



Effect of Using a Technology-Based (Mobile Health) Nursing Protocol on Positive COVID-19 Patients' Dyspnea and Level of Activity

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Nursing faced a challenge in caring for COVID-19 patients in terms of keeping their chests clear from secretions, which required much effort from already-exhausted patients, along with the tasks of minimizing dyspnea and cough, strengthening immunity status, and improving their activity levels. The present study aimed to evaluate improvement of dyspnea and activity levels after 1 week of applying a mobile health nursing protocol for positive COVID-19 patients. The study was conducted in quarantine hospitals in Cairo on 90 COVID-19-positive patients who agreed to participate in the study, were fully conscious, were themselves able to use mobile phone applications (or their accompanying relatives were), and were not in need of artificial ventilation. A self-administered online questionnaire was utilized via Google forms to collect data. Patients who agreed to participate in the study received a video on their WhatsApp application containing audio and visual explanations of how they would apply the nursing intervention protocol. The study's findings showed that the best level of dyspnea was only 10.59% of the sample prior to applying the nursing protocol and increased to 20.00% of the sample after applying the nursing protocol. Also, the highest level of activity was only 50.59% pre-protocol and increased post-protocol to become 70.59%.

KEY WORDS: COVID-19, Dyspnea, Level of activity, mHealth, Nursing protocol

Significant changes to the healthcare service and providers after the novel coronavirus are obviously major and challenging. During periods of quarantine, some clinical staff paid the highest cost of caring for coronavirus disease 2019 (COVID-19) patients, which was, dramatically, losing their own lives.¹ Nursing, as the front line of contacting and caring for patients, has a great challenge in preventing the spread of

COVID-19 infections in hospitals and community outbreaks.² At the same time, and to a similar degree, nursing faces a very complicated challenge in caring for COVID-19 patients. This challenge comes back to the uncertainty of the disease prognosis, along with the health and well-being of patients.³ Scientists still know very little about the disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus.⁴ In addition, nursing care measures are necessary to preserve the safety of those same professionals who work within the institutions and who oversee inter-institutional transfers of patients who were confirmed to be COVID-19 positive.⁵

LITERATURE REVIEW

According to the World Health Organization, more than 509 164 cases of COVID-19 were reported worldwide as of March 27, 2020.⁶ In Egypt, more than 1218 cases of COVID-19 were reported as of March 27, and the total number of cases at the end of July 2020 was 114 475 cases.⁷ The present study emphasizes the direct nursing care provided to COVID-19 patients, because nursing faces a great challenge in caring for COVID-19 patients regarding maintaining their chests clear from secretions, which requires much effort from patients who are already exhausted; they must also minimize dyspnea and cough, strengthen their immunity status, and improve levels of daily activity.⁸

These all place an extra load on nurses in that, until now, there is no exact cure for the SARS-CoV-2 virus, which increases the recovery dependence of these patients. The challenges in caring for COVID-19 patients arise mainly from the extreme levels of anxiety patients face due to the fear of the unknown progression of the disease, which may sometimes be death.⁸ Confirmation of COVID-19 diagnosis is by means of a SARS-CoV-2 positive throat swab (polymerase chain reaction [PCR]).⁵ Most infected patients with the COVID-19 virus experience mild to moderate respiratory illness and recover without requiring special treatment. People who are older or people with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness.⁶ Symptoms reported by patients with COVID-19 have a wide range, from mild cold or flu-like indicators to severe illness. Usually, symptoms appear 2–14 days after exposure to the virus.⁹ According to

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reports from the Centers of Disease Control and Prevention, COVID-19 symptoms may include fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, or diarrhea.¹⁰

Another challenge confronted by nurses in dealing with the COVID-19 pandemic is the need to reach the greatest number of people possible for providing information about COVID-19 prevention in addition to self-care and isolation.¹¹ This challenge is mostly managed by using mobile health (mHealth).¹² Mobile health apps have played an important role in moderating the COVID-19 response. The World Health Organization has defined mHealth as the “use of mobile and wireless technologies to support the achievement of health objectives.” The National Institutes of Health defines mHealth as “the use of mobile and wireless devices (cell phones, tablets, etc) to improve health outcomes, healthcare services, and health research.” Nurses have used social media platforms like Facebook, WhatsApp, Instagram, and Twitter to provide specific information about COVID-19 to the public.⁸

One of the global apps for symptom monitoring is the iPhone and Web-based COVID-19 Screening Tool app developed by Apple. Various countries have also come up with quarantine apps to ensure that quarantine measures are being followed. For example, geofencing apps enforce the quarantine by using mobile phone signals and GPS to track the movements of users.¹³ Mobile health technologies are viable options to monitor COVID-19 patients and can be used to predict symptom escalation for earlier intervention. These technologies could also be utilized to monitor individuals who are presumed non-infected and to enable prediction of exposure to SARS-CoV-2, thus facilitating the prioritization of diagnostic testing.¹⁴

AIM OF THE STUDY

The present study aimed to evaluate the effect of using technology-based (mHealth) nursing protocol on positive COVID-19 patients' dyspnea and level of activity.

Research questions were the following:

1. Has dyspnea improved after 1 week of using the mHealth nursing care protocol?
2. Has level of activity improved after 1 week of using the mHealth nursing care protocol?
3. During the 14 days before the appearance of signs and symptoms, did the COVID-19–positive patient have contact with another person with like signs and symptoms?
4. Have symptoms (fever of 38°C, sore throat, dyspnea, dry cough, and productive cough) improved after 1 week of using the mHealth nursing care protocol?

METHODS

Research Design

A quasi-experimental one-group research design was utilized to test the outcomes of the nursing protocol applied in this study.

Subjects

Sample size was assumed using G*Power analysis software (Heinrich Heine University, Dusseldorf, Germany) by an α error of .05 and power $(1 - \beta) = 0.85$, comparing a constant variable, one sample. The calculated sample size was 87 patients. Considering drops in the number of sample patients during the study, a convenience sample of 90 patients who voluntarily agreed to participate in the study and who were suspected of having COVID-19 was recruited. Five patients did not continue the online questionnaire and dropped out through the follow-up phase; consequently, the total sample size was 85 patients, who participated fully, leaving a single group of subjects, which has been used for the comparison between before and after the application of the nursing care protocol. *Inclusion criteria* are a fully conscious patient, being able to use mobile phone applications, or their accompanying relatives being able to use the application on their behalf, and the patient being not in need of artificial ventilation.

Settings

This study was conducted in quarantine hospitals in Cairo.

Instrument

A self-administered online questionnaire through Google forms was utilized to collect data. The questionnaire has three parts; the *first part* is the patients' demographic data. The *second part* includes signs and symptoms at hospital admission (fever of 38°C, sore throat, dyspnea, dry cough, and productive cough), if the patient had contact with another person with like signs and symptoms throughout the 14 days before hospital admission, complete blood count results, chest x-ray results, degree of dyspnea modified Medical Research Council Dyspnea Scale, and level of activity (mobilization scale). The *third part* has the same questions as the second part, to be used for comparison between before and after applying the nursing intervention protocol.

The modified Medical Research Council Dyspnea Scale was developed using the Medical Research Council dyspnea scale in order to quantify the complex subjective sensation of breathlessness.¹⁵ It comprises five statements that describe almost the entire range of respiratory disability from none (grade 1) to almost complete incapacity (grade 5). Statements are as follows: “dyspnea with strength exercises,” “dyspnea with hurry up,” “walk slower than people of the same age,” “stop for breathing after walk 91 m,” and “too dyspneic to leave house.” The modified Medical Research Council

Dyspnea Scale is validated by categorizing patients with chronic obstructive pulmonary disease in terms of their disability.¹⁶ In addition, there was a highly significant worsening of activities of daily living between patients with Medical Research Council grades 4 and 5 dyspnea.¹⁶

The mobilization scale characterizing the level of activity was adapted from an early version of the validated ICU Mobility Scale.¹⁷ This scale is composed of eight items; the first item expresses the lowest level of activity, and the last item expresses the highest level of activity as follows: (1) no mobilization or passive range of motion of extremities; (2) turning in bed (including active-assisted range of motion of extremities); (3) sitting in bed with the head of the bed elevated; (4) sitting on the edge of the bed with feet on the floor; (5) out of bed sitting in a chair; (6) standing out of bed; (7) marching in place; and (8) ambulating. The ICU Mobility Scale has been shown to have the highest inter-rater reliability with a weighted κ (95% confidence interval) of 0.83 (0.76–0.90), as reported by junior and senior physical therapists, while the senior physical therapists and nurses and the junior physical therapists and nurses had a weighted κ of 0.72 (0.61–0.83) and 0.69 (0.56–0.81), respectively.^{12,18}

Intervention

Researchers contacted nurses providing direct nursing care to COVID-19 patients and explained the aim of the study and the nursing intervention protocol. Nurses recruited patients who met the inclusion criteria and agreed to participate in the study from the quarantine hospitals. The nurses explained the researcher's job title and the aim of the study. The researcher then contacted the recruited patients through the WhatsApp mobile application. The nursing intervention protocol included the instructions in the video patients received and the follow-up of patients' application to these instructions for 1 week by the researchers. The video contained instructions about planning of daily activity, eating a proper diet, dealing with a dry cough and respiratory secretions, and methods of home isolation for patients as directed to do so by a physician. Patients were asked to complete the first and second parts of the online questionnaire. Then, patients received a video on their WhatsApp application. The video contained instructions about planning of daily activities, proper diet, and a demonstration of dealing with dry cough and respiratory secretions. The video also had illustrations of methods of home isolation for patients who were directed to remain isolated at home by physicians.

The video included, first, methods of home isolation, including keeping in a private room, the presence of a table with gloves and masks outside the patient's room door, so that anybody entering the patient's room should wear a mask and gloves and discard them after leaving. The patient had to keep private eating tools throughout the period of

positive COVID-19 test and isolation, and finally whenever the patient entered the bathroom, they should flush the toilet several times.

Second, with respect to dealing with a dry cough, the researcher illustrated in the video ways to maintain a sense of freshness and a feeling of having fresh air by wearing loose-fitting clothing and sitting in an upright, 90° position, with the patient's back supported by pillows, even during sleep, if a dry cough continued to bother the patient during sleep. Methods to help expel sputum include drinking hot drinks, back rubs, and coughing techniques. Avoiding hard and solid foods while increasing intake of juices and soups can also minimize nausea and prevent malnutrition and dehydration.

Researchers kept in contact with patients by means of WhatsApp and mobile phones for 1 week while the patients were applying the nursing intervention protocol. Finally, patients were asked to complete the third part of the online questionnaire, which requested data after 1 week of applying the nursing care protocol, to be compared with data on admission. The study began in March 2020 and finished at the end of September 2020.

Outcomes of the study are as follows: changes in the degree of dyspnea and level of daily activity.

Statistical Analysis

Statistical analysis methods used to describe the study sample that are categorical variables were frequencies and percentages. In addition, the χ^2 test was used to analyze the relationship between two categorical variables in each research question.

Ethical Considerations

Official approval was obtained from quarantine hospitals in Cairo. The researchers clarified the aim and procedures of the study to the patients. Written consent was obtained from patients or their responsible family members. The researchers ensured the maintenance of the patients' anonymity and confidentiality of the subject data. Nurses were trained by the principal investigator about the inclusion and exclusion criteria to include the patients in the study.

RESULTS

Demographic characteristics are illustrated in Table 1; males represented 51.76%, and females represented 48.23%. Middle age had the highest percentage of patients, with age ranging from 31 to 49 years, accounting for 38.25% of the patients. A majority (69.41%) were employed dealing with people, whereas a minority of the patients (30.59%) did not deal with people. Over half (61.18%) of the subjects were university educated, whereas considerably fewer (29.41%) had a secondary school education. Approximately half of the patients did not have contact with persons with a respiratory tract infection within 15 days before hospital admission

Table 1. Frequency of the Patients According to Area, Nationality, Job, and Level of Education (N = 85)

Demographics		n	%
Sex	Male	44	51.7
	Female	41	48.2
Age, y	≥30	13	11.05
	31–49	45	38.25
	≥50	27	22.95
Area	Urban	77	90.59
	Rural	8	9.41
Nationality	Egyptian	85	100.00
	African	0	0.00
	Asian	0	0.00
	American	0	0.00
Job	Employee dealing with people	59	69.41
	Employee not dealing with people	26	30.59
Level of education	Illiterate	0	0.00
	Primary school	8	9.41
	Secondary school	25	29.41
	University	52	61.18
Did you have contact with a person with a respiratory tract infection in the last 15 d?	No	42	49.41
	Yes	43	50.59
Main complaints at hospital admission	Dry cough	17	20.00
	Productive cough	9	10.59
	Fever	34	40.00
	Fever with runny nose	0	0.00
	All of the above	25	29.41
Hospital stay period	1 d	9	10.59
	Less than a week	9	10.59
	1 wk	25	29.41
	2 wk	42	49.41
	More than 2 wk	0	0.00

(50.59%), and nearly half (49.41%) of the patients were in contact with persons with respiratory tract infections within 15 days before hospital admission.

Question 1: Has Dyspnea Improved After 1 Week of Using the Mobile Health Nursing Care Protocol?

The level of dyspnea has been improved after applying the mHealth nursing care protocol. Comparing the levels of dyspnea between pre- and post-application of the mHealth nursing care protocol, Table 2 illustrates a highly statistically significant difference between pre- and post-protocol. Patients who had dyspnea with strength exercises were 10.59% of the sample and became 20.00% of the sample after applying the protocol. Also, patients who were too dyspneic to leave

Table 2. Comparison of Level of Dyspnea Between Pre and Post Applying the mHealth Nursing Care Protocol (N = 85)

Item	Pre		Post		χ^2	P
	n	%	n	%		
1. Dyspnea with strength exercises	9	10.59	17	20.00	21.08	.00031
2. Dyspnea with hurry up	16	18.82	24	28.24		
3. Walk lower than people of the same age	25	29.41	26	30.59		
4. Stop for breathing after walk 91 m	18	21.18	18	21.18		
5. Too dyspneic to leave house	17	20.00	0	0.00		

the house were 20.00% of the sample before applying the protocol, whereas after applying the program, this number dropped to 0.00%.

Question 2: Has the Level of Activity Improved After 1 Week of Using the Mobile Health Nursing Care Protocol?

The activity level has improved after 1 week of using the mHealth nursing care protocol. This is revealed in Table 3, which shows that there is a highly statistically significant difference between pre- and post-application of the nursing protocol. Levels of daily activities markedly improved after

Table 3. Comparison of Level of Daily Activities Between Pre and Post Applying the mHealth Nursing Care Protocol (N = 85)

Item	Pre		Post		χ^2	P
	n	%	n	%		
1. No mobilization	9	10.59	0	0.00	30.78	<.001
2. Turning in bed	0	0.00	0	0.00		
3. Sitting in bed with head elevated	0	0.00	9	10.59		
4. Sitting on the edge of the bed with feet on the floor	8	9.41	0	0.00		
5. Standing	0	0.00	0	0.00		
6. Marching in place	25	29.41	16	18.82		
7. Ambulation	43	50.59	60	70.59		

Table 4. Comparison of Symptom Improvement Between Pre and Post Applying the mHealth Nursing Care Protocol (N = 85)

Item	Pre		Post		χ^2	P
	n	%	n	%		
1. Worsen	8	9.41	0	0.00	16.14	.00106
2. No	17	20.00	9	10.59		
3. Somewhat	43	50.59	42	49.41		
4. Yes	17	20.00	34	40.00		

applying the nursing protocol in that patients had an “ambulation” level of 50.59% before applying the protocol, and after applying the protocol, this has increased to 70.59%.

Question 3: Before Appearance of Signs and Symptoms Within 14 Days, Did COVID-19-Positive Patients Come Into Contact With Another Person With Like Signs and Symptoms?

The answers for question 3 can be found in Tables 1 and 4. About half of the patients did have contact with another person with the same signs and symptoms before the appearance of symptoms by 15 days, and another half did not. This is revealed in Table 1. Patients who did not have contact with persons with respiratory tract infections within 15 days before hospital admission were represented by 50.59%, and nearly half (49.41%) of the patients were in contact with persons with respiratory tract infections within 15 days before hospital admission.

Furthermore, one of the most important findings of this study was the highly statistically significant relationship between having contacted a person with a respiratory tract infection in the last 15 days before hospital admission and improvements in symptoms. Table 4 reveals that patients who did not contact persons with a respiratory tract infection in the last 15 days before their own hospital admissions reported higher percentages of symptom improvement (29.41%) after applying the protocol than patients who did come into contact with persons with a respiratory tract infection, who reported symptom improvement by only 10.59%.

Table 5. Relationship Between Job (Employee Dealing With People) and Symptom Improvement After Applying the mHealth Nursing Care Protocol

Dealing With People Symptoms	Pre				Post			
	Yes		No		Yes		No	
	n	%	n	%	n	%	n	%
Worsen	0	0.00	8	9.41	0	0.00	0	0.00
No	8	9.41	9	10.59	0	0.00	9	10.59
Somewhat	34	40.00	9	10.59	42	49.41	0	0.00
Yes	17	20.00	0	0.00	17	20.00	17	20.00
χ^2	31.54				44.97			
P	<.001				<.001			

Question 4: Have Symptoms (Fever of 38°C, Sore Throat, Dyspnea, Dry Cough, and Productive Cough) Improved After 1 Week of Using the Mobile Health Nursing Care Protocol?

The answers for question 4 can be found in Table 5. Symptoms (fever of 38°C, sore throat, dyspnea, dry cough, and productive cough) improved after 1 week of using the mHealth nursing care protocol. Table 5 reveals that there is an increase of symptom improvement after applying the nursing protocol. There was a highly statistically significant difference between pre- and post-application of the protocol, $P = .00106$. Patients who reported improvements in their symptoms before receiving the program were 20.00%, whereas patients who reported improvements in their symptoms after receiving the program were 40.00%.

Table 6 shows that there was a strong statistically significant difference between symptom improvement and the kind of job (employees dealing with people and employees not dealing with people) held by the patients. The higher level of symptom improvement was for employees not dealing with people as opposed to employees dealing with people. Employees not dealing with people reported symptom improvement after applying the protocol, by 20.00%.

Finally, Table 7 shows the percentage of patients' PCR test that changed from positive to negative after applying the mHealth nursing protocol: it was found that only 71.76% of patients repeated the PCR test after applying the protocol. A higher percentage of patients had a PCR test that changed from positive to negative (40.00%), whereas a lower percentage had still a positive PCR test post applying the protocol (31.76%).

DISCUSSION

The fact that nurses are on the front lines of the pandemic, since the novel coronavirus has no specified treatment yet, often means that the nursing care provided to patients faces the main challenge of recovery and controlling spread of infection within the health team as well as within the community through continuous awareness with precautions.⁴

Table 6. Relationship Between Having Contact With a Person With a Respiratory Tract Infection in the Last 15 Days and Symptom Improvement After Applying the mHealth Nursing Care Protocol

Contact With a Person With a Respiratory Tract Infection in the Last 15 d Symptoms	Pre				Post			
	No		Yes		No		Yes	
	n	%	n	%	n	%	n	%
Worsen	8	9.41	0	0.00	0	0.00	0	0.00
No	17	20.00	0	0.00	9	10.59	0	0.00
Somewhat	17	20.00	26	30.59	8	9.41	34	40.00
Yes	0	0.00	17	20.00	25	29.41	9	10.59
χ^2	43.88				32.62			
P	<.001				<.001			

The present study aimed to evaluate the effects of using a technology-based (mHealth) nursing protocol on positive COVID-19 patients' dyspnea and level of activity. The goal was to provide a nursing care protocol with an emphasis on minimizing dyspnea and improving level of activity for COVID-19 patients, through keeping patients' lungs and airway clear and enhancing their breathing patterns along with strengthening their immunity.

From the results of the present study, it was found that the percentage of males and females is nearly the same; about half of the subjects were male, and the other half were female. This was in match with Global Health 50/50, which illustrated that “the fact that health is not driven just by biology, but by the social environment in which we all find ourselves and gender is a major part of that.”¹⁹ Furthermore, this finding matches with Centers of Disease Control and Prevention estimation of COVID-19 epidemiology parameters in late May 2020—that the numbers they mention of infected males and females were mostly equal, the number of females was 406 cases per 100000 persons, and the number of males was 401.1 cases per 100000 persons.²⁰

Most of the patients were middle-aged, between 30 and 49 years; a few of them were above 50 years old; and fewer of them were below 25 years old. This also matches with Centers of Disease Control and Prevention epidemiology reports, in that they mentioned the median age of COVID-infected persons was 48 years.²⁰ Approximately half of the subjects reported contact with persons with a respiratory tract infection within 15 days prior to hospital admission.

Table 7. Frequency of the Patients With a PCR Test That Changed to Negative After Applying the mHealth Nursing Care Protocol (N = 61)

PCR	n	%
Positive	27	31.76
Negative	34	40.00
NA	24	28.24

Abbreviation: NA, not applicable.

This finding is in the line with a study performed by Burrell et al,²¹ aimed to describe the extent of co-infections of SARS-CoV-2 with other respiratory viruses and found that the presence of other respiratory viruses in patients doesn't say that they don't have SARS-CoV-2 co-infection. From this finding and the present study's finding, it is concluded that persons with upper respiratory tract infection were most probably COVID-19 carriers.

Regarding the main complaint at hospital admission, results revealed that the majority of patients were complaining of fever, some of the patients complained of all symptoms, and a few of the patients complained of a dry and productive cough. These percentages match with those in a systematic review of the published articles, which was conducted between the 18th and 25th of April 2020 and which aimed to summarize clinical presentations of this newly emerging coronavirus disease. This systematic review used databases such as PubMed, Scopus, and Google Scholar. The symptom with the highest percentage was fever, followed by cough, fatigue, dyspnea, and sputum production.²²

Dyspnea levels decreased, and levels of activity markedly improved after applying the nursing protocol, which illustrates that the technology-based nursing protocol used in the present study worked as represented in measures of improving lung expansion, enhancing clear secretions, and strengthening immunity, and it helped to markedly minimize symptom duration and intensity. This also corresponds with what the European Lung Foundation has mentioned, in that symptoms will be worse in the first 3–4 days and will then improve, with most people feeling back to normal in 7–14 days, but these can take 2–3 weeks to improve for severe infections.^{23,24} Patients in the present study reported improvements after just 1 week of applying the nursing protocol.

Among the important findings of the present study is that there is a relation between having contact with a person with a respiratory tract infection in the last 15 days before hospital admission and symptom improvement. Patients who *did not* have contact with persons with a respiratory tract infection in the last 15 days before hospital admission reported a

higher percentage of symptom improvement than patients who did have contact with persons with a respiratory tract infection. This finding illustrates that infection from one person having symptoms to another may in fact somehow worsen the latter person's symptom improvement more than environmental infection.

Subjects reported improvement of symptoms 1 week after receiving the protocol with twice the number of subjects reporting improvements in symptoms than they did before receiving the protocol. Patients who had one main complaint at hospital admission reported symptom improvement with a higher percentage than patients who had more than one main complaint at hospital admission. This may indicate that the earlier patients seek medical intervention, the earlier their symptoms improve. The present study used an mHealth nursing protocol, which helped in minimizing contact and delivering the protocol to a wider range of patients at the same time. This is supported by Military Health System experts who advised people who are not emergency cases to stay home in order not to expose others to the virus. Instead, they instructed patients to contact the Military Health System Nurse Advice Line. Registered nurses will also offer advice for self-care and, if appropriate, coordinate virtual appointments with healthcare providers. Additionally, nurses may make a referral to visit a healthcare provider in person when necessary.²⁵

RECOMMENDATIONS

It is strongly recommended to generalize the mHealth nursing care protocol used in the present study to be provided by nurses for all COVID-19 patients. Also, it is recommended that further research studies be performed to explore if infection from direct contact with a person causes COVID-19 symptoms that worsen the condition or not. Moreover, greater understanding is needed to know if longer hospital stays for COVID-19 patients who do not require oxygen therapy affect their symptoms at all and, if so, how.

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