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Hand hygiene behavior in a tertiary university hospital: differences between surgical and nonsurgical departments

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Abstract

Background: Health care-associated infections are a major patient safety issue worldwide. Hand hygiene (HH) campaigns have started all over the world to increase awareness and decrease HH barriers. The aim of this study was to assess healthcare professionals' HH-knowledge, HH-barriers as well HH-environmental factors in general and especially in surgical and nonsurgical departments within a tertiary university hospital.

Methods: In order to achieve our primary goal, five phases were implemented: i) environmental audit, ii) baseline survey, iii) HH-campaign, iv) follow-up survey and v) alcohol-based hand rub consumption.

Results: The environmental audits showed that 443 HH-dispensers were missing. A total of 1,340 questionnaires were returned (baseline: 855; follow-up: 485). Eight HH-barriers were addressed in the baseline survey, 2 of which became significantly reduced during the HH-campaign. HH-environment improved and was followed by a significant increase in compliance with respect to the five moments for HH. Progress in the surgical departments was more evident than in nonsurgical departments. The average procurement of alcohol-based hand rub rose from 105 to 108 mL per patient day in intensive care units and from 26 to 31 mL per patient day in wards.

Conclusion: HH-motivation can be addressed with comprehensive HH-campaigns; however, positive role models are needed to attract all healthcare professionals to take part. The necessity of physicians taking part in HH-campaign is the key to the future success of HH-campaigns.

Keywords: Hand hygiene, Alcohol-based hand rub, Self-reported adherence

Introduction

Health care-associated infections (HAI) are a major patient safety issue worldwide. More than 1.4 million people around the world suffer from nosocomial infections and approximately 5 – 10% of inpatients in industrialized nations acquire one or more infections in a hospital. For Europe it is estimated that HAIs are responsible for approximately 37,000 deaths annually [1]; in the US, HAIs cause 99,000 deaths per year [2]. This major issue with respect to patient safety has led to numerous hand hygiene (HH) campaigns all over the world, as HH compliance is still estimated to

be below 50 % [3–6]. Most healthcare workers are aware of the rationale behind HH-procedures and despite the relative simplicity of HH-procedures, adherence is still unacceptable low [7–9].

Reasons for low adherence are diverse and include environmental barriers such as poor access to HH products, missing and empty dispensers, or personal barriers such as work overload, stress or simply neglecting to ensure hands are clean [10]. Reasons behind this can lie in limited knowledge of the five moments for HH, a lack of positive role models or simply a lack of interest. So far, barriers to compliance, especially with respect to physician-specific barriers, are poorly understood [11].

Results of HH campaigns with special focus on bedside hand sanitizing showed sustained improvement in compliance associated with a significant reduction in

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nosocomial infections [12]. In 2009, the University Hospital Graz, a 1,500-bed tertiary university hospital and the second largest in Austria, began implementing comprehensive patient safety tools through the systematic introduction of clinical risk management into routine hospital procedures [13]. In 2012, the Styrian Public Health Fund started the province-wide campaign “Clean Hands” based on an initiative by the World Health Organization (WHO) and guidelines of the German national HH campaign to increase healthcare professional awareness of the importance of HH through alcohol-based hand rub (ABHR). The campaign was implemented within all publicly funded hospitals in Styria and focused on wards and intensive care units. The campaign “Clean Hands” paid attention on improving healthcare professionals’ knowledge of the “My 5 Moments for HH” [14]. The main components of the campaign comprised training, distribution of posters and provision of materials encouraging patients and relatives to clean their hands [15]. Furthermore, the campaign focused on improving environmental barriers, as recent studies have confirmed that HH compliance can be affected by the accessibility of sanitizing products [16, 17].

The aim of this study was to assess healthcare professionals’ knowledge of HH-standards before and after the campaign. Secondly, environmental HH-barriers were assessed before and after the campaign. Third, to collect further tips for improvement, the barriers to compliance were analyzed. Finally, the effects of the comprehensive HH-campaign were evaluated with respect to ABHR consumption. Taking the differences between surgical and nonsurgical departments into consideration was part of a post-hoc analysis.

Methods

The University Hospital consists of 20 departments, of which 16 departments treat inpatients in 13 intensive care units with 135 beds and 58 nursing wards with 1,381 beds. Due to the size of the University Hospital Graz, the rollout of the HH campaign was carefully planned and implemented over a period of two years to best reach all healthcare professionals. Starting in 2012, 8 departments were included in the campaign (Department of: Dermatology and Venereology, Neurology, Ophthalmology, Orthopedic Surgery, Otorhinolaryngology, Pediatrics and Adolescent Medicine, Pediatrics and Adolescent Surgery, Therapeutic Radiology and Oncology). In 2013 all other departments were added (Department of: Anesthesiology and Intensive Care Medicine, Dentistry and Maxillofacial Surgery, Internal Medicine, Neurosurgery, Obstetrics and Gynecology, Surgery, Trauma Surgery, Urology).

The hand hygiene campaign was divided into following phases within each of the two parts:

Phase 1 – environmental audits

The identification of environmental barriers included the availability of HH products in patient room in wards (1 HH-dispenser for two beds) and intensive care units (1 HH-dispenser for one bed) and was audited by hygiene (nurses) experts in May 2012 and April 2013. Thereafter, missing HH-dispensers were optimally placed to best support the workflow. In November 2013 the final audit took place in order to prove, if missing HH dispensers were placed in the meantime. Each audit lasted approximately between one to two hours for a ward or intensive care unit.

Phase 2 – baseline online survey

At baseline, before starting the HH campaign, an online survey assessing subjective HH-environment, HH-barriers and HH-knowledge with respect to the “My 5 Moments for HH” from WHO was conducted. The survey was financed by the Styrian Public Health Fund and was performed by a third party (HEALTH – Institute for Biomedicine and Health Sciences, Joanneum Research Forschungsgesellschaft mbH, Graz, Styria, Austria). The online survey was open to healthcare professionals with an email account. Questions were divided into following sections:

- assessment of the HH-environment (14 questions, see Table 1)
- Assessment of knowledge of the 5 moments for HH (5 questions, see Table 2)
- Assessment of HH-barriers (8 questions, see Table 3)

Further questions were included in the online survey that will not be part of this publication and contained following sections

- General assessment of the HH-campaign (5 questions)
- Assessment of general knowledge (22 questions)

A letter was sent out in advance informing all healthcare professionals of the HH-campaign as well as measures such as the baseline and follow-up survey. The link to the online survey was sent to all senior department managers by the HEALTH – Institute for Biomedicine and Health Sciences. Healthcare professionals were then invited by their senior managers to participate in the survey and informed about its aims. Additionally, they were told that all data would be stored at the HEALTH – Institute for Biomedicine and Health Sciences and that data analysis would be strictly anonymous. The online survey was open for one month and two reminders were sent to senior managers to increase

Table 1 Survey results regarding HH-environment. Differences between baseline and follow-up data were assessed by means of Pearson's Chi-Square test total cohort compared to nonsurgical and surgical departments (%)

Question	Yes	No	Don't know	no answer	p	
Do you think there are enough HH-dispensers?						
Baseline	92.2	6.3	0.5	1.1		
Follow up	92.4	7.4	0.2	-	ns	
<i>Baseline (nonsurgical)</i>	92.9	5.5	0.3	1.3		
<i>Follow up (nonsurgical)</i>	92.2	7.8	0.0	-	ns	
<i>Baseline (surgical)</i>	91.6	6.9	0.6	0.8		
<i>Follow up (surgical)</i>	92.5	7.2	0.3	-	ns	
Are there enough possibilities to clean your hands with water and soap?						
Baseline	94.2	4.6	0.2	1.1		
Follow up	94.6	4.3	1.0	-	0.03	
<i>Baseline (nonsurgical)</i>	92.6	5.5	0.5	1.3		
<i>Follow up (nonsurgical)</i>	93.4	4.8	1.8	-	ns	
<i>Baseline (surgical)</i>	95.4	3.8	0.0	0.8		
<i>Follow up (surgical)</i>	95.3	4.1	0.6	-	ns	
Are there enough HH-products available (hand creme)?						
Baseline	68.4	28.7	1.9	1.1		
Follow up	71.3	26.6	2.1	-	ns	
<i>Baseline (nonsurgical)</i>	67.5	29.8	1.3	1.3		
<i>Follow up (nonsurgical)</i>	75.4	24.0	0.6	-	ns	
<i>Baseline (surgical)</i>	69.1	27.7	2.3	0.8		
<i>Follow up (surgical)</i>	69.2	28.0	2.8	-	ns	
Is there an HH-representative in your department?						
Baseline	95.7	0.6	2.6	1.2		
Follow up	96.7	0.6	2.7	-	ns	
<i>Baseline (nonsurgical)</i>	96.3	1.3	1.1	1.3		
<i>Follow up (nonsurgical)</i>	99.4	0.0	0.6	-	ns	
<i>Baseline (surgical)</i>	95.2	0.0	3.8	1.1		
<i>Follow up (surgical)</i>	95.3	0.9	3.8	-	0.05	
How often HH-dispensers are empty?						
	never	every day	once per week	once per month	don't know	No answer
Baseline	48.8	2.9	14.9	20.6	11.8	1.1
Follow up	39.0	4.5	19.4	22.1	15.1	-
<i>Baseline (nonsurgical)</i>	46.7	2.6	15.0	21.9	12.4	1.3
<i>Follow up (nonsurgical)</i>	41.9	4.8	25.1	17.4	10.8	-
<i>Baseline (surgical)</i>	50.4	3.2	14.7	19.5	11.3	0.8
<i>Follow up (surgical)</i>	37.4	4.4	16.4	24.5	17.3	-
	never	sometimes	mostly	always	not available	No answer
Are HH-dispensers near to the bed?						
Baseline	6.9	9.9	18.9	50.5	12.5	1.2
Follow up	2.3	8.2	22.1	58.1	9.3	-
<i>Baseline (nonsurgical)</i>	5.8	10.3	20.6	51.2	10.8	1.3
<i>Follow up (nonsurgical)</i>	3.6	8.4	21.0	49.7	17.4	-
<i>Baseline (surgical)</i>	7.8	9.7	17.6	50.0	13.9	1.1
<i>Follow up (surgical)</i>	1.6	8.2	22.6	62.6	5.0	-

Table 1 Survey results regarding HH-environment. Differences between baseline and follow-up data were assessed by means of Pearson's Chi-Square test total cohort compared to nonsurgical and surgical departments (%) (*Continued*)

Are HH-dispensers in the entrance area within the patient room?							
Baseline	3.7	4.6	11.7	67.5	11.5	1.1	
Follow up	1.2	3.7	10.9	74.2	9.9	-	0.009
<i>Baseline (nonsurgical)</i>	3.7	3.2	8.4	74.4	9.0	1.3	
<i>Follow up (nonsurgical)</i>	0.6	3.0	7.8	72.5	16.2	-	0.038
<i>Baseline (surgical)</i>	3.8	5.7	14.3	62.0	13.4	0.8	
<i>Follow up (surgical)</i>	1.6	4.1	12.6	75.2	6.6	-	0.001
Are HH-dispensers anywhere else in the patient room?							
Baseline	7.3	12.9	13.3	44.4	20.9	1.2	
Follow up	6.2	10.9	18.8	49.1	15.1	-	0.001
<i>Baseline (nonsurgical)</i>	6.9	12.4	12.4	47.2	19.8	1.3	
<i>Follow up (nonsurgical)</i>	3.6	9.0	17.4	48.5	21.6	-	ns
<i>Baseline (surgical)</i>	7.6	13.2	14.1	42.2	21.8	1.1	
<i>Follow up (surgical)</i>	7.5	11.9	19.5	49.4	11.6	-	0.001
Are there HH-dispensers for employees (social room, fitting room)?							
Baseline	3.0	7.1	15.1	69.7	3.9	1.2	
Follow up	2.9	8.0	17.7	68.0	3.3	-	ns
<i>Baseline (nonsurgical)</i>	1.3	5.0	12.4	76.8	3.2	1.3	
<i>Follow up (nonsurgical)</i>	3.0	7.2	16.2	73.7	0.0	-	0.041
<i>Baseline (surgical)</i>	4.4	8.8	17.2	64.1	4.4	1.1	
<i>Follow up (surgical)</i>	2.8	8.5	18.6	65.1	5.0	-	ns
Are there HH-dispensers in the consulting room?							
Baseline	0.8	0.6	8.0	81.9	7.6	1.2	
Follow up	0.0	2.1	5.4	88.2	4.3	-	<0.001
<i>Baseline (nonsurgical)</i>	0.5	0.3	7.4	86.8	3.7	1.3	
<i>Follow up (nonsurgical)</i>	0.0	0.6	6.0	86.2	7.2	-	ns
<i>Baseline (surgical)</i>	1.1	0.8	8.4	77.9	10.7	1.1	
<i>Follow up (surgical)</i>	0.0	2.8	5.0	89.3	2.8	-	<0.001
Are there HH-dispensers in public toilets?							
Baseline	0.4	1.2	7.3	81.8	8.3	1.2	
Follow up	0.0	1.2	6.0	89.1	3.7	-	0.001
<i>Baseline (nonsurgical)</i>	0.8	0.8	8.2	85.2	3.7	1.3	
<i>Follow up (nonsurgical)</i>	0.0	0.0	4.2	94.0	1.8	-	ns
<i>Baseline (surgical)</i>	0.0	1.5	6.5	79.0	12.0	1.1	
<i>Follow up (surgical)</i>	0.0	1.9	6.9	86.5	4.7	-	0.003
Are there HH-dispensers in staff lavatory?							
Baseline	0.1	0.4	3.3	94.3	0.8	1.2	
Follow up	0.2	0.6	4.1	94.0	1.0	-	ns
<i>Baseline (nonsurgical)</i>	0.3	0.0	3.7	94.2	0.5	1.3	
<i>Follow up (nonsurgical)</i>	0.0	0.6	3.0	96.4	0.0	-	ns
<i>Baseline (surgical)</i>	0.0	0.6	2.9	94.3	1.1	1.1	
<i>Follow up (surgical)</i>	0.3	0.6	4.7	92.8	1.6	-	ns

Table 1 Survey results regarding HH-environment. Differences between baseline and follow-up data were assessed by means of Pearson's Chi-Square test total cohort compared to nonsurgical and surgical departments (%) (*Continued*)

Are there portable HH-dispensers (i.e., ward round trolley)?							
Baseline	6.5	5.7	9.8	57.9	18.8	1.2	
Follow up	1.6	2.9	10.5	69.7	15.3	-	<0.001
<i>Baseline (nonsurgical)</i>	6.1	5.8	9.2	59.4	18.2	1.3	
<i>Follow up (nonsurgical)</i>	1.8	3.0	8.4	56.9	29.9	-	0.007
<i>Baseline (surgical)</i>	6.9	5.7	10.3	56.7	19.3	1.1	
<i>Follow up (surgical)</i>	1.6	2.8	11.6	76.4	7.5	-	<0.001
Do you use pocket-sized bottles for HH?							
Baseline	64.9	2.8	1.1	1.5	28.3	1.4	
Follow up	59.0	2.3	1.4	4.3	33.0	-	0.001
<i>Baseline (nonsurgical)</i>	65.2	3.2	1.3	1.3	27.7	1.3	
<i>Follow up (nonsurgical)</i>	55.7	1.8	1.8	1.8	38.9	-	ns
<i>Baseline (surgical)</i>	64.7	2.5	0.8	1.7	28.8	1.5	
<i>Follow up (surgical)</i>	60.7	2.5	1.3	5.7	29.9	-	0.011

participation. Healthcare professionals had the option to decline participation or to withdraw from the survey at any time. Participants were also allowed to skip questions if they felt uncomfortable answering them. The online survey was approved by the Management Board of the Medical University Graz and University Hospital Graz. The HH-campaign was approved by the Medical University Graz Ethics Committee (vote-number: 27–233 ex 14/15).

Phase 3 – HH-campaign

Healthcare professionals were informed about the aim and scope of the HH campaign by hygiene experts. In each ward or intensive care unit, an introduction to the “My 5 Moments for HH” was given. Healthcare professionals were also provided face-to-face trainings by hygiene experts and were given the opportunity to use media resources (movie from Charité Berlin, Germany). Posters were strategically located in wards and intensive care units and leaflets were given to healthcare professionals and patients. All training sessions were documented. Finally, HH topics were promoted via an electronic newsletter, via the hospital newspaper and regular in-house conferences organized by the Department of Quality and Risk Management.

Phase 4 – follow up online survey

After implementing the HH campaign, a follow-up online survey was conducted using the analog procedure as described in phase 2.

Phase 5 – alcohol-based hand rub consumption

AHBR was assessed for 2011 and monitored for 2012 and 2013. Data were documented in the “National Reference Centre for the Surveillance of Nosocomial Infections”,

Germany. Results of AHBR usage were continuously reported to all executive managers of the respective departments.

Statistical analysis

Data of the online survey were collected by HEALTH – Institute for Biomedicine and Health Sciences, Joanneum Research Forschungsgesellschaft mbH, Graz, Styria, Austria. Survey data were analyzed using descriptive statistics. Differences between baseline and follow-up data were assessed by means of Pearson's Chi-Square test. All analyses were conducted using R 2.13.1.

Results

Environmental audits

Environmental baseline audits showed that 842 HH dispensers on wards and intensive care units were in place, whereas the evaluated target goal of HH dispensers which came apparent during the audits was 1,285. New HH dispensers were immediately ordered to replace missing ones. In 2013, a third audit revealed that almost all HH dispensers had been fixed, however, 60 remained missing. In case of missing HH dispensers, healthcare professionals received pocket-sized bottles.

Survey participation

General participant demographics are outlined in Table 4. Healthcare professionals (physicians: $n = 1072$; nurses: $n = 2700$; others: $n = 357$) were asked to participate in the baseline online survey and a total of 855 (20.7 %) took part in the baseline survey. The follow-up survey was answered by 485 healthcare professionals (12.0%). The return rate among physicians was low (9.4 % baseline versus 4.1% follow-up), followed by a moderate return rate for nurses (21.6 % baseline versus 11.8 % follow up) and was high for

Table 2 Survey results regarding the behavior with respect to the “My 5 Moments for HH”, total cohort compared to nonsurgical and surgical departments (%)

Question	Answers					p
	always	very often	sometimes	never	n.a.	
Do you clean your hands before patient contact?						
Baseline	63.6	27.5	6.0	0.6	2.3	
Follow up	74.4	20.6	4.5	0.4	-	<0.001
<i>Baseline (nonsurgical)</i>	63.1	27.7	6.3	0.8	2.1	
<i>Follow up (nonsurgical)</i>	71.9	23.4	4.8	0.0	-	ns
<i>Baseline (surgical)</i>	64.1	27.3	5.7	0.4	2.5	
<i>Follow up (surgical)</i>	75.8	19.2	4.4	0.6	-	0.001
Do you clean your hands before aseptic task?						
Baseline	80.6	12.2	3.4	1.5	2.3	
Follow up	85.8	9.3	2.7	2.3	-	0.003
<i>Baseline (nonsurgical)</i>	79.9	12.7	3.7	1.6	2.1	
<i>Follow up (nonsurgical)</i>	82.6	13.2	4.2	0.0	-	ns
<i>Baseline (surgical)</i>	81.1	11.8	3.2	1.5	2.5	
<i>Follow up (surgical)</i>	87.4	7.2	1.9	3.5	-	0.002
Do you clean your hands after body fluid exposure risk?						
Baseline	95.3	1.9	0.2	0.2	2.3	
Follow up	97.9	1.0	0.2	0.8	-	<0.001
<i>Baseline (nonsurgical)</i>	94.2	2.9	0.5	0.3	2.1	
<i>Follow up (nonsurgical)</i>	97.6	1.8	0.6	0.0	-	ns
<i>Baseline (surgical)</i>	96.2	1.1	0.0	0.2	2.5	
<i>Follow up (surgical)</i>	98.1	0.6	0.0	1.3	-	0.008
Do you clean your hands after patient contact?						
Baseline	81.1	14.2	2.3	0.1	2.3	
Follow up	86.8	12.2	0.6	0.4	-	<0.001
<i>Baseline (nonsurgical)</i>	81.0	14.0	2.6	0.3	2.1	
<i>Follow up (nonsurgical)</i>	87.4	12.0	0.6	0.0	-	ns
<i>Baseline (surgical)</i>	81.1	14.3	2.1	0.0	2.5	
<i>Follow up (surgical)</i>	86.5	12.3	0.6	0.6	-	0.005
Do you clean your hands after contact with patient surroundings?						
Baseline	36.1	35.3	23.2	3.0	2.3	
Follow up	48.9	34.0	14.6	2.5	-	<0.001
<i>Baseline (nonsurgical)</i>	36.4	35.6	23.2	2.6	2.1	
<i>Follow up (nonsurgical)</i>	47.3	34.1	16.2	2.4	-	0.044
<i>Baseline (surgical)</i>	35.9	35.1	23.1	3.4	2.5	
<i>Follow up (surgical)</i>	49.7	34.0	13.8	2.5	-	<0.001

the other group (48.2 % baseline versus 34.2% follow up), i.e., medical technical assistants.

A total of 379 employees from nonsurgical departments participated in the baseline survey, and a total of 167 employees in the follow-up survey. The distribution of respondents was as follows: Department of Internal Medicine, 179 (47.2 %) versus 20 (11.9 %), Department of Pediatrics and Adolescent Medicine, 79 (20.8 %)

versus 56 (33.5 %), Department of Neurology, 76 (20.1 %) versus 78 (46.7 %), Department of Therapeutic Radiology and Oncology, 13 (3.4 %) versus 6 (3.6 %). 8.5 % provided no information.

A total of 476 employees from surgical departments participated in the baseline survey, and a total of 318 employees in the follow-up survey. The distribution of respondents was as follows: Department of Surgery,

Table 3 Barriers not to clean their hands (%), total cohort compared to nonsurgical and surgical departments (%)

Reason	Baseline	Follow up	p
1) Not enough time	12.40	13.61	ns
nonsurgical	11.61	9.58	ns
surgical	13.03	15.72	ns
2) HH-dispenser was missing	5.38	5.15	ns
nonsurgical	5.28	3.59	ns
surgical	5.46	5.97	ns
3) HH-dispenser was not on the right place	7.95	5.77	ns
nonsurgical	6.86	4.79	ns
surgical	8.82	6.29	ns
4) HH is irritating the skin	2.22	2.27	ns
nonsurgical	2.37	3.59	ns
surgical	2.10	1.57	ns
5) Forgotten	15.32	16.08	ns
nonsurgical	15.30	16.77	ns
surgical	15.34	15.72	ns
6) I use hand gloves	27.37	17.94	<0.001
nonsurgical	27.70	20.36	ns
surgical	27.10	16.67	0.001
7) There is no reason for HH/no risk	23.39	21.24	ns
nonsurgical	24.54	23.95	ns
surgical	22.48	19.81	ns
8) Emergency case	34.04	25.57	0.002
nonsurgical	37.20	29.94	ns
surgical	31.51	23.27	0.014

179 (37.6 %) versus 53 (46.7 %), Department of Ophthalmology, 104 (21.8 %) versus 50 (16.7 %), Department of Anesthesiology and Intensive Care Medicine 33 (6.9 %) versus 48 (15.1%), Department of Pediatrics and Adolescent Surgery, 45 (9.5 %) versus 40 (12.6 %), Department of Dermatology and Venereology 22 (4.6 %) versus 2 (0.6 %), Department of Orthopedic Surgery, 34 (7.1 %) versus 26 (8.2 %), Department of Neurosurgery 22 (4.6 %) versus 15 (4.7 %), Department of Obstetrics and Gynecology 16 (3.4 %) versus 15 (4.7 %), Department of Otorhinolaryngology, 10 (2.1%) versus 39 (12.3%), Department of Urology, 9 (1.9 %) versus 14 (4.4 %), Department of Trauma Surgery 2 (0.4 %) versus 12 (3.8 %) and Department of Dentistry and Maxillofacial Surgery, 0 (0.0 %) versus 4 (1.3 %).

Assessment of the HH environment

Table 1 shows the perceived barriers to the HH environment and depicts significant improvements in nine out of fourteen questions. With respect to differences between nonsurgical and surgical departments, environmental progress seems to be higher within surgical departments than within nonsurgical ones (Table 1).

Assessment of knowledge with respect to the "My 5 Moments for HH"

The overall self-reported rate of adherence to the "My 5 Moments for HH" after the campaign showed significant improvements (Table 2). With respect to differences between nonsurgical and surgical departments, HH adherence seemed to improve more often within surgical departments than within nonsurgical ones.

Assessment of HH barriers

Healthcare professionals ranked 8 HH barriers. The overall self-reported rate of barriers to hand cleaning

Table 4 Participation of healthcare professionals for the baseline and follow-up online survey

	Baseline			Follow up		
	Total	nonsurgical	surgical	Total	nonsurgical	surgical
Participants (n)	855 (100%)	379 (44.3%)	476 (55.7%)	485 (100%)	167 (34.4%)	318 (65.6%)
Physician	101 (11.8%)	23 (6.1%)	78 (16.4%)	44 (9.1%)	6 (3.6%)	38 (11.9%)
Nurses	582 (68.1%)	279 (73.6%)	303 (63.7%)	319 (65.8%)	119 (71.3%)	200 (62.9%)
Others	172 (20.1%)	77 (20.3%)	95 (19.9%)	122 (25.1%)	42 (25.1%)	80 (25.2%)
Female	724 (84.7%)	314 (82.8%)	410 (86.1%)	425 (87.6%)	153 (91.6%)	272 (85.5%)
Male	131 (15.3%)	65 (17.2%)	66 (13.9%)	60 (12.4%)	14 (8.4%)	46 (14.5%)
Employed < 1 year	47 (5.5%)	25 (6.6%)	22 (4.6%)	18 (3.7%)	6 (3.6%)	12 (3.8%)
Employed 1 to 2 years	85 (9.9%)	39 (10.3%)	46 (9.7%)	33 (6.8%)	11 (6.6%)	22 (6.9%)
Employed 3 to 5 years	98 (11.5%)	46 (12.1%)	52 (10.9%)	69 (14.2%)	28 (16.8%)	41 (12.9%)
Employed 6 to 10 years	146 (17.1%)	56 (14.8%)	90 (18.9%)	78 (16.1%)	22 (13.2%)	56 (17.6%)
Employed 11 to 20 years	201 (23.5%)	99 (26.1%)	102 (21.4%)	116 (23.9%)	51 (30.5%)	65 (20.4%)
Employed > 20 years	278 (32.5%)	114 (30.1%)	164 (34.5%)	171 (35.3%)	49 (29.3%)	122 (38.4%)

showed improvements in two of these barriers (Table 3). Significant improvement was achieved only in surgical departments.

Alcohol-based hand rub consumption

The average use of ABHR increased over time from 105 to 108 mL per patient bed day in intensive care units and from 26 to 31 mL per patient bed day in wards (Table 5), and was similar when compared to centers of reference (ns).

Discussion

HH is considered to be the most important measure to prevent nosocomial infections [5], therefore the WHO started a global campaign to ensure that infection control is acknowledged universally [14]. As suggested by Erasmus, the first step toward developing interventions should be to identify the prevalence of risk behavior, such as non-compliance [5]. Previously, multiple studies were undertaken to identify barriers [18] and within our HH campaign 8 barriers were ranked. The top five reasons for non-hand washing were: i) an emergency case, ii) the use of gloves, iii) no reason to clean the hands, iv) forgetting and finally v) not enough time. In promoting the HH campaign for three years, only two of the top five barriers improved within surgical departments. For diverse reasons, five departments were underrepresented in the online survey; however, the study provides insights into and gives tips for the necessity of senior managers at all levels to support the HH campaign in order to achieve a cultural change. Hugonnet and Perneger [19] explain that attitude towards and compliance with HH is behavioral in essence and that there is a need to enhance role modeling by superiors as prerequisite for the future success.

A plethora of strategies and interventions to best improve HH compliance have been described in the

literature, and can be summarized into six categories, i) resources, ii) staff education and training, iii) prompts or reminders, iv) monitoring and feedback, v) cultural and organizational changes and vi) campaigns [20]. We focused on all of the above-mentioned categories in order to reach our goal of addressing the necessity of HH. The first bundle within the HH-campaign in Styria and within the University Hospital Graz had been certain organizational changes. The Styrian Public Health Fund connected procedure-oriented hospital financing based on diagnosis related groups for public funded hospitals to the HH-campaign. Secondly, much emphasis was put onto improving the HH environment and new HH dispensers were added according to the results of the environmental audits. Although it was remarkable that more than 400 HH dispensers were missing within the University Hospital prior the initiation of the HH-campaign, they were optimally placed thereafter within a reasonable time. In some cases employees received pocket-sized bottles. Environmental audits were very encouraging, as the results of the follow-up audit and the survey showed overall improvements, specifically in surgical departments.

A number of factors affected compliance and were associated with differences in compliance rates between physicians and nurses [5]. The overall participation of physicians in these two surveys was very low, good for nurses and very high for others. The analysis of the survey ensured that the results did not distinguish between professional groups. It is well known that physicians respond less often to surveys and seem to assign less importance to HH in general [21]. However, we believe that in order to attain some type of safety culture, we have to evoke positive rather than negative associations with HH.

The Joint Commission, which expected hospitals to achieve >90 % compliance, found that many hospitals

Table 5 Alcohol-based hand rub consumption over three years (baseline: 2011; follow up period 2012 and 2013) in intensive care units¹ and wards of the University Hospital Graz¹ compared with reference centers² in Germany, Switzerland and Austria

	Patient days (PD)	Yearly consumption Of HH in L	Consumption HH in ml/PD	Mean number of HH/PD ¹	Reference centers consumption					Mean number HH/PD ²	
					Mean	*P10	P25	P50	P75		P90
Intensive Care Units											
2011	43.610	4.595	105	35	95	51	68	88	111	146	32
2012	50.024	5.043	101	34	104	57	73	95	123	159	35
2013	51.152	5.528	108	36	109	57	75	98	127	167	36
Wards											
2011	360.505	9.541	26	9	23	11	15	21	28	40	8
2012	360.866	10.186	28	9	24	12	17	22	30	43	8
2013	356.250	10.950	31	10	25	13	17	23	32	45	8

*percentile

did not achieve the goal [22]. Our study did not measure actual adherence to HH practices, however, according to the self-reported adherence which was assessed during the baseline and follow-up survey, results show improvements with respect to the knowledge to the “My 5 Moments for HH”. For indications 1 and 2 (Table 2), improvements were achieved. For indications 3 and 4, the already good results improved, too. This can be explained as practices that reflect a ritualized behavior mainly for self-protection against infection [8, 21]. For indication 5, a remarkable improvement was achieved; however, the need to clean hands after coming into contact with surfaces in the patient area in general was very low both before and after the campaign. Still, we have to work on increasing acceptance and further enhancing knowledge of the five moments for HH.

Using direct observation to assess HH compliance is considered to be the norm when measuring compliance and is the gold standard [5, 6, 22]; however, it remains unclear how valid the method is as an indicator of adherence to HH guidelines [5]. Apart from direct observation, ABHR-consumption is a further indicator of HH compliance [5]. Therefore, accessibility of HH dispensers was a prerequisite to improve in HH. ABHR-consumption per patient-day slightly increased in wards and intensive care units over the recent years. We assume that this is not only linked to improved HH infrastructure, it shows that staff education and training throughout the campaign was good.

Overall, the study highlighted the need to improve participation of all healthcare professionals in the campaign; generally physicians and especially within this professional group, physicians working in nonsurgical departments were underrepresented in the survey. The majority of healthcare professionals have long and valuable experience, but at the individual level, strengthening a positive attitude towards hand hygiene is needed [7].

The HH-campaign and the survey have several limitations. There was no control group despite having compared behavior before and after the campaign. Another limitation of the current study was the poor response rate to the survey. Poor participation was probably influenced by conducting other surveys within a short period of time. Additionally, the response rate was probably linked to the fact that the survey was sent out by senior managers of corresponding departments. Some might have neglected to send out the email to their employees or some might have just sent out the link to some but not all employees within a department. Another reason for the poor response rate could have been the peculiar fact that 25–50 % of all employees within our hospital had not yet activated their email account, which was discovered after another survey was performed [23]. Finally, the study lacks information on whether training was

inadequate and therefore might have influenced outcome measures.

Conclusion

HH motivation can be addressed with comprehensive HH campaigns; however, positive role models are needed to attract all healthcare professionals to participate. Self-protection is the strongest predictor and increased within our campaign. An improved HH environment supported the use of ABHR and consumption per patient-day slightly increased over time. Still, there is much to learn about the behavior of healthcare professionals with respect to HH barriers in order to improve in the near future.

Competing interests

The authors have no competing interests.

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