

## ORIGINAL ARTICLE

# Improving Hand Hygiene Practices in a Rural Hospital in Sub-Saharan Africa

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**OBJECTIVE.** To improve hand hygiene (HH) compliance among physicians and nurses in a rural hospital in sub-Saharan Africa (SSA) using the World Health Organization's (WHO's) Guidelines on Hand Hygiene in Health Care.

**DESIGN.** This study was a quasi-experimental design divided into 4 phases: (1) preparation of materials and acquisition of the hospital administration's support, (2) baseline evaluation, (3) intervention, and (4) follow-up evaluation.

**SETTING.** A 160-bed, non-referral hospital in Gitwe, Rwanda

**PARTICIPANTS.** A total of 12 physicians and 54 nurses participated in this study.

**METHODS.** The intervention consisted of introducing locally produced alcohol-based hand rub (ABHR); educating healthcare workers (HCWs) on proper HH practice; providing pocket-sized ABHR bottles for HCWs; placing HH reminders in the workplace; and surveying HCWs at surrounding health centers regarding HH compliance barriers. Hand hygiene infrastructure, compliance, and knowledge were assessed among physicians and nurses using baseline observations and a follow-up evaluation survey.

**RESULTS.** Overall, HH compliance improved from 34.1% at baseline to 68.9% post intervention ( $P < .001$ ), and HH knowledge was significantly enhanced ( $P < .001$ ). The 3 departments included in this study had only 1 sink for 29 patient rooms, and 100% of HH opportunities used ABHR. Hand hygiene compliance was significantly higher among physicians than nurses both before and after the intervention. All measures of HH compliance improved except for "after body fluid exposure," which was 51.7% before intervention and 52.8% after intervention ( $P > .05$ ).

**CONCLUSION.** Hand hygiene campaigns using WHO methods in SSA have been implemented exclusively in large, referral hospitals. This study shows that an HH program using the WHO tools successfully improved HH in a low-income, rural hospital in SSA.

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Healthcare-associated infections (HAIs) are a major risk to patient safety worldwide.<sup>1–4</sup> Globally, the burden of HAI is not distributed equally. In low- and middle-income countries, HAIs affect an average of 15.5% of hospitalized patients, which is higher than the rate reported in Europe and the United States.<sup>5–7</sup> In 2011, a systematic review of literature on HAIs in sub-Saharan Africa (SSA) yielded only 2 high-quality studies; they suggested that cumulative HAI incidence could be as high as 45.8%.<sup>8</sup> Thus, while HAI rates are higher in developing countries, the representation of SSA among the global HAI assessments is minimal and, therefore, may be underestimated.

Hand hygiene (HH) is fundamental for the prevention of HAIs. Many studies have demonstrated the benefits of HH for HAI prevention and consequent improvements in morbidity and mortality rates as well as decreases in healthcare costs.<sup>9–12</sup> However, achieving and sustaining high compliance with HH remains a major challenge.

To improve HH in developing countries, the World Health Organization (WHO) has developed an HH Tool Kit.<sup>13,14</sup> However, data relating the impact of the recommended WHO HH intervention strategy in healthcare settings in SSA are scarce.<sup>15–21</sup> The few studies that have been done have been conducted in large referral hospitals, and these results may not be generalizable to other types of facilities. We conducted a study to evaluate the improvement in HH compliance as a result of implementing the WHO HH Tool Kit in a small, non-referral hospital in rural Rwanda.

## METHODS

### Study Design

This study was a quasi-experimental study comprised of 4 phases: (1) preparation and procurement of hospital

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administrative support, (2) baseline evaluation, (3) intervention, and (4) follow-up evaluation. This study was designed using the WHO Guidelines on Hand Hygiene in Health Care Starter Tool Kit<sup>13,14</sup> tailored for use at our site.

### Study Site

The people of Rwanda have made amazing progress in reconstructing their healthcare system in the wake of the genocide in 1994.<sup>22</sup> This study was conducted at Gitwe Hospital in the Ruhango District of Rwanda. Gitwe Hospital is a 160-bed, private, non-referral, district hospital. The hospital serves a large portion of the district population of >300,000 people. At the time of this study, Gitwe Hospital had 12 working physicians and 54 nurses. We selected 3 departments for inclusion in this study: maternity, pediatrics, and internal medicine. These departments were selected because they are inpatient departments with a high risk for HAIs.

The 3 departments selected were divided among the 3 floors of the hospital. The maternity ward was on the first and second floors, the pediatrics ward was on the second floor, and the internal medicine ward was on the third floor. All patient rooms were designed for 3 beds. However, all rooms had at least 4 beds; some had mattresses placed on the floor; and there was often >1 patient per bed. Rooms were separated from hallways by doors that were kept closed. Gloves were available the majority of the time and were used frequently, but there was no system for glove disposal in patient rooms. The hospital employed a Director of Infection Control and regularly convened a committee that was in charge of decision making regarding infection control and interventions.

### Study Population

The study population included the 12 physicians and 54 nurses working at Gitwe Hospital at the time of the study.

### Study Timeline

Multiple meetings between March 2015 and May 2015 focused on efficient and effective quality improvement initiatives. The committee consisted of leaders of Gitwe Hospital administration including the Hospital Director, the Director of Infection Control, the Environment Health Director, and members of the Research Team. At the beginning of June 2015, the Gitwe Hospital administration decided to implement an HH improvement program. Baseline evaluations of HH compliance was done during June and July of 2015. The intervention was implemented later in July of 2015. A post-intervention evaluation of HH compliance was administered during the last 2 weeks of July and the first week of August 2015.

### Data Collection

Data collection regarding HH was conducted during the baseline evaluation phase and the post-intervention follow-up phase of this study. During these phases, HH compliance was assessed using the direct observational method described in the WHO Hand Hygiene Technical Reference Manual.<sup>13</sup> A total of 5 observers were trained and validated by the Director of Infection Control at Gitwe Hospital. Observers included 2 members of the research team and 3 second-year medical students from the nearby private medical university Institut Supérieur Pédagogique de Gitwe. The observers gathered data on HH using the 5 indications specified by the WHO.<sup>13</sup> The observation data were collected anonymously, and the identities of the healthcare workers (HCWs) remained confidential.

All observations took place in the 3 selected departments during morning rounds between 08:00 and 13:00 or evening rounds between 18:00 and 20:00. The periods of observation were formally announced at a staff meeting before they began. Additionally, observers informed physicians and nurses that they were being observed for a study on HH before the observation period began. Observers accompanied physicians and nurses into patient rooms to record HH compliance, but they were instructed to respect patient privacy and not to interfere with healthcare activities. Observers were also instructed not to perform HH observations during extreme situations. Observers stood close enough to the point of care to see, but did not interfere with patient care. Each observation session lasted between 30 and 120 minutes during the time periods stated above. The department and ward were randomly selected before each observation.

Observers also collected data on HH infrastructure. Information on availability of alcohol-based hand rub (ABHR), sinks, running water, clean soap and dispensers, and single-use paper towels were recorded for each patient room.

### Intervention

The intervention was implemented in 3 parts. Intervention materials included training and education programs as well as posted reminders in the workplace. Knowledge and perception questionnaires were delivered in Kinyarwanda.

#### Part 1: Training and Education

Doctors and nurses were encouraged by the administration to take part in 1 of 3 educational training programs designed to improve HH compliance. Each training session lasted 2.5–3.5 hours. Before each training session began, a questionnaire was administered. The questionnaire assessed the knowledge, attitudes, and practices of physicians and nurses regarding HH practices. All questionnaires were voluntary, anonymous, and confidential. The Research Team and the Director of Environmental Health conducted the training

sessions using a PowerPoint presentation and training handouts. Hand hygiene training focused on the definition of HAI, impact of HH on patient outcomes, patterns of transmission with emphasis on HH, and the WHO recommendations on why, when, and how to perform HH in healthcare settings. Doctors and nurses were divided into groups of 5–10 people. Each group discussed (1) upstream factors of noncompliance with HH practices, (2) impacts of noncompliance on patient safety, and (3) solutions to overcome hurdles in HH compliance. Baseline HH compliance results and feedback were also given during the training session. After the training session, each participant was asked to anonymously retake the portion of the questionnaire on HH knowledge and practice that had been administered at the beginning of the training session.

### Part 2: Reminders in the Workplace

After the educational activities, posters were created that were contextualized to the Gitwe Hospital environment and showed HH practices and their impact on patient safety. The posters were placed in all hospital departments at strategic locations: near sinks, beside beds, on doors to bathrooms and patient rooms, and at points where healthcare worker–patient contact occurred.

### Part 3: Introduction of Alcohol Hand Rub

After the training activities, each participant was given a pocket-sized 68-mL bottle of 80% ethanol (v/v) ABHR. The research team worked with the Director of Pharmacy to procure ethanol, glycerol, and hydrogen peroxide to prepare the ABHR according to WHO instructions for Formulation I.<sup>14</sup> Before the intervention, 500-mL bottles of 98% ethanol were sometimes present in patient rooms during exams. The Director of Pharmacy was responsible to keep ABHR stocked so that doctors and nurses could refill their personal 68-mL bottles. Alcohol dispensers were also placed on nurse carts.

### Surveys

To better understand the barriers to HH compliance external to Gitwe Hospital, surveys were conducted in health centers associated with Gitwe Hospital. Under the Rwandan national healthcare system (Mutuelle de Sante), patients are generally seen at a health center before being admitted to a district hospital. Health centers are staffed by nurses and technicians, and they are occasionally visited by physicians. Surveys were administered to all staff present at health centers and were focused on perceptions of HH infrastructure, knowledge, and practice. Of 8 health centers associated with Gitwe Hospital, 4 were randomly selected for HH evaluation. All survey questions were close-ended, and responses were quantitatively stratified. The surveys were administered in Kinyarwanda.

### Data Analysis

All data collected from observations on HH compliance, answers from educational training questionnaires, and survey responses were recorded on Microsoft Excel 2011 (Microsoft, Redmond, WA). All data were analyzed using simple descriptive statistics (ie, percentages) and  $\chi^2$  or independent-sample *t* tests on Microsoft Excel. All tests were 2-sided, and  $P < .05$  was considered statistically significant.

### Ethical Issues

Clearances for the study and survey were obtained from the managers of Gitwe Hospital and individual health centers, and from the heads of each department. The surveys administered at health centers were also approved by the University of Wisconsin Madison Institutional Review Board.

## RESULTS

### Availability and Function of Hand Hygiene Materials

Among the maternity, pediatrics, and internal medicine departments, there were 29 patient rooms. Only 1 sink was available for all 3 departments, and it was located in a patient exam room in the maternity ward. The sink had running water the majority of the time; there was always liquid soap available in a dispenser; and the area was kept clean. However, towels were never available. The availability of sinks and running water did not change after the intervention. Before the intervention, 500-mL bottles of 98% (v/v) ethanol were taken to patient rooms by nurses while exams were performed. However, these bottles were not always accessible. After the intervention, individual, pocket-sized bottles were always accessible to physicians and nurses.

### Hand Hygiene Compliance

A total of 62.83 hours of observation of HH compliance were conducted. Data were collected for 1,049 HH opportunities; 528 HH opportunities were reported before the intervention and 521 HH opportunities were reported after the intervention. The overall HH compliance of doctors and nurses doubled from 34.1% at baseline to 68.9% post intervention ( $X^2 = 127.2$ ;  $P < .001$ ). Compliance improved independently across both medical specialties. Nurse compliance improved by 41.4% and physician compliance improved by 26.3% (Table 1). Importantly, 100% of HH opportunities were completed using ABHR; soap and water were never used. When using ABHR, both physicians and nurses applied ABHR solution for the appropriate amount of time, but they did not consistently rub their hands as suggested by the WHO.

Average compliance at baseline varied significantly between physicians (55.8%) and nurses (11.6%). Physicians complied in 150 of 269 HH opportunities, and nurses complied in only

TABLE 1. Hand Hygiene Compliance at Baseline and Follow-Up, Gitwe Hospital, Rwanda

Indication	Physician			Nurse		
	Before, n/N (%)	After, n/N (%)	P Value	Before, n/N (%)	After, n/N (%)	P Value
Before touching a patient	65/104 (62.5)	95/110 (86.4)	<.001	5/63 (7.9)	25/50 (50.0)	<.001
Before a clean/aseptic procedure	6/19 (31.6)	21/27 (77.8)	0.002	0/12 (0)	26/43 (60.5)	<.001
After body fluid exposure risk	11/18 (61.1)	21/36 (58.3)	0.845	4/11 (36.3)	7/17 (41.2)	0.799
After touching a patient	50/77 (64.9)	67/78 (85.9)	0.002	13/49 (26.5)	41/69 (59.4)	<.001
After touching a patient's surroundings	18/51 (35.3)	30/34 (88.2)	<.001	8/124 (6.5)	26/57 (45.6)	<.001
Total	150/269 (55.8)	234/285 (82.1)	<.001	30/259 (11.6)	125/236 (53.0)	<.001

30 of 259 HH opportunities ( $\chi^2 = 58.28$ ;  $P < .001$ ). This disparity in compliance persisted even after the intervention, with physicians complying in 234 of 285 (82.1%) opportunities and nurses complying in 125 of 234 HH opportunities (53.0%;  $\chi^2 = 9.646$ ,  $P = .002$ ). The follow-up results were shared with the heads of the evaluated departments, and these managers provided feedback within their respective departments.

Hand hygiene improved significantly across all indications among both physicians and nurses except for the indication of "after body fluid exposure risk" (Table 1). The most improvement occurred among nurses for the indication "before a clean/aseptic task," which improved from 0% ( $n = 12$ ) to 60.5% ( $n = 43$ ;  $\chi^2 = 6.659$ ;  $P = .0099$ ).

### Education and Training

Overall, 9 of 12 physicians and 54 of 54 nurses attended 1 of 3 training sessions offered. Each attendee was invited to complete a questionnaire immediately before and after the training session. The response rate on questionnaires was 50.8% before training and 58.7% after training. Knowledge of correct HH practice improved from 41.3% before the training sessions to 78.4% after the training sessions ( $P < .001$ ). Respondents' self-perception on personal compliance to HH indications also decreased from 86.2% before training to 56.2% after training ( $P < .001$ ).

### Surveys

A total of 61 surveys were collected from a convenience sample of HCWs at 4 of 8 randomly selected health centers associated with Gitwe Hospital: Byimana, Mwendo, Karambi, and Gitwe. At Mwendo and Karambi, 100% of HCWs reported having no water at the health center and that the lack of water impacted their work. At Byimana, 60% of HCWs said that there was rarely enough water. Gitwe was the only health center where the majority of HCWs believed there was an adequate water supply. Interestingly, 77% of HCWs at Gitwe later responded that there was not water in patient rooms. Overall, 61% of HCWs from all 4 health centers reported that there was no running water in patient rooms. Furthermore, Karambi was the only health center in which the majority of HCWs said they used ABHR (90%). Among the other 3 health centers, only 21% of HCWs said they used ABHR.

Even with the infrastructural deficits for HH compliance, respondents' self-perception regarding personal HH compliance was 69%. This percentage was significantly lower than the perceived compliance of nurses and physicians at Gitwe Hospital before the HH intervention training (86.2%), but it was still surprisingly high. At Mwendo, 100% of HCWs said there was no running water, and 80% reported that they did not use ABHR, but these HCWs still self-reported HH compliance of 46%.

### DISCUSSION

To our knowledge, this is the first study to report the successful implementation of a multimodal HH improvement strategy at a rural, non-referral hospital in SSA. It is also the first study reporting HH quality improvement in Rwanda. Other published studies have taken place in Ghana, Nigeria, Mali, South Africa, and Eritrea.<sup>16–21</sup> The methods used in this HH intervention were adapted from the WHO HH improvement strategy in Mali and from a similar study done in Nigeria.<sup>17,21</sup> These methods aimed to improve HH compliance with minimal available resources by improving HH knowledge and increasing the availability of ABHR.

In this study, the baseline HH compliance of 34.1% was relatively high; other HH studies in SSA have reported varying rates of compliance. A WHO intervention in a large referral hospital in Mali had an overall baseline compliance of 8.0%,<sup>17</sup> and a follow-up study in Ghana showed baseline HH compliance ranging from 9.2% to 57%.<sup>16</sup> It is possible that the 34.1% baseline was higher than actual compliance at Gitwe Hospital due to the Hawthorne effect. A 2006 study showed that HH compliance increased 16% between covert and overt observations.<sup>23</sup> Overt observations were used in this study because it would have been too difficult to achieve covert observation in such a small facility. Higher compliance at baseline may also be due to the Rwandan Ministry of Health's pay for performance policy, which is impacted by HH compliance; thus, HCWs were already incentivized to undertake HH.

Considering a consistent observational bias for both baseline and follow-up, HH compliance doubled from 34.8% to 68.9%. This improvement is much larger than that reported by the WHO study in Mali, in which HH compliance improved from 8.0% to 21.8%.<sup>17</sup> A similar intervention at a large



hospital in Nigeria reported post-intervention compliance of 65.3%, but baseline compliance was not reported.<sup>21</sup> Achieving <100% compliance when HCWs were aware of observers' intentions may have been due to desensitization to an observer's presence, misunderstanding of HH indications by HCWs, or other factors.

The only indication in which HH compliance did not improve for both physicians and nurse was "after body fluid exposure risk." These HCWs may not have understood the need to wash their hands after removing gloves after a fluid exposure risk. Interestingly, the "after body fluid exposure" indication has been reported to have higher compliance in SSA.<sup>20,21</sup> Moreover, most physicians and nurses appeared to understand the importance of changing gloves between patients post intervention. Other studies reported that not changing gloves between patients occurred frequently in other sub-Saharan hospitals.<sup>18,19</sup>

The WHO intervention in Mali reported "after touching patient surroundings" to be the only indication that had not improved upon follow-up; these researchers attributed this result to poor understanding of the indication among HCWs. Both physicians and nurses in our study showed significant improvement in "after touching patient surroundings." This result may have been due to workplace reminders being placed in locations easily visible to HCWs exiting patient rooms.

Differences in HH compliance between doctors and nurses vary across sub-Saharan Africa. A study in Ghana showed doctors and nurses to have relatively similar rates of compliance,<sup>16</sup> whereas an intervention in Nigeria showed nurses to have higher rates of compliance,<sup>21</sup> and the Mali study reported that physicians had the higher compliance rate.<sup>17</sup> In countries outside Africa, nurses have been reported to have higher HH compliance.<sup>24,25</sup> In this study, similar to the Mali study, we found that physicians had higher rates of compliance in all 5 indications. These results may be attributable to differences in training between physicians and nurses and should be explored fully in subsequent studies.

All HH indications in this study were completed using ABHR, unlike all other studies of HH in SSA, which have shown at least minimal use of soap and water for HH compliance.<sup>16–21</sup> The reason for no recorded use of soap and water is likely due to the lack of readily available running water.

According to the surveys conducted in the health centers, lack of water infrastructure may be a hindrance to HH. Furthermore, in some health centers, HCWs believed they had sufficient water access even when there was no running water in patient rooms. Thus, training sessions and increased availability of ABHR may also be of benefit in these locations.

This study had several limitations. First, there was no infection control department or large hospital, and the quasi-experimental design was most feasible in this setting. Second, data collection was conducted over a short time period; the intervention studies previously done in SSA and other developing countries were implemented over much

longer time spans.<sup>17,21,26</sup> Third, we did not examine glove use as a factor in HCW decision making to undertake HH. Finally, we did not measure HAI incidence. Future studies should include patient outcomes; however, this was beyond the capability of resources available at Gitwe Hospital at the time this study was conducted.

In conclusion, our study shows that the implementation of WHO's multimodal HH improvement tools was feasible and effective in a non-referral, rural hospital in SSA. Therefore, these tools can be successfully and rapidly implemented and can yield significant improvements in HH knowledge and practice. A clear need remains regarding the improvement of HH using soap and water for indications for which ABHR is not recommended.

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