Organization of Infection Control in European hospitals

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Abstract

Background

The Prevention of Hospital Infections by Intervention and Training (PROHIBIT) survey was initiated to investigate the status of healthcare-associated infection (HAI) prevention across Europe.

This paper presents the methodology of the quantitative PROHIBIT survey and outlines descriptive results related to infection control (IC) at the hospital level.

Methods

Hospitals in 34 European countries were invited to participate between September 2011 and March 2012. Respondents included IC clinicians and hospital management.

Results

Data from 309 hospitals in 24 countries were analysed. Hospitals had a median (interquartile range) of four IC nurses (2, 6) and one IC doctor (0, 2) per 1000 beds. Two-thirds (66%) of hospitals had implemented a link-nurse system. Most often, IC was an independent department (39% of hospitals), but it was also affiliated with administration (20%), microbiology (14%), or infectious diseases (7%). Almost all hospitals (96%) had defined IC objectives, which mainly addressed hand hygiene (87%), HAI reduction (84%), and antibiotic stewardship (66%). Senior management provided walk rounds in about half of hospitals, most often in Eastern and Northern Europe (65% and 64%, respectively). In the majority of hospitals (71%), sanctions were not employed for repeated violations of IC practices. Use of sanctions varied significantly by region ($P < 0.001$), but not by countries' healthcare expenditure.

Conclusions

There is great variance in IC staffing and policies across Europe. Some areas of practice e.g. hand hygiene seem to receive considerably more attention than others equally important e.g. ABS. IC programs suffer from deficiencies in human resources and local policies which are ubiquitous concepts in determining IC performance. Strengthening of IC policies in European hospitals should be a public health priority.

Key Words: HAI prevention, patient safety, Europe, hospital

Introduction

Healthcare-associated infections (HAIs) are the most frequent adverse event in health care delivery and result in increased morbidity and mortality [1]. According to the European point prevalence survey (PPS), the number of patients with an HAI on any given day in European acute care hospitals is about 81,000 [2].

Various studies have shown that HAIs are partly preventable [3]. In the Study on the Efficacy of Nosocomial Infection Control (SENIC) project, infection control (IC) programs that included surveillance and control activities and trained IC personnel were strongly associated with HAI reduction [4]. Later, a consensus panel report by the Society for Healthcare Epidemiology of America defined key IC functions as follows: targeted surveillance, detection and control of outbreaks, implementing and auditing written policies, and education and training [5].

In recent years, leadership, organizational mechanisms, and communication strategies have been identified as important determinants of effective practice [6-8]. The Systematic review and evidence-based guidance on organisation of hospital infection control programmes (SIGHT) project has identified components for effective IC programs; besides such factors as staffing, surveillance, audits, education, and training, the authors recommended fostering working relationships and communication across units and staff groups [9].

However, despite these findings, variations in key IC functions have been reported in multiple sources [10,11]. In 2001, the Antimicrobial Resistance Prevention and Control (ARPAC) project surveyed hospitals' IC activities and showed that the intensity of IC programs scored higher in Northern and Western Europe than in other European regions. IC variations in Europe can be explained by differences in social and legal perspectives, and also by cultural norms [12]. The extent to which national and hospital factors influence best practice is one objective of the Prevention of Hospital Infections by Intervention and Training (PROHIBIT) study, a European Union–funded project that was launched in 2010 with the aims of understanding existing guidelines and practices for preventing HAIs, identifying factors that enable and prevent compliance with best practices, and testing the effectiveness of interventions of known efficacy [13].

This paper presents the methodology of the quantitative survey and outlines descriptive results related to the organization of IC at the hospital level in 24 European countries.

Methods

The PROHIBIT survey was developed by an interdisciplinary group and comprised four questionnaires (Q1-4) that explored IC organization and activities at the hospital level (Q1), the intensive care unit level (Q2), and the non-intensive care unit level (Q3, Q4). Various professional groups were invited to answer different parts of the questionnaire (Table I). This report summarizes the findings of IC organization and activities at the hospital level (Q1).

A first draft of the questionnaire was discussed with the European Centre for Disease Prevention and Control national contact points (NCPs) during a PROHIBIT expert meeting in December 2010. An advanced version was piloted in three countries in April 2011 and the final version was translated in 15 languages.

NCPs invited hospitals from each country to participate in the survey between September 2011 and March 2012. Hospitals' leading IC personnel were asked to act as hospital contact points. Hospitals were offered access to the PROHIBIT results later to benchmark their IC practices with other hospitals.

Hospital contact points received individualized web-based questionnaires (Limesurvey version 1.92), distributed the questionnaires within their hospitals, and organized data transfer to their NCPs. Completed anonymized paper forms were entered into the online database either by NCPs or the study center at Charité–University Medicine Berlin (CUB). Data plausibility was checked by the NCPs in collaboration with the study team at CUB.

A preliminary data set was created by CUB and presented at a second PROHIBIT expert meeting in April 2012. NCPs performed further plausibility analyses and sent feedback until March 2013.

A European reference data set with a maximum of 30 hospitals per country was created. In countries with more than 30 participating hospitals, 30 were selected at random for analysis by the study team at CUB.

Data were stratified according to United Nations regional groupings [14] and total health care expenditure as a share of the gross domestic product (above or below the average European expenditure) [15].

Hospital characteristics were analysed descriptively. Differences between groups were tested using the Kruskal-Wallis or Wilcoxon test for continuous variables and the Chi-square test for categorical variables. Two-sided *P*-values of less than 0.05 were considered significant. All analyses were performed using SPSS (IBM SPSS statistics, Somer, NY, USA) and SAS (SAS Institute, Cary, NC, USA).

Results

Thirty-four European countries were invited to participate in the survey, of which 24 (68%) participated with a total of 529 hospitals. Data from 309 hospitals were included in the final analysis after removing hospitals from countries where more than 30 participated in the survey (Table II).

Questions about IC organization were answered by the IC head (42%), an IC doctor (ICD) (30%), or an IC nurse (ICN) (28%). Questions about hospital management were answered most often by the CEO or a deputy (68%), or by administrative residents (11%).

Table III summarizes the characteristics of the respondent hospitals. Hospitals had a median of eight single-room beds per 100 acute care beds, with higher numbers of single rooms in northern and Western Europe.

Per 1000 beds, hospitals had a median of four ICNs and one ICD. For ICNs, data varied significantly, from 2.6 (0, 4.6) in Eastern Europe to 5.4 (2.8, 7.7) in Northern Europe. Two-thirds (66%) of the hospitals had a link-nurse system in place, with the highest numbers in Northern and Western Europe (70% and 72%, respectively).

Table IV shows that almost all hospitals had defined IC objectives, predominantly addressing hand hygiene (87%), HAI reduction (84%), and antibiotic stewardship (ABS) (66%). Surgical site infections, bloodstream infections, and infections due to Methicillin-resistant *Staphylococcus aureus* were the infection types targeted most often.

Senior management provided leadership walk rounds on the wards in about half of the hospitals.

Most hospitals (71%) did not use sanctions for repeated violations of IC practices (Figure 1).

Discussion

We analysed data on IC structure and activities from 24 countries to determine hospitals' IC organization and management at a broad European level.

Variation in the organization of IC programs was apparent. For example, the number of available ICNs differed significantly across Europe. The lower numbers for Southern Europe were in accordance with the results of an Italian survey, which found that only 62% of hospitals had qualified ICNs [16], and a Spanish survey, which found that only 17.4% hospitals had 1 ICN per 250 beds [17].

Still, overall IC staffing levels have improved slightly since the ARPAC project in 2001 (2.3 ICNs per 1000 beds) [10]. Carlet and colleagues have also reported an increase in the bed-to-practitioner ratio for ICNs [18]. Our identified rate of ICDs was similar to the ARPAC findings (0.94 ICD per 1,000 beds) but lower than in the European PPS (1.43 ICD per 1000 beds) [2].

Current staffing levels for ICNs were similar to SENIC recommendations from 30 years ago, and it is debatable whether these recommendations are still valid [4]. Expert opinion suggests that due to increased complexity and enhanced clinical responsibility, the IC-professional-per-bed rate should be 0.8 to 1 per 100 beds in acute care, and 1 per 150 to 250 beds in long-term care [19, 20].

Compared to ARPAC data (link nurses in 46% of the hospitals), the number of hospitals with a link nurse system had also increased but was still lower than Japan, for example, where 90% of teaching hospitals and 71% of non-teaching hospitals have implemented such a system [21].

As reported by the Implementation of a training strategy for Infection Control in the European Union (TRICE) project, well-defined qualifications for IC professionals are still lacking, and many European countries still do not have adopted officially recognized qualifications for ICNs or ICDs [22], possibly explaining differences in the affiliation of IC departments and the educational background of IC heads.

The median percentage of single-room beds as a proxy indicator for hospitals' isolation capacity was lower than in the European PPS, which identified a median of 9.9% single-bed

rooms [2]. Both, the European PPS and PROHIBIT showed that the number of single-bed rooms was lowest in Eastern and Southern European countries.

For the first time, hospitals' IC objectives were surveyed, showing that almost all hospitals had defined objectives; with hand hygiene being most often mentioned, followed by HAI reduction and ABS. Interestingly, ABS was significantly more often mentioned in countries with health care expenditures below the average, which raises the issue to what extent economic concerns may drive ABS.

The role of leaders in creating a positive organisational culture that helps promote good IC practice has been emphasized [9]. Leadership walk round is one example of "safety rounds", which are promoted as a patient safety strategy in hospitals [23]. They help signify senior management's commitment to IC. About half of the hospitals in our survey established such walk rounds, while hospital CEOs were represented only in a similar proportion of IC committees. This leaves room for improvement of active senior leaders' engagement on IC in European hospitals.

To date, there has been limited published data on hospital sanctions when IC practices are violated. Borg and colleagues showed that in hand hygiene promotion rewards were used more often than sanctions [24]. Sanctions may drive organisations or individuals to examine their activities but blame may be self-defeating, undermining transparency expectations that are central to an open safety culture [25].

As described by Wachter and Pronovost, the "no blame" model has been embraced by many hospitals, however, equally important is a culture of accountability [26]. Our findings confirm that hospitals in Europe are not willing to establish sanctions for transgressions in IC. To what extent this may interfere with accountability needs to be explored.

The current survey gives insight into the IC organization of European hospitals. However, there are some limitations. 1) NCPs were involved in national surveillance activities, and hospitals were likely to be selected from such networks; 2) participation was often based on hospital motivation. Thus, data may not be completely representative for all European hospitals and IC activities may have been overestimated. 3) The United Nations geographic regions are not homogeneous in terms of GDP, healthcare organisation and culture. However, by reporting data also by country and in reference to GDP we took into account for such heterogeneity.

Our findings show that there is great variance in the staffing and IC policies across Europe. Some areas of practice e.g. hand hygiene seem to receive considerably more attention than others equally important e.g. ABS. There has been some progress in strengthening the staffing of IC however staffing levels are still suboptimal according to best practice guidance. IC programs suffer from limitations in local healthcare policies, which are ubiquitous concepts in determining IC performance [9]. Strengthening of IC policies in European hospitals should be a public health priority.

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Table I Structure of the survey modules – The Prevention of Hospital Infection by Intervention and Training (PROHIBIT) survey

Questionnaire	Q1	Q2	Q3	Q4
Setting	Hospital level	ICU level	Medical ward level	Surgical ward level
Topic	Structural and organisational parameters[a]	Structural and organisational parameters[b]		
	Organisation of IC, including surveillance[a]	Training of health care workers[b]		
	Shared ownership of IC[a]	Patient safety climate[b]		
	Management IC objectives[c]	CLABSI and VAP prevention[b]	CDI and UTI prevention[b]	SSI prevention[b]
	Implementation of IC practices[a]			
	Process and outcome parameter (AHRC and primary BSI)[a]			

[a]Provided by leading IC personnel
[b]Provided by head nurse of ICU/ward
[c]Provided by hospital management/CEO

AHRC: alcohol-based hand rub consumption; BSI: bloodstream infection; CDI: *Clostridium difficile* associated infection; CLABSI: central line associated bloodstream infection; IC: infection control; ICU: intensive care unit; PROHIBIT: Prevention of Hospital Infections by Intervention and Training; SSI: surgical site infection; UTI: urinary tract infection; VAP: ventilator-associated pneumonia.

Table II: Distribution of participating hospitals and national healthcare expenditure by country – The Prevention of Hospital Infection by Intervention and Training (PROHIBIT) survey

UN geographic region	Country	Total HCE as % of GDP	Participating hospitals, n
Eastern Europe (n = 88)	Bulgaria	7.2	19
	Hungary	7.8	30
	Poland	7	9
	Slovakia	9	30
Northern Europe (n = 73)	Finland	8.9	11
	Ireland	9.2	12
	Latvia	6.8	8
	Lithuania	7	13
	Sweden	9.6	8
	United Kingdom, England	9.6	5
	United Kingdom, Scotland		3
	United Kingdom, Wales		13
Southern Europe (n = 83)	Croatia	7.8	6
	Italy	9.3	18
	Malta	8.6	1
	Portugal	10.7	27
	Slovenia	9	8
	Spain	9.6	23
Western Europe (n = 65)	Austria	11	8
	Belgium	10.5	5
	France	11.6	8
	Germany	11.6	30
	Switzerland	11.4	6
	The Netherlands	12	8
All			309

[a]Regional grouping used by the UN Statistics Department. [15]
[b]HCE as the share of the GDP. [16]

GDP: gross domestic product; HCE: health care expenditure; UN: United Nations.

366 **Table III**: Characteristics of the participating hospitals stratified by United Nation regions and healthcare expenditure – The Prevention of Hospital
367 Infection by Intervention and Training (PROHIBIT) survey

Parameter	Data available	All	Region[a]				HCE[b]	
			Eastern Europe	Northern Europe	Southern Europe	Western Europe	Low HCE	High HCE
Acute care beds, median (IQR)	305	368 (200, 763)	364 (194, 711)	322 (210, 526)	370 (197, 763)	423 (181, 683)	346 (200, 763)	395 (181, 638)
Single-room beds per 100 acute care beds[c,d]	286	8.0 (3, 18)	3.7 (2.2, 7.7)	12.7 (7.2, 20.7)	5.8 (2.0, 18.0)	13.3 (6.6, 33.3)	4.3 (2.2, 8.5)	12.9 (5.6, 32.1)
Acute care admissions, median (IQR)	305	18,389 (9761, 31,913)	16,790 (9319, 30,589)	20,092 (10,856, 36,426)	17,103 (9853, 29,444)	19,260 (8978, 31,913)	15,774 (9063, 31,156)	20,514 (9894, 32,101)
Length of stay (days)[c,] median (IQR)	300	6.0 (5, 7)	5.9 (5.0, 6.6)	4.8 (3.7, 6.5)	6.3 (5.1, 7.7)	6.5 (5.5, 7.3)	6.1 (5.0, 6.7)	6.1 (4.7, 7.3)
Bed occupation rate[c,d,e,] median (IQR)	296	75 (66, 86)	69 (61, 77)	79 (70, 90)	79 (70, 88)	77 (69, 87)	71 (63, 79)	80 (70, 88)
ICN per 1000 beds[c,d,] median (IQR)	297	4.0 (2.0, 6.0)	2.6 (0, 4.6)	5.4 (2.8, 7.7)	3.7 (2.7, 6.3)	3.6 (2.8, 6.4)	2.7 (0, 4.7)	4.7 (3.0, 7.3)
ICD per 1000 beds, median (IQR)	295	1.0 (0, 2.0)	0.7 (0, 1.7)	1.4 (0.4, 2.8)	1.7 (0, 2.4)	1.1 (0, 2.4)	0.9 (0, 2.1)	1.1 (0, 2.6)
Status of hospital								
Public	309	261	84	80	93	84	82	86
Private	309	28	9	10	3	8	15	7
Public and private	309	19	6	10	3	7	3	7
Type of hospital								
Primary care[c]	309	69	22	34	18	12	25	27
Secondary care	309	125	40	38	47	43	34	40
Tertiary care	309	105	34	27	32	40	38	28
Specialized care	309	7	2	0	3	5	2	3
University hospital[c]	309	100	32	24	36	47	22	27
IC department affiliated with								
Nursing	309	33	11	7	18	5	15	5
Infectious diseases	309	22	7	6	8	10	5	9
Microbiology	309	42	14	10	15	16	14	10

Own department	309	119	39	41	36	40	37	40
Administration[c,d]	309	62	20	31	14	19	14	30
Other[c]	309	74	24	19	18	35	23	19
IC head's educational background								
Nursing[c,d]	309	42	14	7	23	6	22	4
Medicine[c,d]	309	180	58	64	53	77	32	67
Microbiology[c]	309	29	9	6	7	8	19	8
Epidemiology[c,d]	309	23	7	16	8	4	0	14
Epidemiology and nursing	309	5	2	1	1	4	0	1
Epidemiology and medicine[c]	309	34	11	14	1	19	6	10
Epidemiology and microbiology	309	10	3	3	0	6	3	2
IC team has direct access to microbiology data [c,d]	309	187	61	45	67	61	72	50
Hospital has an IC committee[c,d]	308	279	91	94	74	99	94	86
Members of the IC committee								
Administrative director/CEO and/or deputy[c]	279	120	43	39	57	23	64	37
Medical director[c]	279	181	65	71	60	51	79	69
Nursing director[c,d]	279	198	71	83	70	50	82	78
ICD and/or ICN[c,d]	279	268	96	92	94	99	100	90
ICD[c]	279	234	84	88	79	95	67	88
ICN[c,d]	279	230	82	54	91	94	98	62
Microbiologist[c]	279	225	81	76	87	95	62	77
Pharmacist[c,d]	279	194	70	65	68	83	59	57
Link-nurse system established	309	204	66	65	70	59	72	64

CEO: chief executive officer; GDP: gross domestic product; HCE: health care expenditure; IC: infection control; ICN: infection control nurse; ICD: infection control doctor; IQR: interquartile range; PROHIBIT: Prevention of Hospital Infections by Intervention and Training; UN: United Nations.

Values in the table are percentages unless otherwise indicated.

[a]Geographic regions according to UN grouping [15]; Eastern Europe (n = 88), Northern Europe (n = 73), Southern Europe (n = 83), Western Europe (n = 65).

[b]Low/high HCE defined as the share of the GDP ≤/> the European mean in 2010 (9%) [16]; low HCE (n = 135), high HCE (n = 174).

[c]Differences between UN regions $P < 0.05$ (Kruskal-Wallis test or Chi-square).
[d]Differences between low/high HCE $P < 0.05$ (Wilcoxon test or Chi-square).
[e]Number of patient days per 100 bed days.

Table IV: Infection control objectives of the participating hospitals stratified by United Nation regions and healthcare expenditure – The Prevention of Hospital Infection by Intervention and Training (PROHIBIT) survey

Parameter	Data available	All		Region[a]				HCE[b]	
				Eastern Europe	Northern Europe	Southern Europe	Western Europe	Low HCE	High HCE
		N	%	%	%	%	%	%	%
IC objectives defined in 2010									
• Hospital-wide	275	244	89	93	90	90	80	89	88
• In specific units	275	19	7	4	3	10	11	5	8
• No objectives defined	275	12	4	4	7	0	9	6	3
Objectives defined									
• Improvement of hand hygiene	275	239	87	82	92	91	83	83	90
• Increase of AHRC[c]	275	139	51	48	39	65	46	49	52
• ABS[c,d]	275	181	66	87	81	54	33	82	53
If ABS, reasons									
i) ABS is part of surveillance[c]	181	139	77	70	94	69	78	72	83
ii) ABS is part of mandatory surveillance	181	63	16	33	38	31	44	33	37
iii) High MDRO rates	181	29	35	19	4	24	17	19	12
iv) Own initiative[c]	181	65	36	37	21	50	39	37	34
• Reduction of infection rates[c]	275	230	84	87	86	90	67	85	82
○ Reduction of BSI[c]	275	180	65	73	69	68	46	65	66
If reduction of BSI, reasons									
i) BSI is part of surveillance	180	131	73	79	71	70	68	75	68
ii) BSI is part of mandatory surveillance[c,d]	180	83	46	62	51	34	24	57	38
iii) High BSI rates	180	13	7	5	2	11	12	4	10
iv) Own initiative[c]	180	47	26	23	12	40	28	25	27
○ Reduction of VAP[c,d]	275	147	53	69	49	53	35	60	48
If reduction of VAP, reasons									
i) VAP is part of surveillance	147	106	72	72	59	76	84	74	70
ii) VAP is part of mandatory surveillance	147	53	36	40	38	42	11	37	35
iii) High VAP rates	147	19	13	10	7	20	16	11	15
iv) Own initiative	147	42	29	29	14	39	26	29	28
○ Reduction of SSI[c]	275	183	67	79	66	65	50	71	63
If reduction of SSI, reasons									
i) SSI is part of surveillance	183	131	72	70	72	71	78	70	73

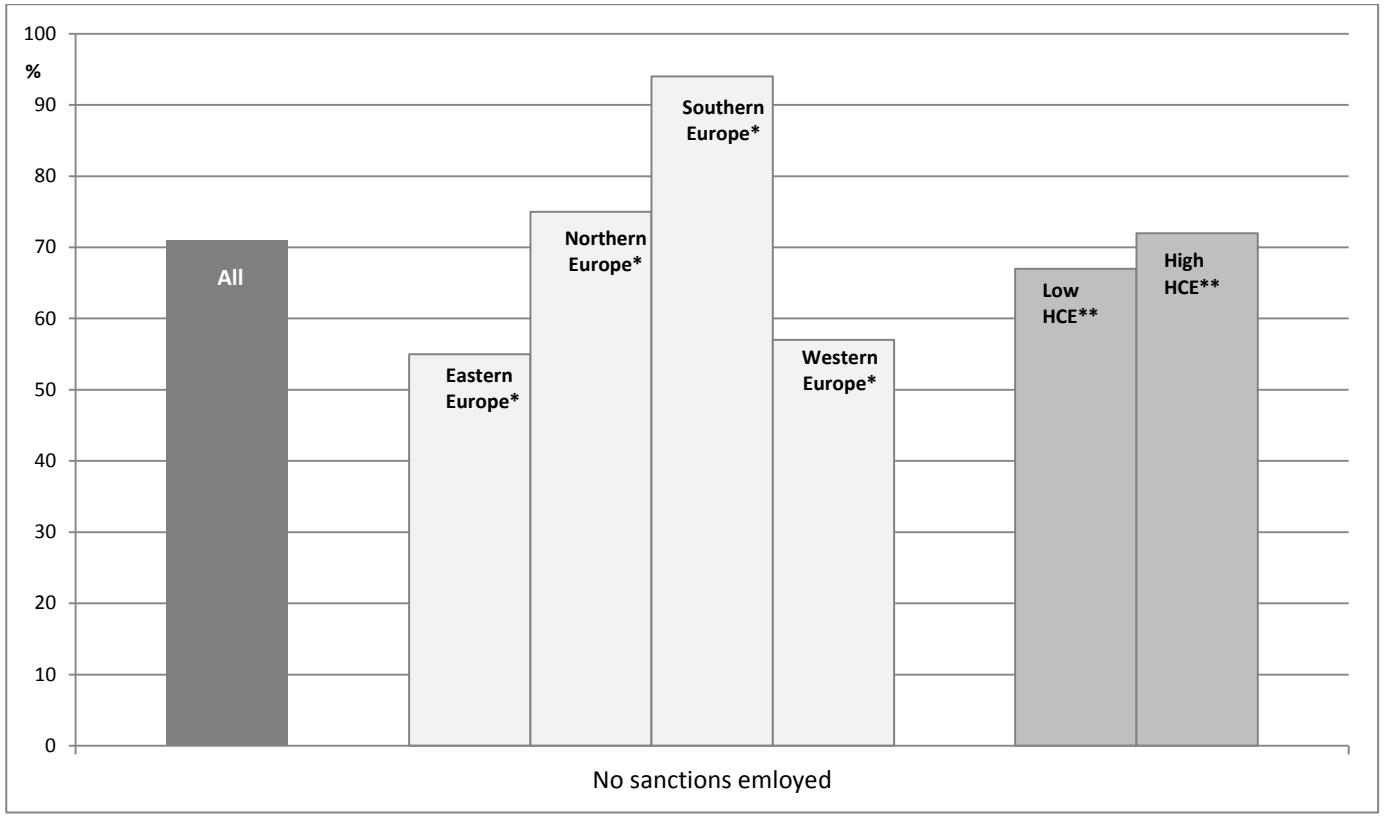
ii) SSI is part of mandatory surveillance	183	76	42	42	41	35	52	42	41
iii) High SSI rates[d]	183	22	12	6	13	22	7	7	17
iv) Own initiative[c]	183	56	31	35	15	43	19	35	28
○ Reduction of UTI[c,d]	275	133	48	69	37	45	33	60	40
If reduction of UTI, reasons									
i) UTI is part of surveillance	133	97	73	74	73	71	72	75	71
ii) UTI is part of mandatory surveillance	133	40	30	41	37	23	0	42	16
iii) High UTI rates	133	11	8	5	5	14	11	6	12
iv) Own initiative	133	45	34	31	23	43	39	32	36
○ Reduction of MRSA[c]	275	172	63	69	73	63	41	67	59
If reduction of MRSA, reasons									
i) MRSA is part of surveillance	172	128	74	72	81	73	68	79	70
ii) MRSA is part of mandatory surveillance	172	84	49	53	61	41	32	56	43
iii) High MRSA rates	172	12	7	5	5	10	9	4	10
iv) Own initiative[c]	172	43	25	22	2	45	32	17	34
○ Reduction of CDI[c]	275	121	44	39	68	35	39	39	48
If reduction of CDI, reasons									
i) CDI is part of surveillance	121	79	65	49	70	78	67	60	69
ii) CDI is part of mandatory surveillance	121	53	44	46	65	30	19	51	39
iii) High CDI rates	121	12	10	12	8	7	14	11	10
iv) Own initiative[c,d]	121	33	27	18	8	56	43	17	34
Hospital management offers walk rounds[a,c]	275	148	54	63	63	37	53	59	50
Results of walk rounds recorded in writing[d]	144	107	74	65	83	70	83	65	83

ABS: antibiotic stewardship; AHRC: alcohol-based hand rub consumption; BSI: bloodstream infection; CDI: *Clostridium difficile* associated infection; HCE: health care expenditure; IC: infection control; PROHIBIT: Prevention of Hospital Infections by Intervention and Training; MDRO: multidrug-resistant organisms; MRSA: methicillin-resistant *Staphylococcus aureus*; SSI: surgical site infection; UTI: urinary tract infection; VAP: ventilator-associated pneumonia.

In 275 (89%) of 309 hospitals participating in PROHIBIT, data were available from the hospital management on IC objectives. Values in the table are percentages unless otherwise indicated.

[a]Geographic regions according to UN grouping [15]; Eastern Europe (n = 88), Northern Europe (n = 73), Southern Europe (n = 83), Western Europe (n = 65)
[b]Low/high HCE defined as the share of the GDP ≤/> the European mean in 2010 (9%) [16]; low HCE (n = 135), high HCE (n = 174).
[c]Differences between UN regions $P<0.05$ (Chi-square).
[d]Differences between low/high HCE $P<0.05$ (Chi-square).

Figure 1 Accountability of repeated violation (sanctions) of infection control practices in participating hospitals stratified by United Nation regions and healthcare expenditure – The Prevention of Hospital Infection by Intervention and Training (PROHIBIT) survey



[Figure legend]

Figure 1

United Nation regions [15]: Eastern Europe (n = 88), Northern Europe (n = 73), Southern Europe (n = 83), Western Europe (n = 65), $P < 0.001$. Low/high healthcare expenditure (HCE) defined as the share of the gross domestic product (GDP) ≤/> the European mean in 2010 (9%) [16]: low HCE (n = 135), high HCE (n = 174), $P = 0.286$.