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Training of Infection Prevention and Control to Healthcare Workers of Mining Health Facilities: A Shared Responsibility for Improving Safety of Mining Communities

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Abstract

Introduction: Without appropriately trained healthcare workers (HCWs), infection prevention and control (IPC) cannot be implemented according to set standards. Although training is crucial, authorities rarely consider those working in health facilities owned by the mining. We describe the training which was conducted in North Mara in Mara region mining health facilities. **Methods:** This was descriptive study on the training of IPC to HCWs of mining health facilities. The training was conducted to North Mara Gold Mine Limited on April 2024. We targeted the HCWs and supporting staff working in the health facilities of the mining communities. The duration of the training was five days. The sessions started with pre-training test to evaluate what participants understood before training and followed with training itself. The training was carried out using mixed adult learning methods like: illustrated lectures, demonstrations, brainstorming, small group activities, group discussions, role plays, case studies and simulations. The training was finalized with posttest. **Results:** A total of ten HCWs were trained out of 13 of the facility. In that training six were males and four were females. Also, out of the ten trained three were clinicians, four nurses, one lab technician, one pharmaceutical technician, one support staff. The average score of the results of the pretest was 70.7% with a range of 16% (minimum 64% and maximum 80%) and that of the posttest was 79.8% with a range of 12% (min 74% and max 88%). **Conclusions:** If HCWs are well trained to comply with IPC standards and transmission-based precautions, they have the ability to deliver safe health services

and protect themselves, patients, environment and the community. Training of HCWs working at the mining, therefore, can be adapted in all mines to improve the quality of mining healthcare and respond to the need to improve the safety of mining communities.

Keywords

Healthcare Associated Infection, Infection Prevention and Control, Safety of Mining Community

1. Introduction

Adherence to Infection Prevention and Control (IPC) needs to be maintained across all health provision settings including at the Mining Health Facilities. Mining health facilities are facilities (dispensaries, Health Centers or Hospitals) which provide health services to the mining communities. When there is good adherence to infection prevention guidelines and standards by frontline healthcare workers (HCWs), the risk of transmission to patients, HCWs, environment and community at large is low [1]. However, healthcare settings continue to report outbreaks, including the Coronavirus disease of 2019 (COVID-19), cholera, Marburg, other healthcare-associated infections (HAIs) as well as infections with antimicrobial resistance (AMR) among patients, HCWs and community [2]. Out of every 100 patients in acute-care hospitals, seven patients in high-income countries and 15 patients in low- and middle-income countries will acquire at least one health care-associated infection (HAI) during their hospital stay. On average, 1 in every 10 affected patients will die from their HAI [3]. The World Health Organization (WHO) estimates 10% - 30% of hospital admissions are associated with poor IPC [4]. HCWs' compliance with IPC standard and transmission-based precautions has been consistently reported to be lower across a broad spectrum of core components of standard precautions [5]. WHO global report on IPC revealed that good IPC programmes can reduce health care infections by 70% [3].

A major cause of transmission is poor compliance with IPC standards [6]. The reasons for poor compliance include: working outside of emergency or intensive care settings; not working with confirmed infection cases; lack of concern about risk of infection; lack of monitoring by superiors; observed noncompliance of colleagues; lack of IPC-related supplies and equipment; perceived difficulty compliance of IPC standards; perceived lack of effectiveness of IPC standard precautions; perceived inconvenience with IPC standard precautions; perceived negative impact of standard precautions like use of personal protective equipment (PPE) on patient care; lack of infection control guidance; and inconsistent or unclear guidance [7]. Use of PPE has been a critical component of the WHO's guidance for prevention of occupational transmission of COVID-19 [8].

In the training to HCWs, we usually consider those working in the healthcare

areas serving the normal community of the public and leave aside those who work in areas like mines. Mining is significant catalyst for socioeconomic development [9] [10]. It generates vital funds for the construction of infrastructure in many areas that are essential to prosperity and the advancement of humanity. In particular, the mining industry in Sub-Saharan Africa (SSA) has enormous potential to alleviate poverty on the continent by transferring wealth from elites to common people and from the national government to communities impacted by mining operations. The health sector is one where mining profits can have especially revolutionary effects on development. Despite all those benefits, the process of mining attracts a lot of people to work together in a way that they might be at risk that may impact their health; hence, ensuring their occupational safety is critical for their wellbeing [11].

The communities living in the mines encounter a lot of risks that can lead to compromisation of their safety. The most frequent risks associated with mining include, but are not restricted to, combustion, mine gas emissions, acid mine water drainage, fault reactivation and fissures, ground collapse, and mine water rebound. Additional noteworthy risks include contamination, waste, abandonment, and seismicity brought on by mining. Mining hazards are not always predictable or forecasted in terms of their timing, location, length, severity, and extent, even though they may be foreseen. Mining risks might appear singly or in clusters at the same time [12].

These risks at the mines' communities can lead to: injuries, psychological trauma, cancers, risky behaviors (drugs and alcohol abuse, sexual violence, multiple sexual partners) and migration across borders, which can all contribute to the rapid spread of diseases. Study by Dietler *et al.* has indicated that mine opening in a community increased the odds of HIV infection almost two-fold [13]. Also, it has been documented that TB prevalence among miners in SSA is estimated at 3000 - 7000/100,000, which is about 3 to 10-times higher than in the general population [14]. Other risk is the chance of having the outbreak of emerging and reemerging infections and some of them being highly infectious such as ebola virus disease, and murbug virus disease. Also, in the mines people tend to overcrowd which has impact on health especially spread of respiratory infectious diseases like COVID-19 and Tuberculosis. These risks call for joint or shared effort in addressing those safety challenges in the mines' areas.

The training programs on IPC, in addition to other employee occupational health strategies, can help decrease the risks enumerated above including infections amongst HCWs and mines communities [15]. In the training we conducted, the focus was to build capacity on how to break the chain of infection transmission based on standard and transmission-based precautions. Hence, the overall aim of this paper was to describe the training around IPC of HCWs in the healthcare settings in the mines of low- and middle-income countries with critical potential of infectious disease transmission in their communities and call upon all stakeholders of safety to join hands in protection of mining communities as a shared

responsibility [16]-[18].

2. Objectives of the Training

2.1. Broad Objective

To conduct capacity building of the HCWs working in the mining healthcare facility on basic IPC.

2.2. Specific Objectives

1) To share new updates on IPC;

2) To share WHO recommendations on IPC practices in healthcare facilities;

3) To disseminate revised IPC guidelines of 2018 and IPC standard operating procedures (SOPs).

2.3. Expected Outputs

1) WHO recommendations on IPC to be practiced effectively in our healthcare facilities for prevention of infections;

2) IPC SOPs for emerging and reemerging diseases to be familiar to all HCWs as a component of preparedness and readiness; and

3) IPC guidelines of 2018 and SOPs to be adhered to by all healthcare providers in healthcare settings.

3. Methods

3.1. Study Design

This is a descriptive case study of the training of the HCWs working at North Mara Gold Mine in April 2024. It was a cross sectional non comparative case study.

Study Setting

The North Mara Gold Mine Limited (NMGML) is located in north-west Tanzania in the Tarime district of the Mara region. It is around 100 kilometres east of Lake Victoria and 20 kilometres south of the Kenyan border. North Mara started commercial production in 2002. The mine is a combined open pit and underground operation from two deposits, Gokona (underground) and Nyabirama (open pit). The process plant has the capacity to process an average of 8000 tonnes of ore per day. The NMGML has succeeded in becoming exactly that. As a result of NMGML's local employment policy, North Mara has seen a 25% increase in local employment since September 2019. The Mine now employs 2923 people of whom: 96% are host nationals (including 64% of management employees); and 46% are from local communities.

3.2. Population

3.2.1. Target Population

All HCWs and the support staff who are working in the mining healthcare

facilities in Tanzania.

3.2.2. Accessible Population

All HCWs and the support staff who are working in the NMGML healthcare facility.

3.2.3. Study Population

All HCWs and the support staff who are working in the mining healthcare facilities and had permission to attend the training in Tanzania. We worked with relevant HCWs in NMGML to improve the IPC for clinician, nurses/midwives, laboratory technicians, pharmaceutical technicians and support staff to the health facility. We focused on HCWs because they are more at risk and in the process, they can protect the entire mining community when well trained. In NMGML, there is a total of 13 HCWs, and out of them we trained ten HCWs. To enhance the IPC of HCWs, we used national IPC training package. Training package for IPC provides a comprehensive set of IPC topics to meet the needs of the country.

4. Description of the Training

Effective facilitation was used to maintain participants' interest with exciting, dynamic delivery approach using variety of facilitation and adult learning techniques which helped the participants to reach the course objectives (Centers for Disease Control and Prevention, 2018). Before implementing the training program, facilitators familiarized themselves with the principles of facilitation and abide to them accordingly using the IPC training package (Facilitators' Guide, Participants Manual and the Power Points) prepared based on IPC guidelines of Tanzania of 2018.

4.1. The Training Process

Establishment of a positive learning climate was key on the understanding of the principles of adult learning. Therefore, facilitators had to understand what the participants needed and expected out of the training to be offered. Adult learners who attended the training with the aim of acquiring or improving their knowledge, attitude and skills related to any topic matter were requested to be free and share their experience during the training.

4.2. Essential Materials

The following materials were used to facilitate the training: Visual aids such as overhead projector, LCD projector, computer, flipcharts, markers, CD and tape; Pens, pencil, paper, index cards; Clock or watch, to keep track of time.

4.3. Venue

We organized the training to be on a residential basis of the mining premises because its sequential development required sustained attention and concentration of the participants and an active participation on the participants' part. The venue of the training had to be able to accommodate size of group of 25 - 30 participants

and activities of the training so as to run smoothly without or with minimal interruptions and spare space to accommodate small group and secretariat activities.

4.4. The Training Environment

The learning environment consisted of the following: an educational philosophy that promoted critical thinking development and emphasized behaviors that respect and respond to the perceived needs of patients and clients; educational materials that were pertinent to adult learning; comprehensive, supervised clinical learning experiences that could enable the development of necessary skills for the implementation of appropriate IPC practices; evaluation techniques that measure knowledge, skills, and attitudes; facilitators who were suitably qualified to use competency-based training methods and possess the necessary competencies to instruct and serve as role models for participants; beginning and ending the session.

4.5. Managing Time

Throughout the program, time management was crucial for both theoretical and practical sessions. In order to effectively manage time, facilitators carried out the following tasks: Every activity had enough time allotted to it; training sessions had suggested times that could be adjusted based on circumstances; each facilitator was required to keep to the time allotted for each activity and training session; they had a workable schedule and followed it; they were aware of the participant characteristics and made the appropriate adjustments to fit the timing of training sessions; all activities had been scheduled ahead of time to prevent delays; and any observation of flexibility had to be handled with intelligence.

4.6. Pre- and Post-Training Evaluation

Evaluation both before and after the training was crucial for both the current training and the development of future trainings. A pre-post training evaluation questionnaire has been created specifically for this purpose in order to evaluate the participants.

4.7. Pre-Course Questionnaire

The pre-course questionnaire was designed primarily to support the participants and the facilitator as they begin their joint work in the course. This was accomplished by assessing each participant's unique and group understanding of the course material. As a result, the facilitator provided pertinent details and guidelines for the pre-course questionnaires; let the participants know when the test is scheduled; administered the test; marked it using the given answer key; discussed the results with the participants; and pointed out specific subjects that might require more attention during the learning sessions.

4.8. Setting Ground Rules and Group Expectations

These were designed to provide an environment that is conducive to experience

sharing and learning, as well as a safe area for facilitators and participants to interact.

4.9. Facilitation Process

To effectively communicate the sessions to participants, the facilitator had to adhere to a strict style of facilitation based on the training manuals specifically facilitators' guide. The instructions were designed to be followed step-by-step in order to gain information, abilities, and good attitudes. The procedures needed to be planned ahead of time to avoid any glitches when providing learning sessions.

4.10. Setting Induction

The presenting session started with setting induction. This stage was crucial because it prepared the participants to pay attention to the session and to be aware. Facilitators were free to undertake any icebreaker activity before the class begins. Some took tales that were relevant to the topic of discussion, while others took the stories that amused the audience by performing musical selections. The challenge here was to extract the participants from their dreams or earlier conversation. Other facilitators began the session by extending a warm greeting, inquiring about participants' health, going over the prior session, and introducing the topic of discussion.

4.11. Presenting Objectives of the Session

This was the phase where the facilitator gave the participants an overview of the session's goals and title. The type of visual assistance that was to be utilized determined how the objectives were presented. The facilitator then read aloud the session objectives. The facilitator clarified the intended outcomes for each aim, and/or participants may be questioned about if the objectives are understood by them.

4.12. Initiating Learning Experiences of Session

This was the stage where the session's materials were introduced. This was contingent upon the kind of facilitation method or methods chosen. Interactive training methods that encouraged involvement of participants were the ones that were chosen for IPC training. Presenting each goal in a reasonable sequence, one at a time. Every goal was covered through a variety of activities (exercises).

4.13. Reflecting Learning Process

Three issues or sub-steps were carried out by the facilitator in this phase. Emotional reflection on the session that was held: giving their emotions during the workshop was permitted for participants. "How do you feel about the session discussed?" was a frequently asked question in this field. Everyone had a chance to voice their opinions about the session that was conducted. It was briefly mentioned how they felt. The period of time during which participants shared or illustrated what they had learned from the workshop. In the session, attendees

provided crucial points. Participants were not allowed to raise broad concerns by the facilitator. As an illustration, rather than stating, "I have discovered that it is crucial to avoid infections".

One infection prevention measure, such as hand washing or decontamination, was encouraged by the facilitator to be mentioned by each participant. The usual query was: From this presentation, what have you learned? Furthermore, implementing acquired knowledge: during the seminar, participants were asked to indicate how they planned to use the knowledge they had gained to their jobs. The chance to verify the session's applicability in actual work scenarios was provided to the participants. Frequently posed was the following query: what application would you make of the educational opportunities you have just illustrated? Everything had its proper time to learn.

4.14. Reviewing Objectives

Following the completion of the learning experiences, the facilitator ought to allow sufficient time to assess the goals' accomplishment. The facilitator may ask each participant to read the objectives one at a time after they are posted. The facilitator must inquire of the participant whether the goal was adequately covered after reading it. In the same way, this continued for other goals.

4.15. Summarizing Session

The facilitator chose to summarize the meeting or asked the participant(s) for feedback. Key aspects were covered in a sufficiently succinct summary.

4.16. Providing References and Documents

Participants received references for additional reading or papers, such as copies of the slides that were displayed, as extra reading material to be read at their convenience.

4.17. Ice-Breakers

It was one of the methods of facilitation that improved relationships, involvement, and communication. By melting the ice and putting participants at ease, icebreakers contributed to the creation of a welcoming learning atmosphere.

4.18. Energizers

These were quick, enjoyable exercises that interjected between focused learning sessions. They were frequently tied to the training session, included group songs, and required physical exercise. They fostered camaraderie among participants and assisted in keeping participants' focus and energy levels up.

4.19. Administrative Support

Administrative tasks were needed during the training sessions. Some of the administrative functions were secretarial supplies to be obtained and sent to the

station prior to the training day. Also, permit participants to know what their plans were for the next day. Moreover, facilitators meetings to assess the day's events and make plans for the next day were carried out in every end of sessions in a day.

4.20. Post-Course Questionnaire

Post-course questionnaire, which was an exact replica of the pre-course questionnaire, was administered when all of the knowledge content and skills have been accomplished to help each participant and the facilitator assess the participants' progress in mastering the course contents. True-false test items were used in this situation. The results of the tests are shown in Table 2.

4.21. The Training Resource Package for IPC

The training resource package was developed in 2020 by the Tanzania—Ministry of Health (MoH) and Partners. The training package contains 33 sessions, each outlining a particular topic. Each session comes with a lesson plan, PowerPoint presentations (PPTs), and additional resources and activities that instructors might find useful for relaying information to participants. The IPC training programme is designed to be implemented in five (5) days covering all key issues related to IPC so as to reduce the risk of infections among key actors in giving and receiving health care services. Actors include patients/client, HCWs and community. This training package has theory and practical sessions which are facilitated by various teaching methods following principles of adult learning (Avera Education & Staffing Solutions, 2014).

The training on IPC is designed to be implemented through face to face and blended online course which will be considered as continuous professional development (CPD) programme. The programme will be taken for six (6) days if implemented in face to face through workshops and 20 days if taken through distance e-learning. The programme covers all key issues related to IPC so as to equip participants with ability to reduce the risk of infections among key actors in giving and receiving health care services. Participants are guided into self-directed learning through classroom and practical sessions which utilize variety of teaching and learning methods. This training has a total of 51 hours which includes classroom and practical teaching hours as shown in Table 1. The training programme has a total of 8.3 credits for CPD.

Table 1. List of modules included in the training of infection prevention and control.

Day One		
TIME	**ACTIVITY**	**RESPONSIBLE PERSON**
07^{30} - 07^{50}	Registration, Self-Introduction, Logistics and Norms and Objectives of the training	WHO
07^{50} - 08^{00}	Opening Remarks	RMO

Continued

08^{00} - 08^{30}	Pre-Comfort Assessment	All
08^{30} - 09^{00}	**Session 1:** Introduction to Infection Prevention and Control in Tanzania	Facilitator
09^{00} - 10^{30}	**Session 2:** Infectious disease transmission cycle and Standard and Transmission Based Precaution	Facilitator
10^{30} - 11^{00}	**Health Break**	**ALL**
12^{00} - 13^{00}	**Session 3;** Hand hygiene	Facilitator
\$13^{00}$ - 14^{00}	**Session 4:** Worker's health and safety in context of IPC	Facilitator
14.00 - 15.00	**Health Break**	**ALL**
15.00 - 17.00	**Session 5:** Utilization of personal protective equipment (Classroom and practical sessions)	Facilitator
17.00 - 17.30	**Evaluation, Closure and Organisers Meeting**	Organisers
	Day Two	
TIME	**ACTIVITY**	**RESPONSIBLE PERSON**
07.30 - 07.40	Recap	Secretariat
07.40 - 08.40	**Session 6:** Antiseptic and disinfectants	Facilitator
08.40 - 10.40	**Session 7:** Decontamination	Facilitator
10.40 - 11.00	**Health Break**	**ALL**
11.00 - 12.00	**Session 8:** Central sterilization and supply department	Facilitator
12:00 - 13:00	**Session 9:** Healthcare waste managements	Facilitator
13.00 - 14.00	**Health Break**	**ALL**
14.00 - 15.00	**Session 10:** Safe handling of sharps	Facilitator
15.00 - 16.00	**Session 11:** Post exposure prophylaxis (PEP)	Facilitator
16.00 - 17.00	**Session 12:** Laundry management	Facilitator
17.00 - 17.20	**Evaluation, Closure and Organizers Meeting**	Organisers
	Day Three	
TIME	**ACTIVITY**	**RESPONSIBLE PERSON**
07.30 - 07.40	Recap	Secretariat
07.40 - 08.40	**Session 13:** House keeping	Facilitator
08.40 - 10.40	**Session 14:** WASH in healthcare facilities	Facilitator
10.40 - 11.00	**Health Break**	**ALL**
11.00 - 12.00	**Session 15:** Food hygiene for wards/units, kitchen procedures	Facilitator
12.00 - 13.00	**Session 16:** Mortuary hygiene	Facilitator
13.00 - 14.00	**Health Break**	**ALL**

Continued

14.00 - 15.00	**Session 17:** Traffic flow and activity pattern at HIDTU	Facilitator
15.00 - 16.00	**Session 18:** IPC practices in operating department	Facilitator
16:00 - 17:00	**Session 19:** Prevention of surgical site infection	Facilitator
17.00 - 17.30	**Evaluation, Closure and Organizers Meeting**	Organisers
	Day Four	
TIME	**ACTIVITY**	**RESPONSIBLE PERSON**
07.30 - 07.40	Recap	Secretariat
07.40 - 08.40	**Session 20:** Prevention of nosocomial urinary tract infection	Facilitator
08.40 - 9.40	**Session 21:** Prevention of nosocomial pneumonia	Facilitator
09:40 - 10:40	**Session 22:** Prevention of infection related to use of intravascular devices	Facilitator
10.40 - 11.00	**Health Break**	**ALL**
11.00 - 12.00	**Session 23:** Prevention of infection to hemodialysis patient.	Facilitator
12.00 - 13.00	**Session 24:** Nosocomial diarrhea	Facilitator
13.00 - 14.00	**Health Break**	**ALL**
14.00 - 15.30	**Session 25:** Prevention of maternal and newborn nosocomial infection	Facilitator
15.30 - 17.30	**Session 26:** Prevention and control of Emerging and reemerging diseases	Facilitator
17.30 - 17.50	**Evaluation, Closure and Organizers Meeting**	Organisers
	Day Five	
TIME	**ACTIVITY**	**RESPONSIBLE PERSON**
07.30 - 07.40	Recap	Secretariat
07.40 - 08.40	**Session 27:** Prevention and control of cholera outbreak.	Facilitator
08.40 - 09.40	**Session 28:** Prevention of infection in health laboratory setting **Session 29:** Prevention of infection in blood banks and transfusion services	Facilitator
09:40 - 10:40	**Session 30:** Antimicrobial resistance (AMR)	Facilitator
10.40 - 11.00	**Health Break**	**ALL**
11.00 - 12.00	**Session 31**: Infections monitoring and surveillance of COVID-19	Facilitator
12.00 - 12.30	Post-Comfort Assessment	ALL
12:30 - 13:30	**Health Break**	**ALL**
13:30 - 14:30	**Session 32**: Programme management on IPC	Facilitator
14:30 - 15:30	**Session 33:** Core IPC interventions in COVID-19 for healthcare facilities at glance	Facilitator
15:30 - 16:00	**Closure of training**	RMO

4.22. Step by Step on How the Training Was Conducted

1) As soon as the team of facilitators arrived, they paid a courtesy call to the North Mara Medical Centre Manager to explain the objective of training on IPC to HCWs.

2) On arrival at the training venue, registration, introduction of facilitators and participants, as well as explanation of other training logistics was carried out.

3) Outlining of the training objectives to participants was done.

4) Opening remarks from MoH and Facility Representative was done.

5) Provision of pre-comfort test before the training and post-comfort assessment test was conducted after the training was completed.

6) Provision of training materials to participants was done.

7) Provision of training certificates to participants soon after completion of the training.

4.23. Resources Used during Training

During training, various materials were used as guidance but not limited to:

- National Infection Prevention and Control Guidelines for Health Care Services in Tanzania (2018);
- The Infection Prevention and Control Assessment Framework (IPCAF);
- National Infection Prevention and Control Standards for Hospitals;
- Infection Prevention and Control Standard Operating Procedures (SOPs); and
- National Infection Prevention and Control training PPTs.

4.24. Proceedings

1) Day One

a) Participants' arrival introduction and registration

Participants arrived at 10:00 AM at emergency response team Boardroom, every participant had an opportunity to register their particulars and were informed of the training logistics.

b) Opening remarks

An opening remark was made by the Acting Facility Manager, and team lead from MoH on behalf of the Director of the Health Quality Assurance Unit (DHQAU).

c) Opening remarks from Acting DHQAU

The National IPC Coordinator presented the opening remark from the MoH on behalf of the DHQAU by saying that, no participant should lag behind, rather the Ministry is expecting much from them to disseminate the information to other staff who could not get the opportunity to attend the training. He insisted that, the facility should ensure that they prepare an action plan that will guide the implementation of IPC activities at their work. He further told them to participate fully and acquire knowledge that will guide in prevention of diseases in healthcare settings and in the surrounding community.

d) Opening remarks from Acting Facility Manager

The Acting Facility Manager welcomed the facilitators and participants to the

training and he insisted to participants to listen carefully and consider what they will be taught due to the occurrence of outbreaks of various diseases that existed and are re-entering which affect HCWs and supporting staff in the provision of services to clients/patients in healthcare facilities and at community levels. He emphasized that mining areas are among the risk areas where different infectious and non-infectious diseases arise as well as major and minor accidents. He said all who encounter problems at working areas they visit the facility for first aid treatment and sometimes referred due to severity of the problem. He further said that all these clients need to be protected and prevented against contacting infections in the healthcare facility that might be due to poor adherence to IPC standards.

He said, for all that they will learn, the participants must inform others who have not attended the training due to different reasons so as to be in one page during care provision and make sure the facility become a place to treat and cure and not a source of transmitting HAIs.

Finaly, the Manager instructed the participants to use the knowledge that will be impacted to them from the training to improve services provision within the facility and fight against diseases by adhering to IPC guidelines.

e) Selection of group leaders

Participants under the guidance of the team lead selected the chairperson who was Irine who was responsible for controlling the discussions as well as managing time during the training.

f) Distribution of working tools

The team lead distributed training tools of the IPC training package, pre-and post-test and PPTs for all sessions as attached to the training schedule.

g) Issue Raised

Definition of IPC was provided by noting that it is a scientific approach and practical solution designed to prevent harm caused by infection to patients/clients and health workers. The cycle of infectious disease transmission was discussed and they agreed to practice IPC standard precautions to break the cycle which was illustrated as infectious agent, then reservoir, then point of entry, then mode of transmission, then susceptible host, and finally point of exit.

During the session discussion, the facilitator elaborated on the relationship between IPC and AMR and the role of IPC interventions as one key step in combating AMR. The issue that popped up is whether AMR can be local or global. The facilitator explained that AMR begins on an individual basis; however, the resistant organism to the particular drug or group of drugs can be transmitted from one person to another and the problem can affect the local community but with time become a global problem since human beings are mobile can move from one community to another, a situation we refer to as "*globalization and health*" (Huynen *et al*., 2005; Labonté *et al*., 2011).

Apart from another proceeding session, the hand hygiene session popped up with many concerns or questions, including the following key concern: is it realistic to wash hands during ward rounds after each patient or procedure? The

facilitators elaborated that, hand washing is one of the transmission-based precautions, during ward rounds every worker should perform a risk assessment before attending the patient, if clinical examination of the patient results on non-visibly dirty hand you can apply hand rub when moving from one patient to another for at least 3 - 5 patients then you must wash your hand with running water and liquid soap.

2) Day Two

The second day training started with a welcome note from the chairperson. Recap of the activities covered on day one was presented then day two sessions started and ended at 4:00 PM.

Issues raised

During facilitation of the day two sessions some of the issues which popped up were as follows:

First concern was, is it recommended to use open shoes (yebo yebo) in working areas and theatres? The response was open shoes are discouraged to be used in any hospital setting by HCWs. In Highly risky areas (operating theatres, labour wards, etc.) in hospital setting it is recommended to use a plastic washable boot as one of the PPE) and areas with low to medium risky areas to wear flat, comfortable, closed, and washable shoes.

Why are we using distilled water in the process of high-level decontamination using chemicals, e.g., chlorine? distilled water is pure water which is thought to be free from microorganisms. It is recommended to be used in high level disinfection using chlorine to avoid contamination of equipment which is soaked in. Normal clean water may increase risk of contamination as equipment do not undergo further disinfection process. According to the guidelines, if the distilled water is not readily available alternatively warm boiled water can be used instead.

3) Day Three

The third day of the workshop started with a welcome note from the chairperson and recap of the previous day activities by the secretary and followed by additional comments from other participants and facilitators. Then, day three sessions started and ended at 4:00 PM.

Issue raised

For how long should the unclaimed dead body be kept in the mortuary? According to guidelines the dead body should not exceed 14 days in mortuary. However, the unclaimed one involves different players the 14 days can be exceeded wherever it is deemed necessary. In case it is a Police case, the relevant authorities should be informed and proper documentation also should be done.

4) Day Four

The chairperson opened the workshop followed by a recap of the previous day's activities by the secretary and followed by additional comments from other participants and facilitators. Then, day four sessions started and ended at 4:00 PM.

Issue raised

How long does the urethral catheter be changed? the indwelling urethral

catheter should be changed every 7 - 10 days if remained clean and no sign for a cloudy crust in the catheter outlet. Catheter should be used only when it is indicated and this should apply to both normal patients and pregnant mothers in labour. Use it when indicated to reduce the risk of HAIs due to catheter use. How long does the feeding tube (nasogastric tube—NGT) be changed? feeding tube *in situ* is recommended to be changed 4 - 6 weeks after use but also should be kept clean all these days. All food particles remained in the tube should be flushed in every end of meal and any possible regurgitates.

Currently, there is practice of patient being cannulated and going back home while cannula is *in situ.* Is it recommended? response: It is strictly prohibited to allow patient going back with cannula *in situ* to reduce risk for possible thrombophlebitis and embolism. Even in hospital setting cannula should be changed in every 72 - 96 hours and daily gentle palpation at the canula site in order to identify possible tenderness is recommended. It is recommended that for every patient who is able to take medication orally should do so and reduce frequency of using injectables unnecessary.

Does the same hemodialysis machine be used even for patients with HIV, Hepatitis in normal patients? Response was No, Hemodialysis that is used for infectious cases should be separated from those used for normal patients. The one used for infectious cases should only be used for those cases. The set should be discarded in every case and the machine should be thoroughly decontaminated with chlorine.

5) Day Five

The chairperson opened the workshop followed by a recap of the previous day activities by the secretary and followed by additional comments from other participants and facilitators. Then, day five session started and ended at 4:00 PM.

Issue Raised and Responses

Some popped up key issues were as follows.

Is the IPC focal person among of the Quality Improvement Team (QIT) members? Response was Yes. IPC focal person is a part and parcel of the QIT reporting to Quality Improvement (QI) focal person (QIFP). IPC focal person assists the QIFP to oversee the IPC issues within the facilities and this person should be appointed by facility in-charge with the recommendation from the QIFP as head of the QIT.

4.25. Pre- and Post-Results

The pre-post tests showed significant gains in IPC knowledge. In the pretest the results show the level of understanding before training was good with average of 70.7% and range of 16% with minimum being 64% and maximum being 80%. The posttest evaluation showed some improvement where the average score was 79.8 and range of 12% with minimum being 74% and maximum being 88%. The details are shown in Table 2.

Table 2. Pre and Post course results.

SNo.	Pre-Test	Post-Test	Average
1	80	78	79
2	76	80	78
3	74	74	74
4	70	82	76
5	70	84	77
6	70	78	74
7	66	88	77
8	66	76	71
9	64	78	71
10		80	80
Average	**70.7**	**79.8**	**75.7**

The Difference between Pre and Post Training Scores

The difference between pre and post training average scores were determined by using paired t-test. The mean(diff) = mean (Post Test - Pretest), t = 9.11 (CI = 3.30-14.92) Pr (|T| > |t|) = 0.0034. The result shows the difference between pretest and posttest evaluations was statistically significant more than zero.

5. Discussion

There appears to be gaps in some HCWs' knowledge of general IPC, modes of transmission of infectious diseases contact, droplets and airborne, the risk of infection from one person to another, the understanding that proper hand hygiene is enough to protect against range of infections, and the IPC guidelines for preventing infections. Lack of knowledge of IPC among HCWs has been linked to the worsening of the healthcare delivery outcomes [19]. For instance, insufficient knowledge of HCWs about IPC resulted in high rates healthcare associated infections due to inadequate adherence to IPC. In Africa, the prevalence of HAI varies between 2.5% and 14.8%. An earlier study in Tanzania revealed an overall prevalence of 14.8%, making it one of the most affected countries in Africa [20]. These unsafe practices may increase exposures and infections among HCWs and community and impede control of infectious disease outbreaks. Therefore, as IPC adherence is associated with knowledge education and training should be strengthened.

In certain studies, HCWs acknowledged that, in addition to their professional education, they had not received any orientation or training on IPC in the previous year or were unsure if they had. Numerous studies have demonstrated that HCWs received inadequate training and education on IPC and that they needed more

education and training. A few HCWs claimed that administrators were the only ones with access to training, not front-line workers [21]. The WHO suggests that education and training be a fundamental element of successful IPC programs [22].

Strengthening IPC education and training for HCWs is advantageous and has significantly lowered HAIs and fought AMR [23]. According to reports, the implementation of isolation precautions, lowering the occurrence of needlestick injuries, and controlling ventilator-associated pneumonia all depend on the effectiveness of educational programs [24]. There are also studies on the efficient application of education for strategies to promote hand hygiene outside of the acute hospital care [25]. Thus, it is critical to keep the formal education program a part of the implementation strategy for the enhancement of the IPC in healthcare. To attain complete compliance with IPC rules, training and education are required. Health care facilities must also schedule training sessions for all HCWs in order to enhance their knowledge and to improve their level of compliance.

Knowledge of IPC among HCWs working in mining health facilities was lower in comparison with those in other health facilities, and their role in tackling HAIs in mining community is pivotal. Basically, this could be due to lack of education and training about IPC in HCWs working in the mines. The role of HCWs working in mining health facilities in IPC is usually underestimated although they themselves and their work can be a vector of infection transmission in mining communities. Before training started the participants were subjected to pretest and their scores had average of 70.7 percent with the range of 16 percent with minimum being 64 percent and maximum being 80 percent. The posttest evaluation showed some improvement, where the average score was 79.8 percent and range of 12 percent with minimum being 74 percent and maximum being 88 percent. The range of 16 percent of the pretest was bigger than that of posttest of 12 percent. The explanation of this is that before training there was big difference in knowledge between the HCWs than after the training. That shows the training had an impact on the knowledge improvement which was evidenced by increase in average score, lowest and highest scores of the post training evaluation.

HCWs working in the mining may be in close contact between patients, other professionals, nonprofessionals working in the mines as well as the community around the mining; high concentrations of medically-vulnerable populations, combined with physical movement between them; which may facilitate HAIs spread within health care institutions and the community. Therefore, WHO guidelines recommend that IPC education and training should be in place for all HCWs using team- and task-based strategies [19]. Inclusion of educational curricula and continuing refresher education programs about IPC is recommended for HCWs working in the mines to ensure a thorough knowledge and understanding of IPC. Education is important to address HCWs' concerns, fears, stigmas and incorrect assumptions regarding transmission or prevention of HAIs.

It is strongly advised to use a multifaceted approach (such as education, training, observation, feedback, and easy access to hand hygiene supplies) and

multimodal approach (build it, teach it, check it, sell it and live it) in order to reduce HAIs. These approaches should also prioritize IPC needs, work with a private advertising firm on a marketing campaign, and encourage active participation at the institutional level.

5.1. Sustainability

Six months post-workshop, we shall check in with workshop participants to assess whether they comply with the IPC measures we had trained them.

During the training we insisted four main things to be done by the health facility and what the MoH also will be doing for the sake of sustainability. The first thing the facility was directed to create the team which will oversee the quality issues in the facility the so-called QIT. Within the quality team there should be a person (IPC FP) or the more than one person to form a sub team called IPC sub team (IPC committee) which will be coordinating all issues of quality for the former and IPC for the latter. The second area which was insisted for the sustainability was supportive supervision and mentorship. The supportive supervision is critical area for sustainability. One of key area for the QIT is to conduct internal supportive supervision and mentorship in the facility while the external supportive supervision shall be done by external authorities like teams from the council or region or national levels. The third obligation is to carry out IPC assessment and audit in order to identify gaps and challenges. Upon identification of the gaps and challenges the facility is responsible to come up with counter measures that will address those issues. The fourth issue which was insisted was carrying out the monitoring and evaluation of the IPC implementation in the facility by implementing the IPC indicators that MoH have developed. Upon implementation of all those it was underscored that the facility need to use multi model strategy recommended by the WHO [26]. Our training revealed some areas for improvement within the IPC training for mining community. The health facility will be part of monitoring and evaluation where IPC indicators are reported through DHIS2 platform for long term check and sustainability. Any future revisions may consider adding content to address the following topics in greater depth:

- Transmission based precautions for infections more prevalent in the mining areas like Tuberculosis [14] [27];
- Occupational health in the context of IPC for mining community;
- Recordkeeping and IPC data management including data use to IPC in the mining community; and
- IPC for mining community apart from those working in the health facility.

5.2. Lessons Learned

We acquired several insights from the mining HCWs' training procedure that could prove beneficial to others in their own countries as follows:

a) Examining the IPC materials is necessary, especially for critical areas of concern such as highly contagious diseases, particularly those that are airborne. The

information that the mining community needs to be identified and discussed in detail should be covered in detail during content review workshops that implementers of IPC inservice training should arrange with all relevant parties.

b) The implementation of IPC training for mining HCWs needs the aid by other safety components from other ministries and organizations like Prime Minister Office's work, employment and youth; Occupational Safety and Health Authority (OSHA), and International Labour Organization (ILO). Also, the process of adaption needs the involvement of other sectors to make the training materials more comprehensive.

c) Context-specific modifications to the IPC training package for HCWs at the mining training are necessary. Since adaptation is a complicated process, no single method will work in every situation. Therefore, it is critical that those participating in the adaptation process have a deep comprehension of the mining community.

d) Our experience has strengthened our opinion that a solid preservice education is a vital component in enhancing the basic abilities of HCWs. However, the quality of facilitators is dependent on the resources and tools at their disposal. Maintaining up-to-date skills in competency-based training approaches and providing technically accurate information to facilitators are crucial.

6. Next Steps

Based on our experience in NMGML, the MoH shall develop a tailer made training material that fit training of HCWs working in the mining. IPC will be trained based on the risk of infections in the mines. The sessions will contain lesson plans and supporting materials that can be used by facilitors to train IPC to HCWs relevant to risks at the mining. The MoH shall also encourage all authorities of the remaining mining companies to have training of their HCWs and support staff and if possible, to all workers in the mining so as to protect them against infections.

7. Conclusion

Strengthening IPC training for clinicians, nurses/midwives, laboratory technicians as well as support staff working in mining health facilities can improve safety for mining communities at large. Quality in IPC training for HCWs is therefore a "shared responsibility" for countries seeking to reduce HAIs at mining places. HCWs if well trained and capacitated to comply with IPC standards and transmission-based precautions, have the ability to deliver safe health services and protect themselves, patients, environment and the community. Training of HCWs working at healthcare facilities in mines, therefore, can be adapted in all mines to improve the quality of mining health workforce and respond to the need to improve the safety of mining communities.

8. Limitation

Not all mining communities had the opportunity to receive the training of infection prevention and control.

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Author Contribution

JCH and ESE conceived and designed the study and wrote the first draft of the paper; all other co-authors reviewed and provided input on the manuscript as well as read and agreed to the published version of the manuscript.

Disclaimer

The MoH Tanzania and Management of NMGML as institutes had no role in the writing of the article. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the MoH and the NMGML.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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