The efficacy of intensive therapy and anaesthesiology virtual distance learning among fifth-year medical students during the COVID-19 pandemic: a cross-sectional study

Enikő Kovács (kovacs.eniko2@med.semmelweis-univ.hu)
Department of Anaesthesiology and Intensive Therapy https://orcid.org/0000-0003-2012-1136
András Kállai
Department of Anaesthesiology and Intensive Therapy
Gábor Fritúz
Department of Anaesthesiology and Intensive Therapy
Zsolt Iványi
Department of Anaesthesiology and Intensive Therapy
Vivien Mikó
Department of Anaesthesiology and Intensive Therapy
Luca Valkó
Department of Anaesthesiology and Intensive Therapy
Balázs Hauser
Department of Anaesthesiology and Intensive Therapy
János Gál
Department of Anaesthesiology and Intensive Therapy

Research Article

Keywords: COVID-19, virtual learning, medical education, intensive therapy, anaesthesiology

Posted Date: September 21st, 2020

DOI: https://doi.org/10.21203/rs.3.rs-80744/v1

Abstract

Background: The coronavirus disease (COVID-19) brought several challenges in medical education. The aim of our study was to investigate whether virtual trainings (VT) organized during the COVID-19 pandemic at our university were effective in replacing in-person bed-side education in intensive therapy and anaesthesiology among fifth-year medical students, both from students' and instructors' perspectives.

Methods: This was a cross-sectional study consisting of three parts: a 20-item students' questionnaire filled out by students participating in VT, a 22-item instructors' questionnaire filled out by instructors taking part in virtual education and a 20-item knowledge test completed by students participating in VT, as well as by students visiting bed-side trainings (BT) during the same semester, before COVID-19 pandemic. The questionnaires focused on effectiveness, content, self-preparedness, technical background and interactivity of VT. Instructors' and students' responses given to the common questions, as well as the knowledge test results were compared. Mann-Whitney U test was used for group comparisons and binary logistic regression was performed to analyse the influence of previous health-care experience on students' feeling of self-preparedness.

Results: 113 students (68% response rate) and 29 instructors (97% response rate) filled out the questionnaires. The majority of students found our VT useful and effective; however, a considerable number of participants felt disadvantaged by taking a virtual course instead of bed-side learning sessions and would recommend to keep virtual distance learning methods combined with BT. Instructors found VT overall effective and deemed the transfer of their knowledge satisfactory; however, they described worse interactivity and contact with students during virtual sessions compared to in-person teaching. Instructors showed a clearer consensus that VT should not replace BT in the future, while students' answers were more divided in this regard. Previous health-care experience did not influence students' feeling of self-preparedness.

One hundred and twenty-seven students (56 after VT and 71 after BT) completed the end-of-semester knowledge test. Students participating in VT performed better than students visiting BT (median score VT:83.5 vs BT:77.3; p=0.015).

Conclusions: The new curriculum incorporating virtual practice sessions was effective in maintaining continuous education of intensive therapy and anaesthesiology among fifth-year medical students during the COVID-19 outbreak.

Background

The COVID-19 (coronavirus disease 2019) pandemic brought several challenges not only for health care, but for economics, education and everyday life in general. Several countries, including Hungary, chose to introduce drastic measures to slow down the spread of the virus and to "flatten the curve" based on the recommendations of the World Health Organization (WHO).[1] One of these actions was the temporary closure of universities with the option of either creating a rapidly developed online curriculum or postponing in-person education until the improvement of the epidemic situation.[2]

Intensive therapy and anaesthesiology education faces several difficulties during the COVID-19 outbreak. Countries affected by a large number of COVID-19 cases suffer from lack of human resources in the intensive care units (ICU), diminishing teaching capacity. In addition, this is a field requiring not only theoretical knowledge, but clinical skills and hands-on experience as well, hence the transition of the curriculum to a fully e-learning platform is quite difficult even at the undergraduate level. [3,4]

Hungary declared a state emergency due to the COVID-19 pandemic on March 11, 2020. The national regulations restricted all levels of in-person education at Hungarian universities from March 11 to May 25, 2020. In an effort to manage this unexpected emergency situation and continue the intensive therapy and anaesthesiology education among fifth-year medical students, we modified our curriculum and introduced online virtual practices instead of bed-side tutorials. However, the efficacy of this rapidly developed course was uncertain.

The aim of our study was to investigate whether virtual trainings as a part of our intensive therapy and anaesthesiology distance learning curriculum were able to replace in-person bed-side education methods among fifth-year medical students during the COVID-19 pandemic. Additionally, we also analyzed if virtual sessions could be incorporated into our curriculum in the future based on our students' and instructors' impressions and opinions.

Methods

Study design and participants

We performed a cross-sectional study (STROBE checklist - Additional file 1) to evaluate the effectiveness of virtual practical sessions in the compulsory Intensive therapy and anaesthesiology (ITA) course among fifth-year medical students both in the Hungarian and German program at Semmelweis University Budapest, Hungary. The study consisted of three parts. An anonymous and voluntary internet-based survey was conducted among our students participating in virtual practices and distance education during the COVID-19 outbreak. Moreover, instructors in charge of virtual sessions during the COVID-19 pandemic were also interviewed through an online questionnaire. Additionally, a multiple-choice knowledge test was filled out on a voluntary basis by students who took part in the virtual practices and also by students, who completed the corresponding practical sessions in the same semester during our traditional bed-side education prior to the restrictions implemented because of the COVID-19 pandemic. The test results of the two student groups were compared.

The Intensive therapy and anaesthesiology (ITA) course

The traditional ITA compulsory course contained five 90-minute long thematic bed-side practice sessions and four 90-minute long simulation sessions (Additional file 2 - Table 1) within a one-week block schedule for each group, supplemented with fourteen 70-minute long lecture sessions held weekly during the spring semester of the 2019/2020 academic year.

The student to instructor ratio was 7:1 or less both during bed-side practices and simulation trainings.

The final exam was administered as an oral exam during the examination period between May 18 and July 3, 2020.

Distance learning during the COVID-19 outbreak

Distance learning and virtual sessions were introduced as a necessity into our curriculum in the middle of the spring semester of the 2019/2020 academic year. Lectures and four of our thematic bed-side practices (introduction, respiratory, shock and anaesthesia trainings) were adapted to virtual sessions. The trauma session was cancelled due to its specific patient population and lack of human resources during the pandemic. Simulation trainings and one bed-side tutorial in the ICU were postponed and then held after the withdrawal of restrictions at the end of the semester, in the same manner as before the restrictions.

Virtual lectures took place through Zoom® (San Jose, California, USA) platform in the same time points, utilizing the same structure as previous face-to-face lectures.

The four virtual thematic practices were conducted at specific time points for a given group through the internet using Zoom® platform. A maximum of 21 students took part in one virtual 90-minute long practice session. A brief PowerPoint® (Microsoft, Redmond, USA) presentation summarizing the principles of the trainings` topic, videos and images showing patients and patient management composed the main framework of a virtual practice with the opportunity of further discussion with students. The same topics were covered as during traditional bed-side trainings. Student engagement was enhanced by using the Poll Everywhere® (San Francisco, USA) application. Moreover, online articles and videos were uploaded to Moodle® (Perth, Australia) learning management system to support learning and understanding of a given topic.

Final exams were conducted in the same manner for students who completed the traditional and distance learning courses.

Students' and instructors' questionnaire

We developed a 20-item questionnaire with 14 Likert-scale questions (graded from 1 to 5), two open-ended questions and four multiple choice questions (Additional file 2 - Table 2) regarding the four virtual thematic practices for our students. The Likert-scale questions and open-ended questions covered the quality of the four virtual trainings, students $self - rep$ or $toftheirpreparede \neq ss \rightarrow recognizecriticallyillpatients$ or $be \in gab \leq \ \rightarrow mana \geq perioperativesituationsaftercomp \leq t \in gth$ opinion about changing bed-side learning to virtual education in the future. Multiple choice questions asked about the students` demographics (age; gender; previous experience in health system).

The instructors received a 22-item questionnaire regarding virtual sessions and distance learning, listed in Additional file 2 - Table 3. 14 Likert-scale questions (graded from 1 to 5) and two open-ended questions covered the quality, strengths and weaknesses of virtual sessions, as well as instructors' opinion about introducing virtual education into our curriculum in the future. Six multiple choice questions asked about demographics (age; gender; experience in education; experience in e-learning as educators; language program; job description).

The questionnaires went through an internal and external validation process based on the recommendations by the Association for Medical Education.[5] Validation steps and timing of the questionnaires are specified in Additional file 2 - Table 4.

Knowledge test

A 20-item internet-based multiple-choice test was developed to assess students' knowledge about the topics covered by the four thematic practices (introduction, respiratory, shock and anaesthesia sessions). The questions were reviewed by three experts and educators in the field of anaesthesiology and intensive therapy. Each question consisted of five possible answers and maximum 100 points could be reached. Time for the knowledge test was maximized in 30 minutes. Both students participating in the traditional learning and students taking part in virtual distance learning received the test at the end of the semester, before the oral exams. Taking the test was voluntary and the results did not influence final grades. As the results of final, oral exams depend on multiple subjective factors, they were not incorporated into the study.

Statistical analysis

The results of the questionnaires were analysed using descriptive statistics. We determined the medians and interquartile ranges of the grades at each Likert-scale question, which were graded from 1 to 5. Additionally, continuous variables (age; knowledge test scores; time to complete knowledge test) were described as medians and interquartile ranges (IQR). Categorical variables (gender; language program; students' previous job experience in health care; students' previous work with critically ill patients; instructors' experience in education and e-learning; instructors' job description) were described as numbers and percentages.

The open-ended responses went through a content-analysis and were summarized into categories.

Less than 5% of data were missing; the missing data were excluded from the analysis.

Mann-Whitney U test was applied to compare the answers to four Likert-scale questions between students and instructors regarding the effectiveness and future application of virtual trainings.

In addition, Mann-Whitney U test was used to compare the knowledge test results of students who participated in the traditional bed-side practices and the ones who underwent virtual practice sessions.

Moreover, a binary logistic regression analysis was performed to determine if previous job experience with critically ill patients has an influence on students' self-reported preparedness after completing the course (Additional file 3 - Table 1).

The level of significance was set at $p<0.05$.

Statistical analysis was performed using SPSS v25.0 (SPSS Inc., Chicago, IL). Figures were created by GraphPad Prism version 8.3.0. (GraphPad Software, La Jolla, CA).

Results

Table 1 shows the number of students participating in our compulsory ITA course in the spring semester of the 2019/2020 academic year, the number of students and instructors taking part in distance learning and the response rate of the corresponding questionnaires.

Table 1. Number of students and instructors participating in the ITA course in the spring semester of the 2019/2020 academic year

	Total	**Virtual training**	**Bed-side training**
	N (%)	N (%)	N (%)
Students, spring semester 2019/2020	272 (100%)	166 (100%)	106 (100%)
Hungarian program	161 (59%)	108 (65%)	53 (50%)
German program	111 (41%)	58 (35%)	53 (50%)
Questionnaire response rate		**113 (68%)**	
Instructors, spring semester 2019/2020*	43 (100%)	30 (100%)	20 (100%)
Hungarian program	31 (72%)	23 (77%)	20 (100%)
German program	29 (67%)	15 (50%)	12 (60%)
Questionnaire response rate		**29 (97%)**	

N: number of students; questionnaire response rate is in bold;

*: The majority of instructors participated both in virtual and traditional courses, as well as in the Hungarian and German program

Demographic data of responders are presented in Table 2 and Table 3.

Table 2. Demographic data of students completing the questionnaire

Students	Median (IQ range)
	or
	N (%)
Total	113 (100%)
Age	24 (23,25)
Gender	
Female	78 (69%)
Male	35 (31%)
Previous job experience (ICU, ED or EMS)	
Yes	10 (9%)
Limited	16 (14%)
No	87 (77%)
Previous job experience with patient contact	
Yes	18 (16%)
Limited	33 (29%)
No	62 (65%)
Language program	
Hungarian	74 (66%)
German	39 (34%)

IQ: interquartile range; N: number of students; ICU: intensive care unit; ED: emergency department; EMS: Emergency Medical System

Table 3. Demographic data of instructors completing the questionnaire

Instructors	Median (IQ range)
	or
	N (%)
Total	29 (100%)
Age	35 (30,45)
Gender	
Female	17 (59%)
Male	12 (41%)
Educator experience	
0-5 years	5 (17%)
5-10 years	11 (38%)
>10 years	13 (45%)
Experience in E-learning as educator	
Yes - regular	2 (7%)
Yes - rare	12 (41%)
No	15 (52%)
Language program	
Hungarian	14 (48%)
German	6 (21%)
Both	9 (31%)
Job description	
Resident	8 (28%)
Consultant	13 (45%)
Academic position	8 (28%)

IQ: interquartile range; N: number of students

Students' Questionnaire

As can be seen in Fig. 1A and Fig. 1B, the students found our virtual thematic practices useful and effective with an acceptable structural and technical quality. However, the majority of participants felt disadvantaged by taking the virtual course as opposed to the traditional bed-side learning and would not recommend to replace bed-side in-person education with virtual trainings in the future. Nonetheless, they suggested to keep virtual distance learning methods in combination with bed-side practical sessions.

Most of the responders reported a positive feeling of self-preparedness in recognizing respiratory failure, shock and in being able to manage perioperative situations after completing the virtual course. Previous experience with critically ill patients did not influence the students' feeling of self-preparedness (Additional file 3 - Fig. 1).

The open-ended questions were answered only by a small group of responders (67 {40%} and 54 {32%} answers, for the two questions respectively). However, satisfactory content, structure and interactivity were achieved during the virtual trainings based on the answers (Fig. 2A and 2B).

Instructors' Questionnaire

The medians and IQR of instructors' answers to Likert-scale questions are shown in Fig. 3A and 3B. As per the responses, the instructors received sufficient information and technical support to teach online. They found virtual trainings overall effective and reported a satisfactory transfer of their knowledge. However, they described worse interactivity and engagement with students during virtual sessions compared to in-person teaching.

The instructors' answers of open-ended questions are shown in Figure 4A and 4B.

As can be seen in Fig. 5A, instructors were significantly more likely to conclude that students were disadvantaged due to virtual course distant learning compared to traditional bed-side learning, than students (instructors' median answer [MA] {IQR}: 4 {4,5}; students' MA {IQR}: 3 {3,4}; p=0.012). However, as Fig. 5B shows, both groups found the virtual course effective to the same extent (instructors' MA {IQR}: 4 {2,4}; students' MA {IQR}: 4 {3,5}; p=0.062). Additionally, instructors showed a clear consensus that virtual trainings should not replace in-person education in the future, while students' answers were more divided in this regard (Fig. 5C and 5D). Instructors were significantly more likely to conclude that virtual practices did not replace bed-side sessions (instructors' MA {IQR}:

1 {1,1}; students' MA {IQR}: 2 {1,3}; p<0.001), as well as virtual practices are useful in a combination with bed-side tutorials (instructors' MA {IQR}: 5 {5,5}; students' MA {IQR}: 5 {3.5,5}; p=0.036).

Knowledge test

The demographic data of students participating in knowledge test and their test results are shown in Table 4. Students completing the virtual course scored significantly higher during the test than students taking part in in-person bed-side practices (virtual training median score {IQR}: 83.5 {74.2, 88.7}; bed-side training median score {IQR}: 77.3 {69.4, 83.6}; p=0.015).

Table 4. Demographic data and test results of students participating in knowledge test.

	Total	**Virtual training**	**Bed-side training**	**p**
	Median (IQ range) or N (%)	Median (IQ range) or N (%)	Median (IQ range) or N (%)	
Total	127 (100%)	56 (100%)	71 (100%)	
Gender				0.400
Female	80 (63%)	33 (59%)	47 (66%)	
Male	47 (37%)	23 (41%)	24 (34%)	
Language program				0.339
Hungarian	78 (61%)	37 (66%)	41 (58%)	
German	49 (39%)	19 (34%)	30 (42%)	
Test score	80 (71.3, 85.8)	83.5 (74.2 ,88.7)	77.3 (69.4, 83.6)	**0.015**
Test duration (min)	13.5 (10, 17)	13 (10, 17)	14.5 (10, 17)	0.292

IQ: interquartile range; N: number of students; min: minutes; significant p value is bold

Discussion

The objective of our study was to examine the effectiveness of distance learning and virtual trainings held instead of in-person bed-side ITA practices for fifth-year medical students at our university during the COVID-19 pandemic. Furthermore, we explored the students' and instructors' opinions about introducing at least some elements of virtual education into our curriculum in the future.

This study is unique. Firstly, as it describes our method introduced urgently in order to provide continuous education and, secondly, as it assesses our efforts to replace bed-side teaching with virtual trainings in the field of intensive therapy and anaesthesiology both from the students' and instructors' point of view.

The restrictions implemented to control the COVID-19 outbreak resulted in several challenges in education and particularly in health-care education.[6] A number of countries simply suspended education at their universities, others redeveloped their curriculum to continue education on online platforms, or allowed face-to-face teaching with some special measures.[7-11] Furthermore, a significant impact of the COVID-19 pandemic was shown in regards to medical student education, particularly in the transition from student to doctor.[12]

In-person education was suspended from the middle of March 2020 until the end of May 2020 in Hungary, with the option of virtual education or postponing courses. Our institute chose to develop a hybrid curriculum with virtual trainings and lectures during the restrictions combined with in-person simulation sessions and one visit at the ICU delayed until restrictions were lifted. Intensive therapy and anaesthesiology is a medical field requiring a complex curriculum even in undergraduate education covering cognitive and technical skills, as well as teaching valuable communication skills and overall attitude in a specialized environment.[13] Conveying these skills using only virtual education is challenging; however, previous data has shown that teaching clinical skills through online education is as effective as traditional in-person learning[14], although experiencing the atmosphere of an intensive care unit is also crucial in the education of medical students.[15]

Students participating in in-person practices met critically ill patients with the previously mentioned conditions (Additional file 2 - Table 1). The biggest challenge during the creation of our new virtual curriculum was to maintain "hands-on patient experience" and the practical aspect of our previous bed-side sessions. To enhance the efficacy and pragmatism of virtual trainings, case reports and discussions with videos and/or photos were used. The benefit of videoconferencing and e-learning systems in medical education has previously been shown, with the opportunity of not only delivering lectures or tutorials, but to present invasive procedures as well.[16,17] In addition, an online focus group qualitative study found a good acceptance rate of synchronized online learning by students during the COVID-19 pandemic.[18]

Both students and instructors found our virtual course effective and acceptable in replacing in-person learning and bed-side sessions to keep education continuous during the COVID-19 pandemic. However, neither group of participants supported the withdrawal of bed-side practices in intensive therapy and anaesthesiology in the future showing the demand for hands-on patient contact and the in-person experience of the ICU atmosphere. Both students and instructors reported that students not participating bed-side practices during the COVID-19 outbreak were disadvantaged compared to students taking part in bed-side teaching; however, this view was significantly more pronounced for that of the instructors'. Moreover, instructors were significantly more likely to conclude that students were disadvantaged due to virtual course distant learning compared to traditional bed-side learning than students. The possible cause of these differences is multifactorial. On the one hand, fifth-year medical students were younger than instructors in our study, representing a generation who is more familiar with online platforms and more experienced in using communication technologies offered by computers and the internet. On the other hand, instructors' previous experience with in-person and hands-on education situations might have emphasized the lack of metacommunication and proper interactivity between students and instructors during virtual education, which are important elements of successful teaching.[19] We need to highlight that instructors had no complaints about technical problems during virtual sessions and they were overall satisfied with this type of education.

Students reported a satisfactory feeling of preparedness in recognizing respiratory failure or shock and managing patients in a perioperative setting after completing the virtual tutorials. Nonetheless, we need to express that these reports are subjective and do not contain objective measurements of the real preparedness of students.

Furthermore, as an interesting finding, students participating in virtual practices instead of in-person bed-side sessions performed significantly better at the end-of-semester multiple choice test than students taking part in bed-side teaching. This result supports the fact that our virtual distance education was successful in replacing in-person education during the COVID-19 outbreak; however, multiple choice tests measure theoretical knowledge instead of practical skills and attitude, which might have been transferred less efficiently. Answers given to open-ended questions by our students indicate that the quality of teaching remained acceptable with adequate structures and methods during trainings. In our experience, virtual trainings permitted a more structured, uniform way of teaching, potentially leading to a more precise transmission of knowledge.

Limitations

Our study has some limitations which need to be considered. First of all, our study is monocentric and only students and instructors of our institution are represented. The number of participants is small; however, questionnaire response rates were acceptable.

The response rate of knowledge test at the end of the semester was low (53%) as filling out the test was voluntary. In addition, the multiple-choice test measures theoretical knowledge and does not give enough information about practical skills and attitudes acquired during the practices. We also need to highlight that more time elapsed between the traditional practice sessions and knowledge test than between virtual practices and knowledge test.

Despite these limitations our investigation gives new information about the implementation of a novel curriculum to keep undergraduate intensive therapy and anaesthesiology education continuous during a pandemic.

Conclusion

Our cross-sectional study demonstrates that the new curriculum including virtual practice sessions is effective in maintaining education of intensive therapy and anaesthesiology continuous among fifth-year medical students during the COVID-19 outbreak. Students and instructors participating in our rapidly introduced virtual sessions during the restrictions due to COVID-19 outbreak found the new method acceptable. However, bed-side sessions, personal communication, interactivity and experiencing ICU atmosphere play a crucial role in teaching intensive therapy and anaesthesiology, and should still be included in the undergraduate educational program.

Declarations

Ethics approval and consent to participate

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analysed during the current study are available in the Synapse repository, https://www.synapse.org/#!Synapse:syn22496218/files/.

Competing interests

The authors declare that they have no competing interests.

Funding

No external funding was applied to this study.

Authors' contributions

EK contributed to study design, acquisition, analysis, and interpretation of data and she wrote the paper. AK and GF were involved in the study design, data analysis, data interpretation, and revised the draft. VM and LV made substantial contributions to the interpretation of data and contributed to a substantial revision of the manuscript. ZsI contributed to study design, and acquisition and interpretation of data and was involved in drafting the manuscript. BH was involved in study design, acquisition, analysis and interpretation of data and drafted the manuscript. JG was involved in study design and data interpretation, revised the draft and added new insights to the topic. All authors read and approved the final manuscript and agreed to be personally accountable for the work.

Abbreviations

COVID-19: coronavirus disease 2019

ICU: intensive care unit

ITA: intensive therapy and anaesthesiology

IQR: interquartile range

References

1. World Health Organization: Country and Technical Guidance - Coronavirus disease (COVID-19). https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance.
2. Arandjelovic A, Arandjelovic K, Dwyer K, Shaw C. COVID-19: Considerations for medical education during a pandemic. MedEdPublish. 2020; doi:10.15694/mep.2020.000087.1
3. Nicholls D, Sweet L, Muller A, Hyett J. Teaching psychomotor skills in the twenty-first century: Revisiting and reviewing instructional approaches through the lens of contemporary literature. Med. Teach. 2016;38:1056-1063. doi: 10.3109/0142159X.2016.1150984.
4. Gooding HC, Mann K, Armstrong E. Twelve tips for applying the science of learning to health professions education. Med Teach. 2016;39:26-31. doi: 10.1080/0142159X.2016.1231913.
5. Artino RA, La Rochelle JS, Dezee KJ, Gehlbach H. Developing questionnaires for educational research: AMEE Guide No. 87. Med Teach. 2014;36(6):463-474. doi: 10.3109/0142159X.2014.889814
6. Rabe A, Sy M, Cheung W, Lucero-Prisno D. COVID-19 and health professions education: a 360° view of the impact of a global health emergency. MedEdPublish. 2020; doi: 10.15694/mep.2020.000148.1.
7. Crawford J, Butler-Henderson K, Rudolph J, Malkawi B, Glowatz M, Burton R, et al. COVID-19: 20 countries' higher education intra-period digital pedagogy responses'. JALT. 2020; doi: 10.37074/jalt.2020.3.1.7.
8. Alvin MD, George E, Deng F, Warhadpande S, Lee SI. The impact of COVID-19 on radiology trainees. Radiology. 2020;296:246-248. doi: 10.1148/radiol.2020201222.
9. Kim CS, Lynch JB, Cohen S, Neme S, Staiger TO, Evans L, et al. One academic health systems' early (and ongoing) experience responding to COVID-19: recommendations from the initial epicenter of the pandemic in the United States. Acad Med. 2020;95:1146-1148. doi: 10.1097/ACM.0000000000003410.
10. Koumpouras F, Helfgott S. Stand together and deliver: challanges and opportunities for rheumatology education during the COVID-19 pandemic. Arthritis Rheumatol. 2020;72:1064-1066. doi: 10.1002/art.41278.
11. Liang ZC, Ooi SBS, Wang W. Pandemics and their impact on medical training: lessons from Singapore. Acad Med. 2020; doi: 10.1097/ACM.0000000000003441.
12. Choi B, Jegatheeswaran L, Minocha A, Alhilani M, Nakhoul M, Mutengesa E. The impact of the COVID-19 pandemic on final year medical students in the United Kingdom: a national survey. BMC Med Educ. 2020;20:206. doi: 10.1186/s12909-020-02117-1.
13. Rohan D, Ahern S, Walsh K. Defining an anaesthetic curriculum for medical undergraduates. A Delphi study. Med Teach. 2009;31:e1-5. doi: 10.1080/01421590802334291.
14. McCutcheon K, Lohan M, Traynor M, Martin D. A systemic review evaluating the impact of online or blended learning vs. face-to-face learning of clinical skills in undergraduate nurse education. J Adv Nurs. 2015;71:255-70. doi: 10.111/jan.12509.
15. Santhosh L, Brown W, Ferreira J, Niroula A, Carlos GW. Practical tips for ICU bedside teaching. Chest. 2018;154:760-765. doi: 10.1016/j.chest.2018.06.034.
16. Kim S. The future of E-Learning in medical education: current trend and future opportunity. J Educ Eval Health Prof. 2006;3:3. doi: 10.3352/jeehp.2006.3.3.
17. Lamba P. Teleconferencing in medical education: a useful tool. Australas Med J. 2011;4:442-7. doi: 10.4066/AMJ.2011.823.
18. Khalil R, Mansour AE, Fadda WA, Almisnid k, Aldamegh M, Al-Nafeesah A, et al. The sudden transition to synchronized online learning during the COVID-19 pandemic in Saudi Arabia: a qualitative study exploring medical students' perspectives. BMC Med Educ. 2020;20:285. doi: 10.1186/s12909-020-02208-z.
19. Faghihi SA, Khankeh HR, Hosseini SJ, Arabshahi SKS, Faghih Z, Parikh SV, et al. Improving continuing medical education by enhancing interactivity: lessons from Iran. J Adv Med Educ Prof. 2016;4:54-63.

Figures

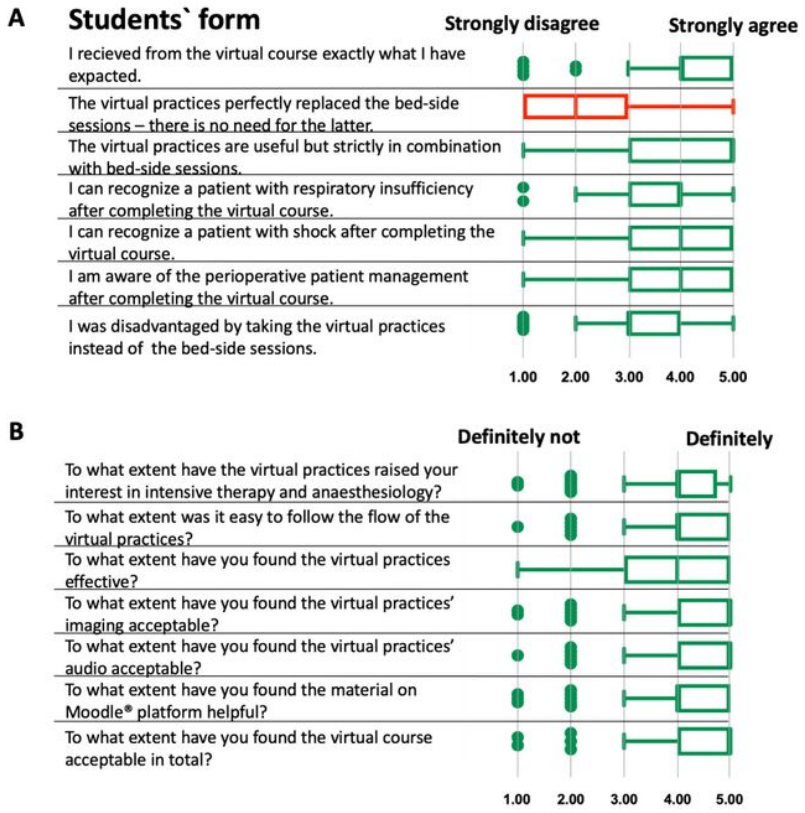

Figure 1

Average grades of answers given by student responders to Likert-scale questions. Box-and-whiskers plots are interpreted with Tukey method. A: 1.00: stronlgy disagree; 2.00: disagree; 3.00: undecided; 4.00: agree; 5.00: strongly agree. B: 1.00: definitely not; 2.00: probably not; 3.00: possibly; 4.00: probably; 5.00: definitely.

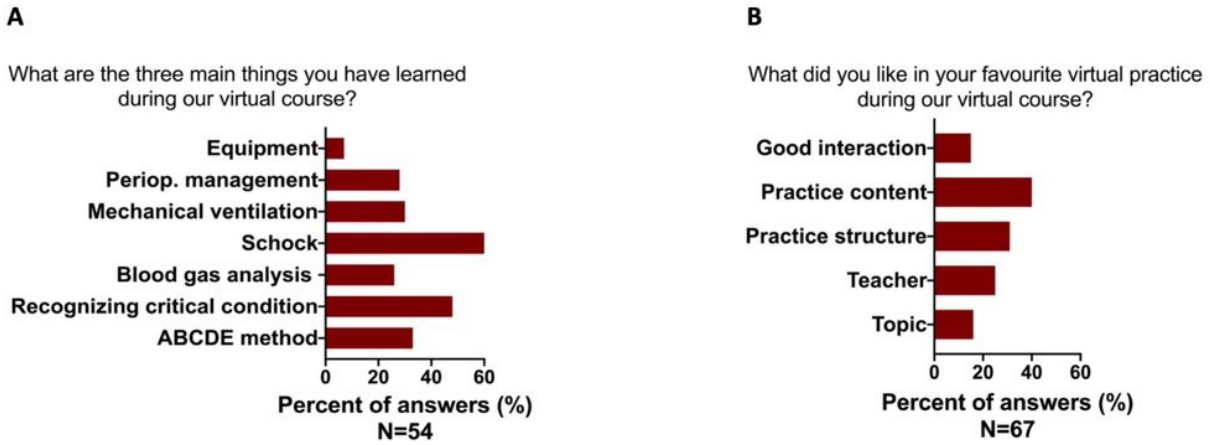

Figure 2

Students' answers given to open-ended questions. A: ”What are the three main things you have learned during our virtual course?” was answered by 54 students. B: ”What did you like in your favourite practice during our virtual course” was answered by 67 students.

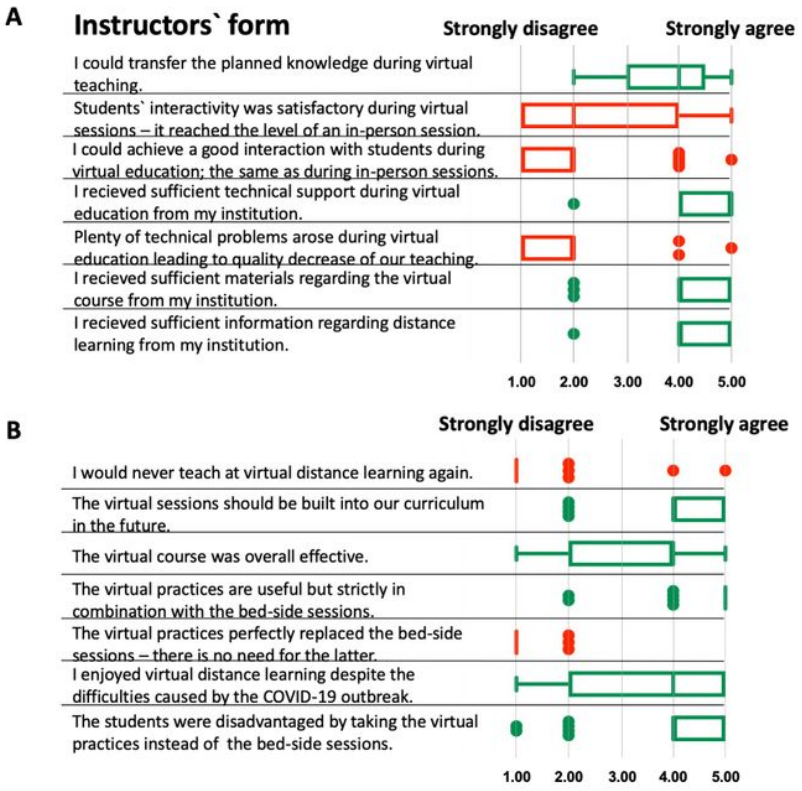

Figure 3

Average grades of answers given by instructor responders to Likert-scale questions. Box-and-whiskers plots are interpreted with Tukey method. 1.00: strongly disagree; 2.00: disagree; 3.00: undecided; 4.00: agree; 5.00: strongly agree.

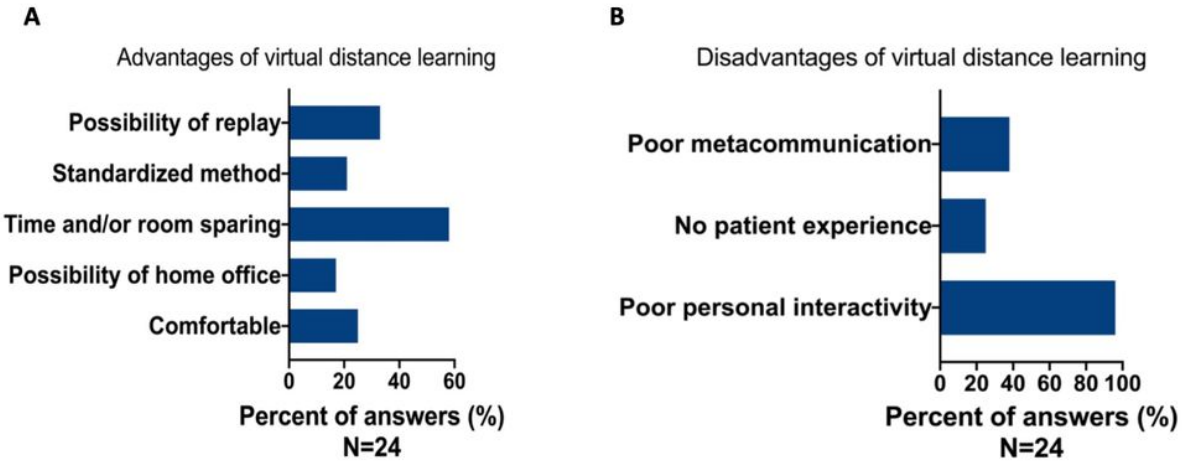

Figure 4

Instructors' answers given to open-ended questions. 24 educators (80% response rate) answered this part of questionnaire.

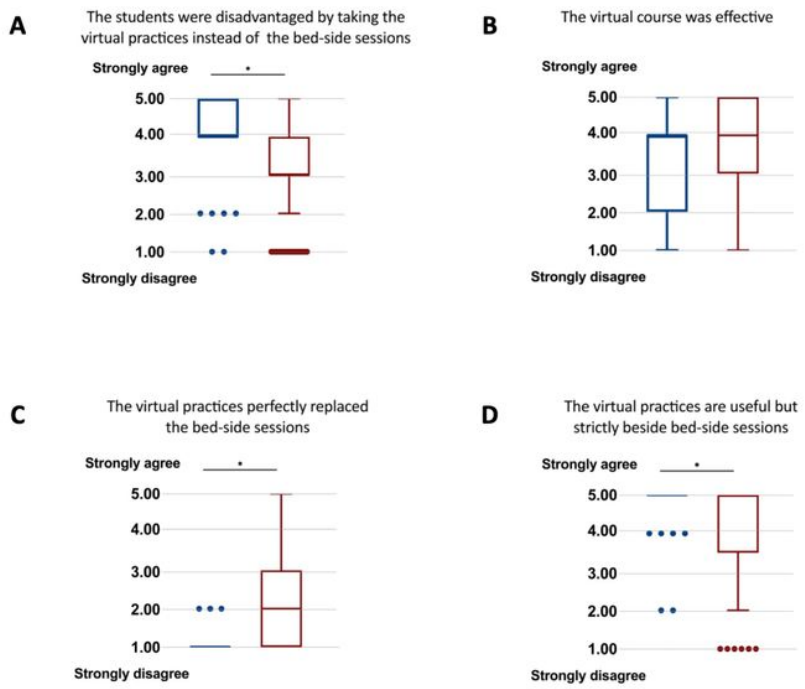

Figure 5

Comparison of instructors and *students* answers to Likert-scale questions. Mann-Whitney U test was performed. $*$: $p<0.05$. Box-and-whiskers plots are interpreted with Tukey method. 1.00: strongly disagree; 2.00: disagree; 3.00: undecided; 4.00: agree; 5.00: strongly agree.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.pdf
- Additionalfile2.pdf
- Additionalfile3.pdf