

BMJ Open Examining the discourse regarding the delivery of occupational infection prevention and control training to healthcare workers: a scoping review of pandemic plans of 23 countries

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ABSTRACT

Background Over the years, countries reformed their pandemic plans but still healthcare systems were unprepared to handle the COVID-19 pandemic. Throughout the COVID-19 pandemic, healthcare workers (HCWs) raised issues around shortage of personal protective equipment (PPE), inadequate occupational infection prevention and control (IPC) training, lack of guidance regarding reuse/extended use of PPE and absence of HCWs.

Objective The objective of this scoping review was to compare national and transnational pandemic plans and COVID-19 guidelines for the inclusion of recommendations regarding pandemic-specific occupational IPC training for HCWs, as well as strategies for managing the surge in PPE needs and staffing.

Inclusion criteria From each of the six WHO defined world regions, four countries with the highest burden of COVID-19 cases (as of mid-2020) were selected and attempted to locate the relevant pandemic plans and COVID-19 guidelines.

Methods Searches were undertaken of 1: National Guidelines Clearinghouse, 2: websites of international public healthcare agencies such as WHO, the European Centre for Disease Prevention and Control (ECDC) and, 3: in-country health departments/Ministry of Health/Department of Public Health, between June 2020 and July 2021. The data were summarised under six themes drawn from publicly available pandemic plans and COVID-19 (IPC) guidelines of WHO, ECDC and 23 countries.

Results The WHO, ECDC and 14 countries reported pandemic-specific IPC training; however, only four discussed training HCWs on correct PPE use; six countries listed strategies to manage the surge in demand of HCWs, while only five discussed managing the shortage of PPE. None of the COVID-19 guidelines recommended training HCWs for correct reuse or extended use of PPE and only one country's guideline outlined mandatory HCWs attendance and delivery of training in a regional language.

Conclusion Pandemic plans should be revised to include guiding principles regarding the delivery of pandemic specific IPC training. There is also a need to provide guidance on when countries should consider reuse and extended use of PPE. This discourse should also

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the largest scoping review conducted to explore the potential gaps in recommendations regarding occupational infection prevention and control (OIPC) training for healthcare workers using national pandemic plans and infection prevention and control COVID-19 guidelines.
- ⇒ This is the first study that compares national pandemic plans and COVID-19 guidelines for the inclusion of OIPC training delivered to healthcare workers and managing personal protective equipment in case of a shortage during a pandemic.
- ⇒ The principal limitation is that the selected documents are not representative of all the publicly available national pandemic plans and/or COVID-19 guidelines.

be reflected in disease-specific pandemic guidelines, like COVID-19 (IPC) guidelines. The aim of this review is to assist international health agencies in generating evidence-based guideline updates.

INTRODUCTION

Frontline healthcare workers (HCWs) are frequently among the earliest groups impacted by public health emergencies like an outbreak, epidemics and pandemics, particularly those resulting from emerging infectious diseases.¹ The terms outbreak, epidemic and pandemic relate to the occurrence of a health condition compared with its predicted rate as well as to its spread in geographic areas.² An outbreak is a sudden rise in the number of cases of a disease.³ An epidemic occurs when an infectious disease spreads rapidly, while a pandemic is a global disease outbreak.⁴ A pandemic is more likely to be caused by a respiratory pathogen rather than a contact pathogen like Ebola or viral haemorrhagic fever (VHF).⁵ The epidemic

of SARS-CoV-1 in 2003,⁶ the 2009 H1N1 pandemic⁷ both highlighted key gaps in the public health and health service responses of the countries directly impacted. Following these events and based on feedback and evaluations subsequently undertaken, countries reformed their national prevention and response pandemic plans.^{8,9} The same pattern of reactive change occurred following the epidemic of another coronavirus, Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012.⁸ Despite these updates, healthcare systems have been unprepared to handle the SARS-CoV-1 COVID-19 pandemic. By 15 August 2020, a study found that 300 000 HCWs from 37 countries had been infected with COVID-19, with over 2500 deaths.¹⁰ And according to figures from WHO, by 24 May 2021, the number of reported deaths of HCWs from COVID-19 rose to 115 000 globally.¹

Throughout the COVID-19 pandemic, HCWs have raised issues around shortage of personal protective equipment (PPE), inadequate occupational infection prevention and control (IPC) training, lack of guidance regarding reuse/extended use of PPE and absence of staff in the healthcare settings.^{11,12} These issues have been previously highlighted, such as during the 2003 SARS-CoV-1 outbreak, when there was an acute shortage of PPE, which led to the reuse by HCWs.¹³ During the 2014 Ebola outbreak, the WHO reported 120 HCWs losing their lives due to shortage of PPE.¹⁴

However, having adequate supplies of PPE does not necessarily equate to automatic reductions in risk. This was documented during the MERS-CoV outbreak, where despite adequate quantities of PPE, HCWs were infected with the virus.¹⁵ Researchers speculated that the most likely reason was their low adherence to IPC measures,¹⁶⁻¹⁸ with a need for further education and training programmes particularly in the use of PPE, and other relevant occupational infection control measures.¹⁹ During a pandemic, HCWs need to get trained for the appropriate use of PPE for which delivery of IPC training has been suggested as a necessary measure.²⁰ While studies have reviewed the availability and/or delivery of IPC training and managing shortages of both PPE and HCWs in healthcare settings in non-emergency situations, less focus had been given to examining the discourse within the national prevention and response pandemic plans. Thus, in order to identify and map the available evidence, a scoping review is conducted in this study.²¹

As per Arksey and O'Malley, there are four possible reasons for undertaking a scoping review.²² First, to examine the extent and nature of research activity; to ascertain if a systematic review is necessary; to consolidate and disseminate research findings and to find potential research gaps within the existing literature. The approach to scoping reviews taken in this study facilitates the identification of potential gaps in national pandemic plans regarding recommendations about the inclusion of pandemic specific occupational IPC training to protect HCWs from infectious diseases and new guidelines for managing PPE in case of a shortage during a pandemic.

The study also sets out to compare the recommendations of pandemic plans against COVID-19 (IPC) guidelines.

METHODS

For this study, we followed the five stage scoping review process outlined by Levac *et al.*²³ This scoping review did not involve primary research with human subjects and therefore did not warrant institutional ethical approval.

Stage 1: Identifying the research questions

The following questions guided this scoping review for the inclusion of information related to pandemic-specific IPC training to protect HCWs from emerging infectious diseases in the national pandemic plans and COVID-19 (IPC) guidelines.

What are the recommendations on delivery of pandemic-specific education and training to HCWs? What are the recommendations on resource allocation, mandatory attendance and frequency of IPC trainings? What are the recommendations on management and use of PPE? What are the recommendations on managing shortages of HCWs? What are the recommendations on delivery of COVID-19 IPC training programmes to HCWs? What are the recommendations on shortage management and use PPE in COVID-19 guidelines?

Stage 2: Identifying relevant studies

To identify pandemic plans and IPC COVID-19 guidelines, we searched websites of international public healthcare agencies such as WHO,²⁴ the European Centre for Disease Prevention and Control (ECDC),²⁵ websites of selected in-country health departments/Ministry of Health/Departments of Public Health between June 2020 and July 2021. Pandemic plans and IPC COVID-19 guidelines were also searched through National Guidelines Clearinghouse, and Google Scholar.

The linked descriptive key search terms that were developed to guide the search are outlined in [box 1](#).

Stage 3: Identifying the study selection criteria

To identify the relevant countries to be included, we searched <https://www.worldometers.info/coronavirus/> and selected those with the highest burden of cumulative

Box 1 Key search terms.

Search terms

('infection prevention and control' OR 'occupational infection prevention and control' OR 'occupational health and safety' OR 'infectious diseases transmission') AND ('guidelines' OR 'plan' OR 'manual' OR 'regulations' OR 'practice guidelines' OR 'training guidelines') ('COVID-19' OR '2019 novel coronavirus' OR 'SARS-CoV-2' OR 'Severe acute respiratory syndrome coronavirus 2') AND ('plan' OR 'guideline' OR 'manual' OR 'regulations' OR 'practice guidelines' OR 'training guidelines') 'healthcare personnel' OR 'healthcare workers' OR 'healthcare providers'

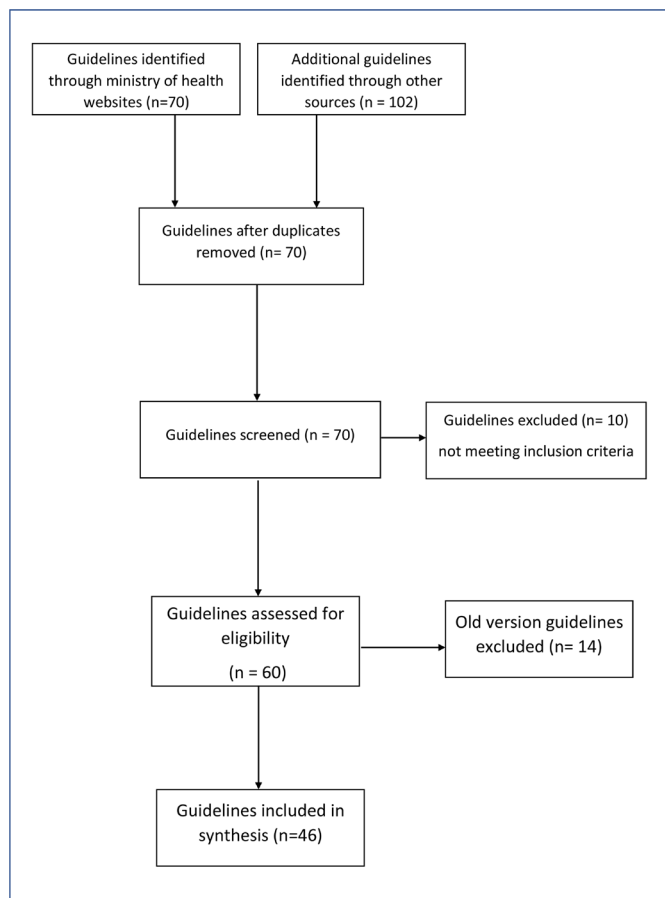


Figure 1 Study flow chart.

COVID-19 cases in numbers at the time of data collection. In case the pandemic plan of a selected country was not publicly available, the next most COVID-19 affected country was selected for that region. We searched for pandemic plans from four countries in each of the six WHO-defined world regions. Additionally, we reviewed pandemic plans and IPC COVID-19 guidelines of the WHO,²⁴ and the ECDC. If two versions of the same document were found, the most recent version was included (see [figure 1](#)). Names of the selected countries and details of the pandemic plans are given in [table 1](#).

The selected pandemic plans included influenza specific and those developed or updated between 2005 and 2020. Several pandemic plans were not able to be located including Brazil (the second most affected country in the region of Americas (PAHO)), Russia (in the European region (EURO)), Iran and Pakistan (two most affected countries in the eastern Mediterranean region (EMRO)) and India and Indonesia (two most affected countries in the South-East Asia Region (SEARO)). In the African Region (AFRO), only the pandemic plans of Nigeria and Algeria were publicly accessible. IPC COVID-19 guidelines of Algeria, Bahrain, Myanmar and Singapore were not publicly available. Also, the IPC COVID-19 guidelines of the 23 selected countries were searched so that comparisons could be made with the country's pandemic plans ([table 2](#)). All plans and guidelines were translated

into English by a bilingual speaker, if required. List of all the websites searched by country are included in the online supplemental table 1.

Stage 4: Charting the data

Pandemic plans and IPC COVID-19 guidelines of the WHO,²⁴ and the ECDC²⁵ were used as a baseline and reviewed to extract the key elements of pandemic-specific IPC training including recommendations focused on pandemic preparedness IPC training delivered to HCWs (pandemic plans), COVID-19 specific training (IPC COVID-19 guidelines), PPE training, reuse/extended use of PPE, fit test for respirators, fit check/seal check for respirators, recommendations for managing the shortage of PPE and HCWs. The following information were also extracted from each of the selected documents: country/organisation, department responsible for development, publication year, year document revised (if relevant), language and document title. The first author (MOQ) extracted the information from the documents, and all coauthors reviewed and validated it.

Stage 5: Summarising results

The results specific to the delivery of pandemic specific IPC training were summarised under the following six themes: pandemic-specific IPC education and training, resource allocation for training, mandatory attendance, frequency of training, PPE training, training on the reuse/extended use of PPEs drawn from documents under study. Two additional themes on management and use of PPE; managing shortages of HCWs were also generated. The findings of pandemic plans were compared against IPC COVID-19 guidelines.

RESULTS

We compiled and reviewed 46 documents, of which 25 included pandemic plans; 16/25 pandemic plans were published after 2009 (following the H1N1 2009 pandemic).²⁶ Of the pandemic plans, the Australian plan was the most recently updated (2019),²⁷ while the Philippines Preparedness and Response Plan for Avian and Pandemic Influenza was the oldest Philippines Preparedness and Response Plan for Avian and Pandemic Influenza was the oldest (2005).²⁸ The most recently updated COVID-19 guideline was that of Spain (July 2021).²⁹ [Tables 1 and 2](#) provide details of the included documents.

Focus: pandemic plans

Delivery of pandemic-specific education and training to HCWs

More than half of the pandemic plans (14 countries and WHO,²⁴ as well as the ECDC document²⁵) discussed the delivery of pandemic-specific training programmes to protect HCWs ([table 3](#)). WHO's pandemic plan states that in the event of a pandemic, its role is to provide support and guidance to Member States (MS) in preparing activities related to training HCWs, including community-level

Table 1 Baseline data of all pandemic plans, along with regional distribution selected for the review

Serial number	Issuing organisation or country	WHO region	Department	Document title	Year of publication or revision
1	WHO	Not applicable	Not applicable	Pandemic Influenza Risk Management ²⁴	2017
2	European Centres for Disease Control and Prevention	EURO	Not applicable	Guide to revision of national pandemic influenza preparedness plans ²⁵	2017
3	USA	PAHO	US Department of Health and Human Services	Pandemic Influenza Plan ³⁶	2017
4	Peru	PAHO	Ministerio De Salud	Plan nacional de preparacion y respuesta frente a una potencial pandemia de influenza u otros virus respiratorios emergentes ⁶⁸	2015
5	Chile	PAHO	Ministerio de Salud	Plan Nacional de Preparación y Respuesta para una Pandemia de Influenza ⁶⁹	2010
6	Canada	PAHO	Public Health Agency of Canada	Canadian Pandemic Influenza Preparedness: Planning Guidance for the Health Sector ³³	2018
7	Spain	EURO	Ministerio de Consumo	Actualización plan nacional de preparación y respuesta ante una pandemia de gripe ⁴²	2006
8	UK	EURO	Public Health England	Pandemic Influenza Response Plan ⁷⁰	2014
9	Italy	EURO	National Centre for the Prevention and Control of Disease	National plan for preparedness and response to an influenza pandemic ³⁰	2010
10	Germany	EURO	Robert Koch Institute	German Influenza Pandemic Preparedness Plan – Scientific part Summary ⁷¹	2016
11	Nigeria	AFRO	National Centre for Disease Control	Nigeria National Pandemic Influenza Preparedness and Response Plan ³⁴	2013
12	Algeria	AFRO	Ministry of Health	Plan national de préparation à une pandémie de grippe ⁷²	2009
13	Saudi Arabia	EMRO	Ministry of Health	The national plan ⁷³	2011
14	Oman	EMRO	Ministry of Health	National pandemic influenza a (h1n1) preparedness plan ⁴⁰	2009
15	Bahrain	EMRO	Ministry of Health	Avian influenza (h5n1) the contingency and surveillance plan ³¹	2006
16	Jordan	EMRO	Ministry of Health	Jordan Pandemic Influenza Preparedness and Response Plan ³⁵	2017
17	Bangladesh	SEARO	Directorate General of Health services	Second National Avian and Pandemic Influenza Preparedness and Response Plan, Bangladesh (draft) ³²	2009
18	Thailand	SEARO	Bureau of Emerging Infectious Disease, Department of Disease Control	National Strategic Plan for Emerging Infectious Disease Preparedness ³⁷	2013
19	Sri Lanka	SEARO	Epidemiology Unit Ministry of Health	National Influenza Preparedness and Response Plan ⁴³	2012

Continued

Table 1 Continued

Serial number	Issuing organisation or country	WHO region	Department	Document title	Year of publication or revision
20	Myanmar	SEARO	Asia-Pacific Alliance for the Control of Influenza	Avian and Human Influenza Pandemic Preparedness and Response in Myanmar (draft) ³⁹	2006
21	China	WPRO	Ministry of Health	Preparedness and Contingency Plan for Influenza Pandemic ³⁸	2006
22	Singapore	WPRO	Ministry of Health	MOH Pandemic Readiness and Response Plan for Influenza and other Acute Respiratory Diseases ⁴¹	2014
23	Philippines	WPRO	Department of Health	Philippines Preparedness and Response Plan for Avian and Pandemic Influenza ²⁸	2005
24	Japan	WPRO	Interministerial Avian Influenza Committee, Ministry of Health	Pandemic Influenza Preparedness Action Plan ⁷⁴	2007
25	Australia	WPRO	Department of Health	Australian Health Management Plan for Pandemic Influenza ²⁷	2019

AFRO, African Region; EMRO, Eastern Mediterranean Region; EURO, European Region; PAHO, Region of the Americas; SEARO, South-East Asia Region; WPRO, Western Pacific Region.

HCW work force to protect themselves from infectious diseases.

The WHO pandemic plan emphasised the development of appropriate, effective and efficient training programmes that are instigated within educational institutions and made a part of continuing professional development for HCWs. Both WHO and ECDC pandemic plans discussed that assessment of capacity should be supported and tailored for different HCWs.^{24 25} Italy's pandemic plan included a detailed section on how to prepare a training plan and emphasised the need to harmonise training activities, which in turn could contribute in establishing integrated cooperation between HCWs and other members of society involved in the pandemic management plan.³⁰ Bahrain's pandemic plan stated that only HCWs with direct patient contact should receive training on the mode of transmission, the appropriate infection control precautions and the exposure protocol, whereas staff not involved in direct patient care could only be given only general advice.³¹ Bangladesh's pandemic plan discussed the need to periodically review training guidelines, but nothing further.³² Australia's key pandemic preparedness strategy was to use existing systems wherever possible to implement the response, rather than initiating new pandemic-specific systems which included training HCWs. According to the document, familiarity with already established systems would foster timeliness and confidence of use and minimise the need for 'just in time' training.²⁷

Only six countries (Canada,³³ Nigeria,³⁴ Bahrain,³¹ Jordan,³⁵ Bangladesh³² and Australia²⁷) discussed delivery of PPE training to HCWs in their pandemic plans, notably, the WHO, ECDC and countries in the EURO region did not. Only the Canadian pandemic plan discussed the delivery of training to HCWs specifically on the reuse and/or extended use of PPE. The US Centres for Disease Control (CDC) pandemic plan emphasised improving knowledge of respirators and other PPE use practices but did not mention strategies to do so.³⁶

Resource allocation, mandatory attendance, and frequency of IPC training

The pandemic plans of Canada,³³ Italy,³⁰ Thailand³⁷ and China³⁸ included a requirement for training in resource allocation during a pandemic. The Canadian pandemic plan discussed the importance of adequate staffing of IPC and occupational health professionals in a healthcare organisation and their role in conducting comprehensive pandemic-specific education and training for front line HCWs.³³ Italy's pandemic plan discussed developing accredited training modules and train the trainers sessions at a national level. The regional trainers then would have the task of organising and conducting training activities at regional and local levels.³⁰ Thailand's pandemic plan did not mention providing pandemic-specific education and skills training to HCWs yet discussed resource allocation for IPC training. Moreover, the document discussed training and capacity building of laboratory staff for

Table 2 Baseline data of all infection prevention and control COVID-19 guidelines selected for the review

Serial number	Issuing organisation or country	WHO region	Department	Document title	Year of publication or revision
1	WHO	Not applicable	Not applicable	Infection prevention and control during healthcare when coronavirus disease (COVID-19) is suspected or confirmed ⁴⁴	June 2020
2	European Centres for Disease Control and Prevention	EURO	Not applicable	Infection prevention and control and preparedness for COVID-19 in healthcare settings ⁴⁵	October 2020
3	USA	PAHO	US Centre for Disease Control	Interim infection prevention and control ⁵⁰ (COVID-19) pandemic ⁵⁰	December 2020
4	Peru	PAHO	Centro De Capacitacion Empresarial	Plan Para La Vigilancia, Prevención Y Control Covid19 En El Trabajo ⁵⁶	February 2021
5	Chile	PAHO	Ministerio De Economía, Fomento Y Turismo	Protocolo De Control Y Prevencion Ante Covid-19 En Instalaciones Y Faenas Productivas ⁵⁷	March 2020
6	Canada	PAHO	Public Health Agency of Canada	COVID-19 pandemic guidance for the healthcare sector ⁵¹	December 2020
7	Spain	EURO	Ministerio de Sanidad	Procedimiento De Actuación Para Los Servicios De Prevención De Riesgos Laborales Frente A La Exposición Al Sars-Cov-2 ²⁹	July 2021
8	UK	EURO	Public Health England	COVID-19: Guidance for maintaining services within health and care settings. Infection prevention and control recommendations ⁵²	January 2021
9	Italy	EURO	Istituto Superiore di Sanità	Interim guidance for the appropriate support of the health workers in the SARS-CoV-2 emergency scenario ⁴⁶	May 2020
10	Germany	EURO	Robert Koch Institute	Empfehlungen des RKI zu Hygienemaßnahmen im Rahmen der Behandlung und Pflege von Patienten mit einer Infektion durch SARS-CoV-2 ⁷⁵	December 2020
11	Nigeria	AFRO	National Centre for Disease Control	Infection prevention and control recommendations during healthcare provision for suspected and confirmed cases of COVID-19 ⁴⁷	September 2020
12	Algeria	AFRO	Ministry of Health	Not publicly available	
13	Saudi Arabia	EMRO	Ministry of Health	COVID-19 coronavirus disease guidelines ⁵⁸	February 2021
14	Oman	EMRO	Ministry of Health	Infection prevention and control guidelines for COVID-19 ⁵³	March 2020
15	Bahrain	EMRO	Ministry of Health	Not publicly available	
16	Jordon	EMRO	Ministry of Health	Guide for health centres and hospitals ⁵⁴	December 2020

Continued

Table 2 Continued

Serial number	Issuing organisation or country	WHO region	Department	Document title	Year of publication or revision
17	Bangladesh	SEARO	Directorate General of Health services	National guideline for healthcare provider on infection prevention and control of COVID-19 pandemic in healthcare setting ⁷⁶	March 2020
18	Thailand	SEARO	Bureau of Emerging Infectious Disease, Department of Disease Control	Guidelines for clinical practice, diagnosis, treatment and prevention of healthcare-associated infection in response to patients with COVID-19 infection ⁷⁷	April 2020
19	Sri Lanka	SEARO	Epidemiology Unit Ministry of Health	Sri Lanka preparedness and response plan COVID-19 ⁴⁸	April 2020
20	Myanmar	SEARO	Asia-Pacific Alliance for the Control of Influenza	Not publicly available	
21	China	WPRO	Ministry of Health	Norms for prevention and control practice in grass-roots medical and health institutions ⁵⁵	April 2020
22	Singapore	WPRO	Ministry of Health	Not publicly available	
23	Philippines	WPRO	Department of Health	Minimum health system capacity standards for COVID-19 Preparedness and Response Strategies ⁷⁸	May 2020
24	Japan	WPRO	Interministerial Avian Influenza Committee, Ministry of Health	Basic Policies for Novel Coronavirus Disease Control by the Government of Japan (Summary) ⁷⁹	May 2020
25	Australia	WPRO	Department of Health	COVID-19 CDNA National Guidelines for Public Health Units ⁴⁹	January 2021

AFRO, African Region ; EMRO, Eastern Mediterranean Region ; EURO, European Region; PAHO, Region of the Americas; SEARO, South-East Asia Region; WPRO, Western Pacific Region.



Table 3 Guidelines on pandemic-specific occupational infection prevention and control training delivered to protect healthcare workers and reuse, extended use and management of shortage of personal protective equipment in pandemic preparedness documents of 25 countries/organisations

Issuing organisation or country	US		EURO		AFRO		EMRO			SEARO			WPRO													
	WHO	ECDC	AERO	Peru	Chile	Canada	Spain	UK	Italy	Germany	Nigeria	Algeria	Saudi Arabia	Oman	Bahrain	Jordan	Bangladesh	Thailand	Sri Lanka	Myanmar	China	Singapore	Philippines	Japan	Australia	
Specific pandemic training items covered in guidelines																										
Pandemic-specific IPC education and training	✓	✓	×	×	×	✓	×	✓	×	✓	×	×	✓	×	✓	×	✓	×	✓	×	✓	×	×	✓	×	×
Resource allocation	×	×	×	×	×	✓	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Mandatory	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Frequency	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×
Personal protective equipment	×	×	×	×	×	✓	×	×	×	×	✓	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	✓
Training on the reuse/extended use of PPE	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Specific items included in guideline on personal protective equipment																										
Reuse of PPE	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×
Extended use of PPE	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓
Management of PPE shortage	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	✓	×	×	×
Fit test for respirators	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×
Fit check/seal check for respirators	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	✓

Shaded columns represent countries that experienced both MERS-CoV and SARS-CoV-2
 AFRO, African Region; ECDC, European Centre for Disease Prevention and Control; EMRO, Eastern Mediterranean Region; EURO, European Region; IPC, infection prevention and control; PAHO, Region of the Americas; PPE, personal protective equipment; SEARO, South-East Asia Region; US CDC, US Centres for Disease Control; WPRO, Western Pacific Region.

handling and testing of emerging infectious disease pathogens. The pandemic plan mentioned establishing model training centres on communicable disease prevention and control in communities.³⁷ China's pandemic plan suggested supporting the health administration at various levels by providing budget for education and training of HCWs to protect from infectious diseases.³⁸

Most of the pandemic plans did not discuss making pandemic-specific IPC training for HCWs mandatory, however, Nigeria's pandemic plan emphasised including mental health resilience training as a part of pandemic response training for HCWs and ensuring a system was in place for tracking which HCWs completed the training.³⁴ Most plans did not discuss how often training should be delivered to HCWs. There were three plans that did include a reference to timing. First, the Jordanian pandemic plan mentioned that in case of shortage of time and resources, pandemic preparedness IPC training should at least be conducted yearly and the operational efficiency of the training should be tested through exercises and drills to assure that HCWs are aware of their role in the event of a pandemic.³⁵ Myanmar's pandemic plan discussed providing refresher training to HCWs.³⁹ While Canada's pandemic plan emphasised conducting training on a regular basis for continuous improvement and prioritising new HCWs to obtain pandemic-specific IPC training. However, it did not however specify how often training should be conducted. The pandemic plan asserted that problem areas or weaknesses could be corrected by providing additional training to HCWs.³³

Management and use of personal protective equipment

Only the pandemic plans of Canada³³ and Oman⁴⁰ provided guidance on PPE reuse; however, both highlighted the risk of reuse. According to the Canadian pandemic plan, reusable PPE may be cleaned and decontaminated as per manufacturer's instructions, when resources are limited, and disposable PPE are unavailable. Only the Australian pandemic plan recommended guidelines for extended use of respirators. The Australian pandemic plan recommended that respirators used for extended periods should be available in appropriate size and properly fit checked for each HCW.²⁷ Jordan's pandemic plan discussed making PPE available for HCWs in case of a shortage but emphasised that WHO should provide updated infection control guidance.³⁵ However, the WHO document did not comment on PPE shortage management.²⁴ Finally, the Singapore pandemic plan recommended maintaining a 3-to-6-month stockpile of PPE.⁴¹

Managing shortage of HCWs

The WHO,²⁴ ECDC,²⁵ Canada,³³ Spain,⁴² Bangladesh³² and Sri Lanka⁴³ pandemic plans considered the need for healthcare organisations to have contingency plans to manage any potential need to surge the number of HCW to maintain healthcare-related services during a pandemic. Nigeria's pandemic plan³⁴ recommended

identifying volunteers and recently retired personnel to expand staffing in both non-professional (ie, custodial, etc.) and professional capacities (ie, nursing, physicians, etc.) and manage the shortage of HCWs during pandemic. Additionally, requesting part-time personnel to work full-time schedules was another method suggested. Bahrain's pandemic plan³¹ reported that a database of HCWs who contracted the disease and survived (hence theoretically immune) should be maintained, asserting that these HCWs would not require vaccination (immediately) when it becomes available, thereby easing the pressure on vaccinating the remaining non-immune population. Although Jordan's pandemic plan³⁵ discussed the challenge of HCWs shortage, it did not discuss a plan of action to manage such a situation.

Focus: COVID-19 guidelines

Delivery of COVID-19 IPC training programs to HCWs

More than half of the COVID-19 plans (15 countries and WHO,⁴⁴ ECDC⁴⁵) recommended the delivery of IPC COVID-19 training programmes to HCWs (table 4). The WHO guideline suggested that the provision of IPC training to HCWs was an administrative measure, to control the spread of COVID-19.⁴⁴ The ECDC⁴⁵ and Spain's²⁹ COVID-19 guideline emphasised the need to regularly update COVID-19 training programmes to ensure that emerging evidence on the effectiveness of the various IPC measures and changing guidance was captured.^{29 45} The Italian COVID-19 guideline⁴⁶ discussed the need to consider the psychological well-being of HCWs by providing adequate training. The guideline asserted that training and coaching could play a crucial role in reducing the stress of health professionals who have worked in a COVID-19 treatment area from other disciplines.⁴⁶ The Nigerian COVID-19 guideline suggested that HCWs should be provided job-specific or task-specific education and training on preventing transmission of COVID-19.⁴⁷ Sri Lanka's guideline recommended training to HCWs be provided in three different regional languages: Sinhala, Tamil and English;⁴⁸ While the Australian⁴⁹ and Italian⁴⁶ COVID-19 guidelines stipulated the provision of both face-to-face and online training for HCWs.

The WHO, as a part of its multimodal strategy, recommends PPE training for HCWs.⁴⁴ This recommendation is also reflected in the guidelines of ECDC, US CDC, Canada, UK, Italy, Nigeria, Oman, Jordan, Sri Lanka, China and Australia^{45 48–55}

Resource allocation, mandatory attendance and frequency of IPC training

The guidelines from Peru,⁵⁶ Italy,⁴⁶ Nigeria⁴⁷ and ECDC⁴⁵ discussed instituting a dedicated and trained team for the delivery of IPC COVID-19 training. The ECDC guidelines recommended ensuring accessibility of resources for guidance and training materials relevant to COVID-19. An implicit objective of such a repository would be to provide all facilities, including those not yet registered



Table 4 Guidelines on COVID-19-specific occupational infection prevention and control training delivered to protect healthcare workers and reuse, extended use and management of shortage of personal protective equipment during COVID-19 in documents of 25 countries/organisations

Issuing organisation or country	US		Canada		Chile		Peru		AERO		EURO			AFRO			EMRO			SEARO			WPRO		
	WHO	ECDC	AERO	WHO	ECDC	AERO	WHO	ECDC	AERO	WHO	ECDC	AERO	WHO	ECDC	AERO	WHO	ECDC	AERO	WHO	ECDC	AERO	WHO	ECDC	AERO	
Specific COVID-19 pandemic training items covered in guideline																									
COVID-19 Infection prevention and control training	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Resource allocation	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Mandatory	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Frequency	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Personal protective equipment	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Training on the reuse/extended use of PPE	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Specific items included on personal protective equipment																									
Reuse of PPE	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Extended use of PPE	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Management of PPE shortage	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Fit test for respirators	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
Fit check/seal check for respirators	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	

AFRO, African Region; ECDC, European Centre for Disease Prevention and Control; EMRO, Eastern Mediterranean Region; EURO, European Region; PAHO, Region of the Americas; PPE, personal protective equipment; SEARO, South-East Asia Region; US CDC, US Centres for Disease Control; WPRO, Western Pacific Region.

with national authorities and those not yet included in current guidance, with the tools to develop their own comprehensive COVID-19 plans, including IPC training activities.⁴⁵ The Australian guidance recommended mandatory IPC COVID-19 training for all HCWs, while the Chilean guideline⁵⁷ did not recommend mandatory IPC COVID-19 training, it did suggest keeping a record of trained HCWs.⁴⁹ Only the ECDC guideline discussed the frequency of IPC COVID-19 training to HCWs. ECDC's guideline emphasised that training should be given when commencing working in an area that involves contact with biological agents, with training repeated periodically if necessary.⁴⁵

Guidelines on shortage management and use of personal protective equipment

In an event of shortage of PPE, the ECDC recommends reuse or extended use of PPE.⁴⁵ For example, in case of shortage of respirators, the use of medical face masks and options for prolonged use of respirators, decontamination and reuse of respirators can be considered in agreement with the health and safety committee or occupational safety and health experts at facility level. ECDC guidelines considered the reuse of respirator/medical face masks as a last-resort to conserve PPE.⁴⁵ In the event of a shortage, the US CDC and UK guidelines recommend reuse or extended use of PPE after it is cleaned and disinfected according to manufacturer's reprocessing instructions.^{50 52} The Canadian COVID-19 guideline recommends using spreadsheet models based on scenarios to estimate the demand for PPE⁵¹ and subsequent stockpiling. While the Spanish guideline recommends reuse of PPE only in the event of a foreseeable shortage, suggesting storing them in containers or suitable bags following decontamination, as per the manufacturer instructions.²⁹ In the instance of a global PPE shortage, the Sri Lankan guideline considered that the apparel industry in Sri Lanka could manufacture PPE locally which could also be exported to other countries.⁴⁸ None of the COVID-19 guidelines from AFRO, EMRO, SEARO and WPRO discuss extended use of PPEs.

The ECDC and guidelines of six other countries including USA,⁵⁰ Canada,⁵¹ UK,⁵² Saudi Arabia,⁵⁸ Oman⁵³ and Australia⁴⁹ recommended fit testing for respirators. Additionally, Oman's guideline suggested that HCWs failing a N95 mask fit test should receive training on the use of Powered Air Purifying Respirators or otherwise be exempted from looking after suspected or confirmed COVID-19 cases.⁵³ The WHO plan recommended that when HCWs put on a disposable particulate respirator, they should always perform a seal check to ensure there is no leakage.⁴⁴ This recommendation is reflected in the guidelines of the US CDC, Italy, Saudi Arabia and Australia.^{29 49 50 58}

Guidance on managing shortage of HCWs

Guidelines of the ECDC,⁴⁵ US CDC,⁵⁰ Canada⁵¹ and Australia⁴⁹ considered the requirement for a contingency

plan to manage the need to surge HCWs during the COVID-19 pandemic. There are various approaches proposed to manage an HCW workforce shortage. The ECDC and Canadian plan recommends recruiting and training agency staff, student doctors/nurses and retired HCWs.⁴⁵ Additionally, the Canadian guideline recommends hiring physicians and nurses currently working in non-clinical roles (eg, education, administration, research and private industry) as well as certified nursing assistants, patient care assistants and personal support workers; other healthcare providers—midwives, paramedics, pharmacists, therapists (respiratory/occupational/physio), dentists, psychologists and veterinarians.⁵¹ Conversely, the Australian's plan suggested that should all alternative surge workforce strategies be exhausted, exposed HCWs who are not confirmed cases can return to work⁴⁹ but did not outline alternative surge workforce strategies. Likewise, the US CDC guideline recommended that healthcare facilities must foresee and prepare for staffing shortages, with plans and processes to manage the surge of HCWs, including resources to assist HCWs with anxiety and stress. However, the guideline did not discuss what that plan to mitigate staffing shortage should be.⁵⁰ The Sri Lankan COVID-19 guideline,⁴⁸ published April 2020 highlighted that its healthcare sector had already experienced a shortage of trained HCWs due to COVID-19, with the potential for the situation to be further exacerbated by non-compliance of safety measures but the guideline did not discuss mitigating strategies for managing the shortage HCWs.⁴⁸

DISCUSSION

In addition to the pandemic plans and IPC COVID-19 guidelines of the WHO and ECDC, guidelines from 23 countries from six WHO defined regions were included in this study. Together, the populations of these countries represent around 38% of the world's population and 59% of COVID-19 related cases globally as of 1 June 2020.

HCWs are on the frontline during epidemics and pandemics and need to be protected from infectious diseases, with data from many countries showing that the rate of COVID-19 infection⁵⁹ is significantly higher among HCWs compared with the general public.⁶⁰ Reducing the risk of COVID-19 transmission to HCWs requires a multi-modal approach. One aspect of this is the availability of a comprehensive plan that considers the various aspects of IPC including pandemic-specific IPC training. However, our review found only 9 of 23 countries acknowledged this in both their pandemic plan and COVID-19 guideline.

We found omissions and inconsistencies in the way pandemic-specific IPC training programmes for HCWs were considered, with documents frequently omitting or provided few key details regarding the target audience, training delivery systems, mode of delivery (including delivery language) and content. Additionally, consideration for the use of existing systems to deliver training was



seldom mentioned, even though it would help expedite the delivery of specific training programmes.

This review also identified significant gaps regarding resource allocation. While one country did mention allocating resources for IPC training HCWs in both its pandemic plan and COVID-19 guideline, it failed to document infrastructure development, availability of training material or budget allocation. Less consideration was given to whether the training should be mandatory, or whether annual or refresher training should be provided. None of the pandemic plans and only one COVID-19 guideline mandated training and only two pandemic plans (Jordanian³⁵ and Myanmar³⁹) suggested yearly and/or refresher training for HCWs. Of concern was the fact that only the ECDC COVID-19 guidelines suggested training HCWs when commencing working in specific areas as well as retraining, if necessary. The importance of regularly attending IPC training programmes by HCWs has received significant attention in recent years especially during the outbreaks of emerging and re-emerging infectious diseases like SARS, MERS-CoV and Ebola.^{61 62}

One strategy to reduce the risk for contamination during donning and doffing of PPE is to educate HCWs on proper technique. However, in this review, we found that only a few of the pandemic plans and the COVID-19 guidelines outlined the need for training HCWs on this, with only four countries (Canada, Nigeria, Jordan and Australia) having discussed this in both the pandemic plans and COVID-19 guidelines. Lapses in adequate technique can lead to an increased risk for transmission among HCWs including getting infected with potentially fatal pathogens such as MERS-CoV, Ebola virus and COVID-19.^{63 64} There is a need to ensure refresher training to HCWs including volunteers and reinstated retired HCWs and that this should be included as a recommendation in the guidelines. It should be noted here that donning and doffing techniques of PPE differs between emerging and high consequence infectious diseases. The PPE training delivered to HCWs for VHF can be different from a training delivered in response to a respiratory virus like COVID-19.⁶⁵

During a pandemic increased demand and shortage of PPE is expected, however only five pandemic plans discussed managing shortages of PPE. Surprisingly, the WHO documents did not comment on management of PPE shortage. To manage the shortage of PPE, a few of the guidelines considered engaging their apparel industry in manufacturing them locally. However, domestic demand may result in PPE exporting countries imposing export restrictions which put other countries at a disadvantage.⁶⁶

Given the potential for a gap between demand and supply during a pandemic, possible reuse and extended use of PPE has received significant attention.⁶⁷ During the COVID-19 pandemic, the reuse of PPE by HCWs has been taken into consideration by various countries due to shortages that could have hampered healthcare. However, in this review, we found that only a few of the pandemic plans and COVID-19 guidelines provided

instructions on the reuse of PPE and only one pandemic plan (Australia) commenting on its extended use. These documents recommend reprocessing PPE as per manufacturer's instructions to reduce consumption and maximise their use in case of a shortage. As global demand may vastly affect availability of PPE, emergency contingency planning during pandemic for reuse and extended use of PPE by HCWs should be supported by recommendations in pandemic guidelines to protect HCWs from getting infected.

Limitations

A limitation of this study is that our findings are not representative of all the publicly available pandemic and/or COVID-19 guidelines. Also, the selected influenza pandemic plans and IPC COVID-19 guidelines included in this study could have been updated since February 2021. We assumed that IPC was better in countries where COVID-19 cases were less. We also acknowledge that there could be other disease-specific IPC guidelines adhered to by occupational health and safety professionals.

CONCLUSION

Training alone will not change the behaviour of HCWs and is only one measure to protect HCWs from acquiring infections. Findings from our study highlight the importance of constantly updating the existing systems for the delivery of pandemic-specific IPC training to HCWs. From the review, significant gaps were identified between the recommendations suggested by the selected pandemic plans and COVID-19 guidelines. COVID-19 guidelines are comparatively better framed as compared with the selected pandemic plans. Based on the experiences during the COVID-19 pandemic, there is a strong need for countries to strengthen the guidance provided in their pandemic plans regarding reuse/extended use of PPE and delivery of IPC training to HCWs including volunteers and reinstated retired HCWs.

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