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Infection prevention and control practices in Jimma, Ethiopia

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Abstract

Healthcare-associated infections (HAIs) are frequent adverse outcomes of medical care. The HAI burden in low- and middle-income countries is much higher and associated with more severe outcomes. The Systems Engineering Initiative for Patient Safety (SEIPS) model provides a framework that can be used to identify barriers and facilitators of infection control practices and evaluate interactions between structures, processes, and outcomes.

A qualitative study was done to evaluate the implementation of effective infection control practices at Jimma University Hospital in Jimma, Ethiopia. Twenty-two semi-structured interviews of hospital employees, selected by convenience sampling, were conducted to assess the five components of SEIPS framework: person, physical environment, tasks, organization and tools. The interviews were transcribed, coded for themes, and analyzed using the software Dedoose (Version 8.0.42 SocioCultural Research Consultants, Los Angeles, CA).

Staff overwhelmingly reported a shortage of personal protective equipment (PPE) as a barrier to adequate infection prevention and control (IPC) practices but cited poor supply chain management versus financial resources as the cause. Most interviewees also noted unreliable water availability as an impediment for hand hygiene. Prominent facilitators of effective IPC included a manageable workload, sufficient budget, and positive individual attitude towards improving IPC. The major barriers were identified as an inconsistent and incomplete training program for employees, a lack of IPC policies, and a nurse rotation program that increases unit staff turnover.

Interventions designed to address the identified barriers include developing IPC policies and protocols, regularly scheduled IPC training, and establishing an HAI surveillance program to better identify IPC trends and track progress. Innovative interventions are needed to improve IPC practices, such as faculty training on supply chain management and utilization of simple local resources to increase hand washing practices.

Keywords: healthcare-associated infections, infection control, global health, qualitative research, human factors engineering, Ethiopia

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Background

Healthcare-associated infections (HAIs) are cited as the most frequent adverse outcome of medical care.[1] HAIs affect millions of patients worldwide and are responsible for worse health outcomes, higher medical costs, increased length of stay, increased antibiotic resistance, and overall higher rates of patient morbidity and mortality.[2] In developed countries, the pooled HAI prevalence is 7.6%.[2] The HAI burden in low- and middle-income countries (LMICs) is estimated to be much higher and associated with more severe outcomes on patient health.[3] Regional reviews of HAI incidence revealed that the rate of adult intensive care unit (ICU) HAI was three times higher in resource-limited countries compared to industrialised countries, and rates of neonatal HAI ranged from three to twenty times that of industrialised countries.[3,4] Despite the sizable impact HAIs have on the medical system, the true global prevalence is not well known, partly due to poor surveillance systems in LMICs and the complexity and lack of uniform criteria to diagnose HAIs.[5]

Ethiopia, similar to other LMICs, does not have a well-described burden of HAI. A point prevalence study evaluating two teaching hospitals of the Amhara region found the mean prevalence of HAI to be 14.9% amongst inpatients admitted for at least 48 hours.[6] Another study at a referral hospital in Bahirdar, Ethiopia found that 10.9% of post-operative patients had a confirmed bacterial HAI.[7] A review of 1069 inpatient cases from May 1 through September 30, 2016 at Jimma University Medical Centre revealed an HAI incidence rate of 28.5 per 1000 patient days, a prevalence of 19.1%, with the highest incidence occurring in the ICU.[5] These data suggest that HAI is a significant burden in the area, even if the extent has not been fully characterised.

In order to identify appropriate interventions to reduce HAIs, it is important to understand the specific areas of breakdown within an individual work system. The Systems Engineering Initiative for Patient Safety (SEIPS) model of work system and patient safety provides a framework that can be used to identify gaps in infection prevention and control (IPC) practices by analysing interacting structures, processes, and outcomes within healthcare settings.[7] The SEIPS model evaluates the interactions between the five components of the work system including person, tasks, physical environment, organizational conditions, and tools and technology, the effect these components have on processes (care and other), and the final manifestations of employee, organizational, and patient outcomes including quality of care and patient safety.[8] This framework can be used to identify both barriers and facilitators of IPC practices and to identify potential areas of improvement within the complex environment of a hospital.

Using the SEIPS work systems and patient safety model, we aimed to identify barriers and facilitators that impact the implementation of IPC procedures at Jimma University Specialty Hospital (JUSH) in Jimma, Ethiopia with the intent of using this information to improve IPC practices and reduce the rate of hospital acquired infection.

Methods

We conducted a qualitative study to evaluate the potential barriers and facilitators to implementation of effective IPC practices at a public tertiary hospital in Ethiopia. Semi-structured qualitative interviews were conducted in June of 2017.

Study population

This study was conducted at JUSH, a public tertiary care hospital in Jimma, Ethiopia. JUSH is one of the oldest and the largest teaching hospitals in Ethiopia. The hospital provides specialized and referral services to an estimated population of 15 million located in a wide catchment area, with a radius of about 250kms. The hospital has departments of internal medicine, paediatrics, surgery, obstetrics and gynaecology, and emergency medicine.[9] During this study, the hospital was in the process of transitioning to a new 600 bed hospital directly neighbouring the older facility. JUSH had an infection control team in previous years, however, at the time of the study this team had disbanded secondary to lack of participating staff and organization. During the study period JUSH was in the process of re-establishing an infection control team, but the team was not well organized with clear roles, job descriptions, mandates or leadership.

Participants were selected using convenience sampling. They were recruited by other hospital employees. Inclusion criteria included being a JUSH hospital employee (regardless of involvement with direct patient care) and being proficient in communicating in Amharic or English. Exclusion criteria included unwillingness to participate or inability to communicate in Amharic or English. The goal was to select participants from a wide variety of employee roles in order to eliminate bias specific to one specialty viewpoint (Table I). A total of 22 participants were included, at which point the data set reached theoretical saturation with no new data likely to be generated by adding more participants.

Data collection

We conducted interviews using a semi-structured interview guide. The initial interview guide was based on the SEIPS model and included questions that addressed the interactions between the five components of the IPC work system: person, tasks, physical environment, organizational conditions, and tools and technologies. The interview guide was modified throughout the course of the study in response to participant responses to facilitate clarity and data set completeness. Questions that did not apply to the study setting (e.g., questions on antibiotics resistance testing) were removed and additional questions were added to prompt more detailed responses about common topics.

Interviews were conducted and recorded by two of the study authors, one of whom served as the on-site Amharic to English translator. Interviews were conducted in either English or Amharic depending on participant preference. Each interview lasted approximately 30 minutes and was recorded by a handheld device. All participants provided written informed consent in English or Amharic, depending on their stated preference. The interviews took place at JUSH in an available area near the interviewee's work environment.

To ensure participant confidentiality, each interview location was isolated from other employees and patient care areas. The interview recordings were assigned numbers that corresponded to a numbered consent form. Interview transcriptions were referred to by the assigned number. The author who conducted the study was the only individual with the key corresponding numbers to the interview responses.

Table I. Participant characteristics

Position	Number of participants	Average Length of Employment (years)
Lab personnel	2	5.5
Clinic Coordinator	2	33
Physicians	8	6.6
Nurses	6	5
Dentist	1	NA
Pharmacist	1	3.5
Infection Prevention Coordinator	1	NA
Environmental Services	1	12

Lab personnel: microbiologist, lab safety manager
Clinic coordinators: ART Coordinator, TB Clinic Coordinator
Physicians: Internal medicine resident, internal medicine physician, pediatrician, OB/GYN (x2), anesthesiologist, nephrologist, surgical resident
Nurses: Head ICU nurse, emergency department, surgical, Head maternity nurse, dental, stroke
Environmental Services: head of environmental services

Data analysis

The interviews were recorded and subsequently transcribed for thematic analysis using Dedoose (Version 8.0.42 SocioCultural Research Consultants, Los Angeles, CA). Dedoose is a qualitative data analysis software that integrates data captured from mixed media. We used a coding key to assign themes to the interview transcriptions to ensure reproducibility across interpreters and any future studies. The coding key was developed by the author who conducted the interviews. All data were entered by the same author who did the interview. The interview transcriptions were analysed and coded responses by defined themes based on the SEIPS framework. The quotes included in the results were typical views expressed in each interview to exemplify ideas of the participants.

Results

Participant characteristics

Twenty-two hospital employees participated in the interviews. Participants were selected from a variety of hospital roles including in direct patient care (physicians and nurses), organizational aspects of care (clinic coordinators and IPC staff), and the environmental services staff, different levels of acuity (e.g., primary care, ICU), and length of employment (Table I). Diverse subspecialties were represented in the sample, including internal medicine, nephrology, maternal health, paediatrics, intensive care unit (ICU), anaesthesia, emergency medicine, pharmacy, and dentistry. The length of employment ranged from two years to 33 years.

Tools and technology

Staff overwhelmingly reported a shortage of personal protective equipment (PPE) as a barrier to adequate IPC practices (Table II). PPE, including disposable non-sterile gloves, sterile gloves, gowns, shoe covers, surgical masks, and N95 respirators, was often unavailable. Shortages correlated with the end of the year, when new materials were ordered and the budgets were approved for each clinical department. Many staff members interviewed believed this was secondary to a poorly organized and executed supply chain management system rather than a budget shortage. Those responsible for supply inventory were reported to regularly underestimate the actual need, such as including employee use but not accounting

Table II. Barriers and facilitators to infection control, categorized by components of the Systems Engineering Initiative for Patient Safety (SEIPS)

Tools and Technology	Organization	Environment	Person	Tasks
Barriers				
Personal protective equipment (PPE) shortages	Inadequate supply chain management	Lack of isolation rooms	No dedicated infection control staff	High Workload
Inconsistent water supply	High turnover of nurse trainees	Overcrowding	Irregular/ inadequate infection control training	Poor adherence to handwashing
Facilitators				
Improved water access at new hospital	Adequate budget available	Routine cleaning by environmental services	Awareness of the issues surrounding infection control	
	Management receptive to feedback	Adequate sink locations		

for the PPE used by student trainees. A member of IPC staff summarized the issue as, "*The problem is that there are two activities, the clinical activities and the teaching activities. There are professionals coming from academic staffs, [the] hospital is planning for its own staff.*" To circumvent these shortages, some patients were told to bring their own disposable gloves with them to the hospital, similar to the way one would get a prescription for a medication, patients would get a "prescription" for supplies. PPE shortages were reported across a multitude of settings including the ICU, surgery department, inpatient units, and the outpatient units. Staff believed that without the availability of necessary PPE, employees were developing negligent attitudes towards IPC as a result of not having the materials needed to form consistent good habits.

Additionally, the hospital's water access was unreliable and varied between units. Notably, the maternity ward had yet to move to the new hospital facility and reported rarely having regular access to running water. When there was no running water, staff reported the next step was to use antiseptic solution if it was available. If there was no antiseptic, many units reported having a container of collected water that could be used, but staff expressed they did not feel this was a sanitary option. Others reported that they waited to wash their hands until they went home if there was no water available on the wards. An anaesthesiologist described the practice in his ward as follows, *"We either rub with alcohol, or we put [water] in a bucket. From [the] bucket you take out [the water] and wash your hands. How clean that bucket [is] nobody knows."* JUSH recently constructed a new hospital building and was in the process of transitioning units to the new facility during the data collection period. Interviewees reported that the new facility had improved access to water but access was still not always available when and where it was needed.

Alcohol-based hand washing products were not always available. An Ob/Gyn resident described the difficulty with maintaining hand hygiene in the face of these shortages, "*I have to buy hand sanitizer, you couldn't get [sanitizer]. It's sometimes, rarely, you found [sanitizer] on the ward. Otherwise no [sanitizer], no decontamination, you go home and wash with your own soap at home.*" Access to alcohol-based hand sanitizer was widely variable between units, similar to the access to running water. Some interviewees reported they felt the need to supply their own sanitizer to ensure adequate hand hygiene.

Organization

Staff often reported inaccurate prognostication of supplies as the reason for the frequent shortages in materials, including PPE and microbiology lab testing materials. At JUSH, supplies are ordered in advance by each department submitting a request to management for supplies for the upcoming year. Employees stated that those who were responsible for ordering supplies did not monitor inventory, adequately account for future use, or factor in the necessary budget for the supplies that would be needed. A surgical resident explained the following ordering problem in his unit, "*most of our surgeons their sizes are small sized people as in general, and our [glove] sizes 7.5 and 7 and the like. But most of the time what is purchased is number 8 or number 6, both extremes. This is part of the problem. The other thing is they don't know how [much] stock they have, they don't have [extras in] reserve, [so] always they start to run for purchasing when it was out of the store.*" Despite availability issues, participants repeatedly stated they believed that JUSH had adequate financial resources to purchase the correct items and number of supplies. As evidence, they listed adequate finances to support building a new hospital and improvements being made to the microbiology building at Jimma University.

Another reported problem was the persistent turnover of nursing staff. Nurse trainees at JUSH spend six months on one unit then rotate to a new unit. This creates a high level of internal turnover. Moreover, once nurses complete their training, they commonly leave JUSH. An Ob/Gyn physician said, "*In the operating room you know it take some time for them to be effective. I mean, so that they understand everything. Once they are accustomed to the things, once they have perfected the good [techniques], when they are doing things very good, they will be changed [to a new unit].*" This internal turnover was mentioned as an issue by both Ob/Gyn staff as well as Operating Room staff, units with infection control measures different than commonly expected to be practiced

by a floor nurse. In addition to the internal turnover, the reportedly high level of nursing staff leaving once completing their training, results in a high level of employee turnover.

Environment

JUSH has a large environmental services department that regular cleans the hospital buildings. Employees clean the floors twice daily, once in the morning once in the afternoon, and clean beds between patients. Nurses and environmental services staff did not always agree on whose job it was to ensure patients beds remain clean throughout the day.

Though water supply was intermittent, interviewees reported that sinks were located in easy-to-access locations that facilitate use when water was available.

Despite the new, larger hospital building, many individuals reported that units struggled with overcrowding. The maternity ward in the "older" hospital and the emergency department were both reported to be exceptionally overcrowded. A paediatrician said, "*Yes of course that is a major issue because the number of patients we are having is quite high compared with the space we have and at times we may be forced to keep many patients in a single room.*" Overcrowding is exacerbated by visitors and students (medical, nursing and pharmacy). There is not enough space to have dedicated isolation rooms to follow IPC guidelines for infectious diseases such as *Clostridium difficile* infections or tuberculosis. An Ob/Gyn physician said of isolation rooms: "*Surprisingly there is no such area. You can go and check the wards, they are overcrowded and there's no [beds] designated for isolation. You can't, [the beds are too] close, so can't go between the beds.*"

Person

Every interviewee said they were concerned with inadequate IPC at JUSH, indicating a high level of awareness of infection control. JUSH provided infrequent and inadequate IPC training programs. For care providers, there were no regular training or standard curriculum. Few participants reported having ever participated in training, and those that did reported that it occurred over two years ago. Employee services provide a regular IPC training, but employees have to wait multiple years to go through the training due to limited training slots. Interviewees expressed concern that the infrequency of the training resulted in large knowledge gaps for appropriate IPC practices and contributed to poor habits. Administrators were reportedly not included in IPC training, leading to a large knowledge gap for those responsible for overseeing supplies inventory and budget allocation. An IPC staff member explained, "*The in-service training should be given as I've said before, for these three disciplines: for professionals, for supportive staffs, as well as for all managements. We believe that what I think for our failure contribute more is that all staffs are not fully trained.*"

Additionally, interviewees reported that JUSH had neither a dedicated IPC staff/team nor a hospital-wide IPC policy. A former IPC team dissolved due to employee turnover; those who were on the committee reportedly did not see their IPC responsibilities as a main priority. The IPC committee had been tasked with creating IPC policies, and as a result of its dissolution, no standard, hospital-wide infection control policies were instated. Instead, some individual units such as the ICU created *ad hoc* policies. There was an effort being made to reassemble the IPC committee at JUSH, but that will require a budget and support from leadership with the power to mandate and implement an action plan that includes infection control.

Tasks

The majority of participants stated that they did not believe that employees of JUSH regularly or adequately wash their hands while providing patient care. Suggested reasons included not having adequate access to the necessary supplies such as running water, which then created poor habits even when supplies were available. Additionally, there was no consensus among the participants for how often hand washing needed to be done throughout the workday or in relation to patient care activities. "*It's not even trained to wash [hands] in between patients. It's after you complete the ward [rounds]*" – said one of the interviewees. Others stated they would wash their hands once they got home for the day since it was rare to have the materials needed to wash their hands at work. Interviewees also mentioned the heavy workload as a barrier to hand washing, especially

physicians in the maternity ward or emergency department. The overcrowded wards and busy workload resulted in physicians washing their hands after multiple patients rather than in between each patient interaction. *"Sometimes we cannot perform routine [hand washing]. When we are busy, just from one patient to one patient we can miss because it is a lot of patients" – Surgical Resident*.

Discussion

At Jimma University Specialized Hospital in Ethiopia, our qualitative analysis showed the major barriers to adequate IPC were shortages in PPE, poor management of supplies chain and inventory, the absence of an IPC team, limited knowledge and training opportunities in IPC, and a nurse trainee rotation schedule that created high turnover. Interestingly, our study identified an organizational weakness in the supply chain management as the leading barrier for the poor IPC practices seen at Jimma University. Unlike what is seen in most literature, the budget dedicated to buy PPE or alcohol based hand hygiene materials was not an important barrier in our study. These findings support the need for structural leadership changes to the IPC program to outline clear road map for step-by-step implementation of IPC practices. The facilitators identified included having an adequate budget available, the construction of a new hospital building with improved albeit inconsistent water access, and adequate environmental cleaning. The barriers and facilitators identified map to person, organization, tools, and task components of the SEIPS model.

Adherence to basic IPC principles including hand hygiene was identified as a barrier to IPC. Barriers to hand hygiene are not unique to JUSH. Observational studies of hand hygiene compliance in Ethiopian regional hospitals implicated both process and tools and technology in the overall poor rates of compliance with adequate hand hygiene routines. At a referral hospital in Debre Berhan, the overall hand hygiene compliance rate was only 22% and researchers cited lack of resources, lack of monitoring, and lack of performance feedback as reasons for the low compliance.[10] Similarly, the compliance rate observed at Hiwot Fana Specialized University Hospital was 18.7% and barriers identified included lack of training, lack of hand washing agents, and lack of time.[11] These studies mirror the barriers that were identified at JUSH, where we identified supply shortages to be a major barrier to hand hygiene compliance. An observational study conducted in central Ethiopia supports the use of the WHO multimodal hand hygiene campaign to improve rates of compliance in resource limited settings.[14] Although absolute rates remained low, this intervention increased hand hygiene compliance from 1.4% to 13.1%.[12]

A qualitative study utilizing the SEIPS model of analysis in the Philippines identified the presence of an effective IPC committee as a major facilitator of IPC.[13] The World Health Organization recommends that an IPC program, with a dedicated trained team, should be present at every acute healthcare facility to prevent HAI.[14] JUSH needs a team of invested individuals to reform the IPC team. This newly established IPC team must outline a specific IPC agenda for the hospital by breaking down the specific work components of a good IPC program and incorporating them into their program design. Guidelines on IPC best practices and procedures are effective in reducing HAI when concurrently implemented with employee education and training.[15] Therefore, the IPC committee at JUSH must lead IPC trainings and refresher courses, design, implement, and enforce IPC guidelines and policies, and monitor staff adherence. For the new program to be successful, hospital administrative leadership must regularly monitor/audit guideline compliance and provide timely feedback to those audited and relevant staff.[16] Moreover, leaders of the IPC program have to be empowered by the institution to implement the program successfully.

Hospital leadership should consider and investigate the impact of the nurse training rotation schedule on patient care on the wards. Studies conducted in northern India and the Philippines have documented that high rates of nursing staff turnover acts as a barrier to adequate IPC.[13,16] This rotation schedule necessitates consistent re-training of IPC practices specific to each new ward and subsequently places strain on the already limited IPC educational resources. To address this barrier we suggest reducing the frequency at which nurses change units, to thereby reduce the effects of employee turnover.

Common barriers to local implementation of an intervention include local attitudes and culture and availability of resources. Our results suggest that the hospital budget is sufficient, which will help with the successful implementation of a new IPC program.

Because hand hygiene compliance was said to be low at JUSH, it would be a great priority for the new IPC team to tackle as its first initiative. Not only would it create the opportunity for the IPC team to implement surveillance and audits to understand the magnitude of the problem and identify barriers to the practice, it would inform an intervention that can succeed in the local context. Furthermore, as hand hygiene is relevant to all healthcare professionals, improving adherence to best practices would improve IPC at the institution-level.

This is the first SEIPS work system analysis of IPC practices in a tertiary care hospital in Ethiopia. Our study in Jimma, Ethiopia identified facilitators to infection control and prevention at the person and organizational levels including the interest in improving IPC and available budget. Areas to improve IPC include restructuring supply chain management, instating an IPC committee, and limiting nurse rotation if possible. These findings can be used to guide further studies and interventions to improve IPC in Ethiopia as well as other resource limited countries. These recommendations should be considered with the understanding that any intervention should be adapted to local culture and context.

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Ethical approval

The institutional review board overseeing JUSH approved this study and the Health Sciences Institutional Review Board at the University of Wisconsin-Madison granted this study exemption from review. All participants signed a consent that was available in English or Amharic before any data were collected.

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