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Implementation of a coronavirus disease 2019 infection prevention and control training program in a low-middle income country

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ABSTRACT

Introduction and aims: The COVID-19 pandemic poses an ongoing risk to health workers globally. This is particularly true in low- and middle-income countries (LMICs) where resource constraints, ongoing waves of infection, and limited access to vaccines disproportionately burden health systems. Thus, infection prevention and control (IPC) training for COVID-19 remains an important tool to safeguard health workers. We report on the implementation of evidence-based and role-specific COVID-19 IPC training for health workers in a hospital and public health field setting in Sri Lanka.

Methods: We describe the development of training materials, which were contextualized to local needs and targeted to different staffing categories including support staff. We describe development of role- and context-specific IPC guidelines and accompanying training materials and videos during the first year of the COVID-19 pandemic. We describe in-person training activities and an overview of session leadership and participation.

Results: Key to program implementation was the role of champions in facilitating the training, as well as delivery of training sessions featuring multi-media videos and role play to enhance the training experience. A total of 296 health workers participated in the training program sessions. Of these, 198 were hospital staff and 98 were from the public health workforce. Of the 296 health workers who participated in a training session, 277 completed a pre-test questionnaire and 256 completed post-test questionnaires. A significant increase in knowledge score was observed among all categories of staff who participated in training; however, support staff had the lowest pre-test knowledge on IPC practices at 71%, which improved to only 77% after the formal class.

Conclusion: Implementing an IPC training program during a complex health emergency is a challenging, yet necessary task. Leveraging champions, offering training through multiple modalities including the use of videos and role play, as well as inclusion of all staff categories, is crucial to making training accessible.

Key words: coronavirus disease 2019, health worker, infection prevention and control, low- and middle-income countries

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What is known about this topic?

- Health workers are first responders to public health emergencies and a particular risk to novel infectious disease outbreaks, such as COVID-19.
- Guideline and training on infection prevention and control (IPC) to safeguard health workers are often generic and not appropriate for health facilities in low- and middle-income countries (LMICs).
- There is a need for contextually tailored and role-specific guidelines and trainings to protect front-line staff.

What does this article add?

- Multimedia and multimodal IPC trainings can be rapidly developed and implemented during public health emergencies in LMICs.
- Leveraging IPC champions in health facilities can support training development, implementation, and uptake during public health emergencies.
- IPC guidelines and training in LMICs must include all staff categories including ancillary staff, such as cleaners, particularly during public health emergencies.

Introduction and aims

The coronavirus disease 2019 (COVID-19) pandemic is an ongoing threat to health workers globally.^{1–4} These health workers represent the front line of strained health systems grappling with waves of rising case numbers, variants of concern, human resource and medical supply shortages, and the demands of routine health service delivery.^{5,6} Such challenges are ever more acute for health workers in low- and middle-income countries (LMICs), which in many regions bear a disproportionate burden of COVID-19 infections, while facing limited and inequitable access to lifesaving COVID-19 vaccines.^{7–9}

To protect health workers during the pandemic, multiple infection prevention and control (IPC) guidelines have been produced. COVID-19 guidelines, as with other novel infectious hazards, have relied on best practices and evolving evidence to ensure health workers are equipped with the knowledge and skills to protect themselves and patients while delivering care.¹⁰ However, these guidelines are often developed in well-resourced settings or are too generic to be readily applied in LMICs.¹¹ Although providing guidelines is an important step towards safeguarding health workers, there is a need to provide training on the skills and key learning points of IPC. Further, such guidelines and complementary training must be accessible and approachable for all staff, including ancillary staff.¹² This is particularly important, given the intensity and duration of the COVID-19 pandemic.

However, there is little literature on such programs during the COVID-19 pandemic in LMICs. This descriptive study aims to describe the implementation of evidence-based and role-specific COVID-19 IPC training for health workers in Sri Lanka, and to report on pre-test and posttest knowledge gained after IPC training program participation.

Methods**Study setting and implementation context**

Sri Lanka, an island in the Indian Ocean, is divided into 25 districts under nine provinces and has universal free health services. Public health services are delivered through field health teams led by public health physicians, also known as the Medical Officers of Health (MOH). Field teams include the MOH in addition to 6–7 Public Health Inspectors (PHI) and 25–30 Public Health Midwives (PHM). These teams serve areas that geographically coincide with administrative boundaries of the Divisional Secretariat areas of the country.¹³ Leveraging the strength of these pre-existing public health teams, Sri Lanka successfully contained the first wave of the COVID-19 pandemic in 2020. During this time, the health workforce was provided regularly updated guidelines for IPC.^{14,15} However, as the country reopened, infections began to rise. This led to several challenges in containing the pandemic, including obtaining a steady supply of vaccines to reduce community transmission, and in April 2021, cases sharply rose. As such, the need for contextand role-specific IPC guidelines and training grew, as more health workers provided front-line care for COVID-19 patients.

This study is part of a larger study, which aims to create and test role-specific COVID-19 IPC guidelines for health workers providing care in LMICs through a development and piloting process in the Philippines and Sri Lanka. The guidelines development team in Sri Lanka included stakeholders from the Ministry of Health Sri Lanka with extensive clinical and public health experience. Partner sites included a District General Hospital (DGH) and two MOH areas within the National Institute of Health Sciences (NIHS) area. The NIHS is the premier public health training institute responsible for training Sri Lanka's public health field staff under the Ministry of Health Sri Lanka. The DGH is the largest hospital in the Kalutara district with a 900-bed capacity providing outpatient, inpatient, and emergency health services. During the pandemic, a temporary 400-bed, COVID-19 intermediate centre was also implemented by the DGH staff.

Case study methods

The authorial team represents key stakeholders in the design and implementation of the IPC training program. The narrative presented here reflects the shared experience of the development and implementation process. Ethical approval for this study was obtained from the Office of Research Ethics at the University of Toronto (Ref: 20291) and the Sri Lanka Medical Council (ERC 20-013).

We conducted a pre-test and post-test questionnaire to test knowledge before and after the training session.

The decision to test knowledge was important to key site stakeholders and we took a pragmatic approach to designing the questionnaire. We developed four knowledge assessment questionnaires, one for each training group: physicians (both hospital and public health physicians), nurses (both hospital and public health nurses), public health midwives and support staff (hospital transport and cleaning staff). Each questionnaire consisted of demographic information including age, gender, job type and number of years in practice, in addition to 30 knowledge-testing questions based on common clinical presentations and methods of transmission of COVID-19, IPC practices for COVID-19, mental wellbeing of patients, and donning and doffing techniques. Additional questions were added for specific health workers, for example: clinical management for clinicians; nursing care for nurses; community preventive health measures for public health staff; and cleaning, garbage disposal and linen disinfection for support staff.

The questionnaires were piloted among 10 healthcare workers in Sri Lanka and refined. These were reviewed by the research team in Toronto and in Sri Lanka for validity and suitability to program goals and the context of the intervention. One questionnaire was offered in English, given the literacy level of the target population (hospital and public health physicians), and three questionnaires (for nursing, field health staff and support staff) were translated to Sinhala, the native language of participants.

The pre-test and post-test questionnaires were administered immediately prior to and following the training sessions. However, as the training took place during a public health emergency in health care settings, participation in the testing was not mandatory as participants may have joined the session late or had to leave early to attend to urgent needs of the pandemic response.

Although a clear passing score for IPC training has not been established, 80% scores on knowledge testing has been previously used as a cut-off for adequate knowledge of IPC practices.¹⁶ We believed the percent of correct answers for such critical situations should be high, comparable with the 75–85% passing recommended for knowledge test passing scores for various resuscitation courses, thus we decided to use 80% as the passing score.^{17–19} As such, the questionnaires were scored out of 30, and 80% was assumed as knowledge competency. The scoring was used to mainly identify baseline knowledge and knowledge gain in IPC practices. Pre-test and post-test questionnaire answers were anonymized and analyzed using SPSS version 16. Descriptive statistics were used to present data and paired sample t test was used to compare pre-test and post-test scores within job categories.

Results

Developing the training program

In Sri Lanka, we used an interdisciplinary approach to develop IPC guidelines for health workers in the following settings: health workers providing care in inpatient settings, namely public hospitals; health workers providing primary care; health workers providing care in outpatient settings, namely in outpatient departments of public hospitals and field health workers providing community care. Details of the guideline development process have been described elsewhere.²⁰ Briefly, role-specific guideline documents offered a comprehensive and contextually relevant overview of IPC consideration for COVID-19. These were paired with deskguides for quick reference by health workers. Desk guides are a condensed and easily accessible clinical tool to provide guidance to front-line healthcare workers based on experience from other disease control (<http://comdis-hsd.leeds.ac.uk>).

Our COVID-19 IPC guidelines and desk guides cover a breadth of topics relevant to COVID-19 IPC including: an introduction to the COVID-19 pandemic; COVID-19 diagnosis and management; advice for mental health; tips for COVID-19 prevention including an overview of personal protective equipment (PPE); and PPE donning and doffing practices. Table 1 offers a comparative overview of topics offered across the different role-specific guideline documents.

The content of these were translated into PowerPoint slide presentations for field health staff and hospital staff. When developing the presentations, we emphasized clarity of concepts and practical application of the content. The content and visual layout of the training presentations were modified through an iterative process including feedback from a microbiologist and infection control team in the partner hospital. Slides relevant to the field health staff were similarly modified with input from both a public health physician and nursing sisters. PowerPoint presentations for field health staff and support staff was translated to Sinhala, the local working language.

From these PowerPoint slides, training videos were developed as an additional teaching tool to enhance the IPC training. These videos also provide a way for staff unable to attend the training to gain knowledge, or for staff to routinely refresh their knowledge. The topics and content of these videos are in line with the training materials but certain skills were selected to emphasize key areas for learning. These were selected based on the need assessment interviews carried out among NIHS staff and hospital staff, which was a part of the larger study. As such, two videos were developed: one

Table 1. Overview of role-specific desk guide topics

Topic	Primary care health worker	Outpatient consultation	Field health worker desk guide
Clinical features of COVID-19	✓	✓	✓
Diagnosis and management	✓	✓	✓
Nursing care	✓	✓	
Specimen collection	✓	✓	
Home quarantine advice	✓	✓	✓
Protecting your mental health	✓	✓	✓
Reducing stigma			✓
COVID-19 prevention	✓	✓	✓
PPE donning and doffing		✓	✓
Facility lay out	✓		
Facility cleaning and disinfection	✓		
Severity assessment tool (optional)	✓	✓	
Case definition	✓	✓	
Patient contingency management	✓	✓	
Case investigation form	✓	✓	

COVID-19, coronavirus disease 2019.

including hand hygiene technique and donning-doffing technique, and the other video based on obtaining PCR samples and carrying out rapid antigen testing in field health settings. Similar to the presentations, the video scripts were checked for accuracy by a microbiologist and public health physicians. Video production was carried out by a professional video team and guided throughout by health professionals. Following several rounds of editing, health professionals agreed on the final videos. Both videos were dubbed in Tamil, the other official language used in the country and with subtitles in English.

Implementing the training program

Six training sessions were held between mid-March 2021 and the end of April 2021. The in-hospital training was coordinated by the hospital director and infection prevention unit, which is headed by a microbiologist. For the field health staff, we leveraged on existing monthly in-service training to conduct the IPC training program. A senior public health physician was responsible for organizing the field staff training.

Hospital physicians and nurses had combined training sessions, while support workers (cleaning staff and transport staff) had separate training sessions. All public health staff including physicians, nurses and public health mid-wives attended combined training sessions. These sessions were conducted face-to-face either in English (if only for physicians) or Sinhala (for sessions with interdisciplinary health workers). Sessions were held in respect of all public health guidance including the use of PPE and physical distancing as applicable in each setting.

Each session lasted 1 h and was led by a ‘training leader’, a physician who had themselves been trained by project staff on how to run the session. The hospital training programmes were conducted under the guidance of a microbiologist and consultant emergency physician who were part of the research team and with the support of infection prevention nursing staff. The field health staff training program was conducted by a senior public health physician who was a research team member.

Training began with an introduction from the training leader and administration of the pre-test. The training leader then used the PowerPoint presentation to review the key IPC concepts for each group. This included a multimedia presentation using the videos on handwashing and donning and doffing. Sessions included role play of scenarios, and staff were encouraged to ask questions or seek clarifications specific to their setting. After the session the post-test was administered.

A total of 296 participated in the training program sessions. Of these, 198 were hospital staff and 98 were from the public health workforce (Table 2).

Table 2. Participants attending training program

Participant's occupation	Work station		
	Hospital	Field health staff	Total
Physician	15	8	22
Nurse	99	10	109
Public health midwife	–	80	80
Supportive staff	84	–	84
Total	198	98	296

Infection prevention and control training pretesting and post-testing

Of the 296 health workers who participated in a training session, 277 completed a pre-test questionnaire and 256 completed post-test questionnaires. Pre-test and post-test questionnaires were administered to all participants present at the time of training; however, because of increased workload and the emergency situation, some participants joined after the pre-test was administered and some left before post-test was administered.

Among the 277 participants who completed a pretest questionnaire, 67% (186) were hospital staff members, consisting of 93 nurses, 80 support staff members and 13 physicians; of those who completed a pre-test questionnaire, 33% (91) were field health workers consisting of 77 public health midwives, 8 public health nurses and 6 public health physicians. The vast majority (90.4%), of the participants were women. Mean age of the participants was 40.7 years (SD 10.2 years, age range 21 years of age to 63) and mean duration of service in the healthcare sector was 13.8 years (SD 10.1 years, duration of service range <1 to 35 years). Please refer to Fig. 1 for age category distribution and Fig. 2 for duration of service category distribution.

A total of 256 participants completed post-test questionnaires. The total score for knowledge was calculated out of 30 and converted to percentage score. Overall, participants had a mean score of 77.14% for the pre-test knowledge assessment and a significantly higher mean score 84.06% on post-training knowledge assessment ($P=0.001$). When the results were analysed by

designation, a significant increase in knowledge score was observed among all categories (Table 3). Both physicians and nurses had more than 80% scores on pre-testing, public health staff had an average scores of 75% on pretest, which improved to 84% after training. Support staff had the lowest pre-test knowledge on IPC practices at 71%, which improved to only 77% after the formal class.

Discussion

We describe the implementation of role-specific IPC training during a complex public health emergency caused by a novel respiratory pathogen. In these circumstances, there is a need for context-specific and updated guidance to ensure that front-line health workers can safely provide care. Our findings show an increase in knowledge across all staff categories, emphasizing that even those with a baseline knowledge of IPC can benefit from such training. Further, our results emphasize that during complex emergencies, IPC training must be extended to all staff as the conceptualization of who is ‘front line’ and at risk for infection expands.

There were several challenges arising in developing and implementing the training program in the hospital setting. Challenges related to the development of the guidelines have been described elsewhere.²⁰ Regarding implementation, key challenges arose from the demands of the pandemic on front-line health workers, who were also responsible for providing ongoing routine health service delivery. First, it was challenging to find a free time for the different staff categories, in

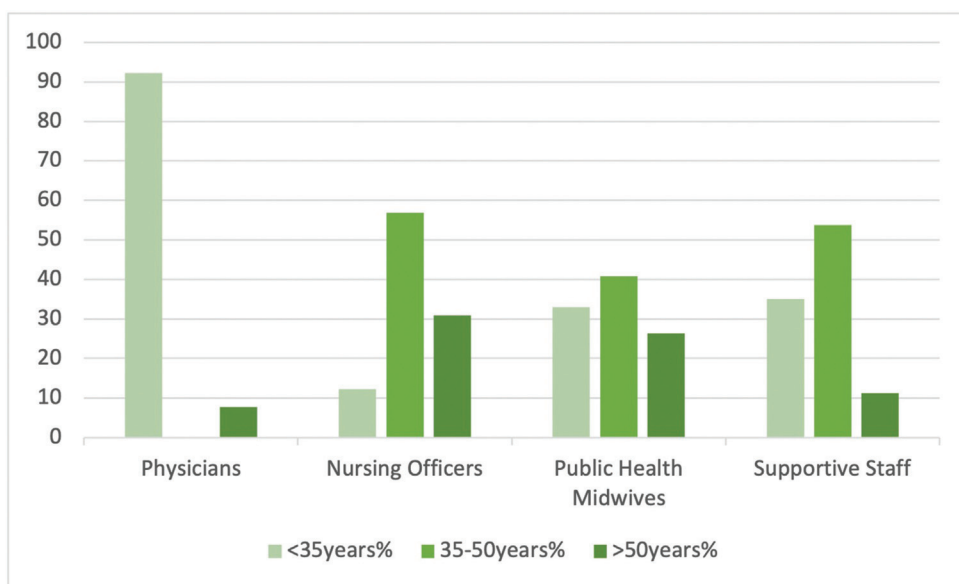


FIGURE 1. Distribution of age categories of participants.

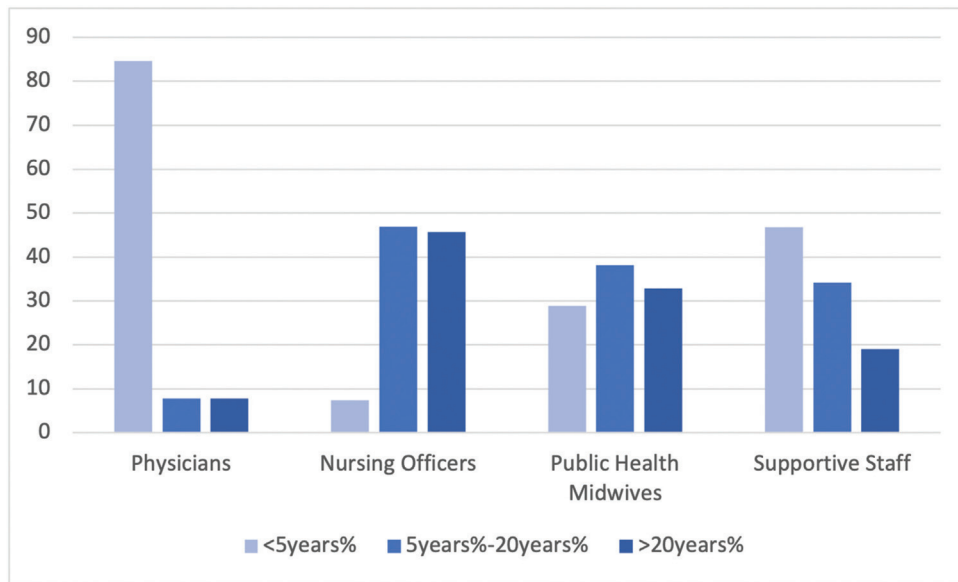


FIGURE 2. Distribution of duration of service of participants.

different shifts, amidst heavy workloads. Second, during this time, hospital staff were overwhelmed by repeated staff quarantine because of COVID-19 exposure and covering staff duties at the temporary COVID-19 intermediate treatment centre. There were also challenges related to conducting the training assessment. These included a limited evidence base on IPC assessment surveys in our setting, uncertainties as to the appropriateness of the assessment modality for some staffing categories, and challenges ensuring that staff were able to attend both the pre-test and post-test, given their other responsibilities.

However, there were also key enablers, which helped to overcome the challenges faced in delivering IPC training. For example, having senior staff members as program champions helped to identify and address implementation challenges. Other studies have similarly found that empowered champions with institutional support have been key to IPC initiatives across settings.^{21,22} In our context, these champions were able to ensure hospital staff training was held at the hospital

auditorium during working hours and at different times on different days to expand training coverage. Additionally, both in the hospital setting and at field sites, champions helped create adequate buy-in from other senior staff that this IPC training would strengthen existing IPC awareness. An additional enabler to overcome the challenge of staff workload and limited time was the use of multimedia to communicate the guidelines. This included physical documents, PowerPoint presentations, role play and training videos. Others have similarly found that multimedia and role play can strengthen IPC education delivery.²³

Conclusion

Implementing an IPC training program during a complex health emergency is a challenging, yet necessary task. Our findings offer implications for both practice and policies on IPC for health workers. COVID-19 has highlighted the need for coordinated and contextualized training for all staff on IPC to reduce the risk of nosocomial transmission.²⁴ During a complex public

Table 3. Pre and post knowledge assessment scores according to designation

Designation	Number of participants	Mean pre-score	Mean post-score	Difference in means and SD	Significance (P value)
Physicians	13	82.76	88.30	5.53 (5.30)	0.003
Nurses	87	83.29	89.71	6.41 (9.4)	0.001
Public health midwives	76	75.39	84.14	8.75 (13.04)	0.001
Support staff	80	71.20	77.15	5.94 (11.09)	0.001

health emergency, IPC training must include all front-line staff and take an expanded view of who is considered front line, given their exposure and the role they could play in spreading the pathogen. To ensure training is prioritized, champions within healthcare settings should be leveraged to ensure the training is context-specific and role-specific, as well as accessible to all staff. Champions are key to the success of many quality improvement endeavours, including those related to IPC, and more broadly are viewed as agents of change within health facilities.^{21,25,26} The potential of champions and staff leaders to lead change is particularly important during emergencies where the demands of the workload, and assumed baseline knowledge, may take precedence over training. For example, in our setting, working with champions to offer training materials through different modalities including in print, digitally, in-person, and through video medium helped increase accessibility.

Future research into IPC training should include a targeted need assessment and user experience study to better understand how training can be adapted for those groups with lower IPC knowledge scores in our context. There may be specific learning needs and learning approaches that could better reach these groups. Additionally, this group may benefit from a different method of assessment, such as verbal questions or demonstration of skills as opposed to a multiple-choice questionnaire. Future research into IPC assessment would benefit from an investigation of assessment modalities across groups.

Protecting the health and well-being of health workers is central to a robust and sustainable emergency response. This is particularly important during an unpredictable and extended emergency, such as COVID-19. Our study offers a valuable perspective on holding IPC training for a breadth of health workers in an LMIC during the COVID-19 pandemic, with key findings for other LMICs both for the ongoing COVID-19 response and for future emergency preparedness and response.

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Consent for publication: the authors consent to publication.

Availability of data and materials: all relevant data and materials are included in the text.

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Conflicts of interest

There are no conflicts of interest.

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