Original Article

Assessment of the efficacy of a video-based hybrid teaching module of oxygen therapy and critical care area troubleshooting in nursing professionals managing COVID-19 patients

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Abstract:

BACKGROUND: Video-based teaching has become rapidly popular during the coronavirus disease 2019 (COVID-19) pandemic. The current study aimed to assess the efficacy of a hybrid video-based teaching module of oxygen therapy and critical care troubleshooting in nursing professionals managing COVID-19 patients in our institute.

MATERIALS AND METHODS: A retrospective analytical study (pretest and posttest design) was conducted in our medical education department in March 2022 using the data from a workshop conducted on oxygen therapy and critical care area troubleshooting during COVID-19 patient management for 296 nursing professionals. A hybrid video-based teaching module was used. Pretest and posttest data were compared along with subgroup analysis. P value <0.05 was considered significant.

RESULTS: Posttest scores were significantly higher than the baseline scores in the overall group as well as in all subgroups ($P < 0.001$). Subgroup comparisons revealed no significant difference in mean baseline pretest and posttest scores in male versus female participants. Baseline pretest scores ($P = 0.02$) and posttest scores ($P = 0.08$) were lower in the nurses of the noncritical areas compared to critical area nurses. Mean improvement in posttest score compared to baseline score was similar between all groups.

CONCLUSION: Hybrid technique involving both video aspects and in-person teacher presence for demonstration or troubleshooting improves perceived knowledge in nursing professionals with some prior formal training and may be superior to the conventional only didactic/lecture-based demonstrations, especially in the context of imparting rapid training during pandemics or similar urgent situations.

Keywords:
COVID-19, nursing education, oxygen inhalation therapy, teaching methods, video-assisted techniques, video–audio demonstration

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Introduction

During the coronavirus disease 2019 (COVID-19) pandemic, institutions were suddenly burdened with the extra responsibility of rapidly training health-care workers (HCWs) and front-line workers for the management of covid patients.[1,2] Most of this training involved teaching high-risk critical procedures or skills related

to airway, ventilator management, personal protection techniques, cardiopulmonary resuscitation, and so on.[2] This urgent training helped the HCWs, especially those who did not routinely work in critical areas with sick patients, become more confident, less apprehensive, and willing to take care of covid patients.[1,2] During this period, we observed a drastic change in the medical and nursing teaching techniques and strategies, with more focus being on simulation-based hands-on training.[1-4] Other techniques included remote teaching modules like webinars, online audio/video vignettes, problem-based tutorials, and so on.[5-8]

Video-based teaching techniques have been shown to be superior to conventional didactic teaching and equally efficient compared to small group demonstration-based teaching, especially for procedural training.[9-13] Many small videos carrying certain minimal essential information were dispersed widely during the pandemic to reach a wider audience in a short period of time.[2,14] There are numerous variations of video-based teaching techniques. It could be done via both online and physical modes. It could also be done live or via pre-recorded, customized, and focused videos.[3,12,13]

Nursing professionals form an important link between the physician and the patient. This has become much more important in the covid pandemic with restricted access to the patients and more reliance on the "on-ground" HCWs.[6,10] The current study aimed to assess the efficacy of a hybrid video-based teaching module of oxygen therapy and critical care troubleshooting in nursing professionals managing COVID-19 patients in our institute. With the repeated covid waves, retraining of a large number of nurses had to be done at regular intervals. Thus, this in-person video-based module (supplemented with the guidance of a medical education nurse) was conducted with the aim to refresh the knowledge and troubleshoot problems encountered by the nurses, so as to be adequately prepared for a subsequent covid wave. To the best of our knowledge, there is no other similar study that involves training of nursing professionals in the middle of the pandemic using such a hybrid video technique, with the aim to impart rapid training to a large number of participants in a short period.

Materials and Methods

Study design and setting
A retrospective analytical study with a pretest and posttest design was conducted in the Department of Medical Education in March 2022. Data was used from a workshop on "oxygen therapy and critical care area troubleshooting during COVID-19 patient management" conducted in our institute in August 2021 [Figure 1].

Participants and sampling
The workshop was conducted over a period of 2 weeks in batches of 10–15 students at a time. Study participants included were registered nurses working in various COVID-19 patient areas, which included critical areas like intensive care units (ICUs) and noncritical areas like high dependency units (HDUs) and wards of various different specialties. Taking the first 50 participants as a pilot for sample size analysis, with a mean baseline score of 8.1 and a standard deviation (SD) of 3.4, a 25% increase in the score (effect size of 0.6) would be detected by taking a minimum sample of 42, with a two-tailed α error of 0.05 and power of 0.95. We included all the participants who appeared for this module over the course of 2 weeks (296).

Data collection tools and techniques
The teaching module was primarily based on the display of a short video (approximately 8 min long) that highlighted the most common problems encountered in the ICU with COVID-19 patients and other areas, related to monitoring, oxygen therapy, and ventilator management [Figure 2]. The problems were followed by a brief commentary and showing ways to troubleshoot the problems in the video itself. The selection of problems tackled in the video was based on the responses from an online survey conducted on the nursing personnel working in the COVID-19–related areas. The video was intended to target specific issues and was brief and concise. It was shot and edited by a resident and faculty of the Department of Anesthesiology, along with technical help from a medical education nurse [Video 1].

The purpose of this video-based teaching module was to brush up skills and knowledge of nursing personnel who had undergone some sort of prior training on airway management, oxygen therapy, and ventilator management for COVID-19 patients. Also, a large number of participants could be trained within a short period of time just before a new covid wave was expected, without too much strain on the resource faculty (especially those from various clinical departments who themselves were occupied with COVID-19 patient management at the time of training).

The session began with a pretest evaluation of the participants [Table 1]. Questions were based on the content of the video and were framed as clinical scenarios involving patients of COVID-19 of varying levels of severity and were validated by subject experts from the departments of anesthesiology and medical education (20 marks). This was followed by playing the video, which was moderated by a medical education nurse. The video could be paused or rewound to answer specific queries and clarify doubts related to the video content. A handout of related content with extra information was also given to the participants,

providing information in a concise form. A posttest was then taken for the same set of questions before the end of the teaching session.

Outcomes

Primary outcome was the comparison of pretest and posttest scores of the participants in the workshop. Secondary outcomes were comparison of test scores in various subgroups such as males, females, nurses working in critical areas, noncritical areas, and subgroup analysis comparing baseline and post-session test scores between males and females, as well as nurses in critical areas and noncritical areas.

Table 1: Questions for the pretest and posttest evaluation (Maximum marks: 20)

Question
A male client abruptly sits up in bed and reports having difficulty breathing with arterial oxygen saturation of 88%. He is already on a nasal cannula with 4 l/min of oxygen. Which mode of oxygen delivery device would be used next to improve the symptoms?
Patient X who is admitted to ICU is having moderate lung consolidation in both lungs, on NIV FiO_2 80%, PEEP 8 cm H_2O, a known case of coronary artery disease. While taking rounds on that cubicle, you see no ECG trace on the monitor. What will you do?
Mr. XXY, admitted to ICU, intubated on mechanical ventilation VCV Mode FiO_2 50%, TV 500 ml, hemodynamically stable. The morning shift nursing officer handed over the patient to you. When you entered the cubicle, you are seeing a weak SpO_2 trace and no numbers on the monitor. What will you do?
Mr. YYZZ was admitted to CCU 9 covid-positive with respiratory arrest. The patient was resuscitated and intubated by the on-duty anesthesiologist. He has set the mode and settings and given an order to connect him to the ventilator. Write the correct sequence and arrangement for ventilator circuit components (from patient end to machine end) - viral filter, closed suction catheter, ET tube, ventilator circuit limbs, $ETCO_2$
You are posted and assigned for Mr. XXY who is admitted in CCU 8, intubated on mechanical ventilator VCV Mode with an FiO2 of 50%, TV 500 ml, PEEP 8 cm H2O, RR 12/min, and I: E ratio 1:2. When attending to the patient, the ventilator starts giving a high-pressure alarm. What will you do?
What is the difference between BiPAP mask and NIV mask?
Mr. XXZZ who is admitted in HDU is a known case of COVID-19 positive bilateral lung consolidation. HR 92/min, SpO_2 88, BP 110/70 mmHg, RR 24/min. The duty doctor has advised you to put him on NIV. What are the steps you will follow for initiating and maintaining NIV?
Mr. XXZZ is just admitted and brought from the emergency. The team leader nurse asks you to receive the patient and connect the cardiac monitor. You have a 5-lead ECG cable with the monitor. What is the correct location of electrodes to connect the ECG 5-lead cable on the chest?
You are posted and assigned for Mr. ZZXY who is admitted to CCU 8. Intubated on mechanical ventilator on VCV Mode, FiO_2 50%, TV 500 ml, PEEP 8 cm H_2O, RR 12/min, I: E ratio 1:2. While giving oral care to the patient, you observed that the ET tube fixation plaster is loose and soiled. What will you do?
You are posted in ICU 5. Mr. XXZZ who is a known case of COPD, covid positive was intubated and resuscitated in the emergency is being brought to your department in the next 15 min. The team leader asks you to prepare a mechanical ventilator for that patient. What will you do?

Data analysis plan

The data of scores obtained from the Department of Medical Education was first entered in MS Excel spreadsheet, and statistical analysis was done using GraphPad InStat version 3.05. The data were analyzed by using descriptive (demographic/area of work) and inferential (improvement in test scores) statistics. Categorical variables were presented as numbers and percentages (%). Test scores were presented as median (interquartile range). Test scores were compared using Wilcoxon matched-pairs test. Subgroup comparisons of test scores were done using the unpaired *t*-test or Mann–Whitney U test based on the normality of data. *P* value less than 0.05 was considered significant [Figure 1].

Ethical considerations

Permission to use the test data was acquired, and approval was obtained from the institutional ethical and review board (AIIMS/IEC/22/102). There were no major ethical issues as no patients were involved.

Results

Gender distribution showed that there were 165 (55.8%) male and 131 (44.2%) female participants. The distribution of nurses showed that in critical care areas, there were 138 (46.6%) nurses and in noncritical areas, there were 158 (53.4%) nurses.
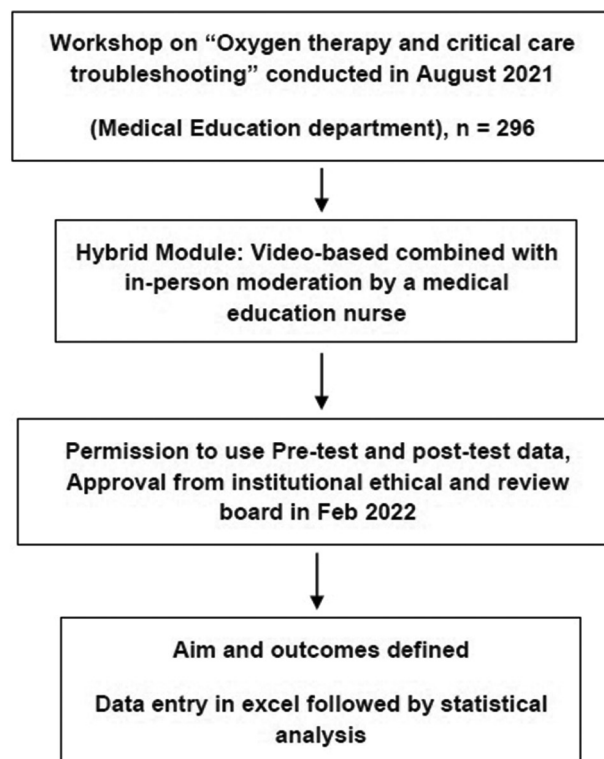

Figure 1: Flow diagram of the study

Posttest scores were significantly higher than the baseline scores in the overall group (296) as well as in all subgroups ($P < 0.001$) [Table 2]. Subgroup comparisons revealed no significant difference in the mean baseline pretest and posttest scores in males versus female participants [Table 3]. Baseline pretest scores ($P = 0.02$) and posttest scores ($P = 0.08$) were lower in the nurses of the noncritical areas compared to critical area nurses [Table 3]. Mean improvement in posttest score compared to baseline was similar between all groups [Table 3].

Discussion

The technique of audio–visual-based teaching finds its roots in the dual coding theory, which was initially described by Paivio and states that learning via two processing mechanisms of verbal (language) and nonverbal (imagery/audio) will reinforce memory and knowledge much better compared to only verbal teaching.[15,16] Video-based teaching techniques have gained rapid popularity among students and teachers both, especially since the outbreak of the COVID-19 pandemic, which has forced them to adapt and evolve to more convenient and, sometimes, remote teaching situations.[5,8,17] Most of the teaching at the peak of the pandemic was happening via online modes like webinars and teaching videos demonstrating procedural skills,[6,14,17] although initial parts of the preparation stage saw a lot of simulation-based teaching modules.[6,18]

Although conventional didactic teaching has mostly lost favor in the teaching and learning community, small group demonstrative teaching still finds use,

Table 2: Comparison of pretest versus posttest scores in the participants of the workshop

Groups	Pretest	Posttest	P*
Overall	8 (5-10)	15 (13-17)	P<0.001
Males	8 (6-10)	15 (13-17)	P<0.001
Females	8 (5-10)	15 (13-18)	P<0.001
Critical area	8 (6-11)	15 (13-17)	P<0.001
Noncritical	7 (5-10)	14 (12-17)	P<0.001

Expressed as median (Q1-3), *Wilcoxon matched pairs test

Table 3: Comparisons of test scores between subgroups in the participants of the workshop

Groups	Males	Females	P
Pretest score	8 (6-10)	8 (5-10)	0.8262*
Posttest score	15 (13-17)	15 (13-18)	0.4832#
Improvement in score	6 (5-9)	7 (4-10)	0.4590*
	Critical areas	Noncritical areas	P
Pretest score	8 (6-11)	7 (5-10)	0.02*
Posttest score	15 (13-17)	14 (12-17)	0.08#
Improvement in score	7 (5-9)	7 (4-9)	0.7956*

Expressed as median (Q1-3). *Unpaired *t*-test (Welch correction).
#Mann-Whitney U test

especially in specialties where procedural skill training is predominant, like nursing, dentistry, and so on.[6,11,12,19] Its advantage is that it allows student–teacher interaction and also supervised practice for the student.[19] Numerous drawbacks in this mode of teaching include inequitable dispersion of information to all students based on how they are visualizing or perceiving, variation in the demonstration or teaching techniques between different instructors, and lastly, dependence on the time allotted and the number of students in the group.[19] This point became more relevant during the pandemic, where social distancing further hampered this technique.[8] Kozlowski *et al.*,[6] in a single group study similar to the current study, evaluated the role of video-based teaching of rapid sequence induction to nurse anesthetist trainees and found significant increase in perceived knowledge. Similar findings were observed in the current study as well. Sugathapala *et al.*[11] in their study found no significant difference in the scores in video- versus lecture-based demonstration, but students preferred the video-based teaching during feedback. David *et al.*, in their study comparing lecture cum demonstration versus video demonstration, found similar knowledge scores but slightly higher skill scores in lecture cum demonstration, reiterating the role of such demonstrations in skill acquisition compared to only video.[9]

Thus, through the current study, we intended to highlight the fact that hybrid techniques incorporating both video-based and in-person/demo-based aspects would be the ideal teaching tool. Iqbal *et al.*,[19] in a study comparing traditional techniques with blended (e-learning–assisted traditional techniques), demonstrated an enhanced learning and skill competency level in the blended technique compared to only traditional teaching. A similar conclusion in favor of blended or hybrid technique was given by Devi *et al.*[10] in a study on nursing students learning obstetric palpation. Komasawa *et al.*,[20] in a study on medical students learning emergency airway management using a hybrid video plus mannequin technique, found increased subjective confidence relating to knowledge and skill in the students. Using such techniques will allow the student to experience the in-person interaction and demonstration initially and revise the information at his own convenience later using the video tools. This was also concluded by Farhat *et al.*,[21] who described a hybrid approach of flipped laboratory sessions using video vignettes and active learning. This strategy substantiated student learning, helped clarify students' misconceptions on the spot, and allowed multiple revisions of the methodology.

In the current study/workshop, we have used a hybrid mode incorporating a focused troubleshooting video, which is being moderated by a medical education nurse.

Figure 2: Still images of the troubleshooting video

This allowed the participants to stop and ask queries during the video. The shorter duration sessions with small batches could be repeated frequently to cover a large portion of the nursing manpower within a short period of time. Thus, this kind of hybrid technique might be more useful in refreshing knowledge of those students with some previous formal training on the subject, as in the current study where a rapid training schedule was required before an upcoming covid wave.

A major limitation of the current study was that being a retrospective study, we have analyzed the effect of the intervention (video module) only in one group with no comparator. Also, the purpose of the workshop module being analyzed in the current study was very specific for the nursing professionals working in covid areas. Future prospective studies can include comparisons and trials with conventional and other standard teaching techniques and can explore more generalized applications across specialties.

Conclusion

Video-based teaching techniques have become more established tools for knowledge and skill enhancement, especially during the COVID-19 pandemic. A hybrid technique involving both video aspects and in-person teacher presence for demonstration or troubleshooting improves perceived knowledge in nursing professionals with some prior formal training and may be superior to the conventional only didactic/lecture-based demonstrations, especially in the context of imparting rapid training during such pandemics or similar urgent situations.

Conflicts of interest
There are no conflicts of interest.

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