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RESEARCH ARTICLE

Action research on promoting hand hygiene practices in an intensive care unit

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Abstract

Aim: Evaluate the intensive care acquired infections incidence and the change over time in infection practices in one intensive care unit.

Design: We used an action research approach with cyclical activities.

Methods: Our study included two cycles with hand hygiene observation based on the WHO's five-moments observation tool, observing hand hygiene practices, analysing the observations, and giving feedback on observations, intensive care acquired infection rates, and alcohol-based hand rub consumption. The Revised Standards for Quality Improvement Reporting Excellence is the basis for this research report describing research aimed at improving patient safety and quality of care.

Results: During the study, annual alcohol-based hand rub consumption increased by 6.7 litres per 1000 patient days and observed hand hygiene compliance improved. In the first cycle of the study, there was a decrease in critical care acquired infection rates, but the improvement was not sustainable.

KEYWORDS
action research, consumption, hand hygiene, hand rub, healthcare-associated infection, intensive care

1 | INTRODUCTION

Healthcare–associated infections (HAIs) represent the most frequent iatrogenic adverse events affecting patients. In a European prevalence study, 19.2% of patients in intensive care units (ICUs) had at least one HAI (Suetens et al., 2018). The incidence of HAIs among ICU patients in Finland was 31.4 infections per 1000 patient days (Terho et al., 2018). Practices in accordance with infection-prevention guidelines have reduced HAI rates, but infection-prevention practices, especially the maintenance of hand hygiene (HH), have been suboptimal (Sax et al., 2013). Infection prevention is fundamental for patient safety. In our study, we investigated the association between feedback for HH performance and annual alcohol-based hand rub consumption and HAI rates.

2 | BACKGROUND

Patients acquire HAIs in healthcare facilities, or healthcare interventions can cause the infection (Suetens et al., 2007). HAIs are common in the ICU setting (ECDC, 2019; Kollef et al., 2021). In addition to serious illness, various devices increase the infection risk of ICU patients. In European ICUs patients treated for more than 2 days, 6.3% get at least one pneumonia, 3.7% get a blood culture-positive infection and 2% get a urinary tract infection (ECDC, 2019).

Approximately 20%–70% of HAIs are preventable, especially in ICUs (Lambert et al., 2014; Umscheid et al., 2011). According to systematic reviews and expert opinions, HAI prevention consists of several elements, including how infection control is organized in the organization and how the unit is involved in infection control (Zingg et al., 2015).

Hand hygiene is the most important single means of preventing HAIs in many cases (WHO, 2009) and in preventing the spread of multi-resistant microbes (Popovich et al., 2021). Although not the most important means of prevention, HH played an important role in the COVID-19 pandemic outbreak, for which even asymptomatic persons could spread transmission (Ran et al., 2020). The transmission of microbes through the air, direct patient contact and surfaces underlines the importance of HH in the ICU (Guo et al., 2020; Razzini et al., 2020). Compliance with infection control measures such as HH is crucial for preventing outbreaks in intensive care (Al-Dorzi & Arabi, 2017).

In a recent study of six Italian ICUs, the observed HH compliance among nurses and physicians in various situations was 28%–95.5% (Musu et al., 2017). A large observational study in European ICUs found that profession, ICU type, and HH indication impacted the variation in HH compliance (Hoffmann et al., 2020; Musu et al., 2017). Furthermore, HH was performed more often after patient contact than before the aseptic procedures or before patient contact. High glove use may alter the use of alcohol-based hand rubs (Musu et al., 2017; Woodard et al., 2019).

The observation of HH performance and HAI surveillance with timely feedback data is the main component by which to guide infection prevention interventions (Storr et al., 2017). Strategies that have improved HH compliance include increasing the availability of ABHR, staff education, reminders, performance feedback, administrative support and staff involvement (Gould, Moralejo, et al., 2017). The multimodal and multidisciplinary prevention programmes that include behavioural change, champion engagement and positive organizational culture have been impressive (Zingg et al., 2015). Although several studies have researched improving HH and infection prevention, it is still unclear which methods are the most effective (Gould, Moralejo, et al., 2017). The Doronina et al.'s study (2017) found that a single practice could improve adherence to hand hygiene, but the changes were not permanent.

Hand hygiene observation is the gold standard for evaluating HH performance. Besides other approaches to improve HH practices among healthcare professionals, the World Health Organization (WHO) announced an HH observation tool for infection control and prevention. (WHO, 2009). The WHO's five-moments protocol, HH observations and performance feedback have improved HH compliance (Luangasanatip et al., 2015; Storr et al., 2017). HH observation is time-consuming, and the Hawthorne effect of nurses' awareness that they are being observed can alter their performance (Gould, Creedon, et al., 2017).

In addition to HH observation, alcohol-based hand rub (ABHR) consumption is one means to assess HH practices. In one study, ABHR consumption correlated with observed HH in a long-term follow-up study (Haubitz et al., 2016). In one study, consumption of ABHR was shown to be associated with a reduction in HAIs (Aldeyab et al., 2014).

To summarize, HAIs pose a risk to patient safety, especially in intensive care, and reduce the quality of care. HH performance feedback has been shown to decrease the frequency of HAIs. Observation studies have been used to detect HH compliance and use of HH products. The starting point for this study was the need to improve HH practices in one ICU and to implement evidence-based HH procedures as part of the usual work practices. The Revised Standards for Quality Improvement Reporting Excellence is the basis for this research report describing research aimed at improving patient safety and quality of care (Ogrinc et al., 2015).

2.1 | Research questions

The aim of this study was to evaluate the HAI incidence and the change over time of infection practices in one ICU. What is the annual ABHR consumption during the intervention cycles and how does it change over time? What is the frequency of ICU-HAI's during the intervention cycles? What are the HH practices of the unit at two observation periods and how do the practices change over time? Are the HH practices and ABHR consumption associated with the ICU-HAI's?

3 | THE STUDY

3.1 | Design

We used an action-research approach with cyclical activities, including observation of HH practices which according to Bruchez et al. (2020) was seen as an intervention. The cyclical activities included analysing and giving feedback on observations, ICU-HAI rates, and ABHR consumption as well as planning new observation of HH and aseptic practices and in turn implementing those plans (Hegney & Francis, 2015). Figure 1 shows the research design. We observed that ward personnel shared our aim to improve infection control, patient safety and quality of care in the ICU (Battistella et al., 2017; Holter & Schwartz-Barcott, 1993).

The studied ICU contained many infection prevention elements such as feedback of ICU-HAI rates and ABHR consumption and nominated link nurses (Figure 1). However, baseline ABHR consumption reached only 39% of the WHO's recommended threshold (WHO, 2009). Moreover, based on the annual surveillance system analysis, the ICU-HAI (i.e., healthcare-acquired infections originating from intensive care) rates remained stable, with no improvement for several years in a row. The annual feedback of ICU-HAI rates and ABHR was not enough to improve the results, thus necessitating the present research.

We evaluated the outcomes by examining ICU-HAI rates and ABHR consumption surveillance and feedback (Casey et al., 2021) in one ICU for 4 years by observing the annual ICU-HAI rates and ABHR consumption. In addition, we added descriptive information about the HH observations, such as glove use and HH compliance in different HH indications, to obtain additional information about these practices.

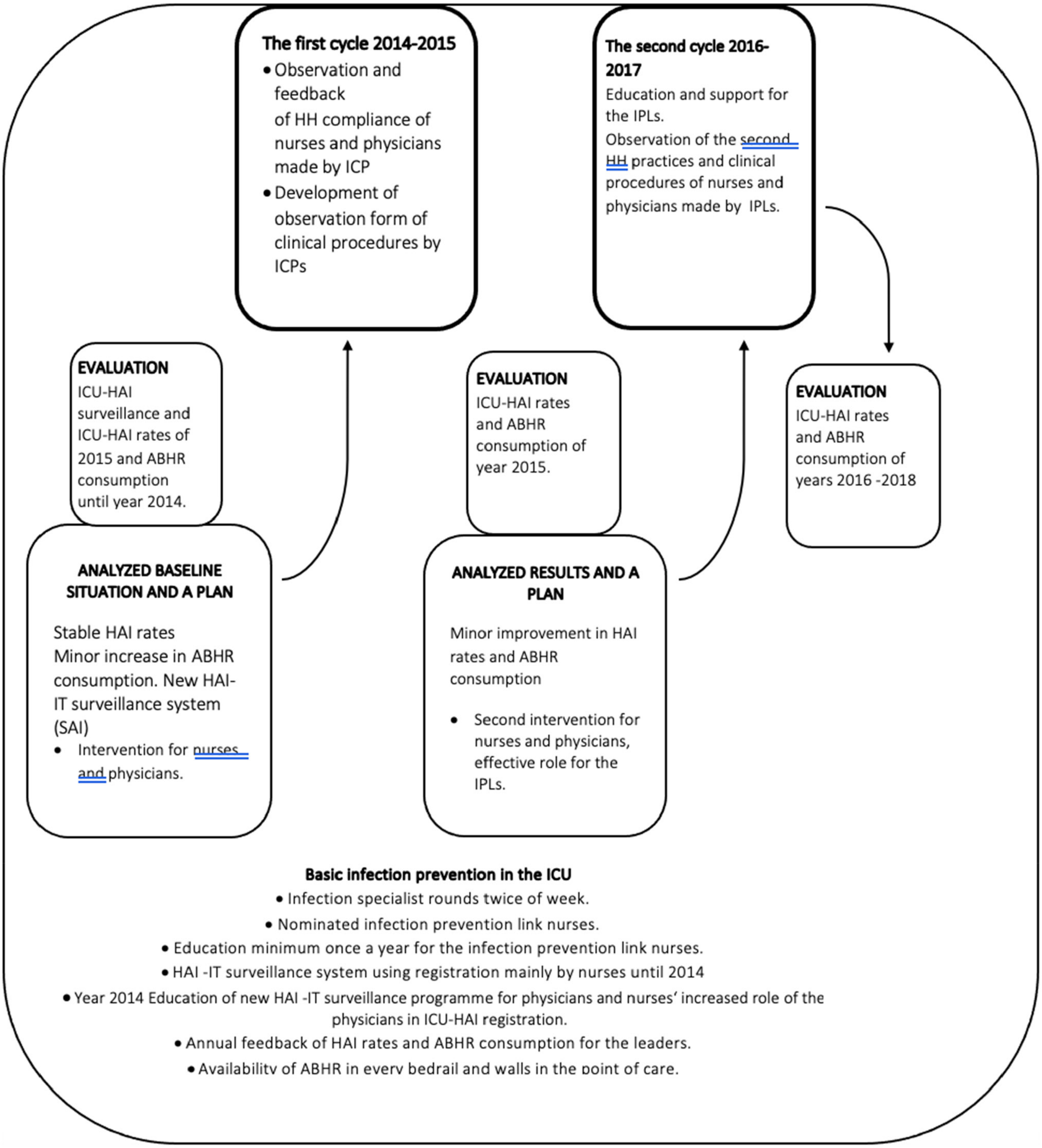


FIGURE 1 The cycle on the action research. ABHR, alcohol-based hand rub; HH, hand hygiene; ICP, infection control preventionist; ICU, intensive care; ICU-HAI, intensive care–related infection; IPL, infection prevention link nurse; SAI, antibiotic prescription-based health care–acquired infection-surveillance system.

3.2 | Method

3.2.1 | Sample

The study included one adult ICU that was observed from 2015 to 2018. The targets for the interventions and observations were the practices of all nurses and physicians.

3.2.2 | Setting

We conducted the study in a mixed medical–surgical ICU with 24 beds in a tertiary care university hospital in Finland. The study site was a closed-model ICU managed by a full-time intensivist. The selected ICU cares for an average of 1800 patients annually, and the annual patient day average was 5806. The mean treatment period was 3.3 days. The unit had 146 Registered Nurses and 10 physicians, and the average annual nurse-to-patient ratio was 1:1.

HH with ABHR is the general practice in Finland. The selected ICU has given ABHR in wall- and bed-mounted dispensers at the point of care for many years. The annual average consumption of ABHR was 155 L per 1000 PDs during 2013–2014 before our study. Through the local observation results, the defined target level was 400 L per 1000 PDs, which was in the WHO's target levels.

The action research cycles in the ICU.

Our study included two cycles. Both cycles included a hand hygiene observation based on the WHO's five-moments observation tool. According to WHO, an HH opportunity occurs when HH is necessary. HH action must correspond to each opportunity (WHO, 2009).

The observers in the first cycle were infection control preventionists (ICPs). Infection control preventionists are healthcare workers who work in infection control and patient safety. An infection control preventionist does not give direct patient care and is not tied to a specific care unit. In the first cycle, information about the observations was offered to the ICU staff, but they had no input in observation process. After observation process, in the first cycle, the feedback on the HH compliance rate was given by the ICPs to the whole staff.

In the second cycle, infection control link nurses made the observations. Infection prevention link nurses (IPLs) are nurses who are based in the ICUs and in addition to their own work, they are responsible for improving infection control in their wards. One task of theirs is observation of HH practices. Their work is supported by infection control professionals through training and meetings. In the second cycle, the whole staff including IPLs were given information about the study. The IPLs conducted the observations of the study in cycle two (Cordeiro & Soares, 2018).

The first cycle started with ICPs informing the unit leadership and infection prevention link nurses (IPLs) about an upcoming HH observation period that would be conducted by the ICPs.

Before the observations, the ICPs gave information about the observations to the ICU staff, but the staff had no input in the observation process. The information was given orally in the unit meetings. The same information was also e-mailed to all nurses and physicians before the HH observation period.

In the first cycle, we used a technical approach to action research where the ICPs controlled the observations, feedback and information. The observations took place in 2015. The aim was to observe all nurses and physicians in their normal work. ICPs informed about the observation at every shift and asked for observation consent. ICPs gave no feedback during the immediate observation period (as recommended by the WHO, 2009). Data were collected anonymously during the observations.

In the first cycle after the observation period, the ICPs and the unit's leadership and IPLs evaluated the results. The results were reported on profession level and not on an individual level. ICPs gave feedback on the observations to nurses and physicians in a unit-based training, both verbally and in writing. Feedback consisted of general HH compliance and compliance during different HH opportunities according to indication and type of profession.

In the second cycle, we used an emancipatory approach to action research where the IPL's took responsibility for doing the observations and giving the information.

Since HH compliance was poor in the first cycle, especially before the aseptic procedures, the ICPs developed an observation form to support the observations by the IPLs. IPLs observed the aseptic performance in the unit in detail using this form.

The ICPs trained the IPLs on the research protocol for observing HH with our support. Teaching occurred in meetings via discussions and written and audio-visual materials. Then, ICPs and IPLs conducted 70 observations together to standardize the protocol. The ICPs and IPLs compared the observation results and discussed possible problems. To support the IPLs, the lead researcher (KT) visited the unit seven times during the observation period and was available by e-mail and phone whenever needed (Jain et al., 2015). IPLs conducted the observations when opportunities for HH occurred and IPLs were available during the shifts.

In addition to these two observation periods, ICPs gave annual feedback on ABHR consumption and ICU-HAI rates to all staff throughout the study period continuously.

3.3 | Data collection

The primary variables of the study were the ICU-HAI rates, ABHR consumption and their possible associations with observed HH practices. Annual evaluation of the ICU-HAI rates and ABHR consumption was an ongoing process (Hegney & Francis, 2015).

The secondary assessments were the detailed maintenance of HH. We set the target to 500 HH opportunities in both cycles. Due to the large staff, we decided on a higher target than the 200 HH situations set by the WHO (2009).

We collected data on ICU patient characteristics such as APACHE II values and the number of central line, urinary catheter and intubation days patients had to confirm whether the ICU patient population had changed over the course of the study.

We tracked ABHR consumption through ICU inventory recorded by the pharmacy dispensary. During the study, we analysed annual ABHR consumption by PDs. We identified HAI cases through the Hospital Antibiotic and Infection Monitoring System (SAI) (Neotide, Finland), an antibiotic prescription-based case-finding HAI surveillance system. We modified the definitions of HAIs in accordance with the European Centre for Disease Prevention and Control's (ECDC) definitions. ICU physicians and nurses registered patient cases, which an ICP analysed individually. Furthermore, we considered infections beginning 48 hr after arrival in the ICU to be ICU-HAI cases (ECDC, 2019).

During the 4-year study, we evaluated the ICU-HAI rates, including the rates of ICU-related pneumonia, ICU-related bloodstream infection and ICU-related urinary catheter infection. Because the frequency of bacterial patient samples influences the detection of HAIs (Karch et al., 2015), we also examined the bacterial sample rate between 2015 and –2018.

3.4 | Analysis

We analysed the incidence density of ICU-HAIs as a rate of all ICU-HAIs and device-associated infections to PDs and at-risk days. Risk days are days when the relevant device was used, such as a central line, indwelling catheter or the patient was on a respirator (ECDC, 2019). We analysed nurse and physician observations and any indication for HH as a proportion of all HH opportunities. From the data describing the patient population, we calculated the mean and ranges.

We used SAS® version 9.4 and R version 4.0.2 for the statistical analysis. We used descriptive statistics to present data characteristics. We used estimates and *p*-value of differences of two percentages of detailed results of HH compliance in two HH observations. To estimate and compare yearly means of rates in Tables 2 and 3, we used Poisson regression analysis to account for non-normal count data. We performed ordinary regression analysis to estimate the yearly changes in ABHR consumption.

3.5 | Validity, reliability and rigour

One limitation was that we did not perform a power analysis before the study. However, if we would calculate a sample size for a future study, we would need 356, 60 and 31 participants (HH opportunities) per group to detect small, medium and large effects, respectively (for effect sizes, see Cohen, 1988), with a difference of 10, 25 and 35 percentage points of two proportions ($\alpha = 0.05$, $\beta = 0.8$). This is in line with the sample sizes in observation, for which the sample sizes were between 33 (subgroup HH observations after body fluid) and 504 HH observations.

3.6 | Ethics

The Ethics Committee of the University (diary number redacted) approved the study's ethics, and the authorities of the Hospital (diary number redacted) granted the research permission.

4 | RESULTS

We surveyed 8785 patient records with 22,872 PDs. For 2015–2018, the PD mean was 5718 (range 5587–5818), and the mean amount of annually treated patients was 1757 (range 1735–1837). The average hospital stay was 3.3 days. The annual mean of APACHE II was 17.7–18.7. The annual mean of CVC days was 5232.5 (range 5034–5473) and 4579.5 urethral catheter days (range 4257–4821), and the mean intubation days was 2379.5 (range 2251–2448).

In the first cycle, the ICPs observed 504 HH opportunities. HH observations were made from 6th November 2014 to 10th March 2015 between 7 AM and 3 PM. A total of 866 min (14 h 26 min) were observed, with the range of 1–24 min per observation session, averaging 26 min.

In the first cycle, the HH compliance was 59.6 in HH observations. The incidence of ICU-HAIs was 16.53 per 1000 PDs in the year 2015. ABHR consumption was 168 in 2015.

In the second cycle, IPLs observed 589 HH opportunities. HH observations were made between 1 March and 30 September 2016 and in the morning and evening shifts the between 8.00 AM and 9.00 PM. A total of 1276 min (21 h 16 min) were observed, with the range of 1–53 min per observation session, averaging 22 min.

In the second cycle, HH compliance was 68.3 in HH observations. The incidence of ICU-HAIs was 13.27 per 1000 PDs in the year 2016 and 14.36 per 1000 PDs in the year 2017. After the second cycle, the ICU-HAI rate was 16.34 in the year 2018. ABHR consumption was 185 in 2016, 180 in 2017 and 187 in 2018.

Table 1 shows detailed information about the HH results. The overall HH compliance was 59.5%, and HH compliance before aseptic procedures was 41.2%. The HH compliance was 8.7% higher in the second cycle than in the first cycle. The HH compliance increased primarily before touching the patient, but the improvement before an aseptic procedure was also high. The HH compliance with gloves was lower than it was without gloves in both cycles. The implementation of hand hygiene when using gloves improved statistically significantly in the second observation.

TABLE 1 Detailed results of HH compliance in HH observations.

	First observation (%)	Second observation (%)	Difference (*p*-value)
Overall HH compliance	300/504 (59.6)	402/589 (68.3)	+8.7% (0.0027*)
Before patient touch	48/121 (39.7)	193/274 (70.4)	+30.7% (<0.0001*)
Before aseptic procedure	54/131 (41.2)	38/63 (60.3)	+19.1% (<0.0001*)
After body fluids	21/33 (63.4)	67/101 (66.3)	+2.9% (0.78)
After patient touch	135/165 (81.8)	218/282 (77.3)	−4.5% (0.26)
After patient surroundings	42/54 (77.8)	29/43 (67.4)	−10.4% (0.25)
HH compliance with gloves	79/172 (46.0)	160/258 (60.0)	+14.0% (<0.01*)

Abbreviation: HH, hand hygiene.

*$p < 0.05$, Statistically significant.

During the research between 2015 and 2018 the annual mean ABHR consumption per 1000 PDs was 178.8 L, and the consumption increased from 2015 when the action research started to year 2018 after the action research. The mean yearly increase was 6.7 L per 1000 PDs ($p > 0.05$).

The overall ICU-HAI rates trended downwards from 2015 to 2017, (Figure 2 and Table 2), but this result was not statistically significant. The largest decrease was in ICU -related blood stream infections (BSIs), where the statistically significant decrease occurred between 2015 and 2016. The rates continued to decrease between 2016 and 2017, but this decrease was not statistically significant. The range number of blood stream infections was between two and five; pneumonia cases ranged from 54 to 70; and urethral tract infections ranged from one to four (Figure 3 and Table 3).

5 | DISCUSSION

At baseline in the research ICU, the ABHR consumption was already at a high level. After the first observations began (2015), the mean ABHR consumption was 178.8 ml/PD compared to the European average of 66 ml/PD (IQR 33–103 ml/PD) at the ICU level (Hansen et al., 2015). In the cycle one of our study, a year after the observations started and feedback was given, the ABHR increased statistically significant. The ABHR consumption remained still high in the second observation cycle and the model for ABHR trends were statistically significant. It has been shown that the ABHR availability at the point of care could influence the nurses' use of ABHR (Hansen et al., 2015; Lambe et al., 2021). Therefore, one reason for the high level of ABHR consumption in our study could be that, in this ICU, the hospital had positioned ABHR dispensers close to the patients many years prior to the study period.

In the first cycle, the rate of ICU-HAIs decreased. The decrease in ICU-HAIs was not statistically significant, but the overall numbers were so small that it is perhaps still reasonable to think that the fall was significant in practice. Although the observations continued and feedback on annual ABHR consumption and ICU-HAIs was given in a same manner, this positive trend did not continue in the second cycle.

The ICU-HAI level in our study was quite like the level found in Bouzbid et al.'s (2011) study, in which they evaluated different automated systems of HAI surveillance in ICUs. However, our intervention had only a slight effect on the infection rates, but ICU-HAI trended downwards between after first cycle started until the year 2018. It seems that initiating our study influenced the ICU-BSI rates, but this positive trend did not continue in the second cycle. The improvement could be due to the influence of HH improvement, but according to a German study (Karch et al., 2015), a rate lower than 100 blood cultures/1000 PD impairs detection of the BSIs in ICUs.

According to a systematic review, the HH compliance in high-income countries averages 64.5% (Lambe et al., 2019), which is comparable to our study and the increase in HH compliance was statistically significant in the second observation cycle. The compliance was better after touching the patient or after touching body fluids

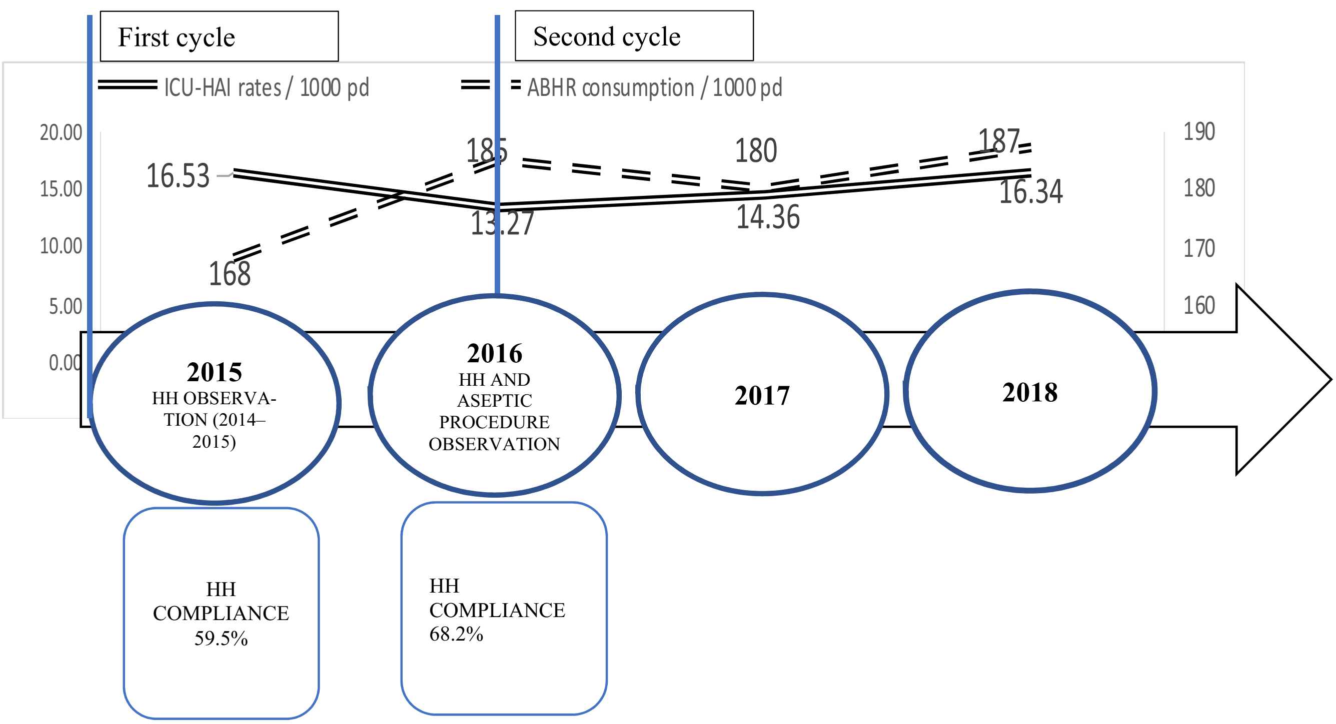


FIGURE 2 The rate of ICU-HAIs/1000 PDs, ABHR Consumption and Hand Hygiene Compliance. *Note*. ICU-HAI (the intensive-care-related infection) rates are given as ICU-HAIs/1000 patient days (PDs) and ABHR (alcohol-based handrub) consumption is given as ABHR consumption/1000 PDs. The Rates of ABHR consumption/1000 patient days (PDs) and ICU-HAIs/1000 PDs. The difference of % of HH Compliance was statistically significant (chi square $p < 0.05$).

than it was before touching the patient or before an aseptic procedure as has been noted in previous studies (Chang et al., 2021; Sastry et al., 2017; Wetzker et al., 2016). Nevertheless, in the latter observation, we found good improvement especially in HH before patient contact or aseptic procedures which reached almost the same level as HH after the patient contact. This increases patient safety. In our study, HH when using non-sterile gloves impaired HH compliance during both observation periods. Previously also Woodard et al. (2019) reported the negative influence of using gloves.

TABLE 2 Difference between yearly intensive care-related infection ratio of rates and confidence intervals.

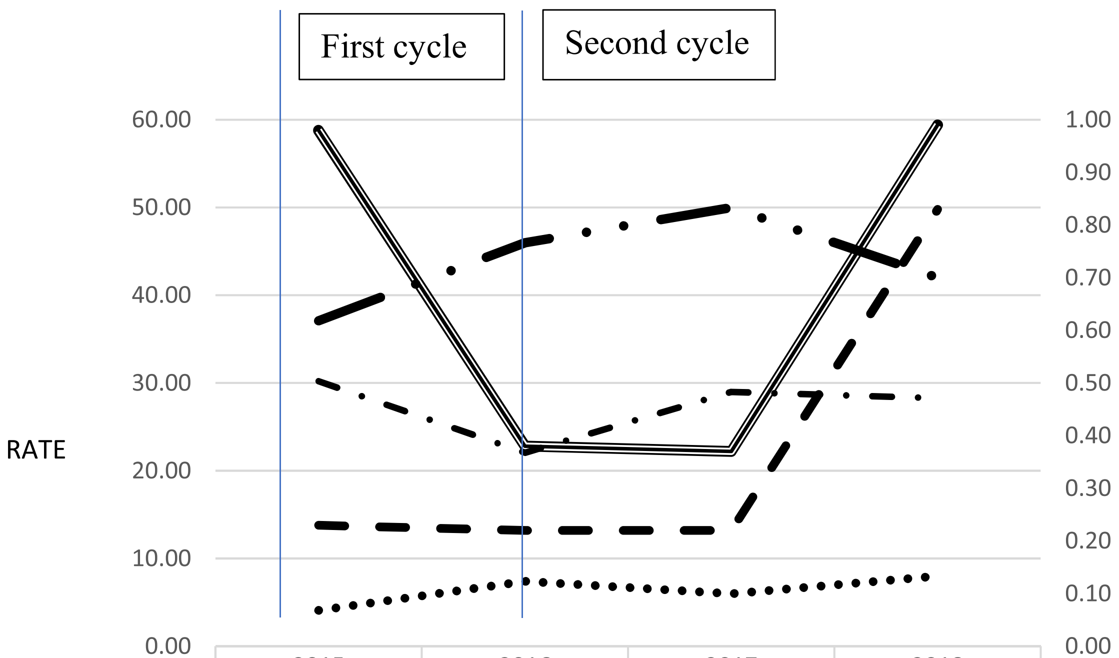
Years	Ratio of means (%; *p*)	95% CI of ratio[a]
2016 vs. 2015	0.80 (−19[b]; $p = 0.14$)	[0.60, 1.08]
2017 vs. 2016	1.08 (+8; $p = 0.61$)	[0.80, 1.47]
2018 vs. 2017	1.14 (+14; $p = 0.38$)	[0.85, 1.52]

[a]The confidence intervals were constructed based on a Poisson distribution assumption.

[b]The proportion decreased when negative.

The annual performance feedback and observations did not impact the ABHR consumption rates or the HH performance as much as expected. Possibly, our approach to action research did not give enough opportunity for participation (Cordeiro & Soares, 2018). According to a review, researchers have conducted only a few action research studies in ICUs, and the majority of these have not focused on the practices or improvement of clinical outcomes (Soh et al., 2011), which could be an important approach to improving hand hygiene (Gould et al., 2018). Also, we could identify only a very few hand hygiene studies in ICU's with an action research approach. The action research approach is rare in this context but could give support to implementation research.

The average ABHR consumption during 2016–2018 was 12.7% higher than in the first cycle observations. Storr et al. (2017) showed that feedback on ABHR consumption improved HH compliance. However, in our study, the improvement in ICU-HAI rates and ABHR consumption did not continue despite the feedback, and



	2015	2016	2017	2018
Blood cultures / 1000 PDs	37.10	46.00	50.00	42.00
Urine samples / 1000 PDs	4.10	7.40	6.00	8.00
ICU-related pneumonias / 1000 intubation days	30.21	22.06	29.00	28.27
ICU-related BSIs/CVC days	0.98	0.38	0.37	0.99
CAUTI/ 1000 urethral catheter days	0.23	0.22	0.22	0.83

YEAR

FIGURE 3 Annual rates of ICU-related BSIs, pneumonias and urinal catheter-acquired urine infections. BSI, bloodstream infection; CAUTI, urethral catheter related urine infection; CVC, central venous catheter; ICU, intensive care; PD, patient day.

TABLE 3 Yearly ratio of ICU-related bloodstream infections, pneumonias and urinal catheter-associated urine infections.

	Years	Ratio of means (%)	*p*-value	95% CI([a]) of means
ICU-BSI/1000 CVC days	2016 vs. 2015	0.56 (−44[b])	0.42	[0.13, 2.33]
	2017 vs. 2016	0.33 (−67[b])	0.34	[0.03, 3.16]
	2018 vs. 2017	5.29 (+429)	0.13	[0.61, 45.32]
ICU-pneumonia/1000 intubation days	2016 vs. 2015	0.77 (−22[b])	0.17	[0.54, 1.11]
	2017 vs. 2016	1.19 (+19)	0.32	[0.84, 1.71]
	2018 vs. 2017	0.94 (−6[b])	0.72	[0.67, 1.32]
ICU-CAUTI/1000 urethral catheter days	2016 vs. 2015	0.93 (−7[b])	0.96	[0.06, 14.81]
	2017 vs. 2016	1.02 (+2)	0.99	[0.06, 16.32]
	2018 vs. 2017	3.80 (+280)	0.23	[0.42, 34.00]

Note: The first cycle of the action research started in November 2014 and the second cycle in March 2016.

Abbreviations: BSI, bloodstream infection; CAUTI, urinal catheter-associated urine infection; CVC central venous catheter; ICU, intensive care.

[a]Confidence intervals are constructed based on a repeated measure and Poisson distribution assumption.

[b]Proportion decreased, when negative.

second cycle of HH observations. This may be due to the lack of individualized feedback, which researchers have reported as an important means of improving HH (e.g. Hoffmann et al., 2020; Lambe et al., 2020; Smiddy et al., 2019).

Measuring ABHR consumption did not give us direct information about whether the staff used ABHR at the correct time. Additionally, users could be patients' family members or other non-staff members. However, researchers have found ABHR consumption to be a good surrogate for HH compliance when it is used with other means (Haubitz et al., 2016). Magnus et al. (2015) found that using different means, such as ABHR consumption, observations and electronic machines, could improve the accuracy of HH compliance surveillance. We explored ABHR consumption already before our study started in the year 2015 for many years and with two HH observations. The trend appeared similar, but with the detailed analysis of HH performance, we saw that the timing was not always correct.

During the observation period, ICPs thoroughly trained IPLs on how to maintain good HH. The opportunity to observe HH practices could give IPLs the opportunity to feel empowered, become role models in the ICU (Jain et al., 2015), and increase their commitment to HH (Sepahvand et al., 2020). Erasmus et al. (2009) argued that a lack of positive role models and social norms might hinder HH compliance. Through strengthened competence, the IPLs could become role models for other personnel, which has proven to be an important issue in HH compliance (Lambe et al., 2021). The role of IPLs did not seem to have an influence on ABHR consumption or ICU-HAI trends. One reason could be the large number of staff.

5.1 | Limitations

Action research studies have some typical limitations. Researchers are not able to control everything that occurs in the study unit during the study period. We collected information about the events in the unit that might affect the results, but to our knowledge, there were no other major changes in the ICU that would have affected our results. It is certainly difficult to assess the impact of general awareness and the passage of time. We cannot avoid the potential influence that the new HAI surveillance system, HH observations and IPLs' education had in comparison to the given feedback.

We failed to observe the physicians' HH compliance. Previous observation studies have shown that physicians' performance impairs the observation results (Lambe et al., 2019). If the observation results had also included observations on physicians' performance of hand hygiene, it might have lowered the overall hand hygiene adherence result of our study.

One limitation, which is related to the comparison of the results between the two observations, was that ICPs made the first observations and IPLs made the second observations (Jeanes et al., 2019). We wanted to give the IPLs a participatory role in our action research. We tried to avoid limitations by giving them as much training and support as needed during the observation period. The Hawthorne effect and the unit's working and social culture may have influenced the observation results (Gould, Creedon, et al., 2017; Turnock & Gibson, 2001).

The first observations, made by the ICPs, were only made during the morning shifts. The IPLs made observations during morning and evening shifts, but not at night-time. Therefore, neither of the two observation periods gave an overall picture of the whole 24-h period.

Observations made by the ICU's personnel could have made the observation results more accurate. IPLs knew the ICU personnel and functions, which could have diminished the loss of opportunities (Turnock & Gibson, 2001; Woodard et al., 2019). The observations during the first cycle made by ICPs were made during the morning shift and the busyness of the shifts did not affect the time of the observations. IPLs made the observations when they had time to do so, which means they made the observations in any situation for every shift, not only during planned events. On the other hand, conducting observations when the workload was low could have influenced the results, as a high workload lowers HH compliance (Jeanes et al., 2019).

6 | CONCLUSION

In our study, ABHR uses improved in both cycles and the HH performance improved in the second cycle. The consumption of alcohol-based hand rub could be a good surrogate for hand hygiene compliance when used with other means of HH improvement such as periodic hand hygiene observation and feedback.

General feedback alone was not powerful enough to sustain the increase in ABHR and HH performance. The performance feedback data on professionals' hand hygiene practices should be individualized, and the feedback should take place regularly. This study gives information on the situations in which hand hygiene is lacking and this information can be used in future hand hygiene instruction and training.

A combination of feedback and observation interventions increased the use of ABHR and HH performance. Observations and training may have acted as a reminder of HH. It is important to remind clinical personnel about HH and aseptic performance on a regular basis. We assume that the location of alcohol-based hand rub dispensers, close to the patients, increases the consumption of ABHR and, hence, supports infection prevention practices in the health care, but more research is needed on this issue.

The compliance with HH standards is a primary duty related to safe patient care, including prevention of HAIs and control of outbreaks. However, effective methods to enforce and monitor compliance need further exploration.

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AUTHOR CONTRIBUTIONS

Kirsi Terho: Supervision, Writing –Original Draft, Preparation, Formal analysis, Investigation, Writing – Reviewing and Editing. Esa Rintala: Writing – Reviewing and Editing. Janne Engblom: Formal analysis, Writing – Reviewing and Editing. Sanna Salanterä: Conceptualization, Writing – Reviewing and Editing.

ETHICAL APPROVAL

This study was conducted in accordance with the human subjects' protection principles Declaration of Helsinki). The Ethics Committee of the University (diary number edacted) approved the study's ethics, and the authorities of the Hospital (diary number redacted) granted the research permission. The participants were informed about the authorship and purpose of the investigation. Furthermore, participants were ensured that all the data obtained would remain anonymous and confidential.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data for this study are not publicly available. Kirsi Terho, Esa Rintala, Janne Engblom and Sanna Salanterä confirm that they had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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