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The role of educating health-care personnel in prevention, diagnosis, or treatment of COVID-19: A narrative mini review

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Abstract:

Front-line clinicians and health-care workers need to be educated to provide care in critical situations such as large-scale catastrophes and pandemics. This narrative review is focused on investigating educational strategies in confrontation with coronavirus disease 2019 (COVID-19) pandemic. We conducted a literature search in December 2020 through LitCovid, PubMed, ERIC, and Cochrane Library in order to retrieve relevant studies regarding the role of education in prevention, diagnosis, and treatment of COVID-19. There were 12 reviewed studies related to this specific subject. The articles selected for this study demonstrated that education and training had a positive impact on the knowledge and attitude of the participants and also the educational interventions, whether they were simulation-based or other formats of training, would be deemed crucial for enhancing participants' level of perceptions and confidence. Therefore, it is highly recommended that public health policymakers consider this important issue.

Keywords:

Coronavirus disease 2019, COVID-19, severe acute respiratory syndrome coronavirus-2, diagnosis, education, health personnel, prevention and control, therapeutics

Introduction

Viruses are microscopic agents that can cause infections for humans and animals,^[1] and viral infections can cause brain dysfunction and neurological illnesses,^[2] tissue damage,^[3] respiratory system disorders including asthma,^[4,5] metabolic issues,^[6] gastrointestinal diseases,^[7] and sudden death.^[8,9] In late 2019, a new virus named severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) emerged in China, and the resulting disease was later named coronavirus disease 2019 (COVID-19).^[10,11] The rapid transmission and spread of this disease impacted countries around the world due

to the increased mortality and morbidity.^[12] The World Health Organization (WHO) announced COVID-19 as a “public health emergency of international concern” in the early 2020 and a few months later designated it a pandemic.^[12] COVID-19 is an infectious disease which may manifest itself differently in each person ranging from common cold-type symptoms to acute respiratory issues.^[13] The WHO and national, local, and regional public health bodies have introduced strategies for the general public for prevention and control of the pandemic; such initiatives include vaccines, social distancing, and hygienic approaches.^[14] However, there have been significant challenges and concerns in the control and prevention of

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COVID-19.^[15] Infectious diseases that lead to pandemics are extremely perilous to humankind and global public health. Therefore, education and support are among the most critical requirements that should be considered for health-care experts all over the world to confront the pandemics. Clinical decision support systems and electronic learning (e-learning) may assist in disseminating such information.^[16]

Health personnel and more specifically hospital workers are highly exposed to the virus and therefore at higher risk for infection.^[17] In this respect, front-line clinicians need to be educated for offering care for COVID-19 as with other critical situations such as large-scale catastrophes and pandemics.^[18] In addition, students (specifically medical students) should be mentored and supported in order to mentally and emotionally deal with additional stress related to the pandemic.^[19]

There are several lessons that can be learned from the previous outbreaks about the role of education in prevention, diagnosis, and treatment of COVID-19. For instance, Yang *et al.* confirmed that, during the outbreak of the Middle East Respiratory Syndrome coronavirus (MERS-CoV) in Korea, there was a positive relationship between hand hygiene education and hand disinfection behaviors, especially in low-income populations, the elderly, and females.^[20] Al-Tawfiq *et al.* found that a nurse-guidance program to monitor MERS-CoV-infected patients on the use of Personal Protective Equipment (PPE), symptom recognition, and accurate sampling had positive effects in reducing the hazards for personnel and patients.^[21] During the Severe Acute Respiratory Syndrome (SARS) outbreak in Singapore, university lecturers utilized simulation strategies in clinical education in order to prevent and reduce the risk of infection in students. Specific educational plans for nurses and some other health-care providers also exist.^[22] In one hospital of Ontario, Canada, SARS screeners were educated through a staff development program. The role of the deployed plan was proved to be extremely critical.^[23]

This research is primarily concerned with reviewing the approaches of educating health personnel and summarizes the role of education in confrontation with COVID-19 pandemic. The results of the present review can highlight the crucial role of education in crises such as pandemics and guide the policymakers in these situations.

Materials and Methods

We conducted a literature search through LitCovid, PubMed, ERIC, and the COVID-19 section of Cochrane Library (<https://covid-19.cochrane.org/>) in order to

retrieve relevant studies about the role of education for both general public and the health personnel in prevention, diagnosis, and treatment of COVID-19. The comprehensive but non-systematic search was done in December 2020 using MeSH terms and subheadings including "COVID-19," "SARS-CoV-2," "Education," "Health education," "Teaching," "Learning," "prevention," "treatment," and "diagnosis." We employed Boolean operators "AND" and "OR" where appropriate.

Inclusion criteria were as follows: (1) original articles that mainly discuss the role of education or training approaches in prevention, diagnosis, or treatment of COVID-19, (2) articles with available abstract and free full-text. We excluded letters to the editors, review articles, and editorials as well as non-English articles. The abstracts of the retrieved articles were further screened by two authors that have expertise in the fields of medical education and infectious diseases; subsequently, they selected the initial articles. After this phase, two other authors, experienced in the field of public health, selected the final studies by comprehensive investigation of full-texts of the articles that were selected in the previous phase. We utilized EndNote X9 in the screening and selecting phases.

We consequently sorted out the finalized studies based on their scope and main objectives. The authors, country, intervention, participants, objectives, and main results and conclusion of the articles were then extracted and compared.

Results

Considering the inclusion criteria and after the comprehensive screening of the selected full texts, we identified 12 studies to review. We classified them into four major categories considering their aims including prevention, diagnosis, treatment, and multi-dimensional. The summary of the articles is illustrated in Table 1. It should be stated that the educational programs can be classified into those related to education of general public and those related to health professional education on prevention, diagnosis, and treatment. Due to the limited number of articles focused on the general public at the moment, we chose to focus on the latter.

Prevention

Abbas *et al.*^[24] developed a web-based module on hand disinfection and respiratory protocols for health-care workers and investigated its effectiveness. Pre- and post-intervention questionnaires demonstrated that the online educational course had a positive impact on the appropriateness of the hand-hygiene process. Li *et al.*^[29] found that simulation-based trainings for nurses

Table 1: The summary of the studied articles concerning the role of education in prevention/diagnosis/treatment of COVID-19

Authors	Country	Intervention	Participants	Objectives	Main results and conclusion
Abbas <i>et al.</i> ^[24]	Pakistan	Web-based course on respiratory and hand hygiene	Health-care personnel (<i>n</i> =500)	To assess the impact of the online course on preventive practices	Positive results regarding the effect of online health education in preventive measures were reported
Abud <i>et al.</i> ^[25]	U.S.	Educational videos and live shows on performing nasopharyngeal and oropharyngeal swabs for the testing of COVID-19	Health personnel at a tertiary care setting (<i>n</i> =40)	To investigate the effect of education on test accuracy, proper sample collection, and the personnel's confidence to perform swabbing	The video was considered as useful by the most of the participants. The knowledge and confidence were enhanced after the intervention
Díaz-Guio <i>et al.</i> ^[26]	Colombia	A workshop based on simulation for donning and doffing of PPE and a debriefing (on two COVID-19-related cases)	Health personnel (<i>n</i> =61)	To evaluate the workshops' effectiveness for educating the personnel	After the intervention, the processes of donning and doffing PPEs were successful and the usefulness of the workshops were confirmed. This strategy would reduce the contamination risk among health-care workers
Favier <i>et al.</i> ^[27]	France	A 3-h training module of percutaneous tracheostomy based on simulation	ENT physicians (<i>n</i> =14)	To illustrate the training process for the physicians	This type of simulation is helpful for training ENT specialists and can reduce errors of this procedure in COVID-19+patients
Khan and Kiani ^[28]	Pakistan	Simulation-based classrooms for management of confirmed and suspected cases	Medical and nonmedical health personnel (<i>n</i> =44)	To assess the readiness and confidence of health-care workers to treat COVID-19 patients	Completion of the course, resulted in increased level of safety and preparedness of caring for COVID-19 patients and enhanced confidence of trainees
Li <i>et al.</i> ^[29]	China	Simulation-based training through videos about donning and doffing PPEs	Pediatric nurses (<i>n</i> =60)	To investigate the impacts of simulation-based education on improving prevention and control of COVID-19 and examine the psychological status among nurses	The knowledge of the participants was enhanced and their level of anxiety and stress was decreased
Li <i>et al.</i> ^[30]	U.S.	Video-based educational course in 20 min, conducted by an otolaryngologist, about accurate nasopharyngeal swabbing method	Nurses (<i>n</i> =17)	To examine the effect of nasal anatomy and swabbing technique education on test optimization	The rate of accurate nasal swab testing was increased
Mark <i>et al.</i> ^[31]	U.S.	Six simulation-based teaching sessions about the correct swabbing of nasopharynx	Health personnel (<i>n</i> =61)	To assess the impact of education on test accuracy and health personnel's confidence	The teaching sessions helped to improve the knowledge and confidence of performing tests in personnel. These strategies can be used to minimize the rate of FN results
Ros and Neuwirth ^[32]	France and U.S.	Revinax® handbook mobile application about COVID-19 guidelines and tutorials in patient care	Healthcare workers and responders who care for COVID-19 patients (<i>n</i> =12,516 downloads)	To help the people efficiently learn COVID-19 procedures in a timely manner	The application received a positive feedback. It was a helpful tool and met their educational needs in patient care
Shi <i>et al.</i> ^[33]	China	A suspected COVID-19 case was simulated based on the real patient's specifications	Family medicine residents (<i>n</i> =25)	To assist in best-practice management in the residency program	The simulation was considered as useful. It helps in crisis management and infectious disease control

Contd...

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Authors	Country	Intervention	Participants	Objectives	Main results and conclusion
Itamura <i>et al.</i> ^[34]	US	126 YouTube videos was investigated for nasopharyngeal swab tests of SARS-CoV-2	Three rhinologists evaluated 126 videos	To evaluate the accuracy of educational videos about the techniques of nasopharyngeal swab tests	Over half of videos contained incorrect technique. This can lead to greater false negative rates. It is important that health personnel be educated in this process
Mileder <i>et al.</i> ^[35]	Austria	A simulation-based training was performed. It was a 375-min course including the topic related to COVID-19 (basics, hygienic measures, swab testing, PPE usage, patient communication and information)	45 emergency medical assistants and a physician (n=46)	To assess the effectiveness of the training course. OSCE was performed for evaluation	97.8% succeeded in the curriculum. The mean rate of OSCE was 98.6%. The training had a positive effect on preparing the personnel for their responsibilities

PPE=Personal protective equipment, ENT=Ear, nose, throat, FN=False-negative, OSCE=Objective structured clinical examination, SARS-CoV-2=Severe acute respiratory syndrome coronavirus2, COVID-19=Coronavirus disease-2019

on donning and doffing PPEs (face masks, gloves, eye patches, and clothing), and hand-hygiene improved the passing rate from 65% (before the intervention) to 98.3% (after the intervention). Díaz-Guio *et al.*^[26] conducted a simulation-based workshop for nurses with two COVID-19 patients which improved donning PPEs to 100% and doffing to 98.4%. The contamination rate reduced to 9.8%. The authors asserted that these trainings might have a positive impact on controlling the virus dissemination among health-care workers. These studies highlight the positive role of any types of educational intervention on the knowledge and skills of health professionals that may be increasingly effective in the prevention of the disease.

Diagnosis

In the study of Abud *et al.*,^[25] educational videos and live presentations about nasopharyngeal and oropharyngeal swab testing were employed. The skills, knowledge, and confidence of the participants were assessed in a pre-post examination. The knowledge scores of the participants in performing the mentioned task were highly improved after the training (mean score of pre-intervention = 1.9, mean score of post-intervention = 2.8). The education intervention also caused a significant improvement in the level of confidence of the participants (mean score of pre-intervention = 2.7, mean score of post-intervention = 4.1). Most of the participants (95%) endorsed the usefulness of the educational videos. Mark *et al.*^[31] had similar aims. The researchers conducted teaching sessions about the correct performing of nasopharyngeal swab test for health-care personnel in 3 days. There were six sessions, and on average, ten personnel participated in each one. The mean self-assessment score in performing the procedure was enhanced after the educational sessions (pre-intervention = 3.13, post-intervention = 4.54). In Itamura *et al.*'s study,^[34] three rhinologists investigated 126 online tutorial

videos (YouTube database) regarding swabbing to evaluate their technical accuracy and find incorrect patterns of the procedure. They established a relationship between the performers of the task in online videos and its accuracy. Those performed by medical professionals or ENT-related experts were more accurate compared to others performed by non-specialized operators. In this study, over 50% of the videos incorrectly illustrated the swabbing technique which can lead to more false-negative rates. In a pre- and post-survey, Li *et al.*^[30] evaluated the performance of 17 nurses responsible for running swab tests. The training session was about 20 minutes, and the educational content was based on Centers for Disease Control and Prevention (CDC) guidelines. An otolaryngologist was the session's provider and the participants were needed to watch tutorial videos of swabbing technique and reviewing nasal anatomy as well as being guided to conduct a test on a mannequin. Subsequently, a six-question test was administered for the participants, and after the intervention, the number of correct responses enhanced to 5.1 ± 1.1 from 3.2 ± 1.2. Generally, in the mentioned research, the authors declared that the educational intervention might have a positive impact on knowledge and comfort of nurses in conducting this type of test.

Treatment

Favier *et al.*^[27] conducted a training session, in which the procedure of percutaneous tracheostomy was simulated. In total, there were three sessions, in which 14 participants worked in a simulation room. Moreover, an anesthetist joined as a facilitator. First, the tutorial video about the basics of the procedure was demonstrated. Next, the simulation-based education was offered, in which four scenarios including "standard tracheostomy, small goiter, pneumothorax, and intubation difficulty" were implemented through a mannequin. This type of simulation technique was shown to be helpful for training ENT specialists and might reduce errors in performing this

procedure in COVID-19 patients. In the study of Ros and Neuwirth,^[32] a video-based content about COVID-19 patient care was established in a mobile application. The target groups were health-care workers and responders who care for COVID-19 patients. Based on a feedback survey, the users considered the application very beneficial in learning the procedures related to COVID-19 at the right time. In another study, Shi *et al.*^[33] offered a 1-h simulation-based training course in best-practice management of the disease among family medicine residents. The simulation was based on the specifications of a real case. The training course had a positive impact on the knowledge of the participants and 96% believed that the simulation-based course was helpful for them.

Multi-dimensional

There were some articles that investigated multidisciplinary training processes including the education about PPE usage, swab testing accuracy, and fundamentals of COVID-19; these studies discuss the role of education in prevention, diagnosis, and treatment. The aim of Khan and Kiani's study^[28] was to assess the rate of preparedness and perception of safety among medical and non-medical health personnel, before and after the interventional training course. The deployed simulation-based course consisted of different scenarios including some essential matters including PPE usage, the methods of sampling (polymerase chain reaction tests and blood test), biosafety guidelines and protocols in the hospital, and disinfection protocols (hand and surface). Simulated scenarios were used, and mannequins were employed. Post-intervention, the participants' perceived rate of preparedness for patient care and safety was improved and had a significant difference compared to the pretest ($P < 0.05$). The researchers concluded that the trainings based on simulation had a positive role in staff preparedness and perceptions in handling and management of COVID-19. Mileder *et al.*^[35] also conducted a multidisciplinary study which was methodologically similar to the study of Khan and Kiani. The 1-day curriculum consisted of theoretical, technical, and simulation-based training. Patient communication and identification, nasal swab testing approaches, and donning and doffing PPEs were taught to emergency medical assistants and a physician. To examine learning effects, the objective structured clinical examination was utilized (mean rate = 98.6%). Based on the results, the training was helpful in preparing participants to deal with COVID-19 (success rate = 97.8%).

Discussion

COVID-19 crisis has been proved to bring about several educational, societal, economic, individual, and even environmental challenges.^[36-39] Health-care personnel as the most exposed group to the virus would be more

susceptible to these challenges and risks. Therefore, it is of vital importance to make plans for educating them in an attempt to mitigate the hazards in this population. This study sought to discuss and review some of these educational efforts and strategies worldwide and evaluate the impacts of these plans in prevention, diagnosis, and treatment of COVID-19.

In general, the reviewed articles were categorized into four groups based on their aims and approaches. The researchers mainly considered the role of educational strategies in prevention, diagnosis, or treatment of COVID-19, and there were some others that assessed the impact of the educational interventions in more than one of the above areas. The articles selected for this study proved that education and training had a positive impact on the knowledge and attitude of the participants.

Some studies deployed educational sessions based on simulation approaches, while some others chose to develop mobile applications. After the educational interventions, the researchers mostly conducted post-test evaluation to assess the actual impact of the trainings. In a number of studies, the participants' satisfaction of the courses was also examined. The results of the present review highlight the crucial role of education in crises including worldwide epidemics which may guide the decision-makers in responding to these situations.

It should also be stated that, in the previous pandemics such as H1N1 and SARS, there were some similar educational measures. In these outbreaks, plans and policies introduced by the CDC included trainings in utilizing PPEs and hand hygiene as well as offering the developed plans on preventive measures to health personnel.^[40] Some other studies aimed to assess educational interventions applied to the general public. To illustrate, in 2019, Paixão *et al.* reviewed and investigated the impact of education on the knowledge about arboviral diseases. Based on most of the reviewed articles in the mentioned study, knowledge of the people was improved after the interventions. Furthermore, their protection against the virus was elevated (self-reportedly).^[41] Charles Shapu *et al.* also conducted a systematic review of articles designed to explore the educative health interventions about malnutrition and whether these training strategies helped to improve the people's knowledge and attitude about this condition. Similarly, this article's findings proved that the general awareness about malnutrition among the target populations was strengthened due to the educational interventions.^[42]

Since the WHO considered COVID-19 pandemic as a "public health emergency of international concern," this crisis would more likely cause harm specifically to

vulnerable health systems.^[36] As a result, in COVID-19 era, it is of vital importance to train and educate health-care workers in an effort to sustain a strengthened health-care system and therefore minimize the risk of viral infection among them. In general, the integration of health-care delivery and medical education is a beneficial way to improve training measures and their outcomes.^[43] In this respect, plans for public health preparedness, constructing guidelines, and education for health-care professionals can play a pivotal role in managing crises brought by infectious diseases. Therefore, international collaboration and coherent plans would be necessary.^[44]

As Paixão *et al.* suggested in their research, it might be beneficial if the mobile phone applications be employed in preventing the diseases, since they can educate people in more personalized ways.^[41] In addition, medical schools can develop curricula for handling the crises such as COVID-19 in an attempt to enhance the knowledge and attitude of medical students as future health-care workers and gain required competencies. Crisis management can be a vital capability in better prevention, diagnosis, and treatment of diseases.^[45] In the lower educational levels, it is also vital that the policymakers consider the education for children at schools with respect to COVID-19 prevention and control. Bubadué *et al.* conducted workshops aimed at teaching hand sanitization strategies to children due to being the important sector of the society and because their actions might have an impact on the public health.^[46]

Strengths, limitations, and suggestions for future studies

To the best of our knowledge, no similar review article has been conducted in this essential field yet. Since the flow of educational information is highly crucial, it seems that this review may help the policymakers and health education authorities in showing the roadmap in conducting the similar strategies for enhancing technical skills, reducing diagnostic test errors, and preventing the transmission of the virus.

However, there are some limitations in conducting this research that can be stated in order to become the guidance for future research in this field. First of all, the search strategy can be more comprehensive to cover a wider range of studies. Second, it would be better if we focused on the role of education not only for health-care workers but also directed toward general public. Third, the researchers could compare the role of education during the current pandemic with previous pandemics such as SARS, MERS-CoV, and H1N1.

To highlight the importance of education and training, it should be asserted that five out of ten international health threats introduced by the WHO are related to

infection prevention and control. To manage these hazards, well-educated and highly-trained health-care workers are required to be employed in health settings.^[47] In this respect, plans for public health preparedness, constructing guidelines, and education for health-care professionals can play a pivotal role in managing crises brought by infectious diseases. Therefore, international collaboration and coherent plans would be necessary.^[44] For future studies, we recommend that researchers place an emphasis on the role of education on general population's knowledge and their behavior in confrontation with COVID-19 pandemic and how the interventions assist in preventing the disease in societies. In addition, it would be crucial that health decision-makers consider the educational strategies aimed at general public, especially those with non-academic education and children, since this population may have a potential in playing an important role in increasing the virus transmission due to their lack of related information and limited knowledge to distinguish between authentic and unreliable news.

Conclusion

Based on these reviewed studies, multimodality educational interventions for health personnel had a beneficial role in participants' knowledge and level of perceptions. It is recommended that public health policymakers and funders consider supporting such trainings, both for health-care personnel and the general population, though we cannot say which interventions are the most cost effective with the best outcomes for particular professionals in specific contexts.

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Conflicts of interest

There are no conflicts of interest.

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