ORIGINAL ARTICLE

# Infection Control Knowledge, Attitudes, and Practices among Healthcare Workers at Mulago Hospital, Kampala, Uganda

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OBJECTIVE. Effective implementation of infection control programs and adherence to standard precautions are challenging in resource-limited settings. The objective of this study was to describe infection control knowledge, attitudes, and practices among healthcare workers (HCWs) in Uganda.

DESIGN. We conducted a survey of hospital employees who had direct contact with patients or their immediate environment. We also performed an environmental assessment of resource availability and utilization within hospital wards.

SETTING. Surgical, medicine, and obstetrics wards at a national referral hospital in Kampala, Uganda.

PARTICIPANTS. One hundred eighty-three randomly selected HCWs.

RESULTS. Almost all HCWs knew to wash their hands, although nursing and support staff were less likely to perceive that HCWs' hands can be a vector of disease transmission. Hand washing was valued more as a means of self-protection than as a means to prevent patient-to-patient transmission, consistent with the prevailing belief that infection control was important for occupational safety. Sinks were not readily accessible, and soap at sinks was uncommon throughout the medicine and obstetrics wards but more commonly available in the surgery wards. Alcohol gel was rarely available.

CONCLUSIONS. Changing infection control practices in developing countries will require a multifaceted approach that addresses resource availability, occupational safety, and local understanding and attitudes about infection control.

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Infection control is an important area of potential improvement and impact in developing countries because of the simplicity of the interventions and the powerful effect of decreasing disease transmission.[1] Studies in sub-Saharan Africa and in many developing countries, in general, have shown that adherence to infection control guidelines is inadequate.[2,3]

In a systematic review of the few studies conducted in Africa, the prevalence of healthcare-associated infection (HAI) was found to be 2.5%–14.8%.[4] In sub-Saharan Africa, a high proportion of hospitalized patients are at increased risk of infection due to human immunodeficiency virus (HIV) and malnutrition, as well as a lack of resources needed to implement standard precautions.[2,3,5] This has been found to be true in Uganda, where a large proportion of hospitalized patients are immunocompromised.[6] This confluence of factors makes the implementation of infection control measures critical in sub-Saharan Africa.

Local culture and beliefs concerning infection control may strongly influence implementation, and guidelines must acknowledge transcultural issues.[1] Healthcare workers (HCWs) adapt practices to the context in which they work, and this must be understood when implementing an infection control program. The objective of this study was to survey knowledge of and attitudes toward infection control and its practice among employees who have daily contact with patients and their immediate environment at the national referral hospital in Uganda.

## METHODS

From June to August 2009, we conducted a survey of HCWs who had contact with patients at Mulago Hospital, a 1,500-bed national referral hospital in Kampala, Uganda, founded in 1917, with current infrastructure constructed in 1962. Participants were classified as support staff (nursing assistants and ward custodial staff, some of whom perform both duties), nurses, intern officers, house officers, and consultant (ie, sen-

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ior) physicians. A wide range of staff was chosen to be inclusive of all individuals who had direct contact with patients and their immediate environment on a daily basis. At the time of the study, the 2004–2005 Uganda National Infection Prevention and Control Guidelines were in place, and staff was aware of the infection control guidelines that were in place. The guidelines contained specific sections on patient isolation and cohorting; however, overcrowding and shortage of space at the hospital limit their implementation. While masks, gowns, and gloves are typically available, goggles are often not. At the time of employment, preservice training on infection control is given to all HCWs, and periodic in-service training is provided by the Ministry of Health. Although there is a clinical microbiology laboratory at Mulago Hospital to support patient care, limited resources prevent infection control staff from carrying out regular surveillance activities.

The survey contained 66 items; domains included hand hygiene, barrier protection, isolation and contact precautions, and prevention of mosquito-borne transmission of disease. Four-point Likert scales were used to assess knowledge and attitudes (strongly agree, agree, disagree, strongly disagree) and practices (all of the time, most of the time, some of the time, never). A sampling frame was created using May 2009 ward-specific employee work schedules. Within each job title, 20% of employees were randomly selected to complete the survey. If an individual refused, another randomly selected individual from the sampling frame was approached. The survey was written in English and designed to be self-administered; participants were given the option to complete an interviewer-administered version in Luganda, the local language in Kampala.

In addition to the survey, an environmental assessment was performed at all medicine ($N = 7$), obstetrics and gynecology (OB/GYN; $N = 4$), intensive care unit (ICU; $N = 2$), and surgery ($N = 5$) wards, during which hand hygiene and standard precaution practices were observed and recorded. Observation was easy because of open-air wards with centrally located sinks. At times HCWs were questioned as to reasons behind behavior to further understand motivations. Observations were carried out at random times, covering all hours of the day and night during the study period, and did not interfere with survey instrument dissemination and collection. The Institutional Review Boards at Makerere University School of Medicine and the University of Wisconsin–Madison approved this study.

Data from the 4-point Likert scales were collapsed as dichotomous (agree or disagree) since inferences did not change and statistical power was improved by doing so. Participant characteristics and the proportion in agreement with individual statements regarding infection control knowledge, attitudes, and practices were compared by HCW type using the Pearson $\chi^2$ test or the Fisher exact test when the expected value for a given cell was less than 5. All analyses were performed using STATA 11 (Statacorp) and SAS, version 8 (SAS Institute).

## RESULTS

### Environmental Assessment

All wards were open-air; at any given day of observation, 2 to more than 50 inpatients were present. Among the 13 nonsurgical wards, 9 wards did not have a functioning sink for hand washing. Functioning sinks were present inside both ICUs, 1 of the 4 obstetrics wards, and 1 of the 7 medicine wards. Sinks were located along one of the walls in the center of the room. Soap was generally not available, and the sinks were underutilized. In all 5 surgical wards, functioning sinks equipped with soap were present at all times observed and were utilized by HCWs. Functioning sinks stocked with soap were abundant in operating rooms. Sinks that were located outside of inpatient wards, typically inside or near restrooms, were not included in the environmental assessment.

Hand hygiene was often equated to glove use instead of hand washing and thus cited as an expensive undertaking. Some physicians carried alcohol gel, but gel was costly and in short supply. Nurses desired to wear gloves, but supplies were short, and the correct size was not always available. Glove change between patients was rare unless gross blood was visible. Physicians would at times opt to avoid physical contact with patients when gloves were not worn or if a sink and soap were not nearby. In the surgery ward, proper hand hygiene was observed more often.

Respiratory cohorting was attempted in the respiratory medicine and tuberculosis wards but was often ineffective due to overcrowding, which led to patient mixing between wards. The open-air floor plans of the units also prevented adequate isolation of patients with respiratory illness. Bed nets, although available in the hospital above some beds, were generally not used at night by patients despite encouragement or actual placement by nurses. In surgery wards, patient bathing was done by support staff; in other inpatient wards, this was done by family members.

### HCW Survey

Of the 201 HCWs approached, 183 (91.0%) completed the survey, including 103 (56.3%) nurses and midwives, 39 (21.3%) physicians, and 41 (20.7%) clinical support staff (1 clinical assistant, 2 physician assistants, 1 counselor, 1 emergency medical technician, 14 nurses aides, 3 pharmacy technicians, 1 public health officer, 13 student nurses, 1 medical record worker, and 4 whose designation was unknown; Table 1). The primary reason cited for refusal was lack of time to complete the questionnaire. Response rates did not vary by HCW or unit type. Respondents were from medicine (45.3%), OB/GYN (27.9%), surgery (13.4%), ICU (7.8%), and tuberculosis (8.4%) departments.

Only 56.2% knew to whom to direct questions about infection control, and 18.6% believed the hospital had adequate resources to prevent the spread of infections. Gloves were the most commonly used barrier protection (68.9%), followed

TABLE 1. Characteristics of Healthcare Workers Completing Survey, Mulago Hospital, July–October 2009

| Characteristic | All healthcare workers | Physicians | Nurses and support staff | $P^a$ |
|---|---|---|---|---|
| Total subjects | 183 (100.0) | 39 (21.3) | 144 (78.7) | |
| Median age (IQR), years | 37 (30.7, 44.0) | 30 (26, 39.5) | 37.5 (33–45) | .001 |
| Sex | | | | |
| Male | 36 (19.7) | 24 (61.5) | 12 (8.3) | <.001 |
| Female | 143 (78.1) | 14 (39.0) | 127 (88.2) | |
| Missing | 4 (2.2) | 1 (2.6) | 3 (2.1) | |
| Position | | | | |
| Professor/consultant | 5 (2.7) | 5 (13.9) | ... | ... |
| Medical officers | 18 (12.5) | 18 (46.2) | ... | |
| Intern officers | 16 (11.1) | 16 (41.0) | ... | |
| Nurses/midwives | 103 (71.5) | ... | 103 (71.5) | |
| Clinical support staff | 41 (28.4) | ... | 37 (25.7) | |
| Department | | | | |
| Medicine | 65 (35.5) | 13 (39.3) | 52 (36.1) | .574 |
| OB/GYN | 51 (35.4) | 14 (35.9) | 37 (25.7) | |
| Surgery | 32 (22.2) | 8 (20.5) | 24 (16.7) | |
| ICU | 16 (11.1) | 2 (5.1) | 14 (9.7) | |
| TB | 16 (11.1) | 2 (5.1) | 14 (9.7) | |
| Missing | 3 (2.1) | 0 (2.6) | 3 (2.1) | |
| Median years worked (IQR) | 9 (3–15.5) | 2 (1–10) | 10 (6.75–17.0) | <.001 |
| Believed that he or she facilitated transmission of healthcare-associated infection | | | | |
| No | 81 (44.3) | 14 (35.9) | 67 (46.5) | .277 |
| Yes | 96 (64.6) | 23 (59.0) | 73 (50.7) | |
| Missing | 6 (4.2) | 2 (5.1) | 4 (2.8) | |
| Believed that he or she became infected as a result of contact with patients | | | | |
| No | 56 (30.6) | 10 (25.6) | 46 (31.9) | .514 |
| Yes | 122 (84.7) | 27 (69.2) | 95 (68.3) | |
| Missing | 5 (3.4) | 2 (5.1) | 3 (2.1) | |

NOTE. Data are no. (%) unless otherwise indicated. ICU, intensive care unit; IQR, interquartile range; OB/GYN, obstetrics and gynecology; TB, tuberculosis.

TABLE 2. Proportion of Healthcare Workers in Agreement with Statements regarding Knowledge, Attitudes, and Practices of Infection Control Principles

| Statement | Physicians ($N$ = 39) | Nurses and support staff ($N$ = 144) | $P$ |
|---|---|---|---|
| Knowledge | | | |
| A common way infections are spread in hospitals is from unclean hands of healthcare workers such as doctors and nurses | 35 (89.7) | 107 (74.3) | .040 |
| Crowded conditions in hospitals increase the chance of spreading infections from one person to another | 38 (97.4) | 141 (97.9) | .860 |
| During my educational training, I received instruction on infection control and the prevention of infections in hospitals | 39 (100.0) | 144 (100.0) | .459 |
| When I have an infection control question I cannot answer, I know whom to ask at this hospital for help | 18 (46.2) | 85 (59.0) | .151 |
| Hand washing before and after every patient contact will reduce the spread of infectious diseases among hospitalized patients | 37 (94.9) | 143 (99.3) | .053 |
| Waterless hand gel is an acceptable substitute for hand washing with soap and water, as long as hands are not visibly soiled | 28 (71.8) | 126 (87.5) | .017 |
| Healthcare workers should always wear gloves when conducting patient care activities | 31 (79.5) | 123 (85.4) | .368 |
| Gloves may be reused between patients without increasing the risk of disease transmission as long as they are not visibly soiled | 1 (2.6) | 13 (9.0) | .178 |
| Patients who have respiratory infections should be physically separated from others by at least 1 meter to prevent the spread of infections | 33 (84.6) | 114 (79.2) | .448 |
| Patients and healthcare workers can reduce spread of infections by covering their mouths and noses when coughing or sneezing | 39 (100.0) | 136 (94.4) | .132 |
| Mosquitoes are directly responsible for infecting patients with malaria | 37 (94.9) | 129 (89.6) | .313 |
| Bed nets prevent mosquito bites in patients | 36 (92.3) | 140 (97.2) | .156 |
| Healthcare workers can prevent malaria acquired in the hospital by using bed nets over patients at night | 39 (100.0) | 136 (94.4) | .132 |
| Gloves prevent healthcare workers' skin coming into contact with bodily fluids, mucous membranes, and nonintact skin | 39 (100.0) | 134 (93.1) | .091 |
| Gowns prevent clothing from becoming contaminated with infectious material | 38 (97.4) | 125 (86.8) | .059 |
| Eye protection protects against bodily fluid exposure when splashing occurs | 39 (100.0) | 134 (93.1) | .091 |
| Masks protect against bodily fluid exposure when splashing occurs | 36 (92.3) | 116 (80.6) | .083 |
| Masks prevent transmission of infectious respiratory secretions (eg, tuberculosis) | 36 (92.3) | 132 (91.7) | .897 |
| Attitudes | | | |
| I feel a personal responsibility to prevent infections among the patients I care for | 38 (97.4) | 138 (95.8) | .644 |
| Preventing the spread of infections in this hospital is important to our hospital administrators | 30 (76.9) | 120 (83.3) | .356 |
| My hospital has adequate resources to prevent the spread of infections among patients | 7 (17.9) | 27 (18.8) | .901 |
| One main reason I wash my hands is protection from infections | 39 (100.0) | 140 (97.2) | .293 |
| Wards are kept clean to reduce patient infection from the environment | 36 (92.3) | 137 (95.1) | .490 |
| A main reason I wash my hands is patient protection from infection | 34 (87.2) | 119 (82.6) | .462 |
| Washing my hands is something my patients expect me to do | 21 (53.8) | 89 (61.8) | .368 |
| Washing my hands before and after touching patients will make my hands become dry and uncomfortable | 8 (20.5) | 16 (11.1) | .123 |
| There is not enough time to wash my hands between every patient | 20 (51.3) | 52 (36.1) | .085 |
| There are not enough supplies such as soap and clean water to wash my hands between every patient | 30 (76.9) | 68 (47.2) | .001 |
| Washing my hands before and after direct patient contact is a necessary part of my job | 37 (94.9) | 137 (95.1) | .945 |
| Washing my hands before and after direct patient contact is a beneficial part of my job | 38 (97.4) | 124 (86.1) | .049 |
| Washing my hands before and after direct patient contact is a practical part of my job | 34 (87.2) | 137 (95.1) | .075 |
| My supervisors at this hospital expect me to wash my hands before and after direct patient contact | 33 (84.6) | 126 (87.5) | .636 |
| My coworkers at this hospital wash their hands before and after patient contact | 17 (43.6) | 96 (66.7) | .009 |

TABLE 2 (*Continued*)

| Statement | Physicians ($N = 39$) | Nurses and support staff ($N = 144$) | $P$ |
|---|---|---|---|
| I intend to wash my hands before and after patient contact when the patient I'm caring for has an infection | 35 (89.7) | 69 (47.9) | .001 |
| I intend to wash my hands before and after patient contact regardless of my clinical assignment | 36 (92.3) | 113 (78.5) | .001 |
| Separating patients with respiratory infections from patients without respiratory infections would be beneficial in this hospital | 39 (100.0) | 137 (95.1) | .160 |
| It is important to cover my mouth and nose when I cough or sneeze to protect my patients from infections | 38 (97.4) | 142 (98.6) | .608 |
| It is important to cover my mouth and nose when I cough or sneeze to protect my coworkers from infections | 39 (100.0) | 139 (96.5) | .238 |
| Separating patients with respiratory infections from patients without respiratory infections by a distance of 1 meter would be practical in this hospital | 11 (28.2) | 100 (69.4) | .001 |
| Bed nets are important for the prevention of malaria among patients in the hospital | 39 (100.0) | 140 (97.2) | .293 |
| It is my responsibility to place bed nets over patients at night | 8 (20.5) | 106 (73.6) | .001 |
| Placing bed nets over my patients at night would be practical in this hospital | 21 (53.8) | 115 (79.9) | .001 |
| It is important to wear gloves when contact with bodily fluids, mucous membranes, or nonintact skin is anticipated | 39 (100.0) | 137 (95.1) | .160 |
| It is important to wear a gown when clothing exposure to bodily fluids is anticipated | 37 (94.9) | 135 (93.8) | .794 |
| It is important to wear eye protection when splashing of bodily fluids is anticipated | 37 (94.9) | 136 (94.4) | .917 |
| It is important to wear a mask to protect against infectious respiratory secretions when necessary | 37 (94.9) | 137 (95.1) | .945 |
| Wearing protective equipment (gowns, masks, gloves, eye protection) makes me uncomfortable | 9 (23.1) | 35 (24.3) | .874 |
| Ease of protective equipment (gowns, masks, gloves, eye protection) access in this hospital makes using it practical | 16 (41.0) | 94 (65.3) | .006 |
| Practices | | | |
| I teach my patients ways they can prevent the spread of infections | 5 (12.8) | 59 (41.0) | .001 |
| When I am ill with a respiratory infection, I stay home from work | 3 (7.7) | 3 (2.1) | .081 |
| Medical instruments I use are disinfected or sterilized | 29 (74.4) | 109 (75.7) | .864 |
| When I have patients with transmissible infections, I isolate them | 12 (30.8) | 68 (47.2) | .067 |
| I wash my hands after removing gloves | 12 (30.8) | 86 (59.7) | .001 |
| I wash my hands before touching every patient | 2 (5.1) | 29 (20.1) | .027 |
| Gloves are available when I need them | 4 (10.3) | 35 (24.3) | .057 |
| I have easy access to a water source for washing my hands in between patients | 5 (12.8) | 55 (38.2) | .003 |
| I wash my hands after touching every patient | 2 (5.1) | 40 (27.8) | .003 |
| I wash my hands after I cough or sneeze | 0 (0.0) | 14 (9.7) | .043 |
| After my patients cough or sneeze, I ask them to wash their hands | 0 (0.0) | 5 (3.5) | .238 |
| The ward on which I currently work separates patients with respiratory infections from patients without respiratory infections by a distance of at least 1 meter | 6 (15.4) | 30 (20.8) | .448 |
| I use gloves when contact with bodily fluids, mucous membranes, or nonintact skin is anticipated | 29 (74.4) | 97 (67.4) | .403 |
| I place bed nets over patients at night | 1 (2.6) | 25 (17.4) | .019 |
| I use gowns when clothing contact with bodily fluids is anticipated | 15 (38.5) | 38 (26.4) | .140 |
| I use eye protection when splashing of bodily fluids is anticipated | 8 (20.5) | 30 (20.8) | .965 |
| I use masks when splashing of bodily fluids is anticipated | 9 (23.1) | 30 (20.8) | .762 |
| I use masks around patients with actively infectious respiratory infections (eg, tuberculosis) | 8 (20.5) | 57 (39.6) | .027 |

NOTE. Data are no. (%).

than physicians to wear masks around patients with active respiratory infections (39.6% vs 20.5%; $P = .027$).

## DISCUSSION

In our study at a national referral hospital of Uganda, HCWs had a general understanding of infection control principles and disease transmission but had less specific knowledge, especially pertaining to hand hygiene. Hand washing, particularly among nurses and support staff, was seen more as a means for self-protection than it was a method of patient protection. There lacked translation of hand hygiene knowledge to practice, which is common in both resourced and resource-limited settings.[7,8] Similarly, there was greater knowledge of the benefits of barrier protection than actual use. In our study, standard universal precautions were not always followed, and isolation or cohorting of infectious patients was often an afterthought rather than an initial step. We presume that an increased adherence to infection control practice and availability of resources in the surgery wards reflects a greater awareness by HCWs and hospital administration of the importance of preventing surgical site infections. Most HCWs cited a lack of time and resources being in too short supply and inconsistently available as reasons for suboptimal infection control; the environmental assessment confirmed this perception.

A limitation of the study was possible optimistic reporting of infection control practices among lower-level nursing staff out of fear of reprisal from administration. This could be seen in the differences between intent and actual implementation of hand hygiene. Although we report information learned from informal conversations with HCWs during the study period, our study did not have a formal qualitative component. Given the few number of HCWs relative to patients served, it was not feasible to gather multiple employees at one time for focus group discussions or individual workers for a long period of time for an in-depth interview. Future studies should include mixed methodology to help further elucidate how differences in knowledge of and attitudes toward infection control impact its practice among HCW types. Also, while a quantitative environmental assessment was not conducted, we believe that our qualitative assessment, which was performed over an extended duration of time, accurately depicted the current state of practice and infrastructure at the hospital.

Resource-limited settings generally have a higher prevalence of HAIs than do resourced settings.[9,10] Major structural factors might include a lack of laws (or their enforcement) mandating infection control programs, limited allocation of funds to support infection control relative to other priorities, outdated equipment and technology, and shortages in the number of HCWs relative to patients requiring health care.[11] Conceivably, a high density of immunocompromised individuals may also play a role. In countries with high HIV prevalence, a large proportion of patients seeking and receiving health care are HIV infected, as observed in a study previously conducted at Mulago Hospital in Kampala, Uganda, where 50% of individuals seen in the emergency department and 40%–60% of hospitalized patients were HIV infected.[6]

Hand hygiene compliance is a worldwide problem.[8] When asked about hand hygiene, most HCWs referred to a shortage of gloves rather than soap or alcohol gel. Even in resourced nations, hand-washing compliance has improved only gradually with intensive education and making alcohol gel easily accessible in all patient care areas.[12] In addition, if reduction of HAIs is the goal, resources must be devoted to making soap and/or alcohol gel easily accessible in all patient wards. Alcohol gel, while seemingly more expensive and scarce, would be more practical in wards with centrally located sinks. Innovative solutions, such as locally produced, low-cost aseptic gel ($0.37/100 mL), as demonstrated in Kenya, are promising.[5,13]

In developed countries, effective programs to ensure occupational safety for HCWs preceded patient safety initiatives. In resource-limited settings, contagious disease in healthcare environments is common, and HCWs are given few protections. Thus, as observed in our study, it is not surprising that HCWs saw the practice of infection control as a means to reduce personal risk for infection. Therefore, an effective infection control program includes adoption of standard universal precautions; education and training of workers; protection of HCWs, including immunization, identification of risks, practicing infection control techniques, environmental management, and incident monitoring; outbreak investigation; surveillance; and evaluation.[14] In developing countries, simply increasing resources for infection control is not enough. Comprehensive, innovative, and sustainable approaches that empower HCWs at all levels and take into account and are adapted to the local culture for infection control are needed.

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