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ORIGINAL ARTICLE

Barriers and enablers to the implementation of infection prevention and control guidance in a Ugandan healthcare facility – a theory-informed qualitative study to guide intervention design

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Abstract

Implementing Infection Prevention and Control (IPC) guidance is crucial for reducing healthcare-associated infection (HAI) rates. However, achieving behavioural and organisational change is necessary for successful implementation. To understand these changes, it is important to identify the barriers and facilitators to IPC implementation, supported by theoretical analysis.

This paper presents the second stage of a study conducted in Uganda, aiming to analyse barriers and enablers to IPC guideline implementation and provide preliminary recommendations for intervention design. Interviews with frontline healthcare workers were conducted, and qualitative content analysis helped identify specific barriers and enablers. The Theoretical Domains Framework (TDF) was used to categorise and map these factors to the BCW/COM-B model, enabling the identification of intervention functions supporting IPC implementation.

The findings highlighted various important factors influencing IPC implementation, including social influences, environmental context and resources, knowledge, skills, professional role and identity, behavioural regulation, memory, attention and decision processes, goals, beliefs about capabilities, beliefs about consequences, intentions, emotion, and reinforcement. All components of the COM-B model (Capability, Opportunity, Motivation) were deemed significant in IPC implementation. Key intervention functions such as enablement, environmental restructuring, training and education, persuasion, and incentivization were identified as potentially useful for designing interventions to improve IPC implementation.

In conclusion, the analysis emphasized the interconnectedness and importance of capability, opportunity, and motivation in adopting IPC guidance in such contexts. The study offers recommendations for future interventions, including education and training programs, leveraging memory and attention, addressing beliefs about consequences, and improving social influences and support systems. These insights can guide the development of effective strategies to enhance IPC implementation.

Keywords: *infection prevention and control guidance*; *behaviour change*; *qualitative*; *low-resource settings*

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According to the World Health Organization (WHO), approximately 5–19% of patients in low-income countries acquire a healthcare-associated infection (HAI) during their hospital stay (1). The risk of contracting an HAI in these countries is exacerbated by various factors, including the lack of essential hygiene facilities, infrastructural challenges, and limited resources (2). As a result, it is crucial for healthcare authorities and facilities in low-income countries to prioritise effective infection prevention and control (IPC) measures. This importance is heightened with the occurrence of novel infectious diseases such as COVID-19, and the emergence of antimicrobial resistance, making the implementation of IPC practices even more essential.

However, the available evidence on the implementation of IPC guidance in low-income countries, particularly in sub-Saharan Africa settings, is limited, although it is gradually growing. Effective implementation of IPC guidelines requires behavioural changes at the team, individual, or organisational level (3). Therefore, it is essential to assess the barriers and facilitators that impact the adoption of evidence or the performance of desired IPC behaviours.

This assessment is crucial for successful planning and evaluation of the implementation process. However, barriers and enablers can vary across professional groups, organisations, healthcare settings, and contexts, making generalisation difficult (4). Consequently, utilising behaviour change theory to examine potential barriers and facilitators to IPC practice before designing or implementing an intervention allows for customisation to the specific context, ensuring acceptability and sustainability (5).

To facilitate the identification of intervention functions that are more likely to result in effective behaviour change interventions, researchers have utilised two multilevel theoretical approaches: the Theoretical Domains Framework (TDF) and the COM-B model and Behaviour Change Wheel (BCW) (5, 6).

The TDF is a synthesis of multiple theories of behaviour and behavioural change into 14 domains which provide a framework for examination of cognitive, affective, social and environmental determinants and influences on behaviour (Appendix B) (6). The BCW serves as a guide for how interventions can be developed using behavioural theory by encouraging designers to consider a full range of intervention options and to select the most promising through a systematic evaluation of theory and evidence. At its centre is the Capability, Opportunity, Motivation and Behaviour (COM-B) model, which forms the hub of the BCW. This model proposes that behaviour is a result of an interaction between three components: capability, opportunity, and motivation which act as underlying conditions to behaviour (Appendix A) (5). As De Leo et al. (7) point out, using the TDF in conjunction with the COM-B/BCW (Appendix A) model of behaviour provides a more detailed structure for behavioural analysis, with the TDF used to categorise factors impacting the uptake of a behaviour of interest, while the COM-B/BCW facilitates the mapping of these factors to corresponding interventions. As such, the COM-B intends to facilitate the selection of interventions most likely to overcome identified barriers and leverage the identified enablers to behaviour change (8). Therefore, the COM-B model of behaviour provides an excellent theoretical approach for designing complex behaviour change interventions, as it considers all the individual determinants of behaviour, and identifies appropriate interventions (9). Therefore, the TDF helps to identify factors influencing behaviour, and the BCW creates a link from identification of these determinants of behaviour (using the TDF) to the mapping of appropriate behaviour change techniques to inform interventions. A scoping review by Greene et al. reported that there is a small number of published studies exploring IPC behaviours using behaviour change theory (10). This indicates that more research in this area is required, which is underpinned by theoretical frameworks.

Within this study, these approaches have been employed to investigate the factors influencing the implementation of IPC guidance among healthcare workers (HCW) in Uganda. As identified in a systematised review as part of this study, there is a dearth of theory informed qualitative research on the implementation of IPC guidance at the health facility level in Uganda (11) and this, combined with the author's previous experience and personal interest in Ugandan healthcare, guided the selection of the study setting. It is also hoped that findings may resonate with other African low- and middle-income countries (LMIC).

Through applying behaviour change theory (TDF, COM-B model/BCW framework), this study aimed to undertake a post-hoc behavioural analysis of identified factors which may present as barriers and enablers to the implementation of IPC guidance at a tertiary healthcare facility in Uganda and to make preliminary recommendations for intervention design.

Methods

Design

The research study utilised a qualitative design following the constructivist grounded theory (CGT) research methodology (12). Qualitative findings were then subjected to a systematic behavioural analysis applying principles developed by Michie et al. (8) The study was conducted at a government-funded tertiary hospital with 450 beds, situated approximately 250km from the capital city. This hospital serves a population of around 4.6 million people across six districts and boasts a variety of specialised departments, such as surgery, obstetrics and gynaecology, outpatient and community health, internal medicine, diagnostics, and paediatrics. The study included frontline HCWs directly involved in patient care, excluding those not engaged in patient care. The data collection process involved face-to-face individual interviews with 13 frontline HCWs actively involved in implementing IPC guidance at the facility as detailed in Kalule et al. (13). This group included, a senior infection control nurse (n = 1) doctors (n = 2), staff nurses (n = 3), student nurses and interns (n = 2), laboratory technicians (n = 1), IPC committee members (n = 3), and midwives (n = 1). A semi-structured, broad interview guide (Appendix C) was utilised flexibly and developed in line with the national IPC guidelines (14). While not exhaustive, the guide covered general issues related to understanding the meaning of IPC guidance, decision-making processes, and the factors influencing these decisions. Data collection took place between October 2019 and November 2019. Unfortunately, further planned data collection in primary and secondary care settings was not possible due to the COVID-19 pandemic, and therefore the study is limited to the tertiary care setting.

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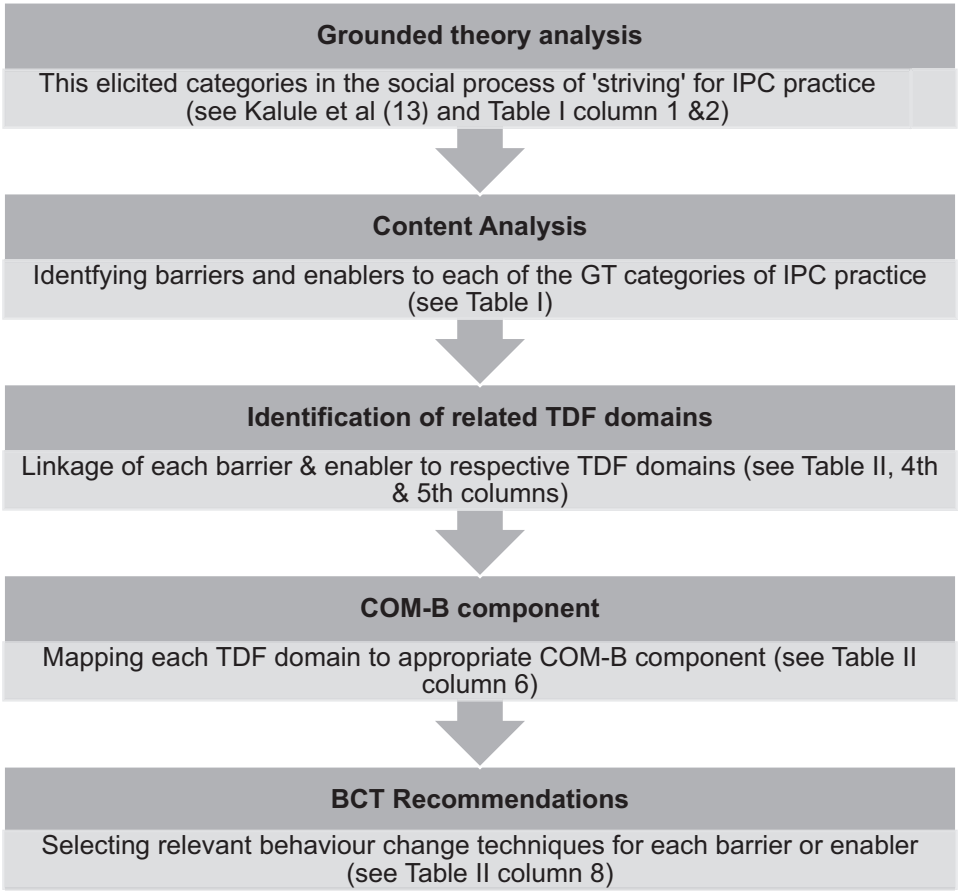

Fig. 1. Stages of the analytical approach.

The TDF was then used to systematically categorise the identified barriers and enablers to IPC guidance implementation. Further, the mapped TDF domains were then matched with the elements from the BCW to allow the specification of broad intervention functions that correspond to the underlying barrier or facilitator.

Ethical considerations

Information on the study was provided to all participants, and written consent was obtained prior to each interview. The study was approved by the Glasgow Caledonian University School of Health and Life Sciences Research Ethics Committee (HLS/NCH/18/031) and the Ugandan Regional Referral Hospital Research & Ethics Committee (MRRH-REC IN-COM 047/2019). To conform with a legal requirement for all persons and organisations carrying out systematic investigations of any form in Uganda, authorisation (HS424ES) was obtained from the Uganda National Council for Science and Technology.

Behavioural analysis methods

The behavioural analysis was conducted in four stages, in line with guidance set out by Michie et al. (5): identifying barriers and enablers to the desired behaviour (implementation of IPC guidance); linking each barrier and enabler to a theoretical domain; mapping each description and domain to an appropriate BCW component; identifying recommendations for behaviour change to address relevant barriers and enablers. This analysis was conducted by one researcher (AK) and cross checked by another senior researcher (KC), with any disagreements resolved by discussion. The complete stages of the analytical approach are illustrated in the graphic (Fig. 1), showing the movement from the primary grounded theory analysis through the steps in behavioural analysis, with each stage illustrated by the results in Tables 1 and 2 in the findings section.

Findings

The results of the behavioural analysis are outlined in Tables 1 and 2 with detailed explanation presented below.

Initial grounded theory analysis led to the identification of five categories that explained the process of 'Striving' towards IPC implementation; this process is discussed in an earlier paper (11, 13). Subsequent content analysis of these grounded theory categories generated lists of specific barriers (hindering practising IPC

Table 1. Identified barriers and enablers to the implementation of IPC guidance

Grounded theory category	Barriers	Enablers
Recognising the importance of IPC	Lack of inclusive trainings and orientation	Training for senior staff and IPC committee members
	Lack of motivation for trainers	
		Having meetings
		Orientation and posters
		Perceived benefit of guidance
Playing a role		Identifying self: role in IPC
		Taking responsibility
Encountering challenges	Shortage of finances	
	Shortage of HCWs	
	Lack of consistent supply of water	
	Infrastructural challenges	
	Delay in delivery of IPC supplies	
	Lack of training and orientation	
	Lack of support supervision from national and local levels	
	A lack of voice	
	Poor attitude from some staff	
Enabling conditions		Support from management
		Having an IPC committee
		Having reminders
		Support supervision
		Having CMEs
		Organised environment
		Team work and cross-organisational collaboration
Overcoming challenges		Preparing Alcohol Based Hand Rub (ABHR) locally
		Adapting
		Asking patients to buy their own supplies
		Use of mobile based tools
		Having Students
		Delegation of duties
		Working with other organisations

measures) and enablers (facilitating the IPC process) within each category, as interpreted from the combined participant data (Table 1).

An overarching narrative description of the barriers and enablers within each grounded theory category (4th column in Table 2) supported the systematic categorisation of barriers and enablers as being linked to specific TDF domains (5th column in Table 2). It is worth noting that some TDF domains were found to be applicable to multiple barriers and enablers, as indicated in Table 2. For this study, the frequency of the linked domains is reported as a proxy for the level of salience in regard to the implementation process, although it is acknowledged that frequency counts should not necessarily be taken as an indicator of importance in qualitative research.

Once each barrier and enabler was aligned with the respective TDF domains, the next step proceeded to map these to appropriate COM-B components, specification of associated broad intervention functions and policy categories, before generating recommendations based on the BCW, as shown in Table 2 (columns 6–8). For example, if the domain was perhaps education, consideration of the barriers and enablers guided decisions as to whether the appropriate COM-B component lay within opportunity (lack of educational opportunity), capability (education provided did not lead to appropriate skills being developed), or motivation (despite education being provided the participant was not motivated to apply it for some reason). This analysis and decision-making process was followed iteratively for all data.

The process of developing recommendations was informed by the methods used by Michie and colleagues to link their analysis of the targeted behaviours to appropriate interventions. As Michie et al. (5) point out, the BCW model is not linear in that components within the

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Table 2. TDF domains matched to COM-B/BCW components and intervention functions

GT category	Barriers	Enablers	Description	TDF domains	COM-B/BCW component	Intervention functions/ policy categories	Examples of recommendations
Recognising the importance of IPC	Lack of inclusive training and orientation	Training for senior staff and IPC committee members	The training helped improve knowledge of IPC. However, the training wasn't inclusive as it targeted senior staff and IPC members leaving out other staff	• Knowledge • Skills	• Psychological capability • Physical capability	• Modelling • Training	Provide information about the latest guidelines and updates to any guidelines through continuous professional development Training needs analysis to tailor training for different groups
	Lack of motivation for trainers		The lack of motivation for trainers, particularly the unavailability of incentives, meant that information wasn't passed on	• Goals • Reinforcement	• Reflective motivation • Psychological capability	• Incentivisation • Coercion	Providing rewards to trainers Coercive strategies are less helpful
		Having meetings	Meetings were helpful in sharing info but not all staff were able to attend	• Knowledge • Social Influences	• Social opportunity	• Enablement	Leveraging these communication processes to pass on information to staff
		Orientation and posters	Students, nurses and interns became aware of IPC guidance through orientation and posters and notices around wards	• Memory, attention and decisions processes • Behaviour regulation	• Physical opportunity	• Education	Ensure up-to-date guidance is provided by clearly displayed posters in clinical areas
		Perceived benefit of guidance	Understanding the benefit of IPC guidance helped improve the willingness of members to accept and practice the required IPC measures	• Beliefs about consequences	• Psychological capability • Automatic motivation	• Persuasion • Training	Strengthening this through information provision and constant communication about the benefits of following guidelines and the harms of not following guidelines, for example, through facilitated workshops
Playing a role		Identifying self as playing a role in IPC	Participants identified and labelled themselves such as being a doctor, being a mother	• Professional role and identity	• Automatic motivation	• Modelling	Peer expert to discuss roles and responsibilities
		Taking responsibility	As a result of role labels, participants took on different responsibilities in the implementation process	• Professional role and identity • Beliefs about capabilities	• Automatic motivation • Reflective motivation	• Enablement	Continue to provide the required tools for HCWs to continue playing their roles and responsibilities, particularly ensuring a steady provision of IPC supplies

(Continued)

Table 2. (Continued) TDF domains matched to COM-B/BCW components and intervention functions

GT category	Barriers	Enablers	Description	TDF domains	COM-B/BCW component	Intervention functions/ policy categories	Examples of recommendations
Encountering challenges	Insufficient funding		A shortage of finances meant that participants were unable to get all the required IPC supplies	• Environmental context and resources	• Physical opportunity	• Enablement	Lobbying the government and hospital management to allocate more funds to IPC activities and obtain formal commitment
	Shortage of HCWs		A shortage of HCWs led to a work overload and being overwhelmed	• Environmental context and resources • Emotion	• Physical opportunity	• Enablement • Incentivisation	By recruiting more HCWs Introducing bonuses for overtime Working with nursing schools to avail more students for cover
	Lack of consistent supply of water		Intermittent supply of water led to challenges in practising proper hand hygiene as well as proper cleaning of the facility	• Environmental context and resources	• Physical opportunity	• Environmental restructuring	Provision of ABHR during times of water shortages. Providing tanks for water storage
	Infrastructural challenges		Buildings were old, often requiring regular maintenance. Inadequate bed capacity led to overcrowding, with some patients sleeping on floors	• Environmental context and resources	• Physical opportunity	• Environmental restructuring	Change infrastructure through provision of extra buildings, creation of isolations and cohorting spaces
	Delay in delivery of IPC supplies		The facility experienced delays in receiving supplies from the government, which meant that they often lacked essential materials during certain times	• Environmental context and resources	• Physical opportunity	• Enablement • Environmental restructuring	Provide regular supplies of requirements to enable HCWs to implement IPC guidelines as required Planning ahead through delivering extra supplies to act as buffer stock
	Absent National IPC committee		Although the policy documents indicate the presence of a national IPC committee, participants spoke of how they had never seen or had anyone from that committee coming to provide any support	• Professional role and identity • Social influences	• Social opportunity • Reflective motivation	• Environmental restructuring • Communication	Organisational changes to increase collaboration among HCWs and IPC members with the National IPC committee Establish channels to improve communication between the facility IPC and the National IPC Committee
	Lack of training and orientation		A lack of training and orientation, particularly for the interns, students and new staff, meant that they experienced a gap in knowledge, and this impeded their efforts in trying to implement the required measures	• Knowledge	• Physical opportunity • Psychological Capability	• Training • Modelling	Tailored training developed through a training needs analysis. Increase the frequency of CMEs Peer experts to discuss the content of guidelines and highlight organisations that endorse it

(Continued)

Table 2. (Continued) TDF domains matched to COM-B/BCW components and intervention functions

GT category	Barriers	Enablers	Description	TDF domains	COM-B/BCW component	Intervention functions/ policy categories	Examples of recommendations
	Lack of support supervision		A lack of supervision meant that participants didn't get an opportunity to get clarity on some IPC issues that arose during their routine practice	• Behaviour regulation • Social influences	• Social opportunity	• Modelling	Through the continuous provision of audit and feedback Use of online platforms to provide solutions or act as brain storming spaces
	Lack of voice		The lack of space to make suggestions meant that some participants were excluded from conversations about decisions regarding guidelines	• Social influences	• Social opportunity	• Enablement • Service provision	Provide suggestion boxes around the facility to encourage ideas from staff Establishing support services within the facility
	Poor attitude from some staff		Some participants did not make the required conscious efforts to practice or follow the recommended guidelines even if they were aware of the guidelines	• Intentions	• Psychological capability • Reflective motivation	• Persuasions • Modelling • Coercion	Through the use of strict rules for non-compliant stuff. Having reminders to trigger non-complaint staff into following guidelines continuously Peer experts to discuss the content of guidelines and highlight organisations that endorse it Creating an expectation of disciplinary action or cost for HCWs not adhering to recommended guidelines
Enabling conditions		Support from management	Management had an impact on the success of guidance implementation as they were responsible for overall planning and budgeting. A strong relationship with hospital management was highly valued	• Social Influences • Environmental context and resources	• Social opportunity • Physical opportunity	• Communication	Strengthen communication channels between HCWs and management to maintain this relationship through town hall type meetings
		Having an IPC committee	Effective IPC governance structure through the presence of an IPC committee was critical to successful IPC implementation as they provided oversight and feedback	• Professional role and identity	• Social opportunity	• Modelling	Create IPC champions
		Having reminders	Having reminders served as an effective memory jogger for people who might otherwise forget	• Memory, attention and decisions processes • Behaviour Regulation	• Physical opportunity	• Persuasion	Strengthening this through provisions of more posters, notices and charts

(Continued)

Table 2. (Continued) TDF domains matched to COM-B/BCW components and intervention functions

GT category	Barriers	Enablers	Description	TDF domains	COM-B/BCW component	Intervention functions/ policy categories	Examples of recommendations
		Support supervision	Supervision provided an opportunity to fill in gaps in information, particularly regarding IPC guidance	• Social Influences • Behaviour regulation	• Social opportunity • Reflective motivation	• Modelling	Peer expert to discuss the content of guidelines
		Having CMEs	These trainings and educational programmes were a trigger for changing practice and crucial for effective IPC implementation	• Knowledge • Skills	• Psychological opportunity	• Education • Training	Strengthening this through the provision of more regular CMEs and other options for CPDs Having protected time for training for HCWs
		Organised environment	Having an organised environment was important in ensuring effective implementation of IPC guidance as it increased productivity and ensured consistency	• Goals	• Physical opportunity • Reflective motivation	• Environmental restructuring • Regulation	Strengthening this by having marked areas or storage for IPC equipment Standardisation of ward layouts
		Teamwork and cross-organisational collaboration	This helped bring all stakeholders together to overcome barriers such as training and supply shortages	• Social Influences	• Social opportunity	• Enablement	Strengthening stakeholder interrelationships and developing resource-sharing agreements Promote network weaving
Overcoming challenges		Preparing ABHR locally	This helped solve the challenge of a lack of water and a shortage of ABHR	• Skills • Environmental context and resources	• Physical capability • Physical opportunity	• Enablement • Training	Provide the required materials to enable the manufacture of ABHR Strengthening this by imparting more skills like manufacturing ABHR
		Adapting	Participants were sensitive to and acknowledged cues within the environment to provide care that is uniquely responsive to the challenges in that setting through adapting some components of IPC guidance	• Beliefs about capabilities • Skills • Environmental context and resources	• Physical capability • Reflective motivation	• Enablement • Environmental restructuring	Providing IPC materials that are fit for the purpose Encourage idea sharing between staff to adapt to challenges
		Asking patients to buy their supplies	Patients were often asked to buy their key IPC materials, which helped overcome challenges such as delays in delivery of IPC supplies and shortages	• Environmental context and resources	• Social opportunity • Physical opportunity	• Environmental restructuring	Social restructuring by encouraging patients and families to provide supplies, rather than hospital management Having a buffer stock to use during such times

(Continued)

Table 2. (Continued) TDF domains matched to COM-B/BCW components and intervention functions

GT category	Barriers	Enablers	Description	TDF domains	COM-B/BCW component	Intervention functions/ policy categories	Examples of recommendations
		Use of mobile-based tools	By working in online contexts with peers, participants were able to ensure a flow of information with minimal resources and equipment, in turn fostering the implementation	• Environmental context and resources	• Physical opportunity	• Enablement	Strengthening the use of information technologies, for example, online meeting platforms, to increase capability and facilitate practice change among IPC members and other HCWs
		Having Students	By having students, the hospital filled gaps as a result of a shortage of HCWs	• Social Influences	• Social opportunity	• Enablement	Strengthening working relations and partnerships with educational institutions
		Delegation of duties	To ensure continuity in the flow of information as well as ensuring that there was no leadership gap during times of absence	• Social Influences	• Social opportunity	• Modelling	Through shadowing IPC committee members
		Working with other organisations	This helped bring all stakeholders together to overcome barriers such as training and supply shortages	• Social Influences	• Social opportunity	• Enablement	Strengthening stakeholder interrelationships and developing resource-sharing agreements Promote network weaving

behaviour system interact with each other, as do the functions within the intervention layer and the categories within the policy layer. The BCW is thus dynamic, permitting interactions both within and between layers; for example, education can also be associated with capability (9). Therefore, this model was implemented as such. This enabled the identification of a wide range of possible COM-B interventions or policy functions as recommendations to improve IPC guideline implementation within this context, without moving to the more detailed intervention stage using the taxonomy of behaviour change techniques (15).

Mapping using the TDF showed that 13 of the 14 domains were found to impact the target behaviour of consistent adherence to recommended national IPC (14) practices within the facility. The domains that appeared most frequently were social influences and environmental context and resources, both occurring 10 times. Following closely were knowledge, skills, professional role and identity, and behavioural regulation, each appearing four times. The least frequently identified domains were memory, attention, and decision processes, goals, beliefs about capabilities, beliefs about consequences, intentions, emotion, and reinforcement, with each domain being identified two times or less. Further analysis using the COM-B model indicated that these determinants seem to influence the implementation of IPC guidance across all three COM-B conditions: Capability, Motivation, and Opportunity.

Capability

Capability encompasses both physical and psychological influences that affect the ability to implement appropriate IPC behaviours. These influences were categorised into three out of the 14 TDF domains: knowledge, skills; memory, attention and decision processes; and behavioural regulation.

Knowledge and skills functioned as both barriers and facilitators. Acquiring knowledge through meetings or trainings such as monthly refresher trainings or ad hoc trainings played a crucial role in ensuring the proper implementation of IPC guidance within the facility. Participants exhibited greater awareness of their obligations as some individuals reported that being taught IPC guidance enabled them to understand the requirements and effectively implement the necessary measures as noted in the following quote.

> 'Once we are taught these things [IPC], we know these things, and once we know about these things, we will always practice them'. (Participant 4, Doctor/ Medical Officer)

However, the lack of this training among other HCWs served as a barrier, especially among students, interns and junior staff, hindering their ability to assume more substantial responsibilities in the implementation process. This challenge led to an information gap, with participants, especially nurse interns, emphasising that they had never received any instruction on IPC guidance as narrated by student intern in a quote below.

> 'Nobody has taught me anything to deal with infection prevention and control or tried to correct me in terms of infection prevention and control'. (Participant 10, Nurse Intern).

Consequently, they were unable to effectively adhere to the required measures.

Additionally, having experience was correlated with a stronger belief in one's capabilities and a higher motivation to implement IPC guidance as they had more knowledge, perhaps in more creative ways HCWs who had accumulated experience were better equipped to handle challenging situations as a senior nurse illustrates.

> 'We are supposed to air [key instruments] dry them after sterilisation through the autoclave. But if the clinic has 60 patients on the day and we have few instruments so what we do is after washing, we dry them, and we boil them instead of autoclaving'. (Participant 5, Senior Nursing officer)

Conversely, participants with limited experience, such as students, were less likely to navigate difficult scenarios effectively, leading to a potential impact on their adherence to IPC measures.

> 'So, there isn't much I can do because…. maybe I feel agitated, I don't want to rub big people the wrong way, I keep quiet'. (Participant 9, student)

Behaviour regulation and Memory, attention, and decision processes, had a beneficial impact on the ability to implement IPC guidance. For instance, the presence of reminders prompted HCWs to actively engage in practicing the recommended IPC measures. Some participants acknowledged that they occasionally forgot and required reminders to recall what needed to be done as illustrated below.

> 'Being a human being, we really need to be reminded on what we are supposed to do, much as we know we can be busy and forget to implement or do it the way it supposed to be done'. (Participant 8, Nursing Officer)

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Opportunity

According to the COM-B model, behaviour requires the presence of opportunities that facilitate its occurrence within a supportive physical and social environment. In the context of implementing IPC guidance, both physical and social opportunities were identified as crucial factors. This encompassed elements such as the environmental context, and resources, and social influences.

The attainment of complete implementation of IPC guidance faced significant obstacles primarily related to the environmental context and resources. Within the current study, various resource constraints such as limited finances, a shortage of HCWs, inconsistent water supply, and delayed delivery of IPC materials adversely affected the opportunities to effectively practice IPC as highlighted by this participant.

> '… but now when there are no things to use, there is nothing I can do – I am there to implement according to the available resources, but when there is nothing there, I have nothing to do [nothing I can do]'. (Participant 8, Nursing Officer)

> 'For example…. recently we had no running water in the maternity ward, how will we then make sure that people (HCWs) wash their hands after touching patients, after palpating mothers'. (Participant 13, Midwife)

Furthermore, the physical environment itself posed substantial challenges for example the absence of an isolation unit.

> 'The only problem we have, that we don't have an isolation unit for any infection in case it's a bad one'. (Participant 3, Nurse In-charge)

On the other hand, social influences emerged as the second most commonly reported factors that exerted a positive impact on IPC practice behaviour, while the absence of such influences acted as a barrier. The presence of an IPC committee, for instance, was deemed crucial by participants. They believed that an IPC committee provided guidance, made informed decisions, conducted IPC audits within the hospital, and ensured the availability of IPC supplies by liaising with management as noted by this participant.

> 'The committee is basically an overseer of safety practices in the lab and in the hospital and also overseeing the planning, budgeting and then also makes sure that people are implementing what you want them to do'. (Participant 6, Lab Technologist)

Conversely, the absence of these social influences posed as a hindrance. For instance, the lack of support supervision was evident due to the absence of a national IPC committee. A participant highlighted that the national IPC committee was not present and did not provide any form of support supervision.

> 'The government doesn't give us support supervision. There is nothing. Those people [national IPC committee] are just there in words'. (Participant 3, Nurse In-Charge/IPC committee member)

Motivation

Motivation, a vital component of the COM-B model, plays a significant role in driving behaviour. Strong motivation is necessary for the behaviour to occur. These determinants encompassed factors such as professional role and identity, beliefs about consequences, intentions, goals, reinforcements, and emotions.

HCWs believed they were best placed to implement IPC guidance by taking responsibility as dictated by their professional roles and identity. Nurses in charge felt that, since they were in charge of wards, they had an extra responsibility of ensuring safety for their patients and staff, with one participant mentioning that they see themselves as 'a mother' who has to ensure all people under their guardianship are safe from infections.

> 'I am like the mother, the housemaid of the home. Hmm, I guard them. I guard the community against the infections, I guard the students against infections to them, and then I protect the patients, I prevent nosocomial infections from the students to the patients and attendants…' (Participant 3, Nurse in-charge)

By having strong beliefs related to their professional role, some participants adapted guidelines to their specific contexts, such as creating locally produced Alcohol Based Hand Rub. This adaptive behaviour positively influenced their perceived ability and confidence in adhering to IPC guidance.

Further, beliefs about consequences played a facilitating role. Within this aspect, HCWs who held positive perceptions about the benefits of adhering to guidelines were more inclined to practice the necessary IPC measures. For example, the awareness that following IPC measures provided protection against HAIs, increased the likelihood of accepting and diligently following the recommended guidelines.

> 'Ohhhhh, first of all, I see what is really going to help me and the patient I am offering care to. That's when I decide what I will do for the good of the patient and the good of my health' (Participant 8, Nursing Officer)

Intentions, goals, and reinforcement played a dual role as both barriers and enablers. Participants highlighted instances where certain staff members harboured negative attitudes towards IPC guidance, leading to a lack of deliberate effort in practicing the recommended IPC measures. This negative mindset sometimes resulted in behaviours that contradicted the recommended guidelines for example not practicing waste segregation.

> 'Some people may have the knowledge, but because of the poor attitude, they will just throw rubbish anywhere'. (Participant 6, Lab Technologist)

In contrast, some participants expressed the belief that incorporating motivational factors, such as providing refreshments during training sessions (reinforcement), could enhance their motivation levels. This increased motivation, in turn, could encourage them to attend more training sessions, leading to a greater acquisition of knowledge about IPC. Ultimately, this improved knowledge could have a positive impact on the implementation of IPC measures.

Emotions were recognised as a hindrance, as the emotional strain caused by an excessive workload negatively affected the implementation of the guidance. This was especially evident in certain departments, such as the emergency ward, which frequently experienced overcrowding of patients and a shortage of staff. As a result, these departments faced a scarcity of both IPC materials and personnel. Participants expressed feelings of being overwhelmed, often attributing it to staff shortages, time constraints, and the pressure arising from a heavy workload as noted in a quote below. These factors were cited as explanations for the occurrence of practice gaps.

> 'We have mass casualties and high numbers of patients and it becomes more and more difficult to manage hygiene and infection control with a huge number of patients'. (Participant 12, Doctor)

Relevant intervention functions identified that can provide potential evidence-based and theoretically informed future intervention content

In the analysis of the BCW intervention functions across all outlined TDF domains, several relevant intervention functions from the BCW were identified to facilitate the implementation of IPC guidance within the study context. These included enablement, environmental restructuring, modelling, training, persuasion, incentivisation, education, and coercion, with varying frequencies of occurrence. Furthermore, in terms of policy categories, communication, regulation, and service provision emerged as highlighted categories, although with differing frequencies.

However, it is worth noting, as Barker et al. (16) pointed out, that a single intervention function can address multiple determinants , as indicated in Table 2. For example, training can effectively target both psychological capability and physical opportunity. Similarly, a single determinant can be addressed by more than one intervention function, such as addressing psychological capability through education, training, or enablement.

Discussion

This study aimed to conduct a behavioural analysis of identified factors that acted as barriers or enablers to the implementation of IPC guidance in a tertiary healthcare facility in Uganda. The analysis revealed that capability, opportunity, and motivation are crucial factors in adopting IPC guidance, and they are interconnected rather than existing independently. This was evident from the overlapping influence observed among various constructs in the mapping analysis. These factors spanned across 13 of the 14 TDF domains and included social influences, environmental context and resources, knowledge, skills, professional role and identity, behavioural regulation, memory, attention, and decision processes, goals, beliefs about capabilities, beliefs about consequences, intentions, emotion, and reinforcement.

These findings align with previous research conducted in low-income countries, highlighting common barriers and facilitators in the implementation of IPC guidance (17). A mixed-methods study conducted in a neonatal unit in Zimbabwe also identified capability, and opportunity, as influential factors in the performance of IPC behaviours among staff. Barriers related to psychological capability, social and physical opportunities, such as resource constraints and a lack of training emerged as significant obstacles to performing IPC-related behaviours, leading to improvisation and poor habit formation (17). The current study further supports these findings by identifying resource constraints as a barrier to implementing IPC guidance; however, it also recognises social opportunities, such as the presence of an IPC committee and collaboration with other organisations, as facilitators to implementation. Social influences have also been found to facilitate IPC practice in other low-income countries (18). Furthermore, a qualitative study conducted in Malawi across 45 healthcare facilities found that relationships HCWs developed with other colleagues and organisations helped them fulfil their IPC responsibilities (19).

Specifically, factors related to capability, such as knowledge and skills, particularly the lack of training, were

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identified as significant barriers within the current study. These findings align with a recent Cochrane review by Houghton et al. which included 36 studies (20), and also emphasised the necessity of training for all HCWs. In this review, HCWs pointed to a lack of training about the infection itself and about how to use Personal Protective Equipment (PPE) as a reason for not complying with IPC measures. Similarly, a qualitative study conducted in Mongolia revealed similar barriers to IPC, where staff had insufficient knowledge of infection control due to inadequate inclusion of IPC in national training programmes (20).

Motivation was found to be a significant factor influencing the implementation of IPC guidance, acting as both a barrier and a facilitator. Automatic motivation, the unconscious process that drives behaviour and reflective motivation that involves conscious thought processes, including beliefs about capabilities, professional role and identity, beliefs about consequences, intentions, goals, reinforcements, and emotions, were identified as crucial determinants. Emotions, specifically stress resulting from high workloads, were highlighted as a barrier in the current study, consistent with a study by McAteer et al. (21) in which ward coordinators reported stress due to time and staffing constraints which hindered their involvement in IPC implementation. However, Yang et al. (22) found that emotions can also serve as a facilitator, with HCWs more likely to turn their stress into motivation for action, leading to high compliance with IPC guidelines particularly during epidemics. However, it can be argued that beliefs about consequences, such as the fear of contracting COVID-19, may have influenced these participants and acted as facilitators to the adoption of IPC guidance, similar to what was noted in the current study.

Recommendations for design of interventions to improve the implementation of IPC guidance

Based on the analysis, education and training emerged as core interventions that could address multiple domains related to the COM-B model to improve IPC practice. These strategies target HCWs' knowledge, skills, social influences, and beliefs around IPC practices, which can collectively enhance behaviour change and improve compliance to IPC measures.

Education and training

These programmes can enhance HCWs' knowledge and skills in IPC, improving both physical and psychological capabilities essential for following IPC measures. Collaborative initiatives, such as those involving Non-Governmental Organizations (NGOs) and cross-organisational networks, can create social opportunities by promoting shared practices and mutual support, which are particularly beneficial in resource-limited settings. Additionally, targeted training strengthens reflective motivation by clarifying the impact of IPC adherence on both personal and organisational levels, reinforcing HCWs' confidence and commitment to maintaining the required IPC standards.

Leveraging memory, attention, and decision-making with visual prompts

To reinforce training efforts, physical and automatic motivation can be enhanced by incorporating visual aids such as posters, notices, and charts strategically placed across hospital wards. For example, placing pictorial guides and step-by-step flowcharts near handwashing stations and patient care areas can visually demonstrate proper hand hygiene, PPE donning and doffing, and safe waste disposal. Designing these materials in the local language can further enhance comprehension. Additionally, sticker reminders on medical equipment, such as labels on intravenous stands or patient beds reminding HCWs to disinfect surfaces after use, can serve as micro-prompts reinforcing IPC practices. These visual aids can support memory, encourage consistent adherence to IPC practices, and strengthen both individual responsibility and the belief in personal impact, making IPC behaviours an integral part of daily workflows.

Beliefs about consequences through information and communication

Persuasion through education ensures HCWs understand the real-world impact of IPC practices. This could be through storytelling-based training sessions such as organising short weekly staff meetings where HCWs share real-life experiences of IPC successes or failures can humanise the consequences of adherence or non-compliance. For example, a nurse could share how proper PPE use prevented the spread of an infection, reinforcing positive reinforcement. Additionally, low-cost awareness campaigns showing instances where IPC breaches led to outbreaks can make consequences more tangible. These could be printed as brief newsletters, WhatsApp messages, or bulletin board updates in local languages. This focus on tangible experiences can reinforce commitment to IPC practices, even within resource constraints. Furthermore, motivation can be reinforced through low-cost initiatives such as 'IPC Champion of the Month' programme, where HCWs demonstrating exceptional IPC practices are recognised during staff meetings. Small incentives, such as certificates or acknowledgements, can boost morale and encourage continued adherence to IPC guidelines.

Supportive social influences and collective responsibility through creating a supportive environment

Implementing regular supervision, open communication, and HCW participation in IPC decision-making would

create a positive social opportunity. Establishing a culture of mutual accountability and teamwork around IPC guidelines will encourage staff to model and reinforce these behaviours among each other, amplifying training's effectiveness. For example, implementing a peer-to-peer accountability system where HCWs provide constructive feedback on IPC compliance can encourage collective responsibility such as a designated 'IPC buddy' system could pair HCWs to remind each other about hand hygiene, PPE use, and safe patient handling. This alongside encouraging attendance at IPC committee meetings will further strengthen these social influences, increasing adherence through collective support.

Addressing HCW shortages and workload through efficient resource management through resource optimisation and external support

Low-cost interventions to optimise workforce distribution, like adjusting scheduling and involving students from local training programmes, can provide much-needed support during busy periods. This approach can be structured as a component of the training strategy, where students assist in non-critical tasks, relieving HCW workloads by providing HCWs with the time and resources to focus on IPC compliance.

In summary, training and education address several domains within the COM-B model, enhancing HCWs' capabilities, creating supportive opportunities, and strengthening motivation to adhere to IPC practices. This approach can significantly improve IPC guideline implementation, even within resource-limited healthcare settings.

Strengths and limitations

The study's strengths lie in the systematic use of evidence-based theoretical frameworks (the TDF, COM-B model, and the BCW) to examine barriers and enablers in IPC guidance implementation and identify relevant interventions.

However, there are limitations to consider. Due to the COVID-19 pandemic, data collection was hindered, resulting in a limited sample that focused on a narrow range of IPC practices at a single tertiary healthcare centre. Lockdowns and travel restrictions prevented the study from recruiting participants from lower-level healthcare facilities and national-level actors as initially planned. Recognising this limitation could inspire further research that includes a diverse and cross-comparative population sample from various healthcare settings. Additionally, the study had geographic limitations, involving HCWs from a rural-based healthcare facility. It can be argued that the rural setting may limit the generalisability of the findings to urban healthcare facilities. Nevertheless, the value of this study's findings within rural locations should be balanced against this limitation.

Implications for future research

After identifying the key factors influencing IPC guidance implementation in Uganda and providing theory-informed recommendations, future research could concentrate on designing and testing interventions using behavioural theory. Considering that this study was designed and conducted prior to the COVID-19 pandemic, it is important to explore the current contemporary context in Uganda. This would enable an examination of the post-pandemic situation, taking into account the effects of both the Ebola and COVID-19 outbreaks, which had significant impacts on the Ugandan healthcare sector. By comparing these findings to the results of the current study, the influence of the pandemic on IPC practice in the country can be determined.

Conclusions

In conclusion, this study utilised behaviour change theory to conduct a post-hoc behavioural analysis of factors influencing the implementation of IPC guidance in a tertiary healthcare facility in Uganda. The analysis revealed that capability, opportunity, and motivation are interconnected and integral factors in adopting IPC guidance. Barriers and enablers were identified across multiple domains, particularly knowledge, skills, resources, social influences, beliefs, and emotions. Similar patterns of barriers such as environmental context and resources and facilitators such as social influences, motivation have been observed in other low-middle countries like Zimbabwe, Malawi, and Mongolia (17, 19, 23). The study also provides recommendations for future interventions, such as education and training programmes, leveraging memory and attention, addressing beliefs about consequences, and improving social influences and support systems. These strategies can provide valuable insights for designing interventions across other low-income healthcare contexts.

Contributors

AOK, KC and LP conceptualised the study. AOK oversaw data collection and local IRB approvals. AOK conducted data analysis with advice from KC and LP. All authors contributed to the final manuscript.

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Appendix A – Behaviour Change Wheel Diagram

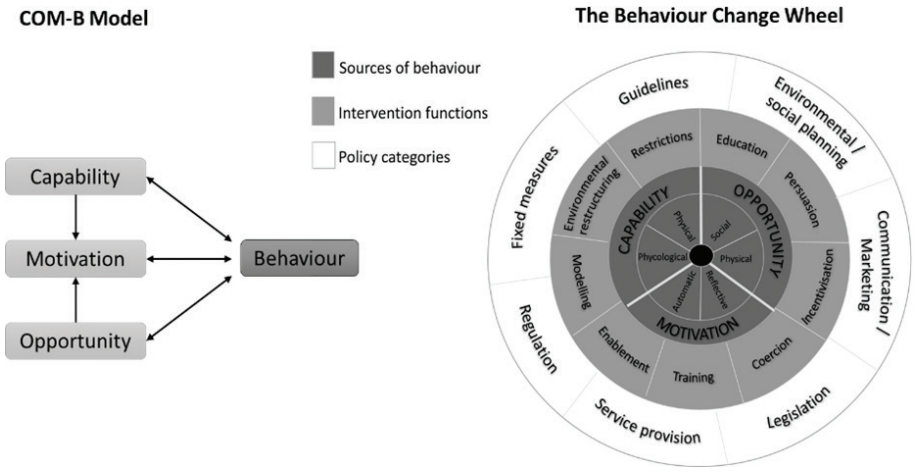

Fig. 2. The COM-B framework and behaviour change wheel. Adapted from Michie et al. (2014).

Appendix B – The TDF version used for this study. Adapted from Cane et al. (2012)

Domain	Description
Knowledge	An awareness of the existence of something
Skills	An ability or proficiency acquired through practice
Social/professional & role and identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting
Beliefs about capabilities	Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use
Beliefs about consequences	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation
Reinforcement	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way
Goals	Mental representations of outcomes or end state that an individual wants to achieve
Memory, Attention and Decision Processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives
Environmental Context and Resources	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives
Social Influences	Interpersonal processes that can cause individuals to change their thoughts, feelings or behaviours
Optimism	The confidence that things will happen for the best or that desired goals will be attained
Emotion	A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions

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Appendix C – Interview Guide

1. Can you tell me about yourself and your role at this facility?
2. Could you tell me about infection prevention and control and what this means to you?
3. How do you go about infection prevention and control in your role?
4. Are you aware of any infection and prevention and control guidelines?
5. Could tell me about any that you are aware of?
6. How do you make decisions about which IPC guidelines to follow or use?
7. What factors influence your decisions about the use of IPC guidelines – what helps or hinders you in using IPC guidelines?