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HEALTH CARE MANAGEMENT

Healthcare infections and antimicrobial consumption in pre-COVID-19 era: a point prevalence survey in three hospitals in a region of Central Italy

MANUELA TAMBURRO[1], ANGELO SALZO[2], MICHELA LUCIA SAMMARCO[1], GIANCARLO RIPABELLI[1]
[1] Department of Medicine and Health Sciences "Vincenzo Tiberio", University of Molise, Campobasso, Italy;
[2] Department of Prevention, Molise Regional Health Authority, Campobasso, Italy

Keywords

Antibiotics • Antimicrobial stewardship • Infection control • Hospital acquired infection • Indication for prescription • Point prevalence survey

Summary

Introduction. *Healthcare-associated infections (HAIs) are a major global public health concern, increasing the transmission of drug-resistant infections. This point prevalence survey investigated HAIs occurrence and antimicrobial consumption (AMC) in pre-COVID-19 era in the public hospitals of a region of Central Italy.*

Methods. *Data were collected using the protocol standardised by the European Centre for Disease Prevention and Control.*

Results. *Three-hundred and sixty-four patients were included (59.3% male) in the study. Overall, HAIs prevalence was 6.6% (95%CI 4.4-9.5), ranging from 5.2% to 7.1% within the surveyed hospitals, with at least one infection in 24 patients (ten each in medical and surgical specialties wards, and four in intensive care). Risk factors for HAIs were advanced age, having undergone surgery and wearing invasive devices. At time of the survey, 44.7% (95%CI 39.7-49.9) of patients was under treatment with at least one antibiotic, and AMC varied between 43% and 48% within hospitals. In all hospitals, a prevalence higher than 10% was found for the prescription reasons other than prophylaxis or therapy.*

Conclusions. *The results revealed a HAIs prevalence lower than that estimated compared to the most recent national data, in contrast to higher antimicrobial usage. These findings highlight the need to reinforce hygiene practices and develop bundles for HAIs, as a broad implementation of infection prevention and control practices extensively applied to both hub and spoke hospitals could significantly reduce their occurrence, as well as to implement antimicrobial stewardship for prescriptive appropriateness.*

Introduction

Healthcare-associated infections (HAIs) can be severe and life-threatening, leading to a significant increase of hospital stay and costs, and causing 90,000 deaths and billions of dollars in preventable expenditures annually [1]. Treatment of HAIs includes antibiotic selection, and the injudicious usage is likely to result in escalated rates of antimicrobials resistance (AMR), aggravated by a decreased development of new antimicrobial drugs [2]. The global burden associated with drug-resistant infections in 2019 was estimated in 5 million deaths [3].

The COVID-19 pandemic had an unprecedent impact on healthcare systems globally, and the effect on HAIs and antimicrobial resistance are still under investigation [4]. COVID-19 has likely caused profound repercussions on hospital ecology, leading to additional increased AMR rates, associated with the disruption of antimicrobial stewardship and infection prevention and control (IPC) activities, widespread use of broad-spectrum antimicrobials, and rise in critical admissions in settings where multidrug resistance (MDR) is already highly endemic [5]. Considering that infection surveillance represents an integral element of any comprehensive IPC, point prevalence surveys (PPSs) are used to assess HAIs prevalence and antimicrobial consumption (AMC), generating valuable information to highlight and address challenges and critical issues for improvement [6].

This study aimed at describing and comparing HAIs prevalence and AMC in all public hospitals for acute care in Molise region, Central Italy (with one hospital previously included in 2016-2017 European PPS coordinated by the European Centre for Disease Control and Prevention) [7]. The study findings provide insights regarding the most important concerns at a regional level and possible public health interventions for HAIs and AMR prevention and control, highlighting the possible relations among different hospitals where patients circulate according to their healthcare needs.

Methods

STUDY SETTING

The network of public hospitals in the Molise region is structured according to the "hub and spoke" model, with the main hospital as hub in the capital city of Campobasso (hospital A), and the other two acting as spoke (hospital B and hospital C in the city of Isernia and in town of

Termoli, respectively), both characterized by low-level intensity care compared to the hub hospital managing complex case-mix patients. Ethical conduct of research was largely ensured as data collected were de-identified, coded, and were anonymously analyzed in accordance with ethics guidelines, and approval or institutional review was not needed for this study as no experimental procedure was applied to individuals. Each participant was given an informed consent prior to the admission to hospitals, and ethical approval was not required due to the analysis of medical records with previous consent of the hospitals administration to participate to the survey here described, and in similar studies carried out in the same hospitals. Furthermore, it should be considered that the study complied with the exemption conditions from Guidelines for Ethical Review Applications and Reports (downloaded at http://www.gssey.com/llwyhd/7948.jhtml) for collection of archived data, documents, or records, and where information is recorded with the investigators unable to contact any subject, either directly, or through an identifier.

Data collection

During May 2019, a PPS was conducted in all three hospitals mentioned above. Healthcare personnel with the accountability for IPC were involved after a proper training on the protocols standardized by the European Centre for Disease Prevention and Control (ECDC) [8]. Hospital, ward, and patient data including McCabe score were collected through ECDC HelicsWin v2.3.4 software. Furthermore, information was collected on HAIs, use of invasive devices, infected site/organ, microbiological examination, AMR patterns of pathogens, and use of antibiotics by Anatomical Therapeutic Chemical (ATC) Classification System code, therapeutic indication, and reasons for prescription.

Statistical analysis

Means, standard deviations (SD) and medians were calculated for the continuous variables, while the categorical ones were numerically defined and expressed as relative frequencies. Percentage variation (Δ%) was evaluated for the aggregated data associated with the hospital indicators. HAIs description included number of infections per patient, affected sites/organs, and ward. Prescription and therapeutic indication for antibiotics were described, together with the use by molecule and class according to the ATC classification system, and reasons for treatment.

Comparison between prevalence data in the three hospitals was carried out using Chi-square or Fisher's exact test and one-way ANOVA for the qualitative variables, while Student's t test for independent samples was applied for the quantitative ones. Univariate analysis was also performed, estimating the relationship between a single risk factor and HAIs or AMC, using Chi-square or Fisher's exact test. Statistical significance was defined for p-values less than 0.05 for two-tailed hypothesis test. All data were analyzed using IBM SPSS software version 28.0.

Results

Characteristics of the included hospitals

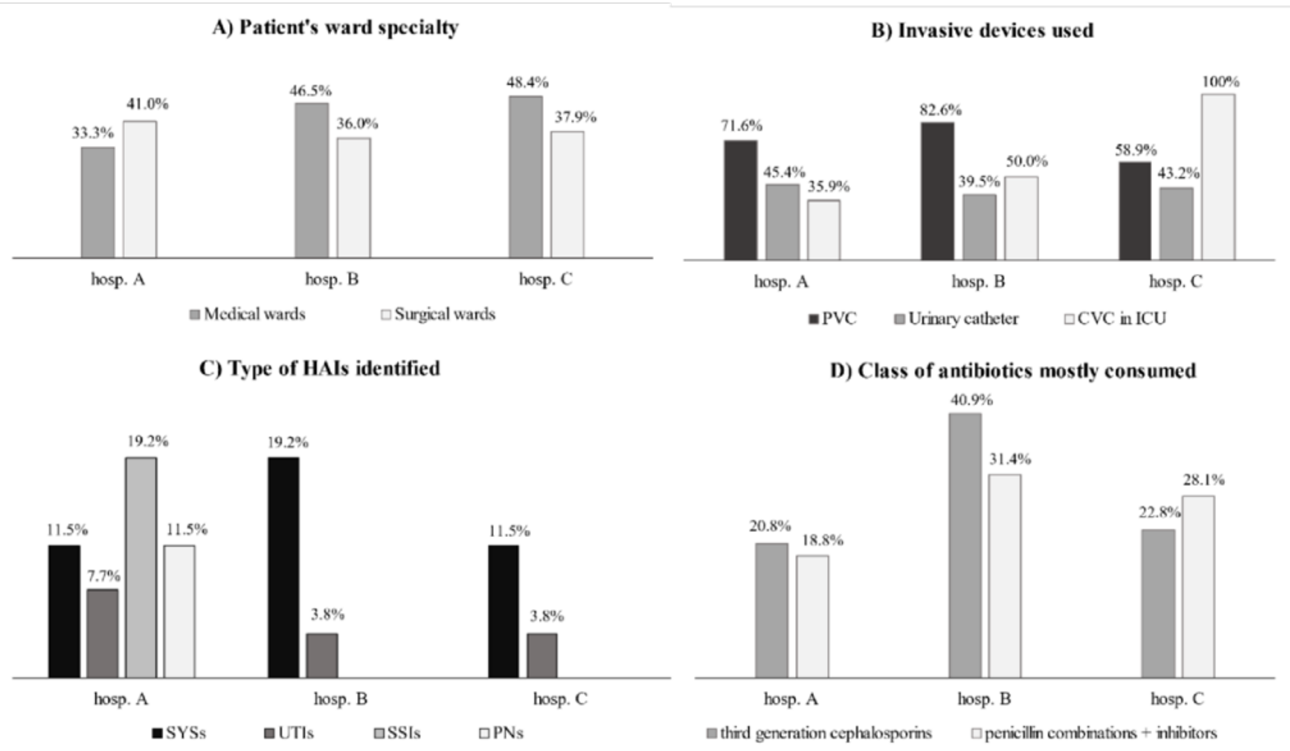
During 2019, the regional network of the public hospitals had 539 total beds for acute and 25 for intensive care (ICU) beds. There were 258, 151 and 130 acute beds for the hospital A, B and C, respectively, and 10, 9 and 6 ICU beds, with number of patient-days per year of 71,855, 47,085 and 43,350 for the three hospitals, respectively. PPS revealed concerns for the hospital hygiene indicators, as there was an insufficient use of alcohol-based solution for hand hygiene (359, 129.5, and 143 liters per year for hospital A, B and C, respectively) corresponding to gel consumption of 4.7, 2.9, and 3.4 liters/1,000 patient-days). Furthermore, a lack of full-time equivalent (FTE) nurses and FTE doctors in charge involved in the IPC, and FTE employees for antimicrobial stewardship was observed for all hospitals.

The IPC strategies and the participation in the surveillance networks, guidelines, and training courses on the management of pneumonia, blood (BSIs) and urinary tract infections (UTIs) were only available in the hospital A. While checklists, audits, surveillance programs, feedback, and bundles for a responsible use of antibiotics and management of surgical site infections (SSIs) were lacking in all the examined hospitals, there was the opportunity to request a microbiological examination during the weekend. Nine wards were present in all hospitals and were examined, including internal medicine, cardiology, general surgery, orthopaedics, anaesthesia and resuscitation, gynaecology and obstetrics, paediatrics, mixed specialties, and psychiatry. Hence, 16 wards were included in the PPS for the hospital A, which had seven additional wards, comprising infectious diseases, nephrology, urology, otolaryngology, neonatal intensive care, rehabilitation, and neonatology. For the hospital B, the wards of urology and neonatology were also included, and that of oncology for the hospital C, for a total of 11 and 10 wards, respectively.

Patients included in the PPS

A total of 364 patients (183, 86, and 95 for hospital A, B and C, respectively) were included in this PPS: 59.3% were male (n = 216) and proportion was similar in all hospitals (n = 113, 61.7%; n = 52, 60.5%; n = 51, 53.7% for hospital A, B and C respectively). The median age was 72 years (mean 65.9) with 53.8% (n = 144) between 51 and 80 years old. The mean/median age of patients in the hospital C was slightly high (70.2 ± 19.8 years/76 years) than that in the hospital B (68.6 ± 19.7 years/75 years) and hospital A (62.4 ± 24.8 years/69 years). Patients included in the PPS were hospitalised in medical or surgical specialties wards (Fig. 1A). According to the McCabe score, 83.8% (n = 305) of patients had clinical conditions classified as non-fatal disease status, while 16.2% (n = 59) were defined as with a severe prognosis. Twenty percent (n = 30) of these patients were in medical specialties, 17.6% (n = 25) in surgical specialties, 15% (n = 3) in ICU, and 8.4% (n = 1) in gynecology and obstetrics wards.

Fig. 1. Ward specialty, invasive devices, HAIs, and antibiotic consumption among the surveyed hospitals.



PVC: peripheral venous catheter; CVC: central venous catheter; SYSs: systemic infections; UTIs: urinary tract infections; SSIs: surgical site infections; PNs: pneumonia infections.

The length of stay from ward admission to date of the survey was on average 9.7 ± 12.9 (median 6 days) in the hospital A, 7.1 ± 6.2 days (median 6 days) for the hospital B, and 7.6 ± 7.5 (median 5 days) for the hospital C. Furthermore, 80.7% (n = 294) of patients had at least one invasive device (peripheral venous catheter – PVC, central venous catheter – CVC, urinary catheter, or were intubated), and 91.2% were hospitalised in medical wards, or a combination of specialties (90%) and surgical wards (88.7%). In detail, 147 (80.3%), 75 (87.1%), and 72 (75.9%) patients in the hospital A, B and C had at least one invasive device, respectively. No significant differences in the use of invasive devices were found between the hospitals, neither for number, nor for type. PVC was the most used invasive device in medical (93.4%, 95% and 65.2% for hospital A, B and C, respectively) and surgical (82.7%, 87.1% and 69.4% for hospital A, B and C, respectively) specialties, while CVC in patients admitted to ICUs (71.9%, 50% and 100% in the hospital A, B and C) (Fig. 1B).

At time of the survey, 25.7% (n = 50) of patients underwent surgery at the hospital A, while 14% and 13.7% at the hospital B and C, respectively, with significant different distribution of the interventions between hospitals ($p < 0.01$).

HAIs prevalence

Amongst the 364 patients, HAIs prevalence was 6.6% (95%CI 4.4-9.5), with at least one infection in 24 patients: 10 (6.8%) patients were in wards of medical specialties, 10 (7%) and 4 (20%) in surgical specialties and ICU, respectively (Tab. I). There were 13 (7.1%) patients with HAIs in the hospital A, while 6 (7%) and 5 (5.2%) cases in the hospital B and C, respectively (Tab. I). In all the facilities, HAIs were most frequent in ICU, with a prevalence of 14.3%, 50% and 25% in the hospital A, B and C, respectively. Twenty-two patients with HAI had a single infection, while two patients in the hospital A had a dual infection, particularly UTI and pneumonia, and SSI associated with BSI.

SSIs were the most frequent HAIs in the hospital A accounting for 19.5% of all, followed by systemic (SYSs) and respiratory infections (both 11.5%), while in the hospital B and C SYSs occurred in 19.2% and 11.5%, respectively (Fig. 1C). In all hospitals, the most common bacteria causing HAIs were gram positive cocci, followed by gram negative bacteria and fungi. A microbiological examination was not routinely performed, or results were not found in medical records, as occurred in the 60%, 66.6%, and 20% of all detected cases for the hospital A, B, and C, respectively. Particularly, 7, 2 and 4 microorganisms were isolated through a microbiological confirmation from six, two and four HAIs detected in the hospital A, B, and C, respectively (Tab. II). The most common microorganisms identified were gram positive cocci, including *Enterococcus faecium* and *Enterococcus faecalis* for the hospital A. Gram negative microorganisms such as *Klebsiella pneumoniae* (hospital

Tab. I. HAIs prevalence stratified by hospitals included in the survey.

	N. patients	N. HAI patients	% HAI patients	N. HAIs
Hospital A				
Medical specialties	61	3	4.9	3
Surgical specialties	75	8	10.7	9
ICU	14	2	14.3	3
Hospital B				
Medical specialties	40	3	7.5	3
Surgical specialties	31	2	6.5	2
ICU	2	1	50	1
Hospital C				
Medical specialties	46	4	8.7	
Surgical specialties	36	-	-	-
ICU	4	1	25	1
All hospitals				
Medical specialties	147	10	6.8	10
Surgical specialties	142	10	7	11
ICU	20	4	20	5

HAIs: healthcare-acquired infections; ICU: intensive care unit.

Tab. II. Microbiological examinations and percentages calculated on total HAIs.

	Hospital A N. (%)	Hospital B N. (%)	Hospital C N. (%)
At least one microorganism identified	6 (40)	2 (33.2)	4 (80)
Results not available at day of the survey	3 (20)	1 (16.6)	0 (0)
No tests performed	6 (40)	4 (50)	1 (20)

A), *Escherichia coli* (hospital B), and *Acinetobacter baumannii* (hospital A and C) were also detected. HAIs sustained by fungi (*Candida albicans* and other species) were also found in the hospital A and C.

AMC

At time of the survey, considering all hospitals, 44.7% (163 out of the 364) of patients was under treatment with at least one antibiotic (95%CI 39.7-49.9), and included 80 (43.7%) patients in the hospital A, 37 (43.0%) in the hospital B, and 46 (48.4%) in the hospital C.

Antibiotic prophylaxis was mostly documented in surgical specialties, as observed in 26 (53.3%) of total patients in surgical wards in the hospital A. Antimicrobial consumption for therapeutic purposes was more commonly recorded among medical specialties and ICUs than in other wards. In all hospitals, a prevalence higher than 10% was found for the prescription reasons other than prophylaxis or therapy, especially in the hospital B and C (Tab. III).

Significant differences were found between the hospitals for the treatment of community-acquired infection ($p < 0.01$), surgical prophylaxis longer than one day ($p < 0.01$), and indeterminate motivation ($p < 0.01$).

The most widely used classes of antibiotics in both hospital A and B were third generation cephalosporins, and penicillin combinations plus β-lactamase inhibitors, while the latter and third generation cephalosporins were the most used antibiotics in the hospital C (Fig. 1D). Use of fluoroquinolones was also relatively consistent in the hospital B (18.2%).

Ceftriaxone was the most used antibiotic for the surgical prophylaxis and treatment of community-acquired infections in the hospital A, while meropenem for HAIs (23.1%), followed by linezolid, colimycin and tigecycline (15.8%). Amoxicillin with clavulanic acid were the most used agents for community-acquired infections and ciprofloxacin for medical prophylaxis (each 60%) in the hospital B, and ceftriaxone was largely used (52.3%).

In the hospital C, ceftriaxone (25%) and piperacillin-tazobactam (25%) were the drugs prescribed for community infections, while fluconazole (40% of prescriptions) for HAIs treatment.

Tab. III. Antibiotic use by ward specialty and prescriptive indication available in the medical record.

	N. treated patients (%)			N. antibiotics for prophylaxis (%)			N. antibiotics for therapy (%)			N. antibiotics for other reasons* (%)		
Wards	Hospital A	Hospital B	Hospital C	Hospital A	Hospital B	Hospital C	Hospital A	Hospital B	Hospital C	Hospital A	Hospital B	Hospital C
Medical specialties	26 (42.6)	14 (40)	19 (41.3)	2 (6)	2 (13)	1 (4)	28 (85)	8 (53)	18 (69)	3 (9)	5 (33)	7 (27)
Surgical specialties	40 (53.3)	20 (64.5)	19 (52.7)	26 (6)	22 (92)	11 (55)	10 (24)	1 (4)	2 (9)	6 (14)	1 (4)	9 (41)
ICU	10 (71.4)	2 (100)	4 (100)	9 (56)	1 (33)	-	7 (44)	2 (67)	3 (60)	0 (0)	0 (0)	2 (40)
Gynaecology and Obstetrics	1 (11.1)	0 (0)	1 (100)	0 (0)	-	1 (100)						
Paediatrics	-	-	3 (100)	-	-	0 (0)	-	-	3 (100)	-	-	0 (0)
Mixed specialties	3 (42.8)	1 (33.3)	-	0 (0)	2 (100)	-	4 (100)	0 (0)	-	1 (100)	0 (0)	-

* Other reasons include Indeterminate Indication (UI) and Unknown Motivation (UNK); UI code was used whenever an antibiotic therapy did not fall specifically into the previous categories (Therapy/Prophylaxis) in case of empirical treatment for non-specific signs and/or symptoms of infection, or did not meet the case definition, or for treatment of "secondary" prophylaxis, in case of suspicion of already acquired infection (for example increases in body temperature or white blood cells), to avoid the full-blown disease; UNK code was used whenever antibiotic therapy without motivation has been prescribed.

Tab. IV. Risk factors significantly associated with a) HAIs occurrence and b) AMC.

		Hospital A	Hospital B	Hospital C
a)				
	Patient characteristics			
	Fatal McCabe score	0.62§	0.10§	0.01§
	Having undergone surgery	0.04§	> 0.99§	> 0.99§
	Indwelling invasive devices			
	CVC	< 0.01§	0.05§	0.01§
	Urinary catheter	< 0.01*	0.21§	0.01§
	Intubation	0.10§	0.13§	< 0.01§
b)				
	Patient characteristics			
	Fatal McCabe score	0.01*	0.59§	0.09§
	Having undergone surgery	0.01*	0.02*	0.03*
	HAI	< 0.01*	< 0.01*	0.02*
	Indwelling Invasive devices			
	CVC	< 0.01*	0.22*	< 0.01*
	PVC	< 0.01*	0.04*	0.23*
	Urinary catheter	< 0.01*	< 0.01*	< 0.01*
	Hospital wards			
	Surgical specialties	0.03*	< 0.01*	0.53*
	ICU	0.04*	0.18*	0.05*
	Rehabilitation	0.03§	-	-
	Neonatology	0.01§	-	> 0.99§

* Chi-square test; § Fisher's exact test.

Risk factors associated with HAIs and AMC

Significant relationships were observed in the hospital A between HAIs risk and having undergone surgery and use of CVC or use of urinary catheter. In the hospital C, HAIs risk correlated with McCabe score, CVC, urinary catheter, and intubation (Tab. IVa). No risk factors were identified for the hospital B.

AMC in the hospital A was significant related with patients' characteristics, HAIs occurrence, having undergone surgery during hospitalization, clinical severity, CVC, PVC, urinary catheter, and being hospitalised in ICU and surgical, rehabilitation, and neonatology wards. For the hospital B, a significant relationship between AMC and HAIs, having undergone surgery, PVC, urinary catheter, and being hospitalised in surgical specialties. In the hospital C, AMC was linked to surgery and HAIs, in addition to the use of invasive devices (Tab. IVb).

Discussion

This study evaluated the epidemiology related to HAIs and antibiotics use in all the public hospitals in the Molise region. The survey revealed critical issues to rapidly address, with further considerations on the regional demographic structure characterized by a high proportion of elderly population increasing the infectious risk. If age does not represent a modifiable factor for reducing HAIs prevalence, the appropriate use of antibiotics is necessary to target drug-resistant bacterial infections, and prevent emerging of bacterial resistance [9].

The overall HAIs prevalence of 6.6% was in line with the 6.5% estimated by the ECDC in the European PPS conducted in 2016-2017, including 1,209 EU acute hospitals [10]. HAIs prevalence was 7.1% in the hospital A, as well as previously found in the PPS conducted in 2016 [7], 7% and 5.2% in the hospital B and C, respectively not surveyed before this PPS. Hence, HAIs prevalence was higher in the hub hospital than in spokes, as reported in the literature [11] and this is probably related to the presence of high-risk wards, as well as to the intrinsic function of hub hospitals, leading to the admission of the most complicated cases. Furthermore, patients' movement may facilitate HAIs transmission, who may then be transferred or treated in other regional hospitals. Indeed, spatial variation in hospital sizes, presence or absence of an ICU, degree of connectivity, and inter-hospital transfer rate may promote source-sink dynamics at a regional scale, and the reintroduction of an infectious agent may re-establish local transmission [12]. HAIs occurrence in the hospitals was lower than that previously found (approximately 10%) related to other Italian regions [13]. It is of note that there was a different prevalence of HAIs in ICUs in the three hospitals included in this survey, being high in the hospital B and C, unlike the hospital A, in which a targeted infection control program was implemented following an outbreak of *K. pneumoniae* carbapenemase-producing (KPC) in ICU [14]. Among the three hospitals, there were further differences regarding type of HAIs, being SSIs resulted as the most frequent in the hospital A, which is likely due to hospitalization of patients with comorbidities, and different type of interventions [15], while these infections were not detected in the other two hospitals, due to a low complexity of the managed patients.

In all surveyed hospitals, a great number of patients had at least one invasive device, a known risk factor associated to HAIs occurrence [16], and was higher than that previously observed in the hospital A [17]. Indeed, all the patients with UTIs in the hospital A had a urinary catheter, as well as the affected patient in the hospital C. Hence, despite the availability of guidelines and training courses to prevent UTIs in the hospitals, there is likely an over-exposure to invasive devices due to patients' characteristics with UTIs. SYS (sepsis from unspecified origin) represented the most frequent HAIs in the hospital B and C, accounting for 80% and 60% of all HAIs respectively, a rate higher than that found in other studies on large and complex hospitals (17.2%) [13, 18].

Concerning antibiotic use, the prevalence of patients under treatment for any reason did not differ between the hospitals. AMC was higher than the 30.5% estimated in the European acute care hospitals in the PPS 2016-2017 [19], but lower than 46% reported in another Italian study [16]. Administration of antibiotics for prophylactic purposes for at least three days after surgery was very high in the hospital A and B. The use of third generation cephalosporins was limited in other Italian settings [13] in contrast to the present survey; this class of antibiotics was the most frequently prescribed, especially for surgical prophylaxis, which is not recommended as promoting the development of resistant strains [20]. A significant difference in the antibiotics prescribed for surgical prophylaxis was found comparing the three hospitals, highlighting the need for antimicrobial stewardship. This study further underlines the need of guidelines for antibiotic prophylaxis, considering the frequency of prescriptions for indeterminate or unknown reasons, or without any indication in the medical record, implying that patients may have received inappropriate therapy. Indeed, there is evidence that antimicrobial stewardship programs significantly improve the prescriptive appropriateness in the hospital setting, with positive effects on clinical outcomes, adverse events, costs, and control of microbial resistance [21].

After the survey described here, the activity of a multidisciplinary working group was launched for the definition of an antimicrobial stewardship document. The use of empirical therapy was considered high also for a reduced number of laboratory tests performed in the hospitals; for example, a microbiological examination was not carried out for 60% patients with HAIs in the hospital A. Analysis of tests performed in this hospital highlighted gram positive bacteria such as *Enterococcus faecium* and *E. faecalis*, according to other reports [18], while a higher prevalence of *C. difficile* in another Italian study was described [13].

The present survey allowed evaluation of hospital indicators and revealed a limited use of alcoholic gel solution for hand hygiene, which should be at least equal to 20 liters per 1,000 patient-days [22]. Moreover, by removing transient skin flora, proper hand hygiene is known to decrease microbial proliferation, reducing infection risk and overall healthcare costs. A further critical issue was the lack of alcoholic gel dispensers at the point-of-care, likely contributing to low compliance with hand hygiene practices. Although use of alcohol-based gel is the optimal solution for infection control [21], it was not possible to evaluate whether the low use, especially in the hospital B and C, was balanced with an increased hand washing, which was not assessed through the adopted protocol. These data are likely expected to be different considering the ongoing SARS-CoV-2 pandemic, as a renewed attention to hand hygiene practices due to the COVID-19 emergency might have changed compliance towards the use of alcoholic gel solution. The survey further revealed an incomplete set of practices for preventing infections in the hospital A, being equipped only by guidelines and training courses for health personnel on some areas or infections, while guidelines were not present in the other two hospitals. Furthermore, the lack of bundle approach for HAIs prevention and control was detected, also in ICUs, although effectiveness has been demonstrated [23]. In the examined hospitals, an antimicrobial stewardship post-prescription review was established only in 2019, which applied a formal procedure to assess prescriptive appropriateness. Benefits of such approaches have been extensively documented to reduce the inappropriate use of antibiotics, related costs, secondary *C. difficile* infections, and circulation of resistant microorganisms [24]. Although the introduction of specific staff to these tasks implies a cost in terms of both human and economic resources, evidence suggested that investing the equivalent of one FTE per 100 beds allows implementation and maintenance of an effective antimicrobial stewardship program over time [25].

Conclusions

A lower HAIs prevalence was estimated through PPS compared to the most recent national data, in contrast to higher antimicrobial usage. This study confirmed that a broad implementation of IPC practices extensively applied to both hub and spoke hospitals could significantly reduce HAIs occurrence. Specific interventions at the organizational level are needed to improve appropriateness of treatments and to reduce risk factors for the AMR emergence. An increased awareness of AMR threat by all health professionals and of HAIs prevention should be widely promoted. The ongoing COVID-19 pandemic has renewed attention on prevention and control of infectious diseases, even by adherence to simple hygiene rules. Indeed, COVID-19 could be seen as an opportunity, due to overlapping key areas, considering that approaches for the management of hospitalised patients with SARS-CoV-2 infection are similar to those applied in patients with HAIs. Furthermore, IPC practices essential for limiting SARS-CoV-2 spread, with hand hygiene above all, significantly contribute to reduce the occurrence of HAIs and the emergence of AMR bacteria.

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Conflict of interest statement

The authors report there are no competing interests to declare.

Ethical approval

Ethical approval was not required since patients signed an informed consent at the hospital admission, due to the analysis of medical records with previous consent of the hospitals administration to participate to the survey here described, and in similar studies carried out in the same hospitals. Furthermore, it should be considered that the study complied with the exemption conditions from Guidelines for Ethical Review Applications and Reports (downloaded at http://www.gssey.com/llwyhd/7948.jhtml) for collections or studies of previously archived data, documents, or records, and where information is recorded with the investigators unable to contact any subject either directly, or through an identifier.

Authors' contributions

All authors have made substantial contributions to the conception and design of the study, acquisition, analysis and interpretation of data, drafting or revising the article critically for important intellectual content, and final approval of the submitted version. MT was responsible of data analysis, manuscript drafting and editing. AS collected and reviewed data and protocols, and critically interpreted results. MLS contributed to data collection and interpretation. GR was responsible for the design, organization and coordination of the study, and critically revised and edited the manuscript. All authors contributed to the writing and revision of the final version of the manuscript.

Availability of data and material

The relevant data are reported in the manuscript; however, the authors are available to provide any further details or information on request.

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Correspondence: Giancarlo Ripabelli, Department of Medicine and Health Sciences "Vincenzo Tiberio", University of Molise, Via De Sanctis, 86100 Campobasso, Italy. Tel.: +39 0874 404961/743 - Fax: +39 0874 404778 - E-mail: ripab@unimol.it

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