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Original Research Article

Development and validation of a questionnaire for assessing preventive practices and barriers among health care workers in COVID-19 pandemic



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ABSTRACT

Objectives: COVID-19 has affected thousands of health care workers worldwide. Suboptimal infection control practices have been identified as important risk factors. The objective of this study was to develop and validate a questionnaire to holistically assess the preventive practices of health care workers related to COVID-19 and identify the reasons for shortcomings therein.

Methods: The development of the questionnaire involved item generation through literature review, focus group discussions and in-depth interviews with health care workers and experts, followed by validation through expert opinion, pilot testing and survey. A cross-sectional survey on 147 healthcare workers was done using an online platform and/or interviews in August 2020 in New Delhi, India. Exploratory factor analysis using principal component extraction with varimax rotation was performed to establish construct validity. Internal consistency of the tool was tested using Cronbach's alpha coefficient.

Results: The developed questionnaire consists of two sections: Section A contains 29 items rated on a five-point Likert scale to assess preventive practices and Section B contains 27 semi-structured items to assess reasons for suboptimal practices. The first section has good validity (CVR = 0.87, S-CVI/Av = 0.978) and internal consistency (Cronbach's alpha coefficient = 0.85)

Conclusions: This questionnaire is a valid and reliable tool for holistic assessment of preventive practices and barriers to it among health care workers. It will be useful to identify vulnerable practices and sections in health care settings which would assist policymakers in designing appropriate interventions for infection prevention and control. This will also be useful in future pandemics of similar nature.

1. Key messages

Suboptimal preventive practices are an important risk factor for getting COVID-19 infection. This questionnaire evaluates preventive practices in health care workers holistically and identifies reasons for suboptimal compliance in these practices. It will help in identifying loopholes in the healthcare system and formulating corrective interventions and policies for infection prevention and control.

2. Introduction

Being at the front line of the outbreak response, millions of healthcare

workers (HCWs) have been infected in the Coronavirus Disease 2019 (COVID-19) pandemic [1]. There is around 11 fold increased risk of infection in HCWs compared to the general population and the incidence of COVID-19 infection in HCWs is reported up to 38.9% in various studies [2,3]. HCWs have an increased risk of acquiring COVID-19 compared to the general population due to interaction with sick patients and/or potentially infected co-workers and hospital environment [4].

Suboptimal preventive practices like improper personal protective equipment (PPE) and handwashing have been identified as important risk factors in HCWs, thus highlighting the importance of proper preventive practices in reducing the spread of COVID-19 [2,5]. Several studies have been done to assess knowledge, attitude and practices among HCWs

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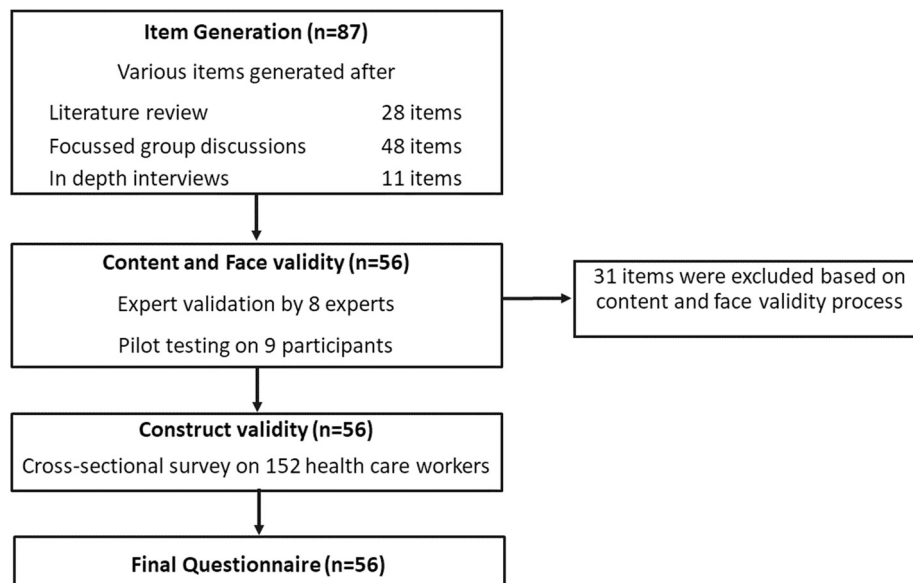


Fig. 1. Flow chart of the development and validation of the questionnaire.

regarding COVID-19 but few of them have focused on preventive practices of HCWs in detail. Also, there is a dearth of studies that have utilised scientifically designed and validated questionnaires to explore the reasons for suboptimal practices.

Therefore, we undertook this study to design and validate a standardized questionnaire that can holistically assess the preventive practices by HCWs related to COVID-19 and identify the reasons for shortcomings therein. Such a tool can help in assessing the lapses and formulating appropriate strategies for infection prevention and control in healthcare settings during the COVID-19 pandemic as well as future pandemics of similar nature.

3. Materials and methods

The development and validation of the questionnaire were done following a standard methodology which included literature review, in-depth-interviews and Focussed Group Discussions (FGDs) to generate items followed by expert validation, pilot testing and a cross-sectional survey to establish validity and reliability (Fig. 1) [6,7]. The study was approved by the Institutional Ethics Committee of the institute. Appropriate consent was obtained from all the participants before their enrolment in the study.

The study was conducted in two phases:

3.1. Phase I: Development of the questionnaire

It involved the following three steps:

In the first step, an extensive review of existing literature was done using medical search engines like PubMed and Google Scholar. Keywords “COVID-19 or Coronavirus”, “Risk factors or Prevention or preventive practices”, for “Health care workers” and MeSH terms like “Coronavirus Infections/prevention and control”, “Health Knowledge, Attitudes, Practice” and “Surveys and Questionnaires” were used to search for articles which led to shortlisting of 506 related articles. After screening titles, abstracts and full texts, 76 articles were found to be relevant. These articles were thoroughly read and twenty-eight items were generated at the end of this stage.

In the second step, FGDs and in-depth interviews were conducted. Five FGDs were done on an online platform-three with HCWs and two with experts. The FGDs with HCWs included 6–7 participants in each session including faculty, residents, nurses, lab technicians and other paramedical staff. This was followed by FGDs with six experts from fields

of infectious diseases, medicine, nutrition and clinical psychology. Each session lasted around 60–70 minutes in which sequential open-ended questions were asked to understand the various aspects of preventive practices related to HCWs. The discussions were analysed qualitatively to generate a comprehensive list of items. This led to the addition of 48 items. In-depth interviews were conducted with experts and HCWs to gain insight into practical issues which led to the further addition of 11 items.

In the third step, relevant items were generated with specific attention to the proper framing of questions in a lucid language, using expressions in the first person. Each item was carefully framed to refer to a single concept, avoiding ambiguity and double negatives. Thus, a total of 87 items were generated and grouped into two sections.

3.2. Phase 2: Validation of questionnaire

It involved the following steps:

In the first step, the developed questionnaire was evaluated by six experts from diverse fields including infectious diseases, medicine and surgical disciplines for critical appraisal and content validation. For qualitative content validity, each expert was asked to comment on the relevance and lucidity of individual items. For quantitative content validity, each expert was asked to rate the items on necessity, clarity and relevance. Necessities of items were evaluated by using a 3-point scale: 1 (not necessary), 0 (useful but not essential), 1 (essential). The formula of content validity ratio (CVR) is $CVR = (N_e - N/2) / (N/2)$ where N_e is the number of experts indicating items as essential and N is the total number of experts. According to Lawshe scores, the acceptable CVR values were determined and items with CVR less than the acceptable score were discarded or modified [8]. The clarity and relevance of items were evaluated by using Content Validity Index (CVI) [9]. Each item was rated on a 4-point Likert scale: 1 (not relevant/clear), 2 (slightly relevant/clear and needs revision), 3 (relevant/clear and needs minor revision), and 4 (very relevant/clear). Items with scoring less than acceptable CVI scores were discarded or modified. On this basis, 31 items were deleted. There was a satisfactory level of agreement between experts on the revised draft of the questionnaire suggesting good content validity ($CVR = 0.87$ and $CVI/Av = 0.978$).

In the second step, the revised draft of the questionnaire was pre-tested on 9 HCWs to evaluate acceptance, relevance and lucidity. Based on the feedback, relevant modifications were done in consultation with experts.

Box 1

Questionnaire to assess prevention practices against COVID-19 in the health care workers

Section A: Prevention practices against COVID-19 infections among Health care workers

Kindly fill the questionnaire below based on your routine in the last 2 weeks.

S.No.	Item	Options
Hand Hygiene		
1	I shake hands while meeting colleagues.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
2	I sanitize my hands after contact with each patient and/or his/her surroundings.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
3	I ensure that I wash/sanitize my hands for at least 20 s.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
4	I properly follow the steps of washing/sanitizing hands.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
5	I touch my eyes, nose or mouth without washing/sanitizing my hands.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
Social Distancing		
6	I maintain at least 1 m distance with family members	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
7	I maintain at least 1 m distance with co-workers at the hospital.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
8	I maintain at least 1 m distance while eating food with my colleagues.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
9	I maintain at least a 1-m distance while talking to my colleagues in the duty rooms.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
10	I maintain at least 1 m distance with others in public spaces (e.g. shopping, social gatherings, etc).	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
11	I have attended social gatherings (Like meeting friends, going to religious places, visiting theatres etc) in the past two months.	<ul style="list-style-type: none"> ● Never ● Once ● Twice ● Thrice ● More than three times
12	I avoid going out of house unnecessarily	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)

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S No.	Item	Options
PPE		
13	I follow the steps of donning and doffing properly.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
14	I wear adequate PPE during duty (according to guidelines for my ward and patients).	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
15	I wear mask inside hospital premises	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
16	I cover both nose and mouth with a mask while wearing it.	<ul style="list-style-type: none"> ● Always (More than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
17	I touch the outer surface of mask while wearing it.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
18	I keep my mask properly in a separate bag/dustbin after using it.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
19	I reuse my gowns/PPE during my single duty shift.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
20	I carry face shields/gowns/PPE to my duty room in ward before completely doffing.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
21	I dispose of PPE in specified coloured dustbins after use according to guidelines.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
22	I take chemoprophylaxis against COVID-19 (e.g. Hydroxychloroquine, etc).	<ul style="list-style-type: none"> ● Yes, taking regularly ● Yes, taking regularly but missed some doses ● Yes, took initially and then left ● Don't remember ● No
Gadgets/Fomites		
23	I use my personal items like mobile phones, etc during duty in the hospital.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
24	I sanitize my personal items like mobile phones, pens, etc with sanitizer after my duty.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
25	I take precautions while buying things to avoid contamination with COVID-19.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)

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S No.	Item	Options
Lifestyle		
26	I take adequate sleep (6–8 h) daily.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
27	I stay updated regarding coronavirus disease by watching news or reading guidelines.	<ul style="list-style-type: none"> ● Always (more than 90% times) ● Mostly (approx. 75% times) ● Commonly (approx. 50% times) ● Occasionally (approx. 25% times) ● Rarely (less than 10% times)
Exposure		
28	How many times did I have high risk exposure to COVID-19 positive/suspect cases?	<ul style="list-style-type: none"> ● Never ● Once ● Twice ● Thrice ● More than 3 times
29	How many times was I quarantined?	<ul style="list-style-type: none"> ● Never ● Once ● Twice ● Thrice ● More than 3 times

Section B: Reasons for Preventive practices among healthcare workers

Kindly give answers to the following questions based on your routine in the last 2 weeks. You can mark more than one option and provide other reasons.

S. No.	Question	Responses
Hand Hygiene		
1	What is/are the reason(s) for shaking hands in the current scenario (COVID-19 pandemic)?	<ul style="list-style-type: none"> ● Not applicable ● I don't know if COVID-19 spreads through handshakes. ● I believe handshaking will not spread COVID. ● It is difficult to change my habit. ● It looks rude not to shake hands when the opposite person extends his hand for a handshake. ● Other reasons (Kindly specify):
2	What is/are the reason(s) for not sanitizing hands after contact with each patient/surroundings?	<ul style="list-style-type: none"> ● Not applicable ● I don't know if sanitizing hands prevents the spread of COVID. ● I believe frequent hand sanitization will not prevent COVID-19 infection. ● There is non-availability/shortage of sanitizer ● I find it cumbersome to sanitize hands too many times ● I don't get time as there are a large number of patients. ● It is difficult for me to change my habit. ● It leads to wastage of time and resources. ● Other reasons (Kindly specify):
3	What is/are the reason(s) for not washing/sanitizing hands for at least 20 s?	<ul style="list-style-type: none"> ● Not applicable ● I don't know that hands should be washed/sanitized for at least 20 s. ● I believe that time duration is not important while washing/sanitizing hands. ● I am unable to check time while washing/sanitizing hands. ● I don't have time as I sanitize hands a lot of times. ● I find it to be cumbersome ● Other reasons (Kindly specify):
4	What is/are the reason(s) for not following steps of washing/sanitizing hands properly?	<ul style="list-style-type: none"> ● Not applicable ● I don't know the steps. ● I don't find these steps to be important. ● I don't remember all the steps. ● I don't have time. ● I find it cumbersome to follow all steps. ● Other reasons (Kindly specify):
5	What is/are the reason(s) for touching eyes/nose/mouth without cleaning hands?	<ul style="list-style-type: none"> ● Not applicable ● I don't know if touching eyes/nose/mouth with unclean hands should be avoided.

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S. No.	Question	Responses
Hand Hygiene		
		<ul style="list-style-type: none"> • I believe that this is not important in preventing the spread of COVID-19. • It is difficult for me to change my habit. • There is shortage of sanitizers • Other reasons (Kindly specify):
Social Distancing		
6	What is/are the reason(s) for maintaining at least 1-m distance with family?	<ul style="list-style-type: none"> • Not applicable • I know that distancing with family members prevents the spread of COVID • I believe it is important in prevention of COVID. • I am not able to talk to others. • There is a lack of space. • I don't have will. • Other reasons (Kindly specify):
7	What is/are the reason(s) for not maintaining at least 1-m distance with co-workers at the hospital?	<ul style="list-style-type: none"> • Not applicable • I don't know if at least 1-2-m distance should be maintained. • I believe that social distancing is not important in COVID-19 spread. • I don't need to as I wear PPE at all times. • It is difficult to change habit • I find it difficult to talk to others • There is a lack of space. • Other reasons (Kindly specify):
8	What is/are the reason(s) for not maintaining at least 1-m distance while having food with colleagues?	<ul style="list-style-type: none"> • Not applicable • I don't know if at least 1-2-m distance should be maintained • It is not important in prevention of COVID-19. • I find it difficult to change habit • I find it difficult to talk to others. • There is a lack of space. • I don't have will. • Other reasons (Kindly specify):
9	What is/are the reason(s) for not maintaining at least 1-m distance in duty rooms?	<ul style="list-style-type: none"> • Not applicable • I don't know if at least 1-2-m distance should be maintained. • I believe it is not important in prevention of COVID • I find it difficult to change my habit • There is a lack of space. • I find it difficult to interact with others. • Other reasons (Kindly specify):
10	What is/are the reason(s) for not maintaining social distancing in public spaces?	<ul style="list-style-type: none"> • Not applicable • I don't know if at least 1-2-m distance should be maintained. • I believe that social distancing doesn't help in preventing COVID-19 spread. • I find it difficult to change my habit • There is a lack of space. • I find it difficult to talk to others • Other reasons (Kindly specify):
11	What is/are the reason(s) for going out of the house?	<ul style="list-style-type: none"> • Not applicable • I go to work. • I go to buy groceries. • I go for walking/exercising. • I go for socializing. • I go to religious places. • I go for entertainment (Club, visiting friends, etc.). • Other reasons (Kindly specify):
PPE		
12	What is/are the reason(s) for not being able to don and doff properly?	<ul style="list-style-type: none"> • Not applicable • I don't know/remember the steps. • I believe they don't matter. • There is no dedicated doffing area. • There is a lack of helping people/mirrors to help in doffing. • There is lack of sanitizers • Others reasons (Kindly specify):
13	What is/are the reason(s) for not wearing adequate PPE?	<ul style="list-style-type: none"> • Not applicable • I don't know about guidelines for wearing PPE • I don't believe adequate PPE protects me against COVID-19 • There are no guidelines for wearing PPE

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S. No.	Question	Responses
Hand Hygiene		
14	What is/are the reason(s) for not wearing a mask in the hospital premises?	<ul style="list-style-type: none"> • There is a lack of availability of PPE. • I find it uncomfortable to wear. • My long duty hours prevent its use. • I don't get time to wear PPE • Other reasons (Kindly specify): • Not applicable • I don't know if masks are protective against COVID. • I don't find it useful. • I don't require it as I work in the administrative section. • There is lack of availability. • I don't feel comfortable wearing it. • I have difficulty breathing while wearing it. • It gets hot while wearing them. • I don't look good wearing it. • Other reasons (Kindly specify):
15	What is/are the reason(s) for not covering both nose and mouth while wearing masks?	<ul style="list-style-type: none"> • Not applicable • I don't know if both nose and mouth have to be covered. • I don't find it useful. • I have difficulty breathing while wearing it. • I don't feel comfortable wearing it. • It slides down due to loose fit. • Other reasons (Kindly specify):
16	What is/are the reason(s) for touching the outer surface of masks?	<ul style="list-style-type: none"> • Not applicable • I don't know that touching the dirty outer surface can lead to the spread of COVID-19. • I believe touching the outer surface causes no harm. • I have to readjust it due to its loose fit. • I feel uncomfortable wearing it. • To remove it for eating food and drinking water. • Other reasons (Kindly specify):
17	What is/are the reason(s) for not disposing masks properly in waste-bin/separate bags?	<ul style="list-style-type: none"> • Not applicable • I don't know if it should be kept properly in a waste-bin/ separate bag. • I don't feel it is important to keep it properly. • I get too tired after work. • I don't find a suitable place to dispose the mask • Other reasons (Kindly specify):
18	What is/are the reason(s) for reusing gowns/PPE during a single shift?	<ul style="list-style-type: none"> • Not applicable • I don't know that I should not reuse the same gown/PPE. • I believe reusing them is not harmful. • There is a lack of availability of gowns/PPE. • I have long duty hours. • Other reasons (Kindly specify):
19	What is/are the reason(s) for not disposing PPE in specific bins?	<ul style="list-style-type: none"> • Not applicable • I don't know how to dispose off PPE. • I believe properly disposing off PPE doesn't matter. • There is a lack of doffing area/dustbins. • I get confused regarding which PPE to dispose off in which bin. • I get too tired after duty hours. • Other reasons (Kindly specify):
Gadgets/Fomites		
20	What is/are the reason (s) for using personal items like mobile phones, etc. during duty in the hospital.	<ul style="list-style-type: none"> • Not applicable • No separate duty phones are provided in hospital • I have to stay connected with colleagues and family. • It is required for professional work and patient management. • It is required for entertainment/avoiding boredom during free time • Other reasons (Kindly specify):
21	What is/are the reason(s) for not cleaning personal items like mobile phones/pens after your duty?	<ul style="list-style-type: none"> • Not applicable • I don't know if I should clean it after work. • I believe it is not useful. • Non availability of sanitizers • It is not needed as I have no contact with COVID-19 positive patients. • I am too tired to do so. • I feel using sanitizer on mobile/personal items will damage it.

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S. No.	Question	Responses
Hand Hygiene		
22	What precaution(s) do you take while buying things?	<ul style="list-style-type: none"> • Other reasons (Kindly specify): • Not applicable • I opt for home delivery • I go out when it is less busy. • I wear a face mask. • I carry a hand sanitizer or wipes. • I opt for cashless payments. • I buy 1-2 weeks-worth of groceries at a time.
23	What is/are the reason(s) you don't take precautions while buying things?	<ul style="list-style-type: none"> • Other reasons (Kindly specify): • Not applicable • I don't know if I can get infected with COVID-19 • I believe it is not useful. • It is difficult to change habit • I am too tired to do so.
24	What is/are the reason(s) for not taking adequate sleep (6–8 h)?	<ul style="list-style-type: none"> • Other reason (Kindly specify): • Not applicable • I don't know the importance of adequate sleep. • I believe it is not important for COVID-19 prevention. • I don't have time for adequate sleep. • I can't sleep due to anxiety
25	What is/are the reason(s) for not staying updated regarding coronavirus disease?	<ul style="list-style-type: none"> • Other reasons (Kindly specify): • Not applicable • I believe staying updated is not useful • It is difficult to find relevant information • I don't have time. • I don't have interest. • I find the news to be distressing. • Other reasons (Kindly specify):
Lifestyle		
26	What is/are the reason(s) for not avoiding PPE in duty rooms?	<ul style="list-style-type: none"> • Not applicable • I believe there is no harm in it. • No separate place available for rest during duty hours. • There is shortage of PPE • I find it cumbersome to don and doff multiple times. • Other reasons (Kindly specify):
27	What do you think is the cause of rising cases of infections among healthcare workers? Kindly give solutions for them in next column	

In the third step, a cross-sectional survey was conducted on HCWs working in the institute. HCWs from diverse socio-cultural backgrounds including faculty, resident doctors, nurses, health assistants, sanitation assistants, security guards, lab technicians, OT technicians, pharmacists and data entry operators were recruited. The data collection was done in August 2020 using Google forms as an online platform.

Thus, content and face validity of the questionnaire was established through FGDs, interviews, expert evaluation and pilot testing. For construct validity, exploratory factor analysis with principal component extraction and varimax rotation was done to evaluate the domain structure. This technique is used for estimating the number of factors and/or item reduction. KMO test and Bartlett's test of sphericity were done before exploratory factor analysis to determine the suitability of data for analysis. Cronbach's alpha coefficient was analysed to measure the internal consistency of the questionnaire. Descriptive statistics were used to analyse the results of the questionnaire.

4. Results

The final questionnaire consisting of 56 items in two sections is enclosed in [box 1](#). The scoring instructions of the questionnaire are enclosed in [box 2](#).

Section A comprised 29 questions on preventive practices covering aspects like hand hygiene, PPE, social distancing, lifestyle, fomites,

exposure and quarantine. Section B comprised 27 semi-structured questions to assess barriers to the adoption of preventive practices. It took approximately 20–25 min to complete the questionnaire.

4.1. Demographic findings of the participants

A total of 152 participants participated in the study out of which five responses were excluded as they were incomplete. The socio-demographic details of the remaining 147 participants are presented in [Table 1](#). The participants were aged 20–54 years with a slight male predominance (62.6% males), with an acceptable representation from various occupational categories. Around 43% of participants had been posted in COVID-19 designated areas and 47% of HCWs were attending to COVID-19 positive/suspect cases at the time of the survey. The case-load was higher in non-COVID-19 areas compared to COVID-19 areas (median beds 10 compared to 4).

4.2. Description of responses of the participants in the validation phase

The responses of participants to part A are given in [Table 2](#) and those to part B are given in [supplementary tables S1 and S2](#).

The highest adherence to preventive practices was observed in the practice of wearing masks inside hospital premises but the majority of participants (75.5%) commonly touched the outer surface of masks while

Box 2

Scoring instructions for the questionnaire to assess prevention practices against COVID-19 in the health care workers

For Section A, each item has 5 options. Except for items 1,5,11,17,19,20,22,23,28,29, the items are scored as given below:

5 = Always (more than 90% times).

4 = Mostly (approx. 75% times).

3 = Commonly (approx. 50% times).

2 = Occasionally (approx. 25% times).

1 = Rarely (less than 10% times).

The items 1,5,17,19,20,23 are scored inversely as.

1 = Always, 2 = Mostly, 3 = Commonly, 4 = Occasionally and 5 = Rarely.

The item 11, 28 and 29 are scored as.

5 = Never, 4 = Once, 3 = Twice, 2 = Thrice, 1 = More than three times.

The item 22 is scored as.

5 = Yes, taking regularly, 4 = Yes, taking regularly but missed some doses, 3 = Yes, took initially and then left, 2 = Don't remember, 1 = No.

Table 1
Socio demographic details of participants. *modified kuppusswamy scale 2020²⁰

Characteristic	Frequency	Percentage
Age	Mean 31.65 ±7.64 years	Range 20-54 years
Sex		
Male	92	62.59%
Female	55	37.41%
Occupation		
Doctor (faculty/specialist)	14	9.52%
Doctor (resident)	49	33.33%
Nurse	48	32.65%
Health assistant	8	5.44%
Sanitation assistant	8	5.44%
Technician(lab/OT)	10	6.80%
Security guard	7	4.76%
Others (pharmacist, Data entry operator, etc.)	3	2.04%
Marital status		
Single	67	45.58%
Married	77	52.38%
Others	3	2.04%
Socioeconomic status*		
Upper	44	29.93%
Upper middle	56	38.09%
Lower middle	20	13.60%
Upper lower	23	15.64%
Lower	4	2.72%
Type of patients being seen by HCWs at current place of posting		
COVID-19 negative cases	66	44.90%
COVID-19 suspect cases	45	30.61%
COVID-19 positive cases	24	16.33%
Others	12	8.16%
Ever posted in COVID-19 designated area		
Yes	62	43.06%
No	82	56.94%
Average number of beds under direct care	Median= 10 (IQR=7-20)	
Average number of COVID-19patients/ beds under direct care	Median= 4 (IQR=0-10)	

wearing it. This was because the majority of them (36%) felt uncomfortable while wearing it while others (32.65%) believed touching the outer surface causes no harm and few (13%) had to readjust it due to loose fit. Most of the HCWs followed hand hygiene practices properly. The reasons for suboptimal practices were a shortage of sanitizers, lack of time due to high patient load and being unable to check the time while

washing hands. HCWs practised social distancing more while eating food (51.0%) compared to talking to peers in duty rooms (36.7%) and working in wards (34.7%). Most of them avoided going out unnecessarily and practised social distancing in public places. A significant proportion of HCWs (31.3%) commonly reused gowns with the majority attributing it to the shortage of PPE and long duty hours. Many participants (34.7%) commonly wore PPE to duty rooms before completely doffing as there was no separate place for rest during duty hours and they found it cumbersome to don and doff multiple times. A significant number (59.2%) also used personal mobile phones commonly during duty. The majority used them for patient management and to stay connected with colleagues and family while few cited absence of separate duty phones and the need for entertainment as additional reasons. Most of the participants (95.2%) commonly took precautions while buying things like opting for cashless payments and home delivery, going out when it's less busy and buying more groceries at a time. 14.3% of participants occasionally/rarely had adequate sleep due to the lack of time and anxiety. Most participants didn't take chemoprophylaxis against COVID-19 with only 11.6% workers taking it regularly. More than 66% of HCWs had one or more high-risk contact with COVID-19 patients.

4.3. Validity of the questionnaire

A satisfactory agreement between experts with CVR = 0.87 and CVI = 0.978 indicated good content validity. Face validity was established through expert opinion and pilot testing. The KMO (Kaiser-Meyer-Olkin) test measure = 0.82 indicated adequacy of sampling and Bartlett's test ($\chi^2 = 1658.1$, d.f. = 406 and $p < 0.001$) indicated suitability of data for factor analysis. To establish construct validity, exploratory factor analysis using principal component extraction using varimax rotation with eigenvalue cut off of 1 was done. A nine-factor solution was obtained on factor analysis (Table 3). The correlation of question 9 with questions 7 and 8 was more than 0.7 but it was retained after consultation with experts as it was deemed to have an important role (Supplementary table S3). Cronbach's alpha coefficient was found to be 0.85. A score of more than 0.7 indicates good internal consistency of the tool. The total variance was 66.488%.

5. Discussion

COVID-19 has overwhelmed the health care systems worldwide. The rising number of infections among HCWs in this pandemic is a matter of

Table 2
Responses on the first section of the questionnaire.

S No.	Item	Mode	Frequency
Hand Hygiene			
1	I shake hands while meeting colleagues.	Rarely	88.4%
2	I sanitize my hands after contact with each patient and/or his/her surroundings.	Always	68.0%
3	I ensure that I wash/sanitize my hands for at least 20 s.	Always	54.4%
4	I properly follow the steps of washing/sanitizing hands.	Always	51.7%
5	I touch my eyes, nose or mouth without washing/sanitizing my hands.	Rarely	72.1%
Social Distancing			
6	I maintain at least 1 m distance with family members	Always	27.9%
7	I maintain at least 1 m distance with co-workers at the hospital.	Always	34.7%
8	I maintain at least 1 m distance while eating food with my colleagues.	Always	51.0%
9	I maintain at least 1 m distance while talking to my colleagues in the duty rooms.	Always	36.7%
10	I maintain at least 1 m distance with others in public spaces (e.g. shopping, social gatherings, etc).	Always	66.0%
11	I have attended social gatherings (Like meeting friends, going to religious places, visiting theatres etc) in the past two months.	Never	75.5%
12	I avoid going out of house unnecessarily.	Always	68.0%
Personal Protective Equipment (PPE)			
13	I follow the steps of donning and doffing properly.	Always	76.2%
14	I wear adequate PPE during duty (according to guidelines for my ward and patients).	Always	70.1%
15	I wear mask inside hospital premises.	Always	94.6%
16	I cover both nose and mouth with a mask while wearing it.	Always	91.2%
17	I touch the outer surface of the mask while wearing it.	Always	39.5%
18	I keep my mask properly in a separate bag/dustbin after using it.	Always	73.5%
19	I reuse my gowns/PPE during my single duty shift.	Rarely	59.9%
20	I carry face shields/gowns/PPE to my duty room in ward before completely doffing.	Rarely	55.8%
21	I dispose off PPE in specified coloured dustbins after use according to guidelines.	Always	88.4%
22	I take chemoprophylaxis against COVID-19(e.g. Hydroxychloroquine).	No	60.5%
Gadgets/Fomites			
23	I use my personal items like mobile phones, etc during duty in the hospital.	Always, Occasionally	24.5% each
24		Always	55.8%

Table 2 (continued)

S No.	Item	Mode	Frequency
Hand Hygiene			
25	I sanitize my personal items like mobile phones, pens, etc with sanitizer after my duty. I take precautions while buying things to avoid contamination with COVID-19.	Always	65.3%
Lifestyle			
26	I take adequate sleep (6–8 h) daily.	Always	54.4%
27	I stay updated regarding coronavirus disease by watching news or reading guidelines.	Always	47.6%
Exposure			
28	How many times did you have high risk exposure to COVID-19positive/suspect cases?	Never	43.5%
29	How many times were you quarantined?	Never	73.5%

grave concern both at the individual and the societal level. With a reduction in functional staff, the remaining workers have to bear the increased workload leading to a vicious cycle of stress, lapses in preventive practices, further exposure, and infection.

Several studies have identified suboptimal handwashing, improper PPE use, reuse of PPE, endotracheal intubation, working in a high-risk department, longer working hours, and COVID-19 infection among family members as important risk factors for contracting COVID-19 infections [2,3,5]. But a limited number of studies have been done to explore the various aspects of preventive practices of HCWs related to COVID-19. Most of the studies have been done in subgroups like dentists and medical students and have focussed on knowledge, attitude and risk perceptions only. Among the few studies dwelling into infection prevention and control practices, most of them have assessed adherence to hand hygiene and personal protective equipment briefly [10–13]. Some questionnaires have also included questions to assess adherence to social distancing [14,15], use of chemoprophylaxis [15], training of HCWs [12, 16] and reporting exposure to authorities [10]. Also, a few studies have utilised validated questionnaires [14,17]. Compared to the above studies, this questionnaire covers various aspects of preventive practices comprehensively. Not only it is validated but also it assesses reasons for suboptimal compliance.

The questionnaire consists of two parts: Part A contains 29 items for evaluating various aspects of preventive practices of participants based on their routine in the last two weeks. These items are rated on a five-point Likert scale and grouped under areas viz. hand hygiene, social distancing, personal protective equipment, fomites, occupational exposure, and lifestyle. Part B contains 27 items for evaluating reasons for suboptimal practices in the above areas. The options in these items reflect the common reasons for deficiency in practices identified through FGDs, interviews and expert opinion. The items are semi-structured to allow identification of distinct reasons applicable in different settings. The participants are allowed to mark multiple options and write the unique reasons applicable to them under the “other reasons” option in each item of part B.

Thus, this questionnaire identifies the specific areas in which lapses in preventive practices are present along with the reasons for these loopholes. It covers major aspects of preventive practices as recommended by the World Health Organisation (WHO), and as revealed in various studies [2,3,5,18]. It holistically covers preventive practices both inside and outside hospital premises and lays adequate stress on important and

Table 3
Factor loading of the items. *Factor loading of more than 0.4 is presented.*

	Rotated Component Matrix								
	Component								
	1	2	3	4	5	6	7	8	9
q9	.786								
q7	.767								
q8	.764								
q10	.731								
q24	.656								
q2	.596								
q12	.557								
q14	.522								
q11	.478								
q23	-.403								
q4		.733							
q21		.705							
q3		.699							
q18		.655							
q25		.510							
q20			.807						
q19			.596						
q5				.778					
q1				.605					
q17				.596					
q22				.421					
q16					.789				
q13					.613				
q26						.773			
q27						.438			
q29							.798		
q28							.674		
q15								.791	
q6									.703

frequently ignored aspects in prevention against COVID-19. It is self-administered and can be filled through an offline or online mode. The flexible nature of part B allows for its application in different socio-economic and cultural settings.

The applications of the tool are manifold. It evaluates both the extent and the reasons for deficiencies in the preventive practices to identify specific loopholes in various subgroups of HCWs in various departments in a health care setting. This would facilitate policymakers to design appropriate interventions to enhance occupational environment based on the results of the survey, particularly in case of an outbreak. It can also play an important role in the surveillance of occupational practices and thus, formulation of the infection control policy of the institution. It has the potential to play an important role in future pandemics of similar nature as a readily available tool too. The application of the questionnaire in various health care settings is recommended.

To holistically assess all major aspects of prevention and identify reasons for shortcomings therein, the questionnaire may take around 30 min to collect data from an individual participant. We suggest that section A may be administered independently for rapid assessment when needed. Other limitations include the inability to ensure proportional representation of various occupational categories of HCWs in the survey and inability to establish predictive or concurrent validity as it would require long-term follow-up. The addition of a question to assess formal training of HCWs in infection prevention practices would be valuable too.

Based on the responses of the participants, few measures to increase adherence of HCWs to preventive practices are suggested [18,19]. Practical and easy-to-remember methods should be devised and promoted to ensure that HCWs wash hands properly for an adequate time. There is a need for intersectoral collaboration to develop ergonomic and comfortable PPE. Adequate training of HCWs, regular monitoring and reinforcement of preventive practices should be done. Their duty rosters should be optimised and adequate psychological support should be provided to them.

The sufficient availability of PPE and sanitizers should be ensured. A robust institutional framework for identifying reasons for high-risk exposure and taking corrective steps for the same is recommended.

6. Conclusion

This questionnaire has been developed for a comprehensive assessment of preventive practices and associated barriers in health care workers. It has good validity and internal consistency. It will play an important role in disease prevention by empowering policymakers to identify appropriate interventions for suboptimal practices and vulnerable sections of health care workers during the COVID-19 pandemic and future pandemics of similar nature as well.

Presentation at a meeting

None.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijmmb.2021.03.006>.

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