

ORIGINAL ARTICLE

Prevalence Survey of Healthcare-Associated Infections and Antimicrobial Use at the University Hospital "Paolo Giaccone", Palermo, Italy

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Key words

Healthcare-associated infections • Antimicrobials drug resistance • Point Prevalence Survey

Summary

Introduction. Healthcare-associated infections (HAIs) and antimicrobial resistance are well known major public health threats. The first goal of our study was to describe the prevalence of HAI, while the second goal was to describe the antibiotic consumption at our University Hospital, "P. Giaccone" in Palermo, Italy.

Methods. A standardized methodology for a combined Point Prevalence Survey (PPS) on healthcare-associated infections (HAIs) and antimicrobial use in European acute care hospital developed by the European Centre for Disease Prevention and Control (ECDC) was piloted across Europe. The teaching Hospital "P. Giaccone" in Palermo, Italy, participated in the study.

Results. Out of 328 surveyed patients, 12 (3.6%) had an HAI and 159 (48.5%) were receiving at least one antimicrobial agent. Prevalence results were highest in intensive care units, with 17.6% patients with HAI. Bloodstream infections represented the most common type (50%) of HAI. Surgical prophylaxis was the indication for antimicrobial prescribing in 59 (37.1%) out of 159 patients and exceeded 24 hours in 54 (91.5%) cases.

Discussion. The results suggest that in our hospital there was a frequent and inappropriate use of antimicrobials, especially in the setting of surgical prophylaxis.

Introduction

Healthcare-associated infections (HAIs) are an important cause of morbidity and mortality worldwide [1]. The annual prevalence of HAIs in Italy is estimated to range between 5% and 8% by year. The most frequent HAIs are the lower respiratory tract infections (LRTIs), followed by urinary tract infections (UTIs), bloodstream infections (BSIs) and surgical site infections (SSIs) [1]. In our country about 450,000-700,000 patients acquire at least one HAI during hospital stay [1-3]. Thus, HAI's surveillance is recognized as a crucial activity for the prevention and control programs.

Excessive and inappropriate use of antibacterial drugs is a major public health problem worldwide, since it is associated to an alarming increase in drug resistance and adverse drug reactions and causes also huge economical costs [4]. Available international and national data about amount and pattern of antibiotic use in both community and hospital setting are not always sufficiently informative because national databases may use different and no standardized methods to measure antibiotic use. To this aim, PPS (Point Prevalence Survey) can provide baseline information about occurrence and distribution of HAI and antibiotic use in healthcare institutions.

On September 2011, the teaching Hospital "Paolo Giaccone" of Palermo, Italy, participated to the European-scale Prevalence Survey for the Surveillance of Healthcare-Associated Infections (HAI) and Antimicrobial Use in Acute Care Hospitals [2]. This project was implemented by the European Center for Disease Prevention and Control (ECDC) through a protocol providing a standardized methodology to the Member States and the participating hospitals.

The specific objectives of Prevalence Survey were to estimate the total burden of HAI and antimicrobial use, by applying a standardized European methodology, and to disseminate the results at a local, regional, national and EU level.

Methods

SETTING

The Teaching Hospital "P. Giaccone" of Palermo, Italy, is a tertiary care hospital with 575 beds, of which 497 reserved to acute and 16 to intensive care, with nearly 20,400 admissions annually. The number of patient-days per year is about 151,700. This hospital in the European-scale Prevalence Survey of Healthcare-Associated Infections and Antimicrobial Use accounted for western Sicily.

POINT PREVALENCE SURVEY (PPS)

The standardized protocol for a combined Point Prevalence Survey (PPS) on healthcare-associated infections (HAIs) and antimicrobial use that we used, represents the final protocol (version 4) defined in 2011-2012 by ECDC, which carried out a review of 17 national or regional point prevalence surveys of HAI (and antimicrobial use) in European countries (ECDC Annual Epidemiological report 2008) [2, 5, 6].

A series of inclusion requirements had to be met. All acute care units were included, but long-term care units, accident and emergency (A&E) Departments, patients admitted to same-day treatment or surgery, the outpatient departments, emergency room and dialysis were ruled out. Data recovered for each patient aimed to identify an active HAI and/or the use of antimicrobial drugs at the time of the survey. Data had to be collected in a single day for each ward/unit. The total time frame of data collection for all units of a single hospital had not to exceed 2-3 weeks. Data were collected using two forms: "Hospital data form" including general information on the type of surveyed hospital and "Patient data form" subdivided in three parts: the first one dedicated to demographic and clinical data, the second one describing antimicrobials use and the last one regarding HAI.

In the pilot study, ECDC recommended that data collection was to be carried out by experienced staff in reading patient charts/notes and in HAIs' identifying (e.g. infection control professionals, clinical microbiologists, infectious disease specialists). In particular, in our survey, data collectors (HAIs' prevention and surveillance staff, residents) were previously trained by the national PPS coordinators to become familiar with protocol and case definition.

CASE DEFINITION

European case definition for HAI was used according to previous surveillance projects (HELICS or other European projects), whereas case definitions from the National Healthcare safety, Centers for Disease Control and Prevention (CDC), were otherwise used. In the HAIs section, data on microorganisms and their resistance phenotype were collected. Only results that were already available at the time of the survey were included. Data were also collected for patients showing an active HAI on the day of the survey. A HAI was defined as active when:

- signs and symptoms fulfilled the survey definitions of HAI and were present on the survey date
- or
- signs and symptoms fulfilling the survey definitions of HAI had been present in the past and the patient was still receiving treatment on the survey date.

DEFINITIONS OF ANTIMICROBIAL USE DATA

The antimicrobial-related informations were only collected if patient was receiving antimicrobials at the time of the survey or alternatively had an active HAI. Both generic and brand names were allowed. The drugs in-

cluded the ATC classes J01 (antibacterials), J02 (antifungals) and J04 (antimycobacterials). The route of administration was also recorded. The patients could receive systemic antimicrobials for:

- community-acquired infection (CI): all infections already present at admission except for those correlated to a previous hospitalization;
- healthcare infection acquired in long term care facility or chronic care hospital (LI);
- acute hospital acquired infection (HI): this also applied to hospital-acquired infections occurring after discharge and for occupational infections among staff of the structure;
- Surgical Prophylaxis (SP): any single dose of an antimicrobial agent given within the 24-hour period before 8:00 am on the day of the survey. This time window for surgical prophylaxis allowed for distinguish single dose prophylaxis, one day prophylaxis or prophylactic doses given over more than one day;
- Medical Prophylaxis (MP): it included antibiotic therapy administered to prevent a disease or its recurrence;
- other indications (e.g. use of erythromycin as a prokinetic agent);
- unknown indication/reason (assessed during PPS);
- unknown/missing information on indication no verified during PPS.

Results

A total of 328 patients, of whom 161 females (49.1%), were included in the PPS. Twenty-one patients were infants aged 0-10 months. The mean age of the remaining 307 patients was 61.8 [standard deviation (SD) 19.4] years for females and 60.4 (SD 18.8 years) for males. One hundred ninety patients out of 328 were hospitalized in clinical medicine departments (57.9%), 112 in surgical departments (34.1%) and 26% in intensive care units (ICUs).

Twelve (3.6%) out of the 328 patients had an HAI. One patient had a triple healthcare infection, so the total burden of HAIs was 14. BSIs represented the commonest type of HAI (7 out of 14), followed by UTIs (four out of 14), pneumonia, decubitus ulcer and SSIs. One (7.1%) central vascular catheter (CVC)-related infection was also identified. All UTIs were occurring in patients with urinary catheter. All of the six BSIs arose in patients with at least an invasive device in situ (CVC and/or peripheral vascular catheter, PVC) within for at least 48-hour. Prevalence was highest in ICUs (17.6%). In the department of gastroenterology two out of 17 patients had an active infection at the moment of survey similarly to the Department of Clinical Medicine Respiratory, where one out of nine patients had an HAI. The remaining infections were detected in the General Medicine ward (three out of 33 patients), Orthopedics and Traumatology ward (one out of 11 patients), Hematology (one out of 14 patients) and Emergency Surgery ward (one out of 20 patients had an HAI).

Overall, 159 (48.5%) out of 328 of the surveyed patients were prescribed one or more antimicrobials. Among the patients receiving at least one antimicrobial, 98 (61.6%) out of 159 were administered with a single agent, 47 (29.5%) two and 14 (8.8%) received three agents. Overall 59 (37.1%) patients were prescribed antibiotics for surgical prophylaxis, 58 (36.5%) for a community infec-

tions, 27 (17.0%) for medical prophylaxis, 12 (7.5%) for HAI, three (1.9%) for LI (Tab. I).

In 36 out of 73 (49.3%) of the cases of SP, cephalosporins were used, alone or in combination with other agents, followed by quinolones 16.4% (12 cases) and metronidazole 13.7% (10 cases) (Tab. II). Among 3rd

Tab. I. Pattern of administration of antibiotics and indications of treatment in the surveyed patients during the PPS, 2011.

Indication of treatment	Treated patients (n. 159)		Number of antimicrobials used			
			1		> 1	
	n*	%	n [‡]	% ¹	n [‡]	% ¹
Medical prophylaxis	27	16.9%	18	66.6%	9	33.4%
Surgical prophylaxis	59	37.1%	42	71.2%	17	28.8%
Community infection	58	36.5%	36	62.1%	22	37.9%
Healthcare-associated infection	12	7.5%	2	16.6%	10	83.4%
Long-term hospital-acquired infection	3	2.0%	–	–	3	100.0%

ECDC: European Centre for Disease Prevention and Control.

* Total of patients treated for relative indication.

Percent of the total.

‡ Patients receiving the indicated number of antimicrobial agents for each indication of treatment.

¹ Percent each within category.

Tab. II. Distribution of antimicrobial agents (ATC* 4th levels) by main indication for use, ECDC pilot point prevalence survey, 2011 (n = 223 antimicrobial agents).

	All indication	Treatment	Surgical prophylaxis	Medical prophylaxis
	n (%)	n (%)	n (%)	n (%)
Antimicrobial agents, total	223 (100)	113 (100)	73 (100)	37 (100)
Top antimicrobial agents at ATC 4th level				
Fluoroquinolones (J01MA)	56 (25.1)	34 (30.1)	12 (16.4)	10 (27.0)
Third-generation cephalosporins (J01DD)	55 (24.6)	12 (10.6)	35 (47.9)	8 (21.6)
First-generation cephalosporins (J01DB)	1 (0.4)	–	1 (1.4)	–
Nitroimidazole derivates (P01AB)	27 (12.1)	11 (9.7)	10 (13.7)	6 (16.2)
Combinations of penicillins, incl.β-lactamase inhibitors (J01CR)	18 (8.1)	11 (9.7)	4 (5.4)	3 (8.1)
Combination of sulfonamides and trimethoprim (J01CA)	10 (4.4)	4 (3.5)	2 (2.7)	4 (10.8)
Macrolides (J01FA)	9 (4.0)	6 (5.3)	–	3 (8.1)
Glycopeptide antibacterials (J01XA)	9 (4.0)	9 (7.9)	–	–
Aminoglycosides (J01GB)	8 (3.6)	4 (3.5)	4 (5.4)	–
Penicillins, extended spectrum without anti-pseudomonal activity (J01CA)	8 (3.6)	6 (5.3)	2 (2.7)	–
Carbapenems (J01DH)	7 (3.1)	6 (5.3)	1 (1.4)	–
Antidiarrheals, intestinal anti-inflammatory/anti-infective agents (A07AA)	5 (2.2)	3 (2.6)	–	2 (5.4)
Triazole derivates (J02AC)	3 (1.3)	3 (2.6)	–	–
Antimycobacterials for treatment of tuberculosis (J04A)	2 (0.8)	2 (1.7)	–	–
Tetracyclines (J01AA)	1 (0.4)	1 (0.8)	–	–
Other antibacterials (J01XX)	3 (1.3)	1 (0.8)	1 (1.4)	1 (2.7)

* Anatomical Therapeutic Chemical

generation cephalosporins, ceftriaxone, was the most frequently used.

In MP the quinolones were administered at a rate of 27.0% (10 out of 37), cephalosporins of 21.6% (8 out of 37) and metronidazole of 16.2% (6 out of 37). Of the 59 patients treated for surgical prophylaxis, only in one case the antibiotics were administered in single dose (1.7%), while in four cases for one day (6.8%) and in all the other cases (54 cases, 91.5%) for more than one day. In these last cases, the antibiotic administration was also prolonged after surgery. One antibiotic was administered to 37 (68.5%) out of 54 patients, while more than one antibiotic was given to the remaining 17 (31.5%).

Data on causal agents and their respective resistant phenotype were included only if they were already available on the date of the survey. Therefore, data on the species of microorganisms causing HAI were unavailable, except for six cases. *Enterobacteriaceae* (*E. cloacae*) and enterococci (*E. faecalis* and *E. faecium*) were associated with urinary tract, blood, decubitus ulcers, including both superficial and deep infections and SSI. One BSI was associated with *Cytomegalovirus*. *Candida albicans* and *Acinetobacter baumannii* were also identified. This last one affected three infection sites in a single patient (decubitus ulcer, bloodstream and urinary tract). Resistance to third generation cephalosporin and carbapenem was reported for *E. cloacae*.

Discussion

HAIs are a serious problem, contributing heavily to the burden of the hospital costs [7]. These infections have a negative impact on patient because of the worsening of underlying medical condition and the increased morbidity and mortality [7].

The rapidly escalating prevalence of antimicrobial resistance is a global concern. The reduced susceptibility to most current of available antimicrobial agents coupled with the progressive shortage of newly approved compounds is a worrisome situation [7]. Major problems are encountered for a growing number of Gram-positive organisms (i.e., *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Enterococcus* spp.) and Gram-negative pathogens (i.e., *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Klebsiella pneumoniae*) [7]. Serious infections caused by resistant bacteria do not respond to therapy and are often associated with worse outcomes, including increased rates of complications, additional costs, higher associated mortality rates and prolonged hospital stays [8].

HAIs' prevalence of 3.6% observed in our survey is lower than that reported in other European studies and that observed in 2008 (6.7%) in the same hospital. The limits of the HAI's estimate by PPS are well known. However, because case-mix and admission rules are not changed in the last years, it can be presumed that some prevention and control interventions have been to some extent effective. In particular

some guidelines were issued to implement infection control procedures, such as Antibiotic perisurgical pro-

phylaxis in adults, Ambulances hygiene, handwashing (Clean care is safer care), Isolation measures in the AOUP P. Giaccone, Palermo, isolation of patients with colonization/infection by multi-resistant pathogens. So healthcare workers training programs were carried out as well.

The European prevalence has been estimated to be 7.1% by ECDC, based on a review of 30 national or multi-centre PPS in 19 countries in its annual epidemiological report for 2008 [4, 6]. However an important issue that should be considered for the interpretation of the epidemiological results of this and future surveys is the standardization of data collection in participating hospitals to compare results between hospitals, regions and countries. Indeed, HAI prevalence may depend on differences in methodology and patients case-mix and not only on performance variations.

High rates of antibiotic usage were observed in our hospital. In particular our survey revealed use of broad spectrum antibiotics, sometimes combined in multidrug protocols, because of emergence of antibiotic-resistant microorganisms [9]. On the other hand, due to the widespread diffusion of MDR organisms in our healthcare settings, it is often necessary to start an initial antibiotic therapy with multidrug protocols or last resource molecules, such as colistin. New diagnostic methods that allow to obtain microbiological confirmation in short time could be very useful. It is known that the excessive and unnecessary use of antibiotics is the main driving force of the high rates of drug resistant infections we are seeing in recent years [10, 11].

The results of this survey confirm those of a parallel analysis with another classical approach in which the antibiotic use in the hospital was measured by evaluating the numbers of defined daily doses (DDD) (Malta R et al., 2010) for 100 bed days or for number of admissions. The DDD consumed in 2011 were in fact 82.06 per 100 bed-days and 5.41 per admission. For the surgical wards, overall the DDD were 94.00 per 100 bed-days and 5.98 per admission; quinolones accounted for 25.6% of the DDD consumed, cephalosporins for 23.7%, penicillins for 16.2% and metronidazole for 14.4%. Moreover, DDD consumed for 100 bed-days in our hospital proved to be higher than those observed in a sample of five hospitals in Emilia Romagna despite increasing by 18% in the three years period, 64.9 DDD/100 bed days in 2002 to 76.7 in 2004 [9, 12, 14].

Results showed also that a significant area of antibacterial overuse was SP. According to the international consensus, antibiotic prophylaxis in surgery involves the administration of an antibacterial agent for a very short time, temporally located just before the beginning of intervention [12]. However, our study revealed that the antibiotics were used for longer intervals of times. A reason of inappropriate antibacterial drug use was the frequent administration as SP of drugs, such as 3rd generation cephalosporins, which are not recommended for surgical prophylaxis and should be reserved to the treatment of severe active infections.

Our study has some limitation. Indeed the PP study design has some inherent limits, including reduced periods

of observation and the possibility of obtaining biased results. It has the advantage to be very economical in terms of both time and human and financial resources. Repeated PPS represent a more feasible alternative for hospital-wide surveillance of all HAIs, while still allowing the estimation of HAIs burden in acute hospitals, and helping to prioritize areas requiring interventions [1]. Therefore, although it was carried out in full compliance with the European protocol, the study has likely some limitations inherent to the study design. Continuous surveillance, especially prospective active surveillance, is the gold standard to improve patient safety.

guidelines (e.g. *Clean Care is Safer Care, WHO*) [15], monitoring of drug resistance patterns, turning to restrictive hospital formularies [16, 17].

References

- [1] Lanini S, Jarris WR, Nicastrì E, et al. *Healthcare-associated infection in Italy: annual point-prevalence surveys, 2002-2004*. Infect Control Hosp Epidemiol 2009;30:659-65.
- [2] CDC/NHSN Surveillance. *Definition of healthcare-associated infection and criteria for specific types of infections in the acute care setting*. AM J Infect Control 2008;36:309-32.
- [3] Zotti CM, Messori Ioli G, Charrier L, et al. *Hospital-acquired infections in Italy: a region wide prevalence study*. J Hosp Infect 2004;56:142-9.
- [4] Brusaferrò S, Regattin, Faruzzo A, et al. *Surveillance of hospital-acquired infections: a model for settings with resource constraints*. Am J Infect Control 2006;34:362-6.
- [5] Kuijper EJ, Coignard B, Tüll P; the ESCMID Study Group for Clostridium difficile (ESGCD); EU Member States and the European Centre for Disease Prevention and Control (ECDC). *Emergence of Clostridium difficile-associated disease in North America and Europe*. Clin Microbiol Infect 2006;12(Suppl. 6):2-18.
- [6] Geffers C, Baerwolff S, Schwab F, et al. *Incidence of healthcare-associated infections in high-risk neonates: results from the German surveillance system for very-low-birthweight infants*. J Hosp Infect 2008;68:214-21.
- [7] Furtado GH, Nicolau DP. *Overview perspective of bacterial resistance*. Expert Opin Ther Pat 2010;20:1273-6.
- [8] Collignon P. *Clinical impact of antimicrobial resistance in humans*. Rev Sci Tech 2012;31:211-20.
- [9] Mazzeo F, Capuano A, Motola G, et al. *Antibiotic use in an Italian University Hospital*. J Chemother 2002;14:332-5.
- [10] Zarb P, Coignard B, Griskeviciene J, et al. *The European Centre for Disease Prevention and Control (ECDC) pilot point prevalence survey of healthcare-associated infections and antimicrobial use*. Euro Surveill 2012;17(46). pii: 20316.
- [11] Malta R, Di Rosa S, D'Alessandro N. *Aspetti etici e controllo di gestione dei farmaci antibiotici antibatterici*. Italian Journal of Medicine 2010;4:137-44.
- [12] Vaccheri A, Silvani MC, Bersaglia L, et al. *A 3 year survey on the use of antibacterial agents in five Italian hospitals*. J Antimicrob Chemother 2008;61:953-8.
- [13] Schön T, Sandelin LL, Bonnedahl J, et al. *A comparative study of three methods to evaluate an intervention to improve empirical antibiotic therapy for acute bacterial infections in hospitalized patients*. Scand J Infect Dis 2011;43:251-7.
- [14] Müller-Peabody B, Muscat M, Pelle B, et al. *Increase and change in pattern of hospital antimicrobial use*. Denmark 1997-2001. J Antimicrob Chemother 2004;54:1122-6.
- [15] Pittet D, Donaldson L. *Clean care is safer care: a worldwide priority*. Lancet 2005;366:1246-7.
- [16] Bassetti M, Topal J, Di Biagio A, et al. *The organization of infection control in Italy*. J Infect 2001;48:83-5.
- [17] Porretta A, Giuliani L, Vegni FE, et al. *Prevalence and pat-*

■ Received on May 16, 2013. Accepted on October 22, 2013.

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