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Application of the behaviour-centred design to understand facilitators and deterrents of hand hygiene among healthcare providers: findings from a formative phase of a cluster randomised trial in the Kampala Metropolitan area

Tonny Ssekamatte[1*], Richard K. Mugambe[1], John Bosco Isunju[1], Rhoda K. Wanyenze[1], Aisha Nalugya[1], Christine Adyedo[2], Solomon T. Wafula[1], Esther Buregyeya[1], Rebecca Nuwematsiko[1], Joann Bateman[3], Julie Balen[3], Lynnette Lusenaka[4], Habib Yakubu[5] and Christine L. Moe[5]

Abstract

Background Hand hygiene is known to reduce healthcare-associated infections. However, it remains suboptimal among healthcare providers. In this study, we used the Behaviour-centered Design approach to explore the facilitators and deterrents to hand hygiene among healthcare providers in the Kampala Metropolitan area, Uganda.

Methods We conducted a formative qualitative study as part of a cluster randomised trial in 19 healthcare facilities (HCFs). The study used 19 semi-structured and 18 key informant interviews to collect data on hand hygiene status and facilitators and deterrents of hand hygiene. Research assistants transcribed verbatim and used a thematic framework aided by Nvivo 14.0. to undertake analysis. We used thick descriptions and illustrative quotes to enhance the credibility and trustworthiness of our findings.

Results About 47.4% of the HCFs had sufficient hand hygiene infrastructure, and 57.9% did not report total compliance with hand hygiene during patient care. The physical facilitator for hand hygiene was the presence of constant reminders such as nudges, while the biological included the frequency of patient contact and the nature of clinical work. The only biological deterrent was the heavy workload in HCFs. The executive brain facilitators included knowledge of workplace health risks, infection prevention and control (IPC) guidelines, and a positive attitude. A negative attitude was the executive brain deterrent to hand hygiene. Recognition, rewards, and fear of infections were the only motivated brain facilitators. Behavioural setting facilitators included proximity to functional hand hygiene infrastructure, the existence of active IPC committees, good leadership, and the availability of a budget for hand

*Correspondence:
Tonny Ssekamatte
tssekamatte@musph.ac.ug

Full list of author information is available at the end of the article

hygiene supplies. Behavioural setting deterrents included the non-functionality and non-proximity to hand hygiene infrastructure and inadequate supplies.

Conclusions The study revealed low compliance with hand hygiene during the critical moments of patient care and inadequacy of hand hygiene infrastructure. The deterrents to hand hygiene included a heavy workload, negative attitude, inadequate supplies, non-functionality, and long distance to hand washing stations. Facilitators included constant reminders, fear of infections, frequency of patient contact and nature of clinical work, positive attitude, knowledge of IPC guidelines, recognition and reward, good leadership, availability of budgets for hand hygiene supplies, availability and proximity to hand hygiene supplies and infrastructure and active IPC committees.

Trial registration ISRCTN Registry with number ISRCTN98148144. The trial was registered on 23/11/2020.

Keywords Hand hygiene, Behaviour centered design, Infection Prevention, And Control, Uganda

Background

Ensuring universal and equitable access to water, sanitation, and hygiene (WASH) services is one of the 17 interlinked global goals designed to be "A blueprint to achieve a better and more sustainable future for all by 2030" [1–4]. However, access to WASH services in healthcare facilities (HCFs) remains a challenge worldwide [5]. Globally, a quarter of HCFs lack basic water services, which means 712 million people have no access to water when they use HCFs, 10% lack sanitation services, and 30% do not have hand hygiene facilities at points of care [5, 6]. Half of the HCFs in low-and-middle-income countries (LMICs) lack basic water services, 60% do not have sanitation services, and only 30% have basic healthcare waste management services. Data on hand hygiene at points of care are still lacking in many LMICs (WHO and UNICEF, 2020). Uganda is no exception to the global WASH in the HCFs crisis. Our recent study indicated that less than half, 41.6%, of the HCFs in the Kampala Metropolitan area (KMA) had fully functional hand hygiene facilities (HHF) in patient care areas,10% did not have hand hygiene supplies, and only 56.6% had functional HHF with soap and water within five meters of the toilet block [7]. A similar deficit has been reported in HCFs in western Uganda [8, 9].

Hand hygiene, if practised at the right time, using the correct technique, with either alcohol-based hand rub or soap, water, and disposable/clean towels, can prevent healthcare-associated infections (HAIs) [10–13]. The transmission of pathogenic microorganisms in healthcare settings primarily occurs through contaminated healthcare providers' (HCPs) hands [14–17] and affects mothers and neonates the most [18, 19]. About 50 to 70% of HAIs are linked to non-compliance with hand hygiene during critical patient care [12, 20]. Pathogens can stay on the HCPs' hands for 2–60 min [21]. The actual burden remains unknown [22]; however, available evidence indicates that an estimated 7% of patients in HICs and 10% of those in LMICs acquire at least one HAI [21], which leads to death in about 10% of the patients [21]. Furthermore, HAIs are associated with prolonged hospital stays, long-term disability, increased antimicrobial resistance, and catastrophic healthcare expenditures [21, 22].

To improve compliance with hand hygiene during patient care, the WHO developed and provided technical guidance to streamline how, when, and what products should be used for hand hygiene [11]. The WHO requires that alcohol-based hand rub products contain at least 60% alcohol to be effective. It discourages chlorinated water of a concentration of 0.05% for routine hand hygiene due to its skin and other toxic effects [11, 23]. Nevertheless, chlorine solutions are still routinely used for hand hygiene in some healthcare settings, especially during disease outbreaks [24, 25]. The recommended duration of hand hygiene with alcohol-based hand rub is 20–30 s and 40–60 s for water and soap [11]. Hand hygiene should be practised in healthcare settings every time a healthcare provider conducts a clean/aseptic procedure, before and after touching a patient or the patient's surroundings, and after exposure to body fluids [11, 26]. The significance of adhering to hand hygiene during the critical moments of patient care is also elaborated in Uganda's infection prevention and control (IPC) guidelines (2015) [27] and the draft national guidelines for WASH in HCFs [28]. Despite the guidance provided by the WHO and the Ugandan Ministry of Health, there is limited evidence of the facilitators and deterrents of hand hygiene among healthcare providers. This study used the Behaviour-Centered Design (BCD) to explore the facilitators and deterrents to hand hygiene compliance among HCPs in the KMA, Uganda [29].

Novelty and the theoretical basis of the behaviour-centered design

The BCD is viewed as a future foundation for an applied science of behaviour change [29]. It blends reinforcement learning (learning through trial and error), the theory of change approach, behavioural determinants, and a practical process of designing, evaluating, and sustaining behaviour change [29, 30]. The BCD theory of change postulates that interventions create a cascade of effects via the environment setting, which causes changes in the

target audience's brain and body, impacting the desired behaviour [29, 30]. The theory of change in BCD guides programmers in making explicit claims about the cause-effect relationships during the design of the interventions [29, 31–34]. The implementation of the BCD follows five steps, i.e., (1) *Assess-* where the intervention designers gather evidence about the target behaviours; (2) *Bolster/Build-* which involves formative research to explore hypotheses about the likely drivers of change; (3) *Create-* where the creative team designs and tests the intervention package, (4) *Delivery* of the intervention via a set of planned activities, and (5) *Evaluate stage* where program designers assess the coherence of interventions with the program theory of change. Some studies in high-income countries have applied the BCD approach to improve hand hygiene practices, although the results have yet to be published [29]. Nonetheless, there is evidence of the impact of BCD interventions on WASH [35]. Figure 1 illustrates the BCD process model [31].

This formative study aimed to inform the design of interventions of a cluster randomised trial whose objective was to establish the impact of mobile phone WASH text messages and environmental cues on hand hygiene practice among healthcare providers. The primary outcome for the cluster randomised trial was the proportion of utilised hand hygiene opportunities, while the secondary was the E. coli concentration levels in 100mls of hand rinsates from HCWs, an indicator of recent faecal contamination of hands [32]. Mugambe, Mselle [32] have already published the detailed trial protocol. At the time of design of the formative study, healthcare providers working in the maternity and children's wards, in both the control and intervention arm, were to be exposed to a constant supply of soap and alcohol-based hand rub at all points of care, and innovatively designed hand hygiene facilities. In addition to the interventions common to both arms, healthcare providers in the intervention arm will be exposed to environmental cues and mHealth messages [32]. Healthcare providers appointed as full-time staff with at least six months' work experience in a healthcare setting who provide informed written consent will be eligible to participate.

Materials and methods

Design of the formative study, context, setting, and population

A formative descriptive study was conducted in HCFs in the KMA between October and November 2020. The study was conducted when the number of COVID-19 cases presenting with severe and acute disease in Uganda, especially in the KMA, increased [36]. The KMA comprises Kampala City and the neighbouring districts of Wakiso and Mukono. According to the Ministry of Health (MOH), the KMA has a total of 2,160 HCFs (1,458 in Kampala, 589 in Wakiso, and 113 in Mukono district) [37]. The description of the levels of healthcare facilities

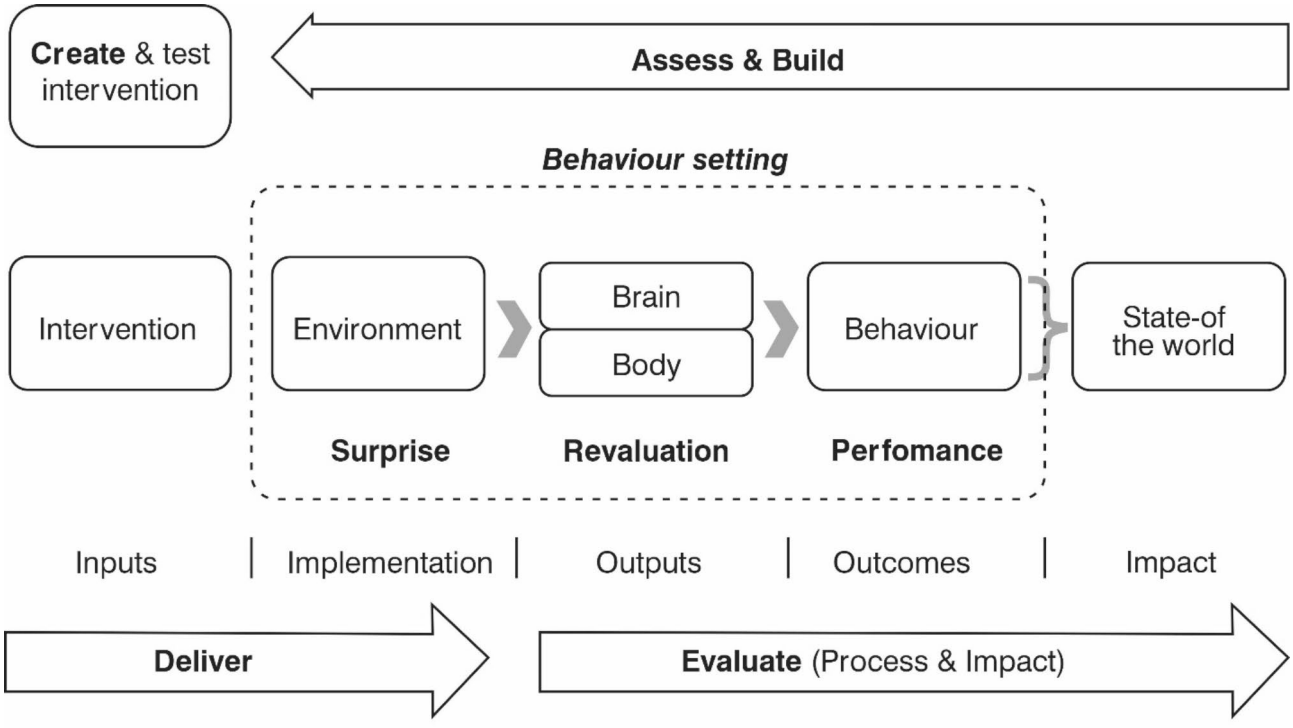

Fig. 1 The behaviour centered design approach [31]

in Uganda is reported in our earlier publications on WASH and IPC in HCFs [38, 39]. Briefly, HC IIIs provide preventive, promotive, outpatient curative, maternity, inpatient health services and laboratory services and have a catchment population of 20,000. In addition to services provided by HC IIIs, HC IVs provide inpatient, emergency surgery, blood transfusion, and laboratory services, with a catchment population of 100,000 [40]. The current study was conducted among healthcare providers, officials from the district public health department, and staff of non-governmental organisations (NGOs) serving the KMA population.

Sample size, sampling, and data collection techniques

During the formative phase, we selected 19 public and private-not-for-profit (PNFP) HCFs at levels III and IV since these have a core mandate to deliver Maternal, Newborn, and Child Health services to a group of people (mothers and children) who were at the most significant risk of getting HAIs. We conducted a total of 18 key informant face-to-face interviews. Key informants were purposively selected based on their knowledge, position, and experience on WASH/IPC in HCFs. They included managers of HC IIIs and IVs, IPC focal persons or nurses, administrators, Environmental Health Officers, officials from the MOH, district Public health teams, and NGOs. Operationally, we considered them HCPs because they were involved in delivering healthcare services [41]. The research assistants interviewed key informants until they reached the theoretical saturation level [42–44], where they obtained no new information. Before the interviews, research assistants made appointments with the participants by phone or physically visiting their workplaces. Research assistants conducted all key informant interviews in English, using a KI interview guide. The interview guide contained guiding questions on the deterrents and facilitators to hand hygiene during critical moments among healthcare providers in the KMA.

Research assistants conducted a total of 19 semi-structured interviews with healthcare providers from HC IIIs and IVs, including clinical officers, midwives, theatre assistants, nurses, and nursing assistants, to gather data on the deterrents to hand hygiene, motives for hand hygiene, social norms related to hand hygiene, behavioural settings, and touchpoints. They included only healthcare facility managers in the semi-structured interviews assessing hand hygiene infrastructure. Given the limited representation of PNFP HCFs, they subjected healthcare managers to key informant and semi-structured interviews in these settings. All the interviews were conducted at the workplaces of the respective participants.

Assessment of the status of hand hygiene infrastructure and behaviour

We used a semi-structured questionnaire to assess the status of hand hygiene infrastructure, supplies, and behaviours among healthcare providers. The questionnaire included questions on whether healthcare providers were motivated to practice hand hygiene, the presence of leaders to foster compliance to hand hygiene, availability and utilisation of hand hygiene supplies and infrastructure, the presence of an IPC committee, and the rating for hand hygiene at the HCF. We operationally defined a healthcare facility as having sufficient hand hygiene infrastructure if it had water, soap, or ABHR at all points of care at the time of the study. The research team developed the semi-structured questionnaire after reviewing the literature and guidelines on WASH in HCFs [38, 39, 45–47]. A semi-structured interview is an exploratory data collection method often used to generate qualitative and quantitative data [48, 49]. A semi-structured interview guide allows the researcher to delve into detailed topical trajectories as the conversation unfolds [48, 49]. Therefore, the quantitative results presented in this study result from the structured questions in the semi-structured interview guide. The assessment was conducted by research assistants, utilising a combination of observations and self-reports. The qualitative component of the study elicited information on compliance with hand hygiene, knowledge of IPC-related policy guidelines and standards, and facilitators and deterrents to hand hygiene.

Data management and analysis

Interviews, each lasting 30 minutes to an hour, were transcribed verbatim by two experienced research assistants (RAs). We used the thematic content analysis approach aided by NVIVO 14.0 Software [50, 51] to identify and describe implicit and explicit ideas within the data. Before the analysis, the research team developed a codebook that included the parent node, child node, and the definitions. Afterwards, two researchers coded the same transcript to establish intercoder reliability (ICR). The child nodes of the executive brain and motivated brain determinants were considered for the ICR test, yielding a 95% agreement. During the subsequent analysis, we followed the thematic analysis approach suggested by Naeem, Ozuem [52]. This specifically included (1) familiarisation with the data and the selection of relevant quotations, (2) selection of keywords, (3) coding, (4) theme development, and (5) conceptualisation through interpretation of keywords, codes, and themes. Two research team members independently coded the transcripts and later agreed on the themes, subthemes, and illustrative quotes. The initial coding process involved the categorisation of excerpts from the transcripts into the broad

themes of facilitators and deterrents. Afterwards, two researchers undertook thematic coding, guided by the BCD components, to uncover underlying meanings of words and sentence structure, relations, and concepts related to hand hygiene practice. Data analysis and interpretation involved data triangulation from the semi-structured interviews with findings from key-informant interviews. The reporting of findings adheres to the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist, a 32-item guideline designed for interviews and focus groups [53].

Quality control measures

We recruited RAs with vast experience in qualitative research methodologies and WASH/IPC in HCFs. The RAs underwent a day's training on the study protocol and ethical issues surrounding the study, such as obtaining informed written consent. Before data collection, the research team piloted/pretested the data collection tools at Kisenyi Health Centre (HC) IV in Kampala district. Pretesting allowed the research assistants to familiarise themselves with the tools and correct any discovered errors. Kisenyi HC IV was purposively selected as a pretest site because it shares characteristics similar to those of healthcare facilities in our study area. Supervisors thoroughly monitored the RAs to ensure they followed the study protocol and addressed ethical issues during interviews. Digital audio recordings captured all respondents' views. Besides, note-takers took handwritten field notes during the interviews using forms prepared to document a wide range of information. The team leader stored backup copies of recordings of qualitative interviews on a password-protected hard drive. The participants provided feedback on the results during a validation meeting.

Table 1 Background characteristics of the respondents

Description	Category	Frequency	Percentage (%)
Nature of interview	Key informant	18	48.6
	Semi-structured	19	51.4
Cadre/position of respondent	Administrator	1	2.7
	Clinical officer	15	40.5
	M&E officer*	1	2.7
	Midwife	8	21.6
	Nurse	8	21.6
	Nursing Assistant	1	2.7
	Program advisor	1	2.7
	Program Manager	1	2.7
	Theatre assistant	1	2.7
Age category	25–34	10	27.0
	35–44	16	43.2
	45 and above	11	29.7
Years of experience in the delivery of healthcare services	2–5	9	24.3
	6–10	7	18.9
	11–20	16	43.2
	21 and above	5	13.5
Place of work	Health centre III	27	73.0
	Health centre IV	6	16.2
	NGO	4	10.8
Ownership	PNFP	17	45.9
	Public	20	54.1
Location of the entity where the respondent works	Rural	12	32.4
	Urban	25	64.9

*M&E officer=Monitoring and valuation officer, NGO=Non-governmental Organisation

Results

Background characteristics of the study participants

The study included 19 semi-structured and 18 key informant interviews. None of the participants declined to participate. The majority, 40.5% (15/37) of the respondents were clinical officers, 43.2% (16/37) had between 35 and 44 years of age, 43.2% (16/37) had between 11 and 20 years of experience in the delivery of healthcare services (Table 1).

Status of hand hygiene

The study assessed hand hygiene infrastructure and practice in 19 HCFs. About 73.6% (14/19) of the HCFs were at the level of health centre III, 68.4% (13/19) were public, and more than half, 57.9% (11/19), were urban. Less than half, 47.4% (9/19) of the HCFs had sufficient hand hygiene infrastructure. Forty-two per cent (8/19) of the healthcare providers mentioned that their colleagues sufficiently complied with hand hygiene, 68.4% (13/19) knew the roles of the IPC committee, and more than half, 57.9% (11/19) mentioned that there was no compliance to hand hygiene during all the critical moments at their facility (Table 2).

Facilitators and deterrents to hand hygiene among healthcare providers

The facilitators and deterrents of hand hygiene have been classified based on the sub-components of the BCD model components (Environment, Brains, Body, Behavioural setting, and external context) (Fig. 2).

Facilitators of hand hygiene among healthcare providers (Fig. 3)

Physical environment determinants

Constant reminders such as mobile text messages, nudges, and posters

Healthcare providers, mainly those in public HCFs, mentioned that the presence of nudges and information, education, and communication (IEC) materials such as

Table 2 Healthcare facility characteristics and status of Hand hygiene infrastructure and practice

Variable	Response	Frequency (*n* = 19)	Percentage (%)
Level of HCF	Health centre III	14	73.6
	Health centre IV	5	26.4
Ownership	PNFP	6	31.6
	Public	13	68.4
Location	Peri-urban	8	42.1
	Urban	11	57.9
Healthcare providers at the healthcare facility are motivated to practice hand hygiene	No	5	26.3
	Yes	14	73.7
The leadership of the HCF facilitates compliance with hand hygiene among healthcare workers	No	2	10.5
	Yes	17	89.5
HCF has a functional hand hygiene infrastructure	No	4	21.0
	Yes	15	79.0
HCF has sufficient hand hygiene infrastructure	No	10	52.6
	Yes	9	47.4
Healthcare providers know the roles of the Infection Prevention and Control (IPC) committee	No	6	31.6
	Yes	13	68.4
How the respondent rated compliance with hand hygiene among the healthcare providers	Very good	6	31.6
	Good	8	42.1
	Average	4	21
	Very poor	1	5.3
Health providers comply with hand hygiene during all the critical moments of patient care	No	11	57.9
	Yes	8	42.1
HCF received support for the implementation of hand hygiene interventions	No	5	26.3
	Yes	14	73.7
Respondent is aware of any IPC guidelines	No	4	21.0
	Yes	15	79.0
HCF usually conducts training for healthcare providers	No	3	15.8
	Yes	16	84.2
HCF usually conducts training for support staff	No	3	15.8
	Yes	16	84.2
Patients/Caretakers are satisfied with healthcare providers' hand hygiene	No	5	26.3
	Yes	14	73.7

posters acted as reminders and thus facilitated them to practice hand hygiene, especially hand washing, during critical moments of patient care. Implementing partners such as the Uganda Virus Research Institute gave healthcare providers posters reminding them to practice hand hygiene during critical moments. Mobile text messages sent through the mTrac (a mobile phone-based health information system strengthening tool) platform also reminded healthcare providers and village health team members to practice hand hygiene, fostering compliance during critical moments.

"Yes, environmental cues are everywhere in the healthcare facility. These continuously remind us to adhere to hand washing during critical moments of patient care. The handwashing posters at the healthcare facility, especially in the wards, also teach and remind us how and when to wash hands during patient care since learning is a continuous process. The person in charge also encourages us to wash hands and monitors us regularly." (Enrolled midwife).

"Through the mTrac platform, we receive messages from the district. These messages are sent to all healthcare providers registered on the platform, including VHTs (Village Health Teams). Since most health providers are registered, we receive reminders on hand hygiene through the platform. Secondly, the other way we have been receiving reminders is through training." (Enrolled nurse).

Social environment determinants

Existence of IPC Committees/ active focal persons

Almost all the HCFs (16/19) had a committee or a focal person in charge of infection prevention and control. The IPC committee or focal persons were involved in routine monitoring and provision of feedback on hand hygiene, display of reminders on hand hygiene, conducting routine continuous medical education (CME), and ensuring the availability of hand hygiene supplies at all points of care.

"The IPC committee reminds us and encourages us always to clean our hands. Each day, the focal person or any other committee member moves around to check and monitor hand hygiene in the different departments. In addition, they conduct CMEs (Continuous Medical Education) at least every month and carry out weekly supervision. They also make duty plans for cleaners and ensure water and soap are available at hand washing stations." (Senior Clinical Officer).

"The IPC (infection prevention and control) committee does monthly assessments in each department. For example, when we go to the theatre, we have to assess whether the equipment is thoroughly cleaned, well-dusted and well-sterilised, then score. We score and give them feedback at the end of the day. Also, before we start our other duties, we move around to ensure that waste is properly segregated and hand hygiene is adhered to. We have to ensure that supplies like water and soap are in place. That is what

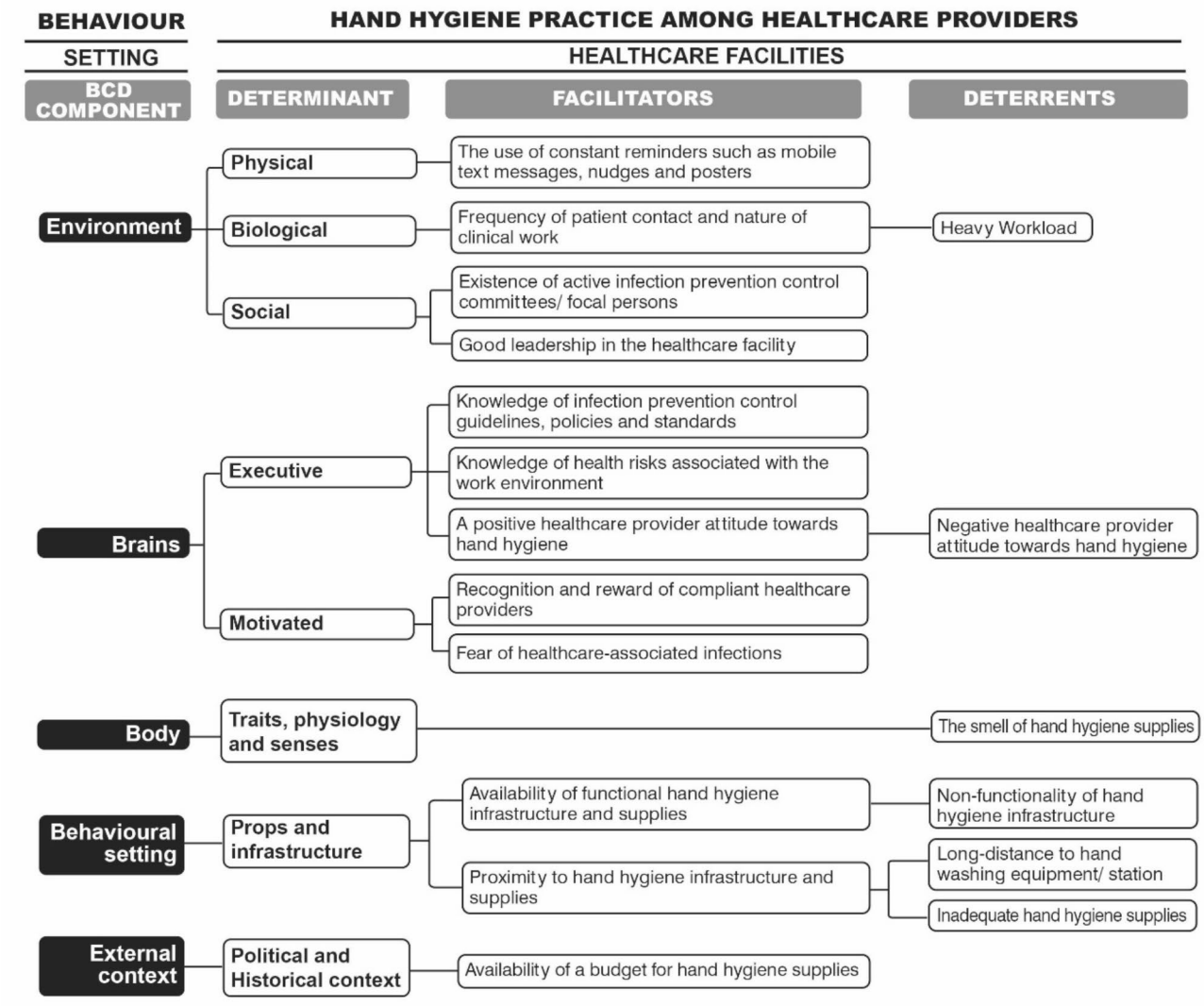

Fig. 2 Facilitators and deterrents to hand hygiene among healthcare providers in the Kampala Metropolitan Region, Uganda

we always do daily." (IPC committee member/theatre assistant).

In 14/19, the IPC committee had someone in charge of enforcing infection prevention and control including hand hygiene and availing hand hygiene supplies to the different departments. The IPC committee provided support supervision, during which they reminded the different staff to practice hand hygiene during critical moments.

"We have an IPC (infection prevention and control) committee that sits regularly, and someone has been appointed for hand hygiene. This person makes sure that there are enough supplies for washing hands. We have enough hand washing facilities available for everyone to use. Also, we have a water tank donated by Water Aid for rainwater harvesting in addition to a national water connection. We have sinks in every room and sanitation stations in every corner. The IPC focal person reminds the clients to wash their hands "(Healthcare facility in charge).

We have a committee on IPC, and we identified someone responsible for enforcing infection prevention and control in each department. Everyone is encouraged to wash their hands!" (Healthcare facility in charge).

Good leadership in the healthcare facility

The study revealed that good leadership by the healthcare facility in-charges and administration portrayed through ensuring a constant and reliable supply of hand hygiene infrastructure and supplies motivated healthcare providers to adhere to hand hygiene during all critical moments.

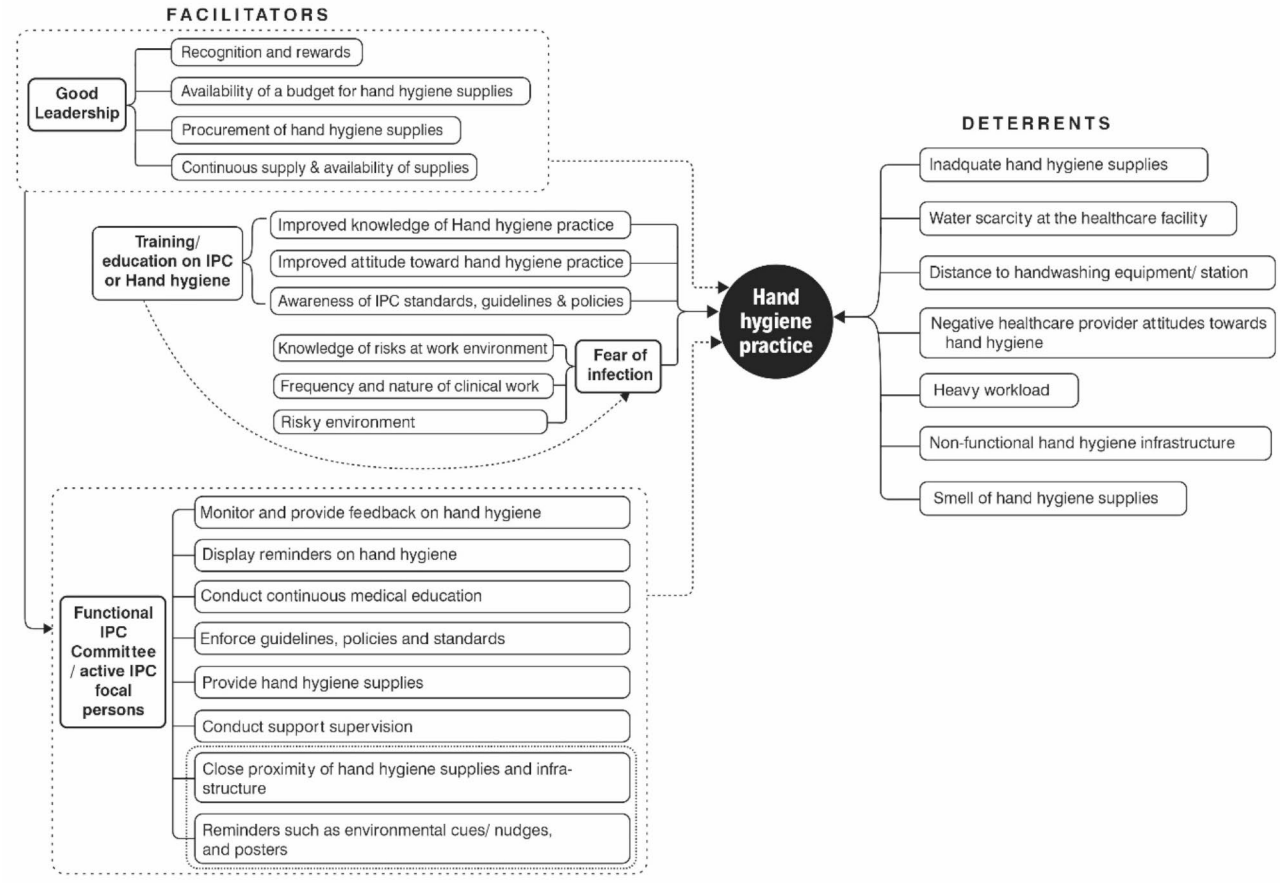

Fig. 3 Facilitators and deterrents of hand hygiene among healthcare providers in the greater Kampala metropolitan region, Uganda

"The administration has provided IPC (infection prevention and control) infrastructure, for example, every clinical room has soap and water. We are encouraged to wash hands after a procedure or even before touching a client." (Key informant).

"Yes, for example, maternity and lab healthcare providers may practice hand hygiene more than people at OPD (outpatient department) or pharmacy, where touching the patient is not necessary." (Assistant Nursing Officer).

Biological environment determinants

Frequency of patient contact and nature of clinical work

Healthcare providers who were frequently involved in the physical examination of patients practised hand hygiene more than their counterparts who did not physically examine patients. Healthcare providers working in the maternity ward, theatre, and laboratory were more likely to practice hand hygiene than their counterparts at the outpatient department (OPD), pharmacy, and other prescription or dispensing stations.

"The fact that my duties in the maternity ward require much examining and constant touching of the patients motivates me to wash my hands. I wash my hands more frequently because we often do not wear gloves, especially during antenatal, and the patients always sweat." (Enrolled midwife).

Executive brain determinants

Knowledge of health risks associated with the work environment

Healthcare providers became knowledgeable of the health risks their work environment posed, and the benefits of hand hygiene through the continuous training provided by the district health office, partner organisations, healthcare facility in-charges, and IPC committees. These built their capacity on hand hygiene, disinfection, waste management, and donning and doffing personal protective equipment. Some respondents mentioned that one of the aims of these trainings was to make sure that healthcare staff adhered to hand hygiene during all the critical moments of patient care.

"We had training on how to wash hands, which solutions to use for hand hygiene, and dilution and mix-

ing of these solutions. So, the training was conducted mainly to make sure that people (healthcare providers) adhere to hand washing during all the critical moments, and also to learn how to mix the chlorine solutions" (Clinical Officer).

"These days, AMREF (The African Medical and Research Foundation) has come up to teach us the 7 steps of hand hygiene. We used to wash our hands normally but when we were taught about the 7 steps, it became a part of us" (Clinical officer).

Knowledge of infection prevention and control guidelines, policies, and standards

Knowledge of some IPC guidelines, policies, and standards among healthcare providers facilitated hand hygiene in the healthcare facility. Although no guidelines were seen in the majority of the HCFs, most respondents were aware of some of the guidelines, such as the hand hygiene technique, critical moments of hand hygiene in a healthcare setting, and how to mix chlorine for purposes of disinfection. Respondents pointed out that these guidelines reminded them of the benefits of hand hygiene and the dangers of hand hygiene non-compliance. The IPC committees enforced these guidelines at the respective HCFs.

"We have Continuous Medical Education sessions where we integrate Infection Prevention and Control. We also have infection prevention and control committee members who enforce these guidelines in the different departments." (Healthcare facility in charge).

"The guidelines usually remind us of the importance of hand washing and the danger of cross-infection in the facility. They remind us of having the IPC (Infection Prevention and Control) committee that should be functional with meetings that discuss issues of IPC." (Healthcare facility in charge).

Knowledge of hand hygiene was derived from training which was conducted by the Ministry of Health and partners like the Infectious Diseases Institute (IDI), GIZ, AMREF, and UNICEF.

"AMREF and GIZ have sensitised us about the steps of hand hygiene. We used to wash our hands normally but when we were taught the steps, it became a part of us." (Clinical officer).

"IDI trained us on the five critical moments of hand hygiene in a healthcare setting. The Ministry of Health has also provided us with brochures talking about hand hygiene." (Enrolled midwife).

While knowledge of some aspects of the guidelines facilitated hand hygiene, it was evident that the knowledge of the policies, guidelines, and standards was suboptimal. For example, some respondents confused the five moments of hand hygiene with the hand hygiene technique.

There is a policy with the five steps of hand hygiene, the policy of washing hands during all critical moments, the policy of washing hands at the entry and exit of the health facility, and the policy of washing hands after handling medical waste. (Healthcare facility in charge).

While healthcare providers had knowledge of which aspects of hand hygiene were covered in the infection prevention and control guidelines, others, particularly those in private-profit HCFs, were not.

"I have not heard about the national policy, guidelines, or standards on hand hygiene and I have not heard of regulations about hand hygiene. What I can say is that in the medical setting, we use hand hygiene to control infections." (KI-PNFP).

A positive healthcare provider's attitude towards hand hygiene

A few respondents reported a positive healthcare worker attitude as a facilitator of hand hygiene during critical moments.

"The attitude of health providers is key. I have been involved in training health providers here and they are positive about hand hygiene. They do practice it not because I am around but do it in good faith." (Enrolled midwife).

Motivated brain determinants

Recognition and reward of compliant healthcare providers

Some healthcare providers pointed out that recognising best-performing departments and staff enhanced hand hygiene compliance during the critical moments of patient care. Respondents mentioned that departments viewed as non-compliant during recognitions were motivated to improve their hand hygiene behaviour to be proclaimed best performers.

"Of course, when you're viewed as a non-compliant department, you get the urge to improve. There is

no penalty, however, the next time, you would also want to be recognised as the best performer in hand hygiene. So, they (management) majorly do recognitions to motivate compliant departments and healthcare providers." (Enrolled nurse).

Fear of healthcare-associated infections

The fear of contracting healthcare-associated infections such as COVID-19 motivated healthcare providers in this study to practice hand hygiene at all possible opportunities. Respondents mentioned that working in a risky environment that is prone to infections instills fear among them, hence they comply to protect themselves and their families.

"Before COVID-19, hand hygiene was not taken seriously now it is. It is practiced continuously with soap and water or sanitisers due to the fear of contracting the infection. So yes, being that we are in an environment prone to infections, we have to practice hand hygiene to protect ourselves and our families." (Assistant Nursing Officer, Wakiso district).

Besides the fear of contracting healthcare-associated infections such as COVID-19, some HCWs were knowledgeable of the health risks their work environment posed, and the role hand hygiene played in controlling and reducing the risk of acquiring infections. They acknowledged that they are exposed to both visible and non-visible dirt, hence the need to practice hand washing.

"We know that we are supposed to practice hand washing since this is not a safe or clean environment. We are exposed to visible and non-visible dirt daily, so we must wash our hands. During the COVID-19 pandemic, we know that we can prevent further infections through hand washing." (Clinical Officer).

Behavioural setting - props and infrastructural determinants

Availability of functional hand hygiene infrastructure and supplies

Healthcare providers in 17/19 of the HCFs mentioned that the provision and availability of hand hygiene infrastructure and supplies such as soap, water, sinks, jerry cans, and alcohol-based hand rub/sanitiser at every point of care and working station facilitated adherence to hand hygiene during critical moments. Hand hygiene supplies were often provided by the Ministry of Health and partners such as UNICEF, AMREF, and Water Aid Uganda. Some healthcare providers also mentioned that the management of their HCFs often ensured continuous supply and availability of hand hygiene supplies which eases hand hygiene compliance during critical moments. Availability of hand hygiene supplies was more common in private not-for-profit HCFs compared to public HCFs.

"First of all, hand hygiene supplies are always available. For instance, after using the toilet, you will be looking at the sink so you can't pass by it without washing your hands. In case you are going to touch a patient the sanitiser or alcohol-based hand rub will be there. If you are done attending to a patient, you wash your hands because the sinks are available." (Enrolled Nurse).

"They (management) provide us with the supplies we need to practice hand hygiene such as soap and water. Water is always available at the sink. This eases the process of hand washing during the critical moments." (Enrolled midwife PNFP).

The role of healthcare providers and other support staff was also evident in ensuring the functionality of hand hygiene infrastructure, safety, and availability of hand hygiene supplies. The functionality of hand hygiene infrastructure was facilitated by regular notification of healthcare facility management (i.e., to the in-charge or IPC focal person) about breakdowns, and immediate replacement of non-functional parts such as taps and sinks. Healthcare providers and other support staff collaboratively worked together to ensure that hand washing stations at all points of care had water and soap. The cleaning staff also ensured the safety of the hand hygiene stations through regular cleaning, which in the end attracted healthcare providers.

"We work as a team, in that if the water can does not have water, you cannot just look on. As an individual, you have to ensure that there is water in the handwashing facility. If your colleagues are busy, then you take the initiative to refill the hand washing facility. The support staff as well as fellow clinical staff often ensure that there is a constant supply of soap. In case it's exhausted, one can just cut a piece and make a replacement. It's not an individual but team effort." (Enrolled nurse).

Besides the availability of hand hygiene supplies and infrastructure, the strict enforcement of hand hygiene before entry and during other critical moments among healthcare providers further reinforced the practice.

"We have made it mandatory for healthcare providers to wash their hands at the gate and put on a face

mask, which safeguards us and the clients. When a healthcare provider enters the gate, he/she must wear a face mask, undergo temperature screening, and wash hands using soap and water. In addition, if one is a health worker, he/she must put on gloves and properly segregate medical wastes." (In-charge, Public HC IV).

Proximity to hand hygiene infrastructure and supplies

The majority of the healthcare providers, particularly those working in public HCFs, pointed out that hand hygiene during critical moments was possible due to the proximity to equipment and supplies such as soap and sinks, water, and jerry cans. Respondents mentioned that having these supplies close to their working stations and points of care motivated them to practice hand hygiene. They further highlighted that the flexibility of movable hand washing cans also eases hand washing.

"They are motivated because of the proximity and availability of hand washing materials like sanitisers, soap, and water. They are too close because every department has a hand washing facility with soap and water. For example, there's a station both in and out of the laboratories, at OPD, clerking room, theatre, and also in the maternity. Even in this room, there is a provision of an in-built sink that you can see with flowing water and soap." (Clinical Officer).

"We have stations at each critical point of care in the ward for example the antenatal, examination, delivery room, postnatal room, and also at the entrances. Of course, the movable hand washing stations have also improved hand hygiene among health providers because you can place them wherever you want or wherever you're seated. In case you want it closer, you can just pull it." (Enrolled midwife).

External context

Availability of a budget for hand hygiene supplies

It was pointed out that having a budget for infection prevention and control facilitated hand hygiene compliance. The availability of a budget facilitated procurement and, thus the availability of hand hygiene supplies at the HCF.

"We have a budget that supports procuring hand hygiene supplies such as soap and sanitisers. It is a sufficient budget and as an in charge, I make sure that hand hygiene supplies and equipment are provided on time." (Manager, Hospital).

Deterrents to hand hygiene compliance among healthcare providers (Fig. 3)

Biological environment deterrents

Heavy workload The heavy workload was cited by healthcare providers as one of the deterrents to compliance with hand hygiene during the critical moments of patient care, particularly among those working in health centre IIIs. Healthcare providers in HC IIIs pointed out that staff shortages left those on duty exhausted after performing their roles, and consequently, they neglected hand washing.

"Due to the nature of health centre IIIs, there is one nurse and a mid-wife who performs all the duties. So as the day goes by, they become tired and might neglect hand washing." (Enrolled midwife, HC III).

"They just forget to wash hands. At times, they tell you that they were so busy to an extent that they didn't find time to practice hand hygiene during the critical moments." (Healthcare facility in charge, private not-for-profit HC III).

Executive brain deterrents

Negative healthcare provider attitude towards hand hygiene A negative attitude towards hand hygiene coupled with unfavourable beliefs and perceptions hindered hand hygiene during the critical moments of patient care. Some healthcare providers in both public and private not-for-profit HCFs believed that hand washing wasn't necessary when they did not get into contact with a patient's body and for procedures performed while wearing gloves, whereas others believed that gloves offered adequate protection and eliminated the need to perform hand hygiene after patient care. Respondents reported that this is common in the Antiretroviral Therapy (ART) clinic.

"Sometimes people's attitudes hinder them from practicing hand hygiene during the critical moments of patient care. There are those health providers who have the belief that hand washing isn't necessary when you perform a procedure while putting on gloves. They think it's okay and safe because she has protected herself with gloves. Yet, if I touch you and then others, I am transferring infections." (Senior Clinical Officer).

"So, for the ART (Antiretroviral Therapy) clinic, they (healthcare providers) rarely examine patients. As you have observed, when they are seeing their patients, they only do refills of ARVs, and when they

are dispensing their patients, there's less interaction with the patient's body. They think it's safe yet one of the moments for hand washing is after touching the patient's surroundings. (Clinical officer).

Furthermore, some healthcare providers, most especially those in public and private-not-for profit lower-level HCFs such as HC IIIs, believed that some clients were not infectious, because they did not appear so, hence the reluctance to practice hand hygiene.

"Some (healthcare providers) believe that their clients are not infectious. The appearance of the clients influences the healthcare providers' tendency to wash hands, while others are just lazy to wash hands." (Enrolled midwife).

Body-traits, physiology, and senses deterrents

The smell of hand hygiene supplies

A few (3/19) healthcare providers cited the smell of hand hygiene supplies, particularly chlorine as a hindrance to practicing hand hygiene during all the critical moments of patient care. These healthcare providers mentioned that the sharp pungent smell of chlorine discouraged them from practicing hand washing during the critical moments of patient care. A few healthcare providers also pointed out that the use of chlorine made their skins rough.

"Yes, something like chlorine, it has a pungent smell. The hands also feel rough after use and the smell is sharp. So, such sensitivities sometimes deter health providers from doing hand hygiene." (Enrolled nurse).

Behavioural setting- props and infrastructural deterrents

Inadequate hand hygiene supplies

Due to insufficient water, soap, and sanitisers, healthcare providers failed to practice hand hygiene during critical moments. For example, the large number of healthcare providers, including healthcare facility staff, students, and volunteers, made it difficult for each to own sanitisers. Due to the failure to access hand hygiene supplies, some healthcare providers were forced not to practice hand hygiene or wash hands with only water until supplies were available. Water scarcity, especially during the dry season, was also reported as a significant barrier to hand hygiene among public and private not-for-profit HCFs.

"There are times when we have a scarcity of hand hygiene supplies. We get our supplies from NMS (National Medical Stores) periodically. So, when our supplies get used up, there isn't any other option but to do without them or to improvise by supporting each other to have these materials. As of today, sanitisers are out of stock. You are aware that every health worker needs to have a pocket sanitiser. However, this may not be feasible for everyone because we have students and volunteers, you know! You cannot start buying for everybody. Even if you decide to buy for yourself, it does not help." (Clinical Officer).

Long-distance to hand washing equipment/ station The distance to a hand washing station or equipment discouraged some healthcare providers in both private not-for-profit and public HCFs from practicing hand hygiene during the critical moments of patient care. Healthcare providers mentioned that hand hygiene stations such as hand washing basins, sinks, and jerry cans were located far away from the users' workstations, making it inconvenient for them to practice hand hygiene during critical patient care.

"Hand washing stations are far away from some healthcare providers' workstations. In some departments, the hand washing facility is several meters away, which can affect hand hygiene during critical moments. They sometimes find it difficult to move from one room to another just to wash their hands. As with my colleagues at that clinic, their handwashing facility is a bit far from theirs. They move from room to room." (Clinical Officer).

Non-functionality of hand hygiene infrastructure

Non-functional or faulty hand washing stations hindered healthcare providers from performing hand hygiene during critical moments of patient care. Healthcare providers noted that taps usually break down due to misuse on busy immunisation days, discouraging them from adhering to hand washing. Furthermore, they highlighted that hand washing stations are often stolen due to their temporary nature, hindering them from complying with the practice.

"Another thing is that some hand washing stations are faulty or non-functional. Every time we have an immunisation clinic, taps get broken. So, breakdowns sometimes hinder us from practicing hand hygiene during the critical moments of patient care. They are also not permanent, as you can see, so they get stolen since the healthcare facility is not fenced." (Senior Clinical Officer).

Discussion

This study used the BCD model to explore the facilitators and deterrents to hand hygiene during the critical moments of patient care among healthcare providers in the Kampala Metropolitan region, Uganda. The current study revealed that constant reminders such as mobile text messages, nudges, and posters facilitated hand hygiene. Based on the BCD model, constant reminders such as posters, nudges, and mobile text messages in the healthcare environment can create a surprise that may attract and grab the attention of healthcare providers to practice hand hygiene [30]. Evidence shows that creating a surprise in an environment like a healthcare setting can help stimulate healthcare providers to practice hand hygiene [54, 55]. For instance, a study conducted in Italy found that text messages, nudges, and posters serve as stimuli that can enhance learning in a healthcare setting [55]. Without such stimuli, healthcare providers may not acquire new knowledge. Besides, posters, mobile text messages, and nudges nullify wrong perceptions about hand hygiene, thereby fostering the practice among healthcare providers. Given that the formative stage has revealed this finding, the study team will now implement nudges, posters, and mobile text messages to increase participants' knowledge of hand hygiene and effectively capture their attention for improved practice.

The fear of healthcare-associated infections, including COVID-19, facilitated hand hygiene among healthcare providers. Biological agents such as viruses, bacteria, and fungi often cause intrinsic disgust, a motive that facilitates disease-avoidance behaviour. Hand hygiene in a healthcare setting is critical for reducing the risk of healthcare provider contamination and infection [56, 57]. Therefore, the fear of healthcare-associated infections such as COVID-19 prompts healthcare providers to practice hand hygiene frequently. The failure to practice hand hygiene compromises the safety of healthcare workers and patients and puts the health of the family members and close contacts of the healthcare providers at risk [58, 59]. Therefore, the motive to care for and protect (also termed as nurture) one's kin and patients from healthcare-associated infections may drive hand hygiene, as indicated in a similar study in the United States [60].

Healthcare providers' knowledge of IPC guidelines, policies, and standards was crucial in improving hand hygiene during critical moments of patient care. Based on the BCD approach, knowledge of infection prevention and control measures such as hand hygiene and its benefits influences intentions and plans and, eventually, the performance of a given behaviour (which in this case was hand hygiene) [29, 61]. Healthcare providers knowledgeable about IPC guidelines, policies, and standards may have been encouraged to practice proper hand hygiene. Uganda's IPC guidelines emphasise the importance of hand hygiene, detailing the different types, recommended agents, techniques, and their application [27]. However, it is essential to acknowledge that while knowledge can contribute to behaviour change, as reported in this study and previous studies in South Korea, Western Cape, and Tanzania [62–64], it alone may not be sufficient to ensure sustained hand hygiene compliance. Several studies, including those conducted in Cambodia, have shown that knowledge alone may have a limited impact on changing hand hygiene practices [65]. Thus, improving knowledge of IPC guidelines, policies, and standards and addressing other contextual factors will likely contribute to achieving optimal hand hygiene practices in healthcare facilities. Despite the evidence derived from our study and earlier research from South Korea, Western Cape, and Tanzania [62–64], it was evident that some healthcare providers still lacked adequate knowledge of IPC guidelines, policies, and standards. This gap underscores the need for implementing partners and health authorities to disseminate these guidelines and sensitise healthcare providers about their importance.

Healthcare providers were motivated to practice hand hygiene during critical moments of patient care if they anticipated being rewarded or recognised. The impact of recognition and rewards is not surprising, as people's actions, including hand hygiene, are often driven by goals. Without a clear goal, individuals may not feel compelled to adopt certain behaviours. Evidence suggests that rewards can effectively encourage desired behaviours such as hand hygiene [66–68]. Our findings are consistent with studies conducted in high-income countries like Australia, which have reported that recognition and rewards are significant motivators for hand hygiene in healthcare settings [69, 70]. However, the fact that healthcare providers in our study are motivated by recognition and rewards suggests that if these incentives are withdrawn or not maintained, compliance with hand hygiene during critical moments could decrease.

Our study revealed that the nature of the behavioural setting was critical in facilitating or hindering hand hygiene among healthcare providers. The presence of active IPC committees/ focal persons, good leadership and a positive healthcare provider attitude were particularly critical for compliance with hand hygiene during the critical moments of patient care. Conversely, a negative attitude negatively impacted hand hygiene during the critical moments of patient care. IPC committees and focal persons are responsible for supporting adherence to standard precautions influencing healthcare providers' perceptions and attitudes towards hand hygiene. IPC committees and focal persons influence the normative setting in which hand hygiene is practised [71–76]. IPC committees and focal persons influence descriptive, personal, injunctive, and subjective norms. Concerning

descriptive norms, IPC committees and focal persons are responsible for influencing the perceptions of healthcare providers so that they embrace hand hygiene in healthcare settings. IPC committees and focal persons are also responsible for influencing personal norms by ensuring that hand hygiene is part of the expected behaviour exhibited by healthcare providers. IPC committees and focal persons make rules and approve IPC measures on behalf of the healthcare staff, which influences the social setting [30]. Approval of hand hygiene (injunctive norm) as an effective measure of breaking transmission of healthcare-associated infections by the IPC committee and focal persons is likely to have facilitated compliance.

Good leadership and the availability of budgets for hand hygiene supplies are crucial for ensuring hand hygiene during critical moments of patient care. Effective leadership enables healthcare providers to plan and allocate resources specifically for hand hygiene. When resources are favourably allocated to IPC and hand hygiene, essential supplies such as water and soap are likely to be available, thereby promoting hand hygiene during critical moments of patient care. Additionally, strong leadership allows healthcare facilities to plan capacity-building interventions, such as IPC training. Other scholars have also documented the vital role of IPC committees and focal persons in facilitating hand hygiene [76–78].

Access to hand hygiene infrastructure and supplies facilitated hand hygiene among healthcare providers. Based on the BCD approach, hand hygiene infrastructure such as hand washing facilities and related supplies may be classified as objects that facilitate healthcare providers' compliance with hand hygiene during critical patient care [33, 66]. The availability of hand hygiene facilities in healthcare settings is not enough to facilitate hand hygiene. These facilities and supplies need to be accessible and user-friendly for healthcare providers. As indicated in our study, long distances to and non-functionality of hand hygiene facilities hinder healthcare providers' intentions to practice hand hygiene during critical moments. Non-availability and long distance to a hand hygiene facility sometimes result in an inconvenience and a waste of a healthcare provider's time [61, 79, 80], thus increasing non-compliance to hand hygiene during the critical moments of patient care. Therefore, our findings highlight the need to ensure the availability and proximity of hand hygiene facilities. Strategically placing hand hygiene facilities or stations would allow healthcare providers to access them and easily perform hand hygiene whenever needed.

The frequency of patient contact and the nature of the clinical work influenced hand hygiene during critical moments of patient care. Healthcare providers working in departments such as maternity and laboratory where there is frequent patient contact were reported to practice hand hygiene during critical moments more often compared to their counterparts working in departments (such as OPD) where there was less patient contact. The close interaction between the healthcare providers and the biological environment may have prompted healthcare providers to practice hand hygiene. Healthcare providers in constant contact with the biological environment often practice hand hygiene due to fear of infection, given their constant exposure to infectious agents such as coronavirus [81–83]. Conversely, a heavy workload was an essential deterrent to practising hand hygiene during the critical moments of patient care. A heavy workload means healthcare providers must see more patients, leaving less time for hand hygiene during critical moments and between patients. Sometimes, healthcare providers are only motivated by clearing all patients instead of practising hand hygiene. Therefore, having no waiting patients turns out to be a reward that happens at the expense of hand hygiene. This implies that hand hygiene may not provide a tangible benefit as working with patients in a queue, yet it is rewarding and drives behaviour [29, 30, 66]. Our findings are consistent with those of other scholars from Ethiopia and other LMICs [58, 84, 85], which have all indicated the negative impact of workload on hand hygiene.

Our study revealed the smell of hand hygiene supplies as a barrier to hand hygiene during critical moments. Hand hygiene supplies like bleach, which is often made from a chlorine solution, have a pungent and irritating odour. Similarly, the smell produced by alcohol is sometimes unpleasant and irritating [86, 87]. Therefore, healthcare providers often avoid practising hand hygiene to avoid unpleasant and irritating smells. In a nutshell, smelly hand hygiene supplies become a disgust that healthcare providers avoid. Aunger and Curtis [61] and Curtis, Danquah [83] elaborate disgust as a human behaviour motive. Smell as a hindrance to hand hygiene should, therefore, be considered in WASH in HCFs' interventions. Availing of hand hygiene supplies such as soap and alcohol-based hand rubs that have a pleasant smell is likely to increase hand hygiene compliance, as reported by [88].

Strengths and limitations

This qualitative study provides an in-depth understanding of the facilitators and deterrents to hand hygiene, which quantitative studies may not. The study used a relatively large sample size, enabling the researchers to reach theoretical saturation on most themes. It quantifies critical indicators such as healthcare provider knowledge of the roles of the IPC committees, availability of such committees, and hand hygiene infrastructure. Limitations included the use of self-reports yet they are

vulnerable to social desirability and recall biases [89]. The current manuscript's quantitative results represent only the cohort studied in the qualitative component and should not be generalised to all HCFs in KMA.

Conclusions

Our study revealed that a multitude of facilitators and deterrents influence hand hygiene behaviour during the critical moments of patient care. The facilitators of hand hygiene compliance included constant reminders such as mobile text messages, nudges, and posters, fear of healthcare-associated infections, including COVID-19, frequency of patient contact and nature of clinical work, knowledge of infection prevention and control guidelines, policies and standards, a positive healthcare provider attitude, recognition and reward of hand hygiene compliant healthcare providers, the existence of active IPC Committees/ focal persons, good leadership, availability of a budget for hand hygiene supplies, and proximity to functional hand hygiene infrastructure and supplies. The deterrents to hand hygiene included a heavy workload, negative healthcare provider attitude, smell of hand hygiene supplies, non-proximity to functional hand hygiene infrastructure/station, and inadequate hand hygiene supplies. This study illustrates that the availability of hand hygiene infrastructure alone is insufficient to influence hand hygiene among healthcare providers; instead, these need to be proximal to the users. Besides, hand hygiene is sometimes driven by recognition and rewards, reminders and policies, guidelines and standards.

Abbreviations

BCD	Behaviour Centered Design
KMA	Kampala Metropolitan Area
HAIs	Healthcare Acquired Infections
HCF	Healthcare facility
HC	Health centre
IPC	Infection Prevention and Control
MOH	Ministry of Health
PNFP	Private Not for Profit
RA	Research Assistant
UN	United Nations
WASH	Water Sanitation and Hygiene
WHO	World Health Organization

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Author contributions

RKM, HY and CLM obtained the funding for this study. TS, RKM, HY, and CLM conceptualized the study, participated in data collection, and analysis and drafted the manuscript. JBI, RKW, AN, CA, STW, EB, RN, JB and LL participated in the analysis and drafting of the manuscript. All authors read and approved this manuscript before submission to this journal.

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Data availability

The transcripts analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study followed the Declaration of Helsinki. Ethical approval was obtained from the Makerere University School of Public Health Research and Ethics Committee (Protocol 775) and was registered by the Uganda National Council for Science and Technology (HS882ES). The investigators then sought administrative clearance from local governments in the Wakiso and Mukono Districts and the administration of the participating healthcare facilities. Participation in the study was entirely voluntary. Informed consent to participate was obtained from the Participants. Privacy and confidentiality were ensured during the study. Participant names, titles, positions, and study healthcare facilities have been de-identified to ensure confidentiality.

Consent to publish

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Disease Control and Environmental Health, School of Public Health, College of Health Sciences, Makerere University, P.O Box 7072, Kampala, Uganda
[2]Mukono District Local government, P.o Box 110, Mukono, Uganda
[3]School of Health and Related Research, The University of Sheffield, Sheffield, UK
[4]National Academy of Sciences, Programs Office, Building 2101 Constitution Avenue, Washington, DC, USA
[5]The Centre for Global Safe Water, Sanitation and Hygiene, Hubert Department of Public Health, Rollins School of Public Health, Emory University, 1518 Clifton Rd. NE, Atlanta, GA 30322, USA

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