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Knowledge, attitudes and practices on prevention and control of high-consequence infectious diseases and critical care among intensive care personnel in Rwanda: a cross-sectional survey

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SUMMARY

Introduction: Intensive care personnel in countries prone to outbreaks of high-consequence infectious diseases (HCIDs), such as Ebola virus disease, stand at the forefront of caring for affected patients. This study describes the knowledge, attitudes and practices (KAP) of intensive care personnel in Rwanda on the management and infection prevention and control (IPC) of HCIDs.

Methods: A cross-sectional survey was carried out among staff working in the 4 operational intensive care units in September 2022. The self-administered questionnaire collected information on participants' background and their KAP on critical care (CC), HCIDs and IPC.

Results: Of the 107 participants, 67 (62.6%) had less than 4 years' work experience in CC. 41 (38.3%) of them had attended trainings on IPC since 2020. In univariate analyses, a higher knowledge score was associated with being a physician, years of working in CC and differed by hospital. A large proportion perceived their knowledge on CC as good or very good (58.0%) and their everyday risk of acquiring an infection as at least high (48.6%).

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Overall, 72.9% reported compliance with hand hygiene measures. However, around a quarter of participants reported rarely or never avoiding recapping of needles or never or rarely taking additional precautions during aerosol-generating procedures.

Conclusions: Staff had a moderate knowledge base and might benefit from continuous learning on CC and HCIDs. The perception of high risk of infection at work stands in contrast with lack of compliance with basic IPC practices which should be reinforced to avoid preventable and potentially fatal infections.

Introduction

Outbreaks of Ebola Virus Disease (EVD) have repeatedly occurred in Rwanda's neighbouring countries. Between 2018 and 2020, the world's second largest EVD outbreak with over 3000 documented cases took place in the Kivus and Ituri regions of the Democratic Republic of the Congo (DRC) [1]. In 2022, Uganda experienced an EVD outbreak with 164 cases; at least 11 healthcare workers (HCWs) got infected, of whom five died [2]. Shortly after in March 2023, the United Republic of Tanzania witnessed a small outbreak of Marburg Virus Disease in the province next to Rwanda's Akagera National Park [3]. Although Rwanda has not yet seen a case of EVD or other HCIDs, high trans-border activities with regions having experienced outbreaks put it at risk of an outbreak.

To save lives and reduce morbidity in HCID outbreaks, appropriate case management including complex critical care (CC) in specialised intensive care units (ICUs) is essential [4]. Treatment and care for HCID patients requires strong compliance with standard precautions and, possibly unfamiliar, additional personal protective equipment. Past outbreaks have shown that healthcare workers (HCWs) are at increased risk of HCID infection [5]. Fear, rumours and stigma among HCWs might lead to abandonment of posts, and a subsequent collapse of routine healthcare services [6].

Knowledge, attitudes, and practices (KAP) among HCWs impact on clinical management of HCIDs. Various quantitative studies have assessed the KAP of HCWs in relation to HCIDs, observing significant variation in the knowledge of infection prevention and control (IPC) as well as in the management of these diseases [7—16]. For ICU staff caring for HCID patients, direct patient contact and invasive procedures while following standard and additional hygiene precautions are unavoidable. The present study extends existing knowledge by focusing on the CC and HCID competencies of ICU staff to adequately and safely treat HCID patients.

A recent cross-sectional study in Rwanda showed that the general population has high EVD-related awareness with 99.6% stating to have heard of Ebola. The study showed some misconceptions about the mode of transmission and preventative measures of EVD infection with 36.2 % of respondents wrongly indicating that it can be spread through air and 17.4 % of respondents reporting that bathing with salt and hot water was protective. Informants saw the country at risk of an EVD outbreak [17].

This study aims to describe the KAP of ICU personnel regarding CC as well as prevention and control of HCIDs in Rwanda. The results of this study will inform training programmes for specialised HCWs of the future high-level isolation and intensive care unit currently under construction in Kigali, Rwanda.

Methods

This cross-sectional study was conducted in September 2022 in the four largest referral hospitals with continuously operated ICUs in Rwanda: Centre Hospitalier Universitaire de Kigali (CHUK), Centre Hospitalier Universitaire de Butare (CHUB), King Faisal Specialist Hospital & Research Centre (KFH) and Rwanda Military Hospital (RMH).

The study was approved by the Rwanda National Ethics Committee (Nr.253/RNEC/2022) and by the Institutional Review Boards of each hospital. Participation in the study was voluntary and signed consent was obtained from all participants prior to their participation.

Study population and recruitment procedure

All department and hospital heads were informed of the study during the design phase. The target population included 21 physicians and 131 nurses working at the ICUs of the four hospitals. Trained study investigators visited each site on at least four separate working days in September 2022 and invited staff to participate. A convenience sampling approach was followed as only HCWs present during the visit of the study investigators were offered to participate.

Study questionnaire

Participants completed a self-administered questionnaire in English, the main medical educational language, using Android tablets using Open Data Kit (ODK) software [18]. The study investigators helped with translation to Kinyarwanda or French and provided clarification when needed. The questionnaire consisted of 65 items divided into 5 sections. The first section covered socio-demographic background as well as working and training experience (see full questionnaire in Appendix A). A total of 29 questions assessed knowledge. Participants had to qualify statements as right or wrong. The CC questions were based on the German curriculum for additional qualification in intensive care medicine following current international guidelines [19—24]. Questions on HCIDs were constructed following World Health Organization (WHO) guidelines on EVD (see Appendix B for a detailed breakdown). Five self-created questions were included to assess attitudes about their self-perceived knowledge levels, the risk of infection and the benefit of their work. Practices were assessed with six questions using three previously tested items from a KAP survey of

Table I
Characteristics of study population (n=107)

Characteristic	n (%)
Female	54 (50.5%)
Male	53 (49.5%)
Age (in years)	33 (24–58)
Age groups (in years)	
20-29	28 (26.2%)
30-39	54 (50.5%)
40-49	22 (20.6%)
50 and above	3 (2.8%)
Hospital	
CHUB	26 (24.3%)
CHUK	27 (25.2%)
KFH	30 (28.0%)
RMH	24 (22.4%)
Profession	
Nurse (without specialisation)	72 (67%)
Nurse with specialisation	10 (9.3%)
Resident	18 (17%)
Physician with specialisation	7 (6.5%)
Work experience in CC (in years)	
0-4	67 (62.6%)
5-9	28 (26.2%)
10 and above	12 (11.2%)
Participation in refresher training on CC	
Since 2020	46 (43.0%)
Before 2020	35 (32.7%)
No training	26 (24.3%)
Participation in refresher training on infection prevention and control	
Since 2020	41 (38.3%)
Before 2020	40 (37.4%)
No training	26 (24.3%)

Centre Hospitalier Universitaire de Kigali (CHUK), Centre Hospitalier Universitaire de Butare (CHUB), King Faisal Hospital (KFH) and Rwanda Military Hospital (RMH).

HCWs towards viral haemorrhagic fevers in Guinea [8](Items 60, 62 and 63 in appendix A). Lastly, three additional questions were included about the availability of materials as well as time to comply with hygiene protocols to contextualise self-reported practices. For attitudes and practices, participants indicated their answer on a 5-point Likert scale. The study investigators adapted and validated the questionnaire. The survey was then pre-tested with one senior specialised ICU nurse who later did not participate in the survey.

Statistical analysis

All data were described as frequencies and percentages. One item was excluded from the analysis (Question 59) as participants had difficulty to understand the answer options during data collection. A knowledge score was calculated by assigning one point to each correct response with 100 percent corresponding to 29 points. The median score of each individual was compared with the score of 19 knowledge items on CC and 10 items on HCIDs and tested for differences between groups with a Mann-Whitney U test for independent samples.

Knowledge scores were assessed as poor (0–50%), moderate (50–70%), good (70–85%) and very good (85–100%). To identify associated factors with the knowledge score, independent samples t-tests and one-way analysis of variance (ANOVA) were used to test whether differences were statistically significant. Answers to attitudes and practices items were not constructed as scores and were only described by frequencies and percentages. A *P*-value <0.05 was considered statistically significant. All data were analysed using R 4.2.3 [25].

Results

The study population included 107 out of 152 eligible staff working in ICUs resulting in a recruitment of approximately 70 % of the target population. 67% of all nurses were without specialisation, and 62.6 % of all participants had less than four years of experience in CC. 57 and 61.7 % of respondents, respectively, had not attended any refresher training of a minimum of one day on CC or IPC since 2020 (Table I).

Knowledge

Overall, participants showed moderate knowledge on CC and on HCIDs with a median score of 58.6% and a standard deviation of 12.6%. There was no statistically significant difference when comparing participants' knowledge on CC and HCIDs (mean score of 61.5% versus 56.1%, *P*-value =0.1122, Mann–Whitney U test). The average score varied more on HCID questions (SD=19.6%) in comparison to questions on CC (SD=13.6%), see supplement C. Conducting univariate analyses, we did not observe differences in mean knowledge scores with respect to age, gender, CC and IPC refresher trainings (Table II). Factors associated with higher knowledge scores were professional background and years of professional experience. Further, knowledge scores differed between hospitals.

Attitudes – self-perceived knowledge, perceived risk of infection and perceived patient benefit

In addition to assessing the knowledge level, we asked personnel to report their self-perceived knowledge levels. 58% and 53.5% of respondents, respectively, rated their knowledge on CC and IPC as good or very good (Figure 1). In relation to risk perception while performing routine tasks on the job, 48.6% of participants perceived a high or very high risk of infection, see Figure 2. We assessed the perceived benefit of their work as a measure of job satisfaction. 94.4% of respondents agreed or fully agreed that ICU services help to save more lives and to treat patients better (Figure 3).

Self-reported practices and availability of material

While 72.9 % of participants stated always following hand hygiene recommendations, 42.3 % of participants reported to never, rarely or even sometimes avoiding the recapping of needles while only 58.9% state to never recap. 33.7 % of participants reported not wearing goggles or a face shield during aerosol generating procedures (Figure 4). For the factors that might affect practices, 89.7 % of participants reported good availability of hand hygiene resources. Fewer (61.7%) participants agreed or rather agreed that personal protective equipment was always available. The same proportion of staff (61.7 %) reported having enough time to adhere to IPC

Table II
Univariate analyses of factors associated with knowledge score: T-tests and ANOVA results

		N	Mean (SD)	t/F	*P*
Sex	Male	54	0.62 (0.13)	-1.7101	0.09021
	Female	55	0.58 (0.12)		
Age group	20—29	29	0.6 (0.13)	0.348	0.791
	30—39	55	0.6 (0.13)		
	40—49	22	0.58 (0.11)		
	50 and above	3	0.66 (0.15)		
Hospital	CHUB	26	0.6 (0.15)	4.425	0.00573**
	CHUK	27	0.6 (0.13)		
	KFH	32	0.63 (0.11)		
	RMH	24	0.53 (0.1)		
Profession	Nurse	89	0.58 (0.12)	-3.4222	0.002439***
	Physician	18	0.7 (0.14)		
Experience	0—4 years	69	0.61 (0.14)	3.417	0.0365*
	5—9 years	28	0.55 (0.1)		
	10 years and above	7	0.65 (0.08)		
Refresher training on CC	No training	26	0.55 (0.12)	2.94	0.0573
	Before 2020	35	0.6 (0.11)		
	Since 2020	46	0.62 (0.14)		
Refresher training on IPC	No training	26	0.56 (0.13)	2.675	0.0737
	Before 2020	40	0.63 (0.12)		
	Since 2020	41	0.59 (0.13)		

*$P < 0.05$; ** $P < 0.01$.; *** $P < 0.001$.
Centre Hospitalier Universitaire de Kigali (CHUK), Centre Hospitalier Universitaire de Butare (CHUB), King Faisal Hospital (KFH) and Rwanda Military Hospital (RMH).

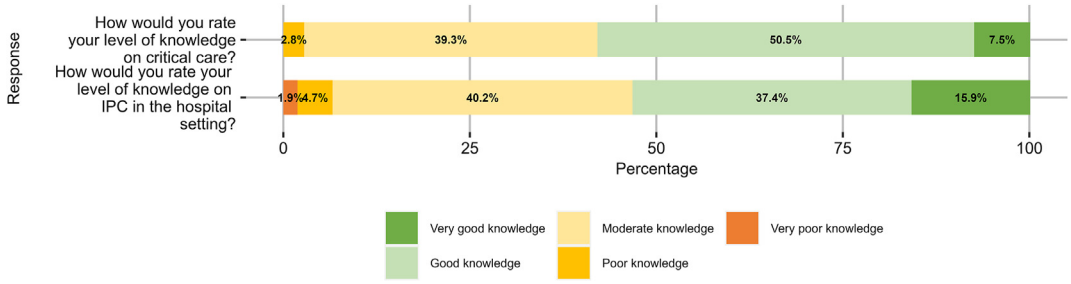

Figure 1. Self-assessed knowledge level of CC and IPC.

guidelines, while 18.6 % reported rather not agreeing or not at all agreeing with this statement, Figure 5.

Discussion

Our results showed that most ICU staff had four or fewer years of experience in CC. Less than half of participants indicated having attended a refresher training on IPC and CC since 2020. Most staff perceived their knowledge as good or very good. They identified themselves as at high risk of acquiring an infection while at work and considered their contribution to improving patient outcomes as important. A small but considerable proportion of ICU staff reported not avoiding the recapping of needles and not taking recommended additional precautions during aerosol-generating procedures. The following section discusses the results focusing on three aspects: the need for continuous training in a rather inexperienced workforce, the knowledge level of ICU staff as well as their perception of the risk of infection and adherence to IPC standards.

The fact that most ICU personnel had few years of experience corresponds with descriptions of healthcare personnel and ICU staff reported in studies from East Africa documenting 80 percent of ICU staff with less than five years of experience [26,27]. Despite the fact that HCW training is mentioned frequently as a key preparedness activity during the COVID-19 pandemic response in Rwanda and elsewhere, less than half of participants reported receiving refresher training on either CC or IPC since 2020 [28,29]. This suggests that sufficient continuous training is lacking. The previously reported low retention rates among HCWs in Rwanda contributes to a loss of knowledge and skills which underlines the importance of regular training to further strengthen ICU staff knowledge, skills and practices [30].

On CC and HCID knowledge, physicians performed significantly better than nurses. This may reflect the different levels of qualification and is in line with other observations

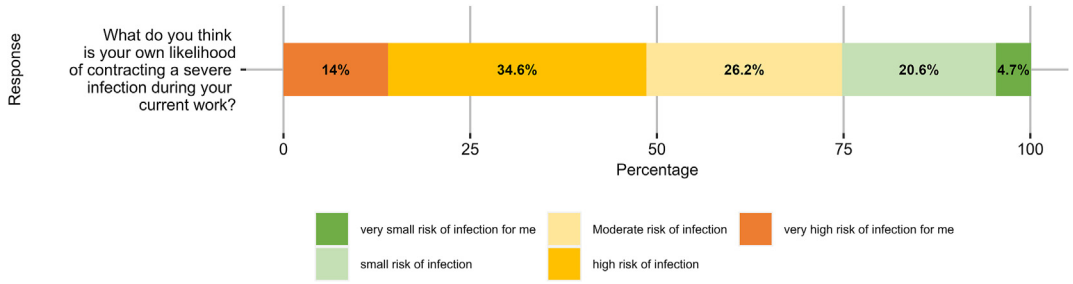

Figure 2. Self-perceived risk of infection during everyday work.

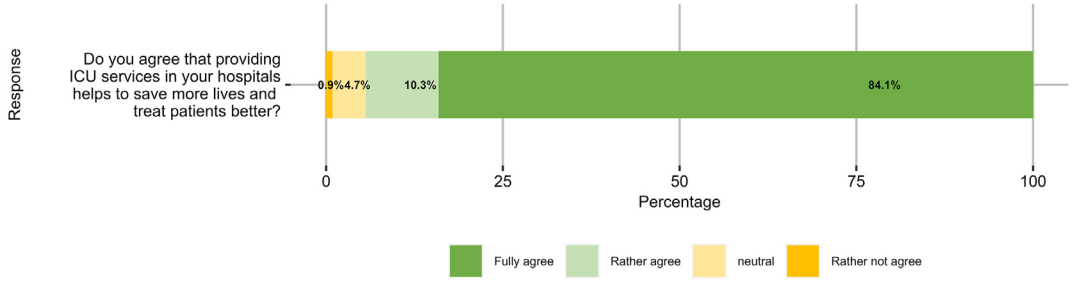

Figure 3. Self-perceived benefit of work for patients.

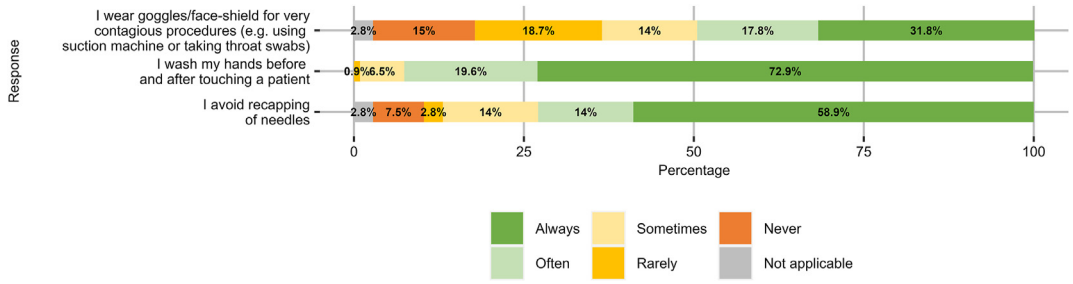

Figure 4. Self-reported IPC practice among ICU staff.

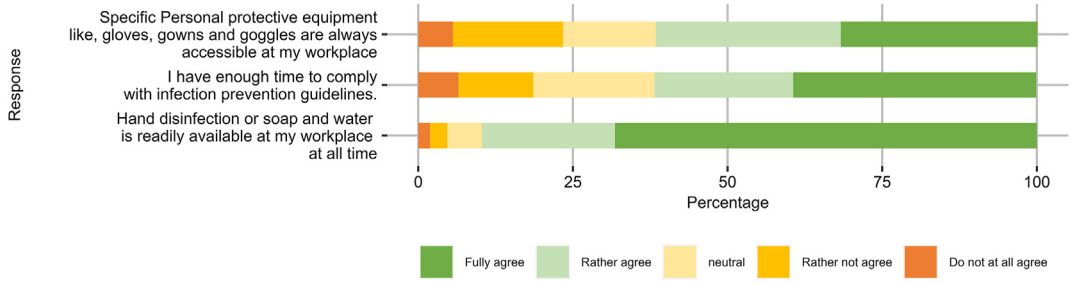

Figure 5. Reported availability of IPC resources including, water and time for IPC precautions.

regarding knowledge on epidemic diseases [10,13]. This study also found an association between knowledge level and years of professional experience which has been reported elsewhere [13,15]. The knowledge scores of staff from the four hospitals differed. Still, a study comparing KAP on EVD among HCWs employed in public and private hospital could not find significant differences [16]. All findings from the univariate analyses should be interpreted with caution. Hospitals might have different compositions of nurses and physicians and varying level of experienced staff which could account for

differences in knowledge score between hospitals, for example.

Our findings are only partly comparable to other KAP studies on HCIDs as most of them do not specifically include questions on CC nor focus on ICU staff. Studies have reported poor knowledge on EVD among HCWs in various settings including countries with frequent disease occurrence such as DRC [9,11,14,15]. In contrast, other studies found good knowledge on EVD among healthcare personnel [8,10,13,16]. This study identified moderate knowledge on HCIDs which may also be attributed to ongoing preparedness efforts in Rwanda [31]. This is reflected by the self-assed knowledge level of the participants who did not themselves indicate any apparent knowledge gaps.

Most participants regarded the risk of infection during everyday work as high or very high. In line with other KAP studies and given the exposures of HCWs working in ICUs, a majority of participants assess their risk of infection as high or very high [14]. Here, training could also contribute to staff feeling safer at work. For example, it is possible that if more frequent refresher training had been carried out, the observed perceived level of risk of infection could have been lower.

The perception of high risk of infection stands in contrast with the non-compliance with basic IPC practices. This is in accordance with other studies showing that knowledge does not necessarily translate into practice [10,32,33]. While 72.9 % of participants reported always following hand hygiene recommendations a significant proportion of staff reported practicing recapping of needles, which poses a significant risk for needle stick injuries [34]. This practice has also been observed elsewhere. Described reasons for recapping of needles are lack of sharp bins and limited understanding of injection safety [10,13,32,33]. While there are only limited anecdotal data regarding the risk of transmission of HCIDs from a needle stick injuries, re-using of contaminated needles was identified as an impactful way of transmission with high fatality rates [35]. Furthermore, more than a third of participants reported not adequately protecting themselves during aerosol generating procedures, which may put them at risk of aerosol and droplet transmission.

Staff who were overall knowledgeable and risk aware seemed to fail to apply such as avoiding the recapping of needles. This raises the question if factors in addition to training and qualifications, affect hygiene compliance. In terms of resource availability, a large majority of participants reported good availability of hand hygiene resources and sufficient time to comply with IPC guidelines. However, only 2 in 3 staff agreed that personal protective equipment was always available directly at the workplace. Almost every fifth staff member reported not having enough time to comply with hygiene measures. This might also be reflected in the reported lower compliance with necessary personal protective equipment during aerosol generating procedures. Another study showed that recapping of needles was influenced by the location of sharp containers and occurred more frequently when staff did not wear gloves [34]. The association between wearing gloves and recapping likely points to a lack of available personal protective equipment. Therefore, the relevance of unavailability of personal protective equipment should be re-assessed at hospital level while enforcing practices through refresher trainings [34,36].

This study explores a gap in the literature on preparedness for HCIDs by focussing on frontline ICU personnel who are most likely to adequately care for affected patients. By employing a cross-sectional study design covering most of the target population, this study provides a snapshot of the current situation of ICU staff in Rwanda.

Limitations

First, this cross-sectional study allowed no inference on the temporal sequence nor direction of association. Second, all data presented were self-reported. Particularly for practices, socially desired answers, such as compliance, were likely to be overreported. Future studies should aim to incorporate observations into their assessment of practices. Third, the language of the survey was English. While staff was able to ask the study investigators for clarification in Kinyarwanda or French, comprehension issues might have occurred. Fourth, we applied a convenience sampling approach which could have led to selection bias as staff that were sick or absent could not participate or actively avoid participating in the survey. Fifth, when asking about refresher training, it was specified as any training lasting at least 1 day to make the training more comparable. Thus, the reported of refresher training might not include shorter sessions such as half days, for example.

Conclusions

The results of this study may contribute to addressing identified gaps in knowledge and practices as well as highlighting attitudes of importance when conceptualising further training programmes.

Given that the overall workforce had few years of experience, ICU personnel should be offered a continuous learning opportunities allowing them to stay updated on treatment and prevention strategies for CC in general and for HCIDs in particular.

The perception of high risk of infection during everyday work stands in contrast with lack of compliance with basic IPC practices. As less than half of ICU staff in Rwanda participated in IPC refresher training since the onset of the pandemic in 2020, regular refresher training should reinforce standards precautions to avoid easily preventable infections of healthcare workers.

Overall, the existing knowledge base among ICU personnel on CC and prevention and control of HCIDs suggests a promising foundation on which to build upon to increase intensive medicine and HCID care capacities in Rwanda.

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Conflict of interest statement

The authors declare that they have no conflicts of interest to disclose beyond the financial support received by the funder.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.infpip.2024.100398.

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