Major Article

Challenges to sustainability of hand hygiene at a rural hospital in Rwanda

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Key Words:  
Hand hygiene  
Quality improvement  
Sub-Saharan Africa  
Sustainability

Background:  
Many hand hygiene (HH) programs have been implemented across Sub-Saharan Africa (SSA); however, most of these have been in large, referral hospitals. Our objective was to assess the impact of HH programs aimed at improving compliance at a rural hospital, and to identify unique challenges to HH sustainability.

Methods:  
Interventions to improve HH through providing handwashing stations, health care worker (HCW) training, and alcohol handrub were completed in 2014 and 2015. HH infrastructure, compliance, and glove use were assessed among HCWs after the intervention in 2015 and 2016. HCWs were interviewed about challenges to sustainability of HH compliance.

Results:  
Total HH compliance decreased 32.1% between 2015 and 2016 ($P < .001$). HH for patient protection was completed significantly less than HH for HCW protection in 2016, and HCWs appeared to substitute HH for patient protection with glove use. A high rate of physician turnover was associated with a larger decrease in HH compliance compared with nurses, and interviews suggested recruiting and retention of key personnel might play a role in HH sustainability. Availability of alcohol-based handrub in patient rooms decreased from 100% in 2015 to 79.5% in 2016 ($P < .01$).

Conclusions:  
Many challenges exist to sustaining HH compliance in SSA. In rural settings, difficulty recruiting and retaining trained personnel, inconsistent availability in HH infrastructure, and variability in HCW HH training may be contributing factors.

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BACKGROUND

Hand hygiene (HH) is a risk factor for health care–associated infection. However, health care workers (HCWs) often practice only half as much as they should.1 In Sub-Saharan Africa (SSA), HH compliance is often worse than in developed countries and has been shown to be as low as 8%.2 To improve HH in low- and middle-income countries, the World Health Organization (WHO) developed an HH Tool Kit in 2009 and implemented it in Mali.2,4 Since then, multiple initiatives to improve HH in SSA have been implemented.

These initiatives usually include infrastructure enhancement, HCW education and reminders, and ongoing feedback.5-9 However, most of these initiatives have been in large, referral hospitals with only a few in rural health care facilities.5-8 There are many challenges to HH in SSA. Many studies suggest that high patient volumes, lack of handwashing facilities, shortages of HH products, and low HCW knowledge and skill with HH are some of the underlying factors.5-8 However, challenges to HH compliance and sustainability in rural SSA may be different from those in urban settings. This study assesses HH compliance at a rural hospital in Rwanda after HH improvement initiatives and challenges to long-term sustainability. We have previously reported in Holmen et al on HH interventions and compliance improvement in 2015.7 This study is a continuation of that study to report the findings of our follow-up assessment on HH compliance and to examine the sustainability over a 13-month period. We also assess an intervention implemented prior to our 2015 study and HCWs use of gloves for HH.

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METHODS

Study site

Gitwe Hospital is a 163-bed, private, nonreferral, district hospital in the Ruhango District of Rwanda. Gitwe Hospital is 1 of 2 district hospitals serving the district’s population of just over 300,000 people. In 2015, Gitwe Hospital had 6,966 hospitalized inpatients and 2,119 live births. Gitwe Hospital’s HH infrastructure and patient population are similar to other rural district hospitals. In 2015 there were 12 physicians and 54 nurses, and in 2016 there were 11 physicians and 56 nurses; 3 of the physicians and 9 of the nurses in 2016 were not present in 2015. We selected 3 departments for inclusion in this study: maternity, pediatrics, and internal medicine. These departments were selected because they are the main inpatient departments, and patients in these departments are at high risk for health care–associated infection.

The 3 departments were divided between a single-story new building and a three-story old building. Pediatrics was located in the new building that was partially under construction, maternity was on the first and second floor of the old building, and internal medicine was on the third floor of the old building. Most patient rooms were designed for 3 beds. However, most rooms had at least 4 beds, and there were sometimes >1 patient per bed. Overcrowding occurred in all 3 departments. Gloves were often available, but there were often no waste containers for glove disposal. The hospital employed an environmental health director, a chief of nursing, and a chief of physicians that were in charge of decision-making regarding infection control and training of new employees on HH protocol.

Study population

The study population included physicians and nurses during the 2015 and 2016 assessments and nursing and medical students in the 2016 assessment. Nursing and medical students were not included in the 2015 assessment because they had not begun clinical rotations at the time of that assessment.

Study timeline

Assessment of HH compliance took place during 2 weeks in early August 2015 and again in late August 2016. The current 2016 assessment of HH was preceded by 2 HH initiatives. The first was in September 2014, which included the installation of portable handwashing stations throughout the hospital. These consisted of a metal frame, a 100-L barrel with a spigot at the bottom, and a basin below the spigot. The second was a HH campaign in July 2015 that included HCW education, workplace reminders, and the introduction of the WHO’s alcohol-based handrub (ABHR). This 2016 assessment is a continuation of the previously published Holmen et al assessment.7

Data collection

HH compliance was assessed using the direct observational method described in the WHO’s “Hand Hygiene Technical Reference Manual.”8 Observational methods for assessing HH compliance were similar to those reported in the Holmen et al assessment.5 Observers were validated according to HH observation method, times of observation were announced to staff prior to the study, observation occurred between 8:00 AM and 1:00 PM or 6:00 PM and 8:00 PM each day, observation department and ward were randomly selected each day, and observers accompanied physicians into patient rooms.7 In addition to the 2015 assessment, observers were instructed to note whether HCWs used portable washing stations installed in 2014 or the one sink in maternity, rather than just soap and water. Observers were also instructed to observe HH compliance of medical and nursing students. Students were not included in the Holmen et al assessment given the medical institution of Gitwe University began in 2013 and did not yet have students in their clinic years. Finally, observers also recorded glove use by HCWs. The use of gloves was not recorded in the 2015 assessment and was considered a limitation of that study.

Interviews

To better understand challenges to HH compliance, administrators, physicians, and nurses were interviewed by the research team about HH in person. A convenience sample of 5 physicians, 9 chief nurses, and 3 administrators were interviewed. The physicians and administrators were selected based on their involvement with infection control policy or the 2015 HH initiative, and all hospital chief nurses were selected. Each individual was specifically asked the following: (1) perception of personal and overall HH compliance at Gitwe Hospital; (2) nonbehavioral upstream factors that hindered compliance, such as water availability and administration support; and (3) solutions to overcome barriers to HH compliance. Survey questions were modified for this study from previous studies at Gitwe Hospital and a federal teaching hospital in Nigeria.67 Responses to questions were kept on an anonymous written record of the interview. Question 1 was asked before releasing 2016 assessment data, and questions 2 and 3 were asked after releasing data. All responses remained anonymous.

Data analysis

All data collected from HH compliance observations were recorded on Microsoft Excel 2011 (Microsoft, Redmond, WA). Data were analyzed using descriptive statistics (ie, percentages) and the χ² test. All tests were 1-sided, and P < .05 was considered statistically significant.

Ethical issues

Permission to conduct this assessment on the sustainability of the quality improvement projects was granted by Gitwe Hospital administration and the hospital ethics committee.

RESULTS

Availability of HH materials

Among the maternity, pediatrics, and internal medicine departments there were 35 patient rooms. Only 1 sink was available for all 3 departments, and it was located in the maternity ward. In August 2015 the sink had running water 4 out of 14 days, and in August 2016 the sink had running water 13 out of 14 days (χ² = 12.1; P < .001), and nonantimicrobial clean soap was always available. HCWs were encouraged to check for running water each day. There were 2 portable washing stations for each department located in the hallways next to patient rooms. These were always filled with water. However, clean soap was only present 15 of 28 days at washing stations, and the wastewater basin was not consistently emptied. There were never single-use paper towels available at the sink or the portable washing stations; therefore, HCWs air-dried their hands. ABHR was available in 70 out of 70 observed patient rooms in 2015 but only in 62 out of 78 observed patient rooms in 2016 (χ² = 16.1; P < .001).
HH compliance

A total of 76.5 hours of HH compliance observations were conducted with a total of 1,273 HH opportunities recorded. Data on 521 opportunities were reported during August 2015, and 752 opportunities were reported during August 2016. The overall compliance of physicians and nurses fell from 68.9% in August 2015 to 36.8% in August 2016 ($\chi^2 = 107.8; P < .001$). Compliance significantly decreased for both physicians and nurses between 2015 and 2016. Physician compliance decreased 40.2%, and nurse compliance decreased 20.8% (Table 1). Physician compliance significantly decreased in 4 of the 5 indications for HH, whereas nurse compliance significantly decreased in only 2 of 5 indications. Soap and water at the sink accounted for 4.4% of HH compliance, whereas ABHR accounted for 95.6% in 2016. In contrast, soap and water accounted for 0% of HH compliance in 2015. The largest contributor to this increase was nurses’ after touching a patient indication, of which soap and water accounted for 50% of completed opportunities. Portable hand washing stations were never successfully used for HH opportunity completion.

There was significant difference in HH compliance between professional groups. In 2015, physician compliance (82.1%) was significantly higher than nurse compliance (53%) ($\chi^2 = 51.1; P < .001$). In 2016, physician total HH compliance was still significantly higher than nurses’ compliance, but the difference had decreased to 9.7% ($\chi^2 = 5.27; P = .022$) (Table 2). Moreover, there was no significant difference within any individual HH indication in 2016. In contrast, physicians showed significantly higher HH compliance than nurses in before touching a patient, after touching a patient, and after touching patient surroundings in 2015. Overall physician and nurse compliance (36.8%) was also significantly higher than student compliance (23.2%) ($\chi^2 = 13.32; P < .001$) (Table 2). Although there was significant difference in HH compliance between physicians and nurses in 2016, we did not observe a significant difference between nursing and medical students (Table 2).

In 2016, HH that was more protective for HCWs, including after body fluid exposure, after touching patient, and after touching patient surrounding, was completed significantly more than that was more protective for patients, including before touching patient and before aseptic task, by physicians, nurses, medical students, and nursing students (58% vs 23%, $P < .001$; 45% vs 16%, $P < .001$; 36% vs 7%, $P < .001$; and 27% vs 6%, respectively; $P = .014$) (Table 3). Moreover, HH protective HH indications were the only indications to not significantly decrease from 2015 to 2016 (Table 1). The only indication not to decrease for both physicians and nurses between 2015 and 2016 was after fluid exposure (Table 1).

All 3 professional groups used gloves for HH opportunities in 2016 without appropriate HH. In 2015, HH compliance before touching patient between physician and nurses was 75%, but in 2016 it was only 22.5%. In 2016, physicians and nurses used gloves without required HH in 42.2% of before touching patient opportunities, which is significantly more than the 22.5% of times that required HH was completed for the indication ($\chi^2 = 12.61; P < .001$). The sum of glove use and required HH for before touching patient in 2016 was 64.8%, which is not significantly different from the 75% appropriate HH completion in 2015 ($\chi^2 = 3.75; P = .053$). It is important to highlight that although gloves were used for the before touching patient indication, the use was not considered compliant with HH if the HCW did not use ABHR or soap and water before donning gloves. Consequently, total compliance for before touching patient in 2016 was 22.5%, not 64.8%. Similarly, physicians and nurses used gloves in 79.8% of the before a clean-aseptic task indication, but they only completed required HH for 13.5% of the indications. Students also used gloves for before touching patient and before clean-aseptic task more frequently than using appropriate HH for these indications. For before touching patient, students used gloves for 43.9% of opportunities, whereas only completing 8.8% of required HH. In before clean-aseptic task, they used gloves in 100% of opportunities, but never completed required HH.

### Table 1

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<tbody>
<tr>
<td>Before touching patient</td>
<td>95/110 (86.4)</td>
<td>17/70 (24.3)</td>
<td>25/50 (50.0)</td>
<td>15/72 (20.8)</td>
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<tr>
<td>Before clean-aseptic procedure</td>
<td>21/27 (77.8)</td>
<td>8/41 (19.5)</td>
<td>26/43 (60.5)</td>
<td>4/48 (8.3)</td>
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<tr>
<td>After body fluid exposure risk</td>
<td>21/36 (58.3)</td>
<td>27/39 (69.2)</td>
<td>7/17 (41.2)</td>
<td>21/42 (50.0)</td>
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<tr>
<td>After touching patient</td>
<td>67/78 (85.9)</td>
<td>39/71 (54.9)</td>
<td>41/69 (59.4)</td>
<td>34/65 (52.3)</td>
</tr>
<tr>
<td>After touching patient surroundings</td>
<td>30/38 (82.2)</td>
<td>13/27 (48.1)</td>
<td>26/57 (45.6)</td>
<td>15/49 (30.6)</td>
</tr>
<tr>
<td>Total</td>
<td>234/285 (82.1)</td>
<td>104/248 (41.0)</td>
<td>125/236 (53.0)</td>
<td>89/276 (32.2)</td>
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NOTE: Values are n/N (%) or as otherwise indicated.

### Table 2

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<tbody>
<tr>
<td>Before touching patient</td>
<td>17/70 (24.1)</td>
<td>15/72 (20.8)</td>
<td>5/57 (8.8)</td>
<td>3/30 (10)</td>
<td>2/27 (7.4)</td>
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<tr>
<td>Before clean-aseptic procedure</td>
<td>8/41 (19.5)</td>
<td>4/8 (8.3)</td>
<td>0/12 (0.0)</td>
<td>0/11 (0.0)</td>
<td>0/1 (0.0)</td>
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<tr>
<td>After body fluid exposure risk</td>
<td>27/39 (69.2)</td>
<td>21/42 (50.0)</td>
<td>4/10 (40.0)</td>
<td>4/9 (44.4)</td>
<td>0/1 (0.0)</td>
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<tr>
<td>After touching patient</td>
<td>39/71 (54.9)</td>
<td>34/65 (52.3)</td>
<td>10/48 (20.8)</td>
<td>4/20 (20.0)</td>
<td>6/28 (21.4)</td>
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<tr>
<td>After touching patient surroundings</td>
<td>13/27 (48.1)</td>
<td>15/49 (30.6)</td>
<td>34/100 (34.0)</td>
<td>13/29 (44.8)</td>
<td>21/71 (29.6)</td>
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<tr>
<td>Total</td>
<td>104/248 (41.9)</td>
<td>89/276 (32.2)</td>
<td>53/228 (23.2)</td>
<td>24/99 (24.2)</td>
<td>29/129 (22.5)</td>
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NOTE: Values are n/N (%).
Interviews

Before the 2016 assessment, all physicians and 6 of 9 chief nurses believed that HH compliance had decreased since 2015, and 1 administrator and 3 of 9 chief nurses believed that it had remained the same. After seeing 2016 assessment data, 100% respondents attributed worsening HH to the fact that the hospital did not have a pharmacist to make ABHR, which anecdotally resulted in a decrease in ABHR availability for HCWs between December 2015 and March 2016. Respondents stated that there was a decrease in ABHR availability during those 3 months. Only 2 doctors and 1 administrator directly stated behavior as an upstream factor of noncompliance. All respondents believed that improved ABHR availability on wards and more frequent classes or meetings on HH could improve compliance.

DISCUSSION

This study is one of the first studies in SSA that shows a significant decrease in HH compliance over time after successful implementation of a HH improvement program.\(^2\) Total HH compliance between physician and nurses decreased 32.1% in just over 1 year. Studies on HH in SSA suggest that adequate HH compliance may be inhibited by patient overcrowding, lack of HH facilities, shortages of HH products, and low HCW knowledge.\(^2,3\) This study elucidates other challenges in sustaining HH practice in rural health care centers in Rwanda and SSA.

The ability to recruit and retain personnel in rural Rwanda may play a role in maintaining HH compliance. Interviews of HCWs and administrators suggest that the overall decrease in compliance was in part because of the absence of the chief pharmacist who was trained to provide in-house ABHR to HCWs in the hospital setting. Rural hospitals often have trouble recruiting qualified personnel; consequently, large periods of time can elapse in which critical roles must be reassigned to other HCWs. Given the additional responsibility this entails, HCWs may not be incentivized to take on the extra role. The decrease in ABHR availability during those 3 months may have impacted the observed decrease in ABHR in patient rooms even 4 months after having hired a new chief pharmacist. A recent HH improvement initiative in Rwanda attempted to avoid this cause of ABHR shortage by training 3 staff members instead of 1 to produce ABHR.\(^2\) However, this hospital was located in the urban center of Kigali; therefore, it may have been less difficult to find and fund extra personnel. The WHO original implementation program in Mali was also able to hire a pharmacist who was trained in infection control at University of Geneva Hospitals (Geneva, Switzerland) to lead their 2006–2007 project. Hiring a pharmacist of similar education and experience is likely to improve the sustainability of HH projects, but such measures are far beyond the means of an average rural health facility in Rwanda.\(^2\)

High turnover of physicians in the rural setting may also play a role in decreasing HH after educational initiatives. Gitwe Hospital experienced a physician turnover of 33% between 2015 and 2016, which correlated with a 40.2% decrease in HH total compliance. In comparison, nurses had a 16.1% turnover within the year, with a 20.8% decrease in compliance. The substantially larger decrease in physician compliance was remarkable across all indications for HH. In comparison with 2015 when physicians had significantly higher compliance than nurses in 3 of 5 HH indications, physicians’ HH was not significantly higher for any individual indication in 2016. Rural health care facilities in Rwanda tend to hire physicians from surrounding Burundi and the eastern Democratic Republic of the Congo, who are looking for better political stability, whereas native Rwandans tend to be drawn to more urban areas. Consequently, there are possible differences in HH training among physicians in rural Rwanda in comparison with more urban areas. Moreover, it has been shown that cultural acceptance of low-frequency HH is prevalent in low-income, rural areas.\(^11\) Given that Burundi and the eastern Democratic Republic of the Congo have worse gross domestic product and political stability than Rwanda, it is possible that HCWs from these areas impact Gitwe Hospital’s HH culture. Rates of high physician turnover affecting HH compliance have not been previously reported in previous studies in Rwanda or other parts of SSA.\(^2,6,8,9,12\)

Glove use appears to have substituted appropriate HH by HCWs to compensate for the decrease in HH in 2016. This is noticed in that completed HH for before touching patient in 2016 was 24.3%, whereas the sum of appropriate HH plus glove use for the indication was 64.8%, which is not significantly less than the 75% completion reported in 2015. One explanation for the shift to using gloves more frequently is behavioral conditioning during the 3-month absence of ABHR that may have forced HCWs to use gloves as protective measures given that portable washing stations and the 1 sink in maternity are often outside of patient care areas. Another reason for the substitution may be the process of reimbursement within Mutuelles de Sante, the nationalized health system, which covers the cost of gloves, but not the cost of ABHR. Although in theory this would incentivize continued glove availability during periods of financial constraints, this was not cited in the interviews as a reason for decreased HH. The pattern of gloves being used more frequently than indicated HH is also present among students, which may be because students mirror their instructors’ behavior. However, this would not explain why students have significantly worse HH than physicians and nurses. Another possibility is that it is more intuitive to put on gloves, which are visible shields, than washing hands with soap and water or using ABHR before patient contact.

All HCWs observed from physicians to nursing students showed significantly higher rates of HH for HCW protection in comparison with HH for patient protection. This may be because all HCWs also used gloves significantly more instead of HH for patient protective indications and consequently only completed HH after patient contact. HCWs have been shown to wash their hands more for inherent events that left their hand visibly dirty or feeling sticky in low-income settings with long-term limited water shortage.\(^11\) In 2015, we also showed that education and ABHR interventions were able to significantly increase all indications of HH except for after body fluid exposure.\(^2\) We now see that this indication is the only one not to decrease for both physicians and nurses after 1 year. This suggests that visible, inherent stimuli and self-protective awareness are likely the strongest drivers for HH completion and are not as easily impacted by education or HH infrastructure.

Diminishing knowledge and understanding of HH practice postraining may also play a role in the decreased HH compliance. Although certain indications for HH, such as before touching patient, may be intuitive, others, such as before aseptic task, require HCWs to recognize tasks that require HH when there is not direct contact with patients, or require HH before putting on gloves. Before the educational intervention in 2015, before aseptic task had the lowest compliance of the 5 indications, and it showed the most robust increase after training.\(^1\) In 2016, before aseptic task had returned to the lowest compliance for both physicians and nurses. This suggests that HCW training may have the biggest impact on this indication, and knowledge of HH indications may have diminished over 1 year. Physicians, nurses, and students also used gloves significantly without indicated HH. Other studies in SSA have shown similar use of gloves without HH, which has been attributed to HCW’s understanding of personal protection but poor understanding of patient safety.\(^13\)

The accessibility and availability of water, sinks, and ABHR also influence sustainable HH. Between 2015 and 2016, ABHR availability fell 20.5%, whereas the availability of running water increased.
This resulted in a small, but noticeable, increase in the number of completed HH opportunities using water instead of ABHR from 0% in 2015 to 4.4% in 2016. A water infrastructure project aimed at improving water availability to the hospital and the surrounding community was completed at the end of 2015, which likely explains the increased availability. Nevertheless, even with increased water availability, HH compliance still decreased. This suggests that solely increasing water availability in a hospital is not sufficient to maintain HH compliance. The lack of accessibility with the single sink that is far less than the WHO recommended 1:10 sink-to-bed ratio is likely the limiting factor. Given that ABHR bottles are easily moved between rooms, it is understandable that decreased ABHR availability is correlated with decreased HH compliance when there is limited accessibility to sinks.

The portable hygiene stations also did not contribute to a single HH opportunity completion. This is in sharp contrast with a recent HH program in Rwanda that significantly improved HH compliance using a similar portable hygiene station and HCW training. Given patient overcrowding and full patient rooms, the portable hygiene stations at Gitwe Hospital could not fit into patient rooms. Consequently, when HCWs washed their hands at them, it was impossible not to recontaminate on entering the patient room and patient zone.

This study had multiple limitations. Being a pre-post study, it is impossible to know the extent to which each factor, such as decreased availability of ABHR, increased availability of water independently, and rates of physician turnover, impacted HH compliance. We have identified several factors challenging sustainability of HH improvement in the rural health care setting. However, there are many factors that were not implemented or addressed in this study, including HH champions within different departments, funding stability within the Rwandan system for reimbursement of care, administrative support and feedback, and cultural, community and cultural influences on hygiene practice. Assessing soiled HCW’s hands, which would contraindicate ABHR use, was out of the scope of this study. Given that most compliance was completed with ABHR, this information would have given better insight into its effectiveness. Finally, we did not assess HCW and student knowledge of HH practice. Future studies should look at these factors more in depth when assessing sustainability of HH programs in rural SSA.

In conclusion, our study elucidates multiple challenges to sustaining HH compliance in rural health care settings in Rwanda and SSA. These challenges may include difficulty recruiting and retaining trained personnel, high turnover rates, retention of HH knowledge from training, and inconsistent availability in HH infrastructure. This study also suggests that solely increasing water quantity without improving accessibility at patient points of care does not significantly improve HH compliance.

Acknowledgments

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References