear anatomical site; SIRS: systemic inflammatory response with no clear anatomical site; OTH: other infection

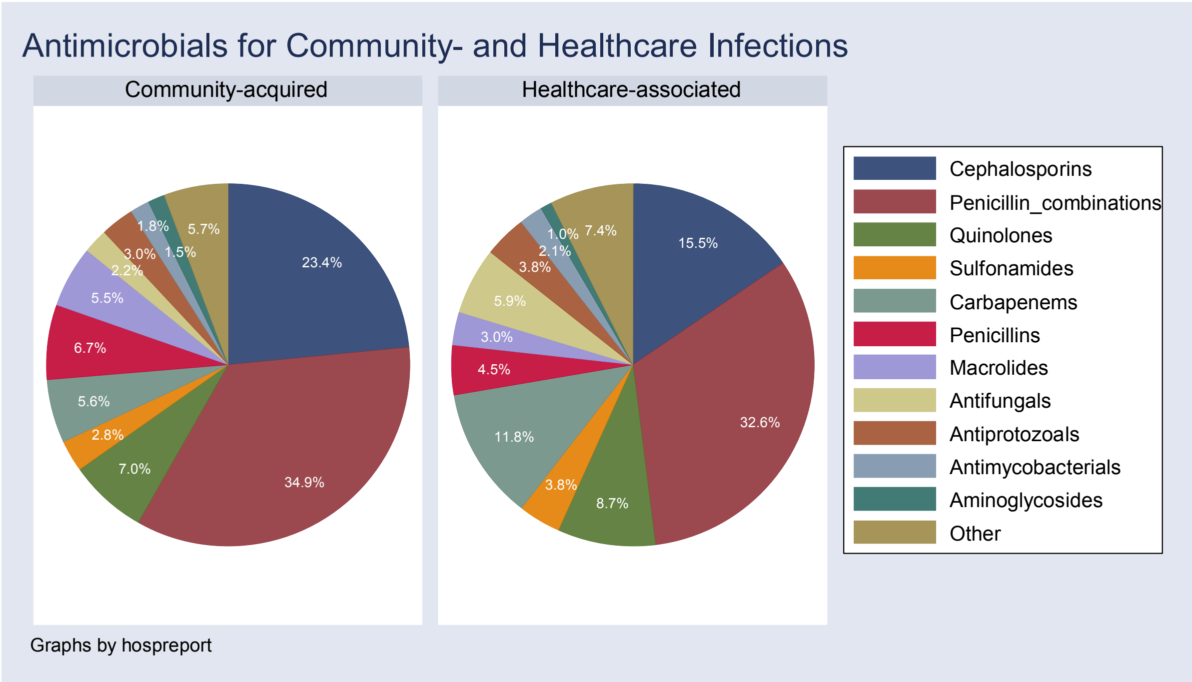
The most frequent diagnosis for antimicrobial use was LRTI, followed by UTI, SSI, SST, IA, and BSI.

Figure 57: Distribution of antimicrobial classes



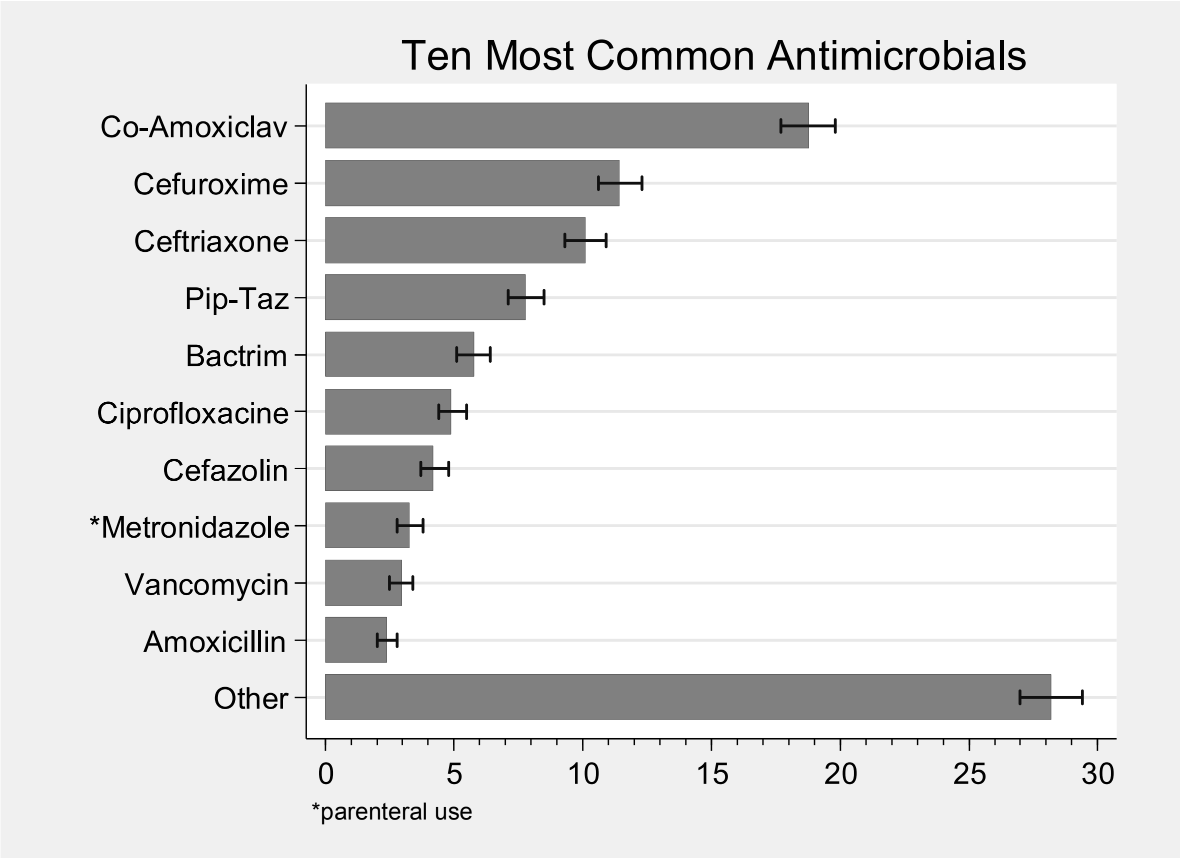
Penicillin combinations: amoxicillin/clavulanic acid, piperacillin/tazobactam

Figure 58: Distribution of antimicrobial classes used for community- and healthcare-acquired infections



Penicillin combinations: amoxicillin/clavulanic acid, piperacillin/tazobactam

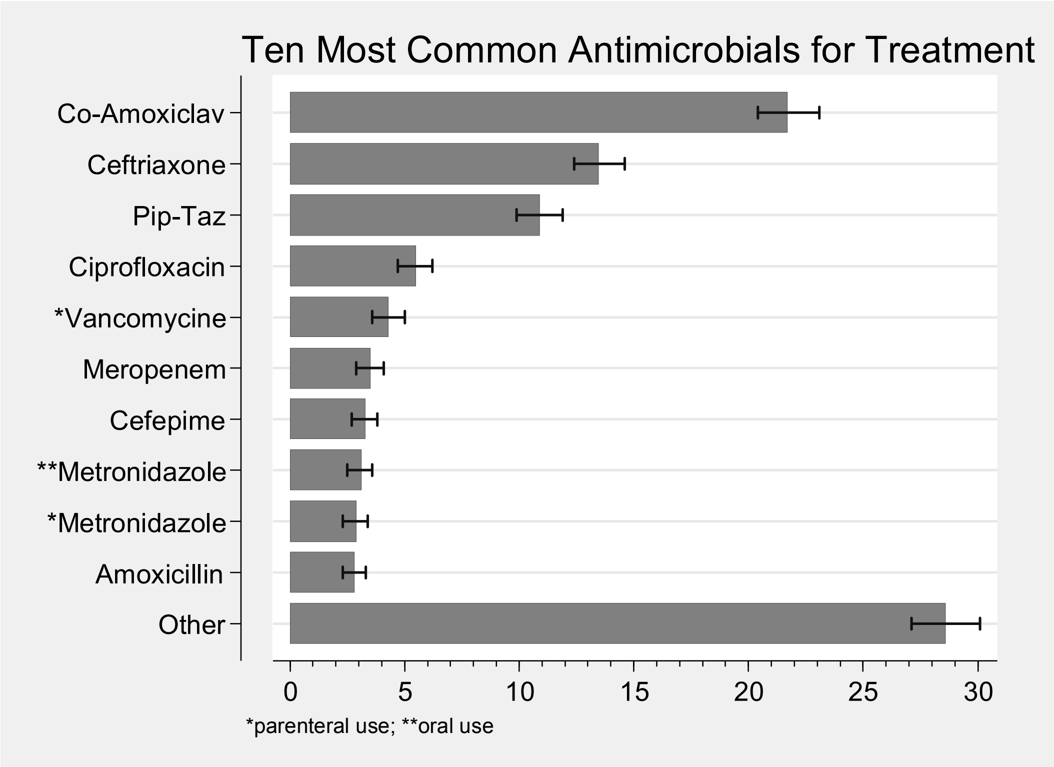
Figure 59: Ten most common antimicrobials



Co-Amoxiclav: amoxicillin/clavulanic acid; Pip-Taz: piperacillin/tazobactam

Together, these antimicrobials account for 71.8% of all antimicrobial use.

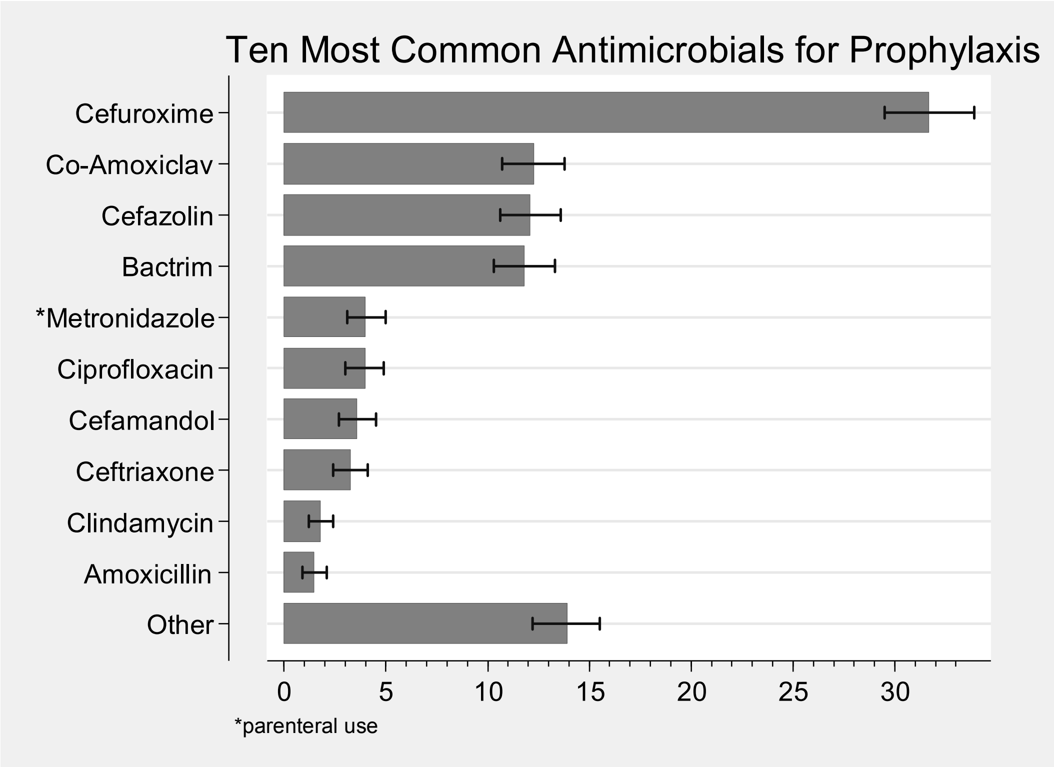
Figure 60: Ten most common antimicrobials for therapeutic purposes



Co-Amoxiclav: amoxicillin/clavulanic acid; Pip-Taz: piperacillin/tazobactam

Together, these antimicrobials account for 71.4% of all antimicrobial treatment.

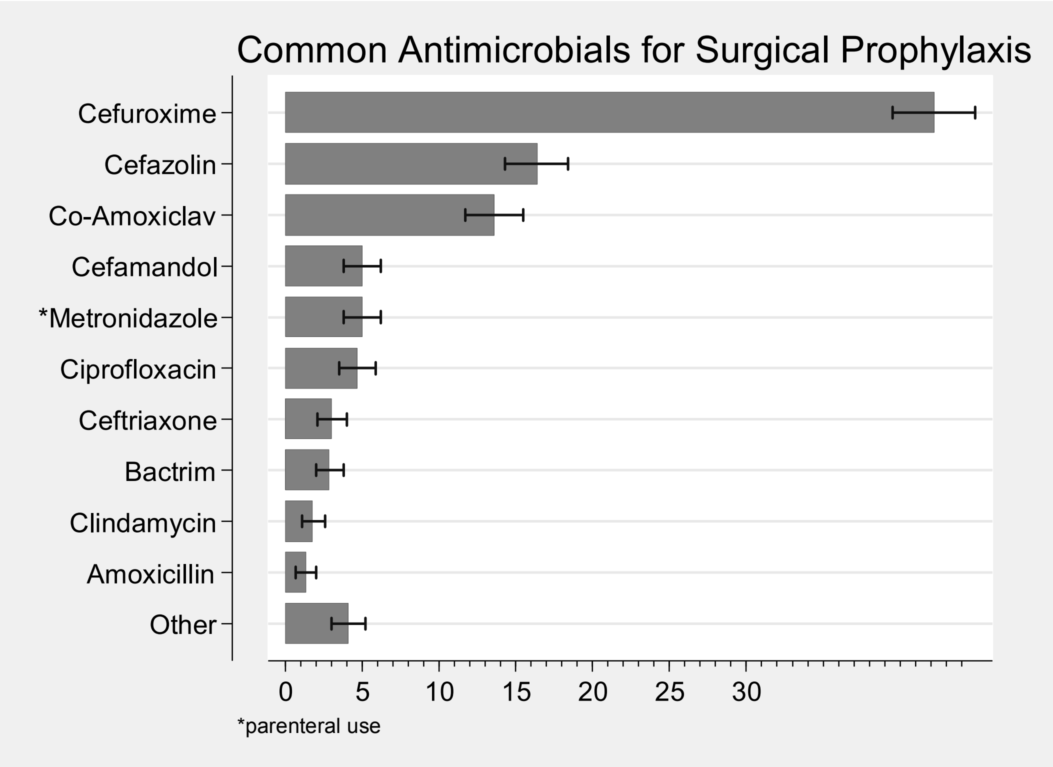
Figure 61: Ten most common antimicrobials for prophylactic purposes



Co-Amoxiclav: amoxicillin/clavulanic acid

Together, these antimicrobials account for 86.2% of all medical and surgical prophylaxis.

Figure 62: Ten most common antimicrobials for surgical prophylaxis



Co-Amoxiclav: amoxicillin/clavulanic acid

Together, these antimicrobials account for 95.9% of all surgical prophylaxis.

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