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Research article

Medical student inclusion and teaching in the COVID-19 pandemic emergency

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Abstract

Background

During the SARS-CoV-2 pandemic all educational activities in Denmark were suspended by the Danish Government. Department of Clinical Medicine at Aalborg University Denmark chose an approach allowing the medical students to take part in the preparations for the emerging pandemic crisis. The purpose of the study was to report the recruitment of the students.

Experiment

A course program was set up within 48 hours to train students to be able to work as nursing assistants and ventilator therapy assistants, and to employ final year students as temporary residents. We shifted teaching to a digital platform allowing students to follow planned learning activities while participating in the clinical work. 454 Medical bachelor students, and 257 Medical Master Students participated.

Within two weeks, 95% of master's students volunteered, and 62 % were active in the pandemic emergency as temporary residents (50 %), ventilator therapy assistants (30 %), or nursing assistants (20 %). More than 72 % of bachelor students volunteered within one week, and 31 % were temporary nursing assistants in the pandemic emergency.

Conclusion

The majority of medical students could be recruited with very short notice to meet the critical shortage and call for healthcare workers during the COVID-19 pandemic. This was supported by alignment with and reflection on the undergraduate medical curriculum, which prevented suspending education when delayed medical education may be detrimental.

Key words: COVID-19, curriculum, digital, inclusion, medical student, teaching

Background

The initial COVID-19 outbreak in December 2019 in Wuhan, China, was linked to a seafood market (1). We were warned that the world was not prepared for such a severe pandemic (2 - 4). It turns out that they were right as we see a fast spread and increasing death rates globally (5).

This pandemic has caused a global shutdown of schools and teaching institutions, sending home both staff and students. The pandemic creates a problem concerning labor for the hospitals due to people getting sick and isolated to avoid infection combined with the whole community shutting down. With the need for health care professionals, this decision may be inappropriate regarding medical students, and we have a different choice. Instead of closing health education programs, one could tap into an unused resource. The role of the medical students in the context of the current pandemic outbreak may appear to be limited at best. However, as a part of the larger health care system, medical students can fill a crucial role to bolster the ranks of health care workers in this and future epidemic crises. This we aimed to do at Aalborg University Hospital while ensuring that the students received training and learning.

In preparation for the COVID-19 pandemic, the structure of the hospital was reorganized. Within two weeks after the first Danish COVID-19 case all non-acute activities were suspended, existing wards were merged or moved, and a line of new pandemic wards was established. This raised a need for assistance in the new pandemic admission wards to assist in triage and care of the pandemic COVID-19 patients. In parallel, the clinical departments minimized and changed their workflow of patients by postponing all non-essential visits and treatments. These changes disrupted the students' usual clinical learning and training opportunities and activities. This caused students'exclusion during the SARS threat (6), but we considered that medical students may have a crucial role to play in a pandemic.

The medical education at Aalborg University had first admissions in 2010 and it has been designed to enhance the intrinsic motivation of medical students to become self-regulated learners and promote the evolvement of their professional identity (7 - 8). Thus, the curriculum was designed as patient-centered and case-organized problem-based learning (PBL) with early clinical clerkships to support building autonomy, competencies, and clinical relations to support intrinsic motivation. The medical students at the final three years are embedded in the clinical environment and all learning activities occur at the clinical departments for an accumulated full two years during this time. In particular, the goal of the clinical three-year master's program was for the students to attain a level of junior doctor after the first year of the Master'sprogram (9 - 10). When the COVID-19 pandemic escalated in Denmark, the clinical fundament of training of medical students at Aalborg University showed its quality in their contribution to the management of the crisis at hand.

Learning in a clinical environment has always been the main priority at Aalborg University, which supported including medical students in the response to pandemic emergencies while continuing the learning activities.

Making available details of this process may contribute to the sharing of knowledge concerning the education of medical students in the context of a global pandemic with the potential to cripple society and education in future pandemic waves. We argue that the collaborative model of the university and hospital is pivotal. We provide a detailed description of the process of rapid mobilization of the medical students to work as temporary residents (junior doctors), ventilator therapy assistants, laboratory technician staff, and nursing assistants. This is particularly important when, by government order, schools and teaching institutions are closed down. This led us to describe how to manage training medical students for a pandemic while at the same time keeping students active as learners and complying with the learning objectives set up by the undergraduate medical curriculum.

Materials and Method

In the spring of 2020, 454 bachelor students and 257 master students were enrolled in the medical program at Aalborg University. Formally it is a traditional three-year bachelor and three-year master education, with separate degrees. The education is effectually a three-step education: a three-year foundation education, a one-year clinical introduction, and a two-year specialization part. Based on this structure, all the master students, upon completion of the first two semesters, are eligible to be temporary residents. Parallel to the official curriculum, all the students in both the bachelor and master programs are eligible to participate in a nursing course, and bypassing this they can apply to participate in a ventilator assistant course.

Our curriculum is inspired by the spiral curriculum at Hull-York (11 - 12) and problem-based-learning (13). The students are prepared for the clinical placements by a teaching program consisting of three initial years of case-based

problem-based learning with increasing complexity as the spiral learning evolves (9). Just prior to clinical rotations, all medical students go through a one-week crash-course of scenarios and hands-on-training to attain essential skills for managing critically ill patient.

When on-site teaching activity was canceled, we shifted to a digital solution allowing the students to continue their education. Considering the clinical learning requirements arising from the pandemic, we analyzed and aligned with the current curriculum. Without changes to the overall competency profile, we included the nurse course and the ventilator therapy assistant course described below and recognized that the work as a nurse assistant, ventilator therapy assistant, laboratory technician, and temporary resident supported the teaching program. Student involvement was incorporated into the process of mobilization of the medical students and the planning and execution of the different course programs. This was done by giving students distinct roles during the problem-based process of mobilization and preparation of the students (13). A revised portfolio log was requested from each student to document reflective learning on clinical activities during the pandemic response.

We initiated two taskforces to deal with the preparedness and mobilization of the students to the pandemic emergency. Two medical students (PS and MSP) from student organizations were integrated into both a master program taskforce and, by the second week, a bachelor taskforce, both aiming to mobilize and train the students to participate in the pandemic emergency.

The Faculty of Medicine and The University Hospital of Aalborg are two organizations headed separately by a dean and a hospital director, respectively. Early contact between the dean and director clarified that the hospital could foresee a need to increase manpower to deal with the rising clinical requirements during the pandemic. Thus, the hospital was prepared to recruit and include medical students in the overall response. The dean and the director of the Clinical Institute set up a task force responsible for clinical medical education and related research groups. The task force was hospital based and included the deputy institute head (SR), the clinical learning coordinator (SA), and two medical students (PS, MSP). The first goal of the task force was to formulate competencies required to work in critical care facilities at the hospital (ventilator therapy assistant and intensive care) and competencies related to non-critical clinical duties affected by the pandemic. The second goal of the task force was to ensure that students could continue their formal education by incorporating the learning opportunities derived from working within the pandemic response.

At the organizational level, this was done in collaboration with the head of the study board and the vice dean of education (JE). Besides, a set of guidelines acting for the entire University was approved by the vice-principal and vice deans. These guidelines enabled an interpretation of the exam and teaching guidelines to comply with the learning from reflection on the integration of the medical students in pandemic response.

The process of organization within the first week after the pandemic was declared an emergency by the Danish Government on March 11, 2020, as presented previously (14).

The prospective study complied with the principles of the Declaration of Helsinki. Due to the study being a survey, ethical approval was not required according to the Danish Act on the Scientific Ethical Committee System (Act no. 593, section 14, subsection 2). Approval was obtained from the Danish Data Protection Agency North Denmark Region (record number 2020-037).

Results and Discussion

After 4 weeks 90,6 % (644 of 711) of the medical students at bachelor and master levelshad completed courses certifying participation in the pandemic response. Figure 1 presents the education and employment of medical students at Aalborg University as temporary residents (TR), ventilator treatment assistants (VTA), and nursing assistants (NA), and the figure show we were able to comply with the demands.

Figure

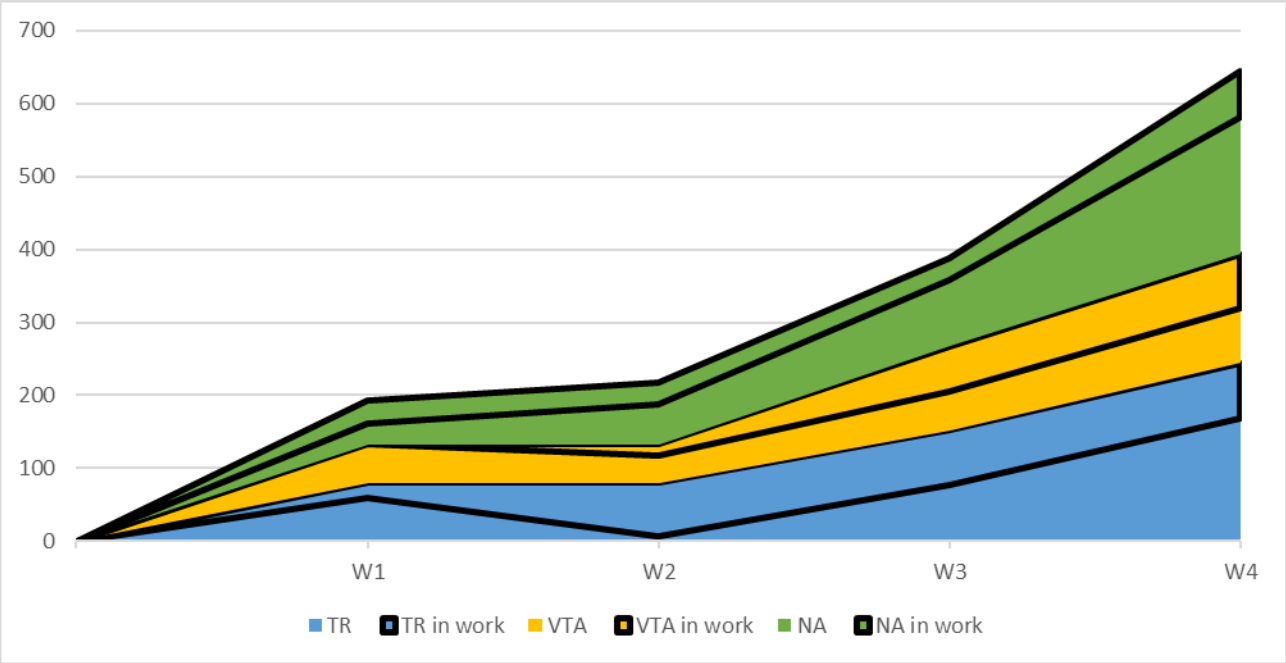

Figure 1. The educationand employment of medical students at Aalborg University as temporary residents (TR), ventilator treatment assistants (VTA) and nursing assistants (NA).

In the following, events and dates are presented focusing on actions and initiatives to mobilize and include medical students.

Day-0, Wednesday, March 11, 2020.

The government ordered schools and institutions to bar buildings and send all staff and students home. Our institutions chose to allow the medical students to take part in the preparations for the emerging pandemic crisis. All master's students received information by mail on the day giving the notice to prepare for the pandemic on the horizon. We planned to shift the teaching to a digital platform allowing students to follow the planned teaching programs and participate in the clinic and the course programs. Besides, the taskforces to deal with the preparedness and mobilization of the students to the pandemic emergency were in effect immediately.

Day-1, Thursday, March 12, 2020.

The department of Informatics Technology at Aalborg University Hospital was included, and a digital teaching platform was tested and employed by Day-5, Monday, March 16, 2020. This enabled support for teaching for the 1sth-, 2nth-, and 6th-semester students, and one week later for the 3rd- and 4th-semester students (the 5th-semester would not commence until autumn 2020). Preparations for the examinations in June were also initiated. We requested the students

to continue their clinical training. A task force, including the vice head of the department of clinical medicine (SR) and two students (PS and MSP), were set up to manage the training and mobilization of the 257 master students. The Department of Anesthesia and Intensive Care, and the Center for Medical Skills Training and Simulation at Aalborg University Hospital joined forces in setting up a ventilator therapy assistant course. Incorporating into the curriculum aspects of temporary residency and courses for a ventilator therapy assistant and a nursing assistant was managed by leaning on the clinical training program.This was included in "The Aalborg Model". All master's students received information by mail on this day. Medical students had additional informal information and discussion source via social media allowing a continuous dialogue between the students and the taskforce. This was managed by a medical student's organization representative (MSP).

Day-2, Friday, March 13, 2020.

The intensive care and ventilator therapy assistant course were organized as a three-day practical and theoretical course in basic care in the Intensive Care Unit (ICU). The course was facilitated at the in-house hospital training facilities. The course curriculum was based upon previous courses developed by The Danish Medical Students Union (FADL). Physicians and nurses working within the intensive care units provided the educational material and facilitated practical skill sessions. It included airway and ventilator management, fluid therapy, preventive measures in infectious diseases, management of sepsis, and current status for the COVID-19 pandemic. SKF and TLK headed the course. The first course commenced on Day-7, Wednesday, March 18, 2020.

Additionally, collaborations with University College North provided training facilities to establish a modified version of the nursing course for medical students already running in The North Denmark Region. The modified course was a six full-day in-depth introduction to theory and hands-on practice regarding observation and care of a variety of different types of hospitalized patients, including communication, personal hygiene, and mobilization of patients. A medical student (SMT) was a courseorganizer. Medical students with experience working as assistant nurses taught the theoretical material and ran the practical sessions and patient cases while the exam on the final day was conducted by trained nurses. The course was ready from Day-5, Monday, March 16, 2020.

Aalborg University Hospital gave access to the clinical training facilities. First, all master students received information by mail and were asked to join both courses at demand. Second, all bachelor students received this information.

Day-4, Sunday, March 15, 2020.

A job application platform was launched asking the students about their qualifications as temporary residents, ventilator therapy assistants, nursing assistants, or other qualifications.

To monitor the students' activities and fulfillment of learning objectives in the Aalborg Model¸ a template student log portfolio was completed. The log portfolio included students'clinical activities, courses, and learning activities, number of patient case involvements, and number of file notes, and most importantly reflections encouraging learning on clinical activity. The log portfolio included questions to guidethe personal reflection supporting learning opportunities, contents, limitations, andany clinical activity.This portfolio-log had an upper limit of 1000 words.

Day-5, Monday, March 16, through Day-8, Sunday, March 19, 2020

Figure 1 depicts the progress of the Aalborg Model on the preparation of the medical students for the pandemic emergency, and the major decisions and responses during the process. All medical bachelor students received information by mail and were asked to join the courses in ventilator assistant or nursing assistant.

Within the first week, 52.5 % (135/257) master students were included in the three-day ventilator therapy assistant course, allowing 15 students to graduate from the course in the first week and 60 students every subsequent week. The six-day nursing program took-in 32 students in the first week and every week following, totaling 96 graduates by three weeks. By Day-8 and 9, 76 students were employed as temporary residents at the University Hospital of Aalborg.

The number of temporary residents in the pandemic emergency increased from zero to 96 of 257 master students. The number of ventilator therapy assistants increased from zero to 45 of 257 master students. The number of nursing assistants in the pandemic emergency increased from zero to 60 of 711 medical students. Thus, 201 students qualified within this limited time frame.

On March 28, 2020, 95% of the master students were included in the preparation for the pandemic emergency and 62 % of the master students were active. Of the bachelor students, 72 % were included and 31 % active in the pandemic emergency. During these two weeks, we included more than 80 % of all medical students, i.e. 573 of 711.

Day-9, Monday, March 20, through Day-15, Sunday, April 26

During the first two weeks in this period, the number of temporary residents increased to 106, and the number of ventilator therapy assistants increased to 135 of 257 master students, with 93% of the master students being active in the pandemic emergency workforce by April 1st. The number of nursing assistants increased to 105 of 454 bachelor medical students. During April, the number of COVID-19 patients at the wards and the intensive care units and in ventilators declined gradually allowing the students to return to their scheduled clinical placements, ready to reengage in the pandemic response if needed.

March 2020 – April 2021

All educational activities were carried forward during the COVID-19 lock-down. Thus, examinations of the medical master students were performed timely while observing requirements by the curriculum. A total of 1167 oral examinations were performed among 452 medical master students. External evaluators from other universities contributed to 2 out of 3 examinations, and their overall feedback was positive. The incidence of re-examinations was 2% and comparable to previous years.

The medical master students each submitted a log portfolio that included an account of all clinical activity and a reflection on action. The portfolio included questions to guide the personal reflection on learning opportunities, contents and limitations. Submission of one portfolio by each medical student each semester extended into questions at the examination as it deepened our insight into the medial master students development and understanding of the medical professional. A total of 415 log portfolios were evaluated.

Discussion and Conclusion

The pandemic caused a global shutdown of schools and teaching institutions, sending home staff and students. Our university hospital was reorganized, non-acute activities were suspended, existing wards were merged or moved, and a line of new pandemic wards was established. We decided to call back the medical master students for inclusion in the pandemic response and to support continuous clinical training and learning. We were challenged by simultaneously training temporary residents, and ventilator, and nursing assistants, and continue the clinical training and learning activities, while the university hospital was reorganized. We succeeded in using the short window of opportunity when the number of patients at the hospital was low, to initiate and conduct the courses for temporary residents, and ventilator and nursing assistants.

The integration of medical students in the pandemic workforce was challenged by several factors. Initially, the reorganization of the university hospital took place at a rapid pace on several levels partly independently to ensure a rapid adaptation of the activities and facilities of the University Hospital to the pandemic. Some students were redirected from clinical departments to a pandemic ward. A minor group of students was asked not to attend clinical departments with immunosuppressed patients. Several groups stayed at the clinical departments with different clinical learning opportunities. At the same time, there was an immense call for temporary residents, and ventilator, and nursing assistants to the pandemic wards. There was a need at the same time to educate, organize, and place the students based on their different levels of competencies to ensure optimal utilization of the students' resources in the pandemic reorganization. Further, we needed to ensure continuous clinical learning and teaching of all the medical students complying with the university recommendation for student preparation. We found a balance within these limits using all 168 hours of the week, allowing the students to contribute 20-40% of working hours in the pandemic while continuing participation in the teaching and learning programs emphasizing the importance of reflective practice. These actions combined availability for learning with the requirement for the students' workforce contribution.

The challenge to be in continuous contact with all the medical students was facilitated by inviting the chairs of the two student societies (PS and MSP) to participate in the task forceand the students’ dedication to the tasks was essential. We considered the options and decided to initiate both ventilator and nurse assistant courses simultaneously since approximately 150 of the bachelor and master students previously have completed the nurse course and were eligible to participate in the ventilator course.

The recruitment of medical students for temporary residencies started immediately. On the 4th day, a job application platform was launched to the students asking for qualifications as a temporary resident, ventilator assistant, nursing assistant, or further qualifications. This early response supports students’ understanding of the importance of their contribution. Within two weeks, 95 % of the master students had volunteered and close to 2/3 were active in the pandemic emergency workforce as temporary residents (50 %), ventilator therapy assistants (30 %), or nursing assistants (20 %). More than 90 % of bachelor students have volunteered within 1 week and 40 % were active in the pandemic emergency department as nursing assistants.

We prioritized the teaching programs and decided first to digitalize teaching for the 1st-, 2nd-, and 6th-semester students to secure the education to temporary residents and graduation without delay. We found a balance in clinical training as the students participated in the pandemic response and continue to have patient contacts while still in

clinical training with teaching lessons streamed to provide access for students from all semesters to ensure the continued education.

The ventilator and nurse assistants course programs prepared the students to participate in the workforce while continuing the planned learning programs using digital platforms. Minor changes were made in the clinical rotations program to allow relocations between the clinical departments. The formal requirements in the required student-portfolio were adapted from a list of cases to focus on a description of the experience and require reflection on content and learning to verify learning from reflection on action.

The role of the medical students in the context of the current pandemic outbreak may appear to be limited at best. However, as a part of the larger health care system, medical students can fill a crucial role to bolster the ranks of health care workers in this and future epidemic crises. We tried to do this at Aalborg University Hospital while ensuring that the students received training and learning. A challenge encountered was the time it takes to efficiently integrate medical students into the healthcare workforce.

The reorganization of the university hospital, the mobilization of the students to participate in the pandemic response, and the distance and segregation requirements of the COVID-19 pandemic challenged the students participating in the teaching programs. The 24/7 participation in the pandemic response hampered the student's participation in the planned learning activities. Also, there was a need to plan and initiate course programs in ventilator therapy assistance and nursing. We needed to adapt the teaching and learning program to these challenges. The introduction and use of digital platforms to continue teaching medical students met these challenges and allowed the deployment of students at the pandemic wards. We streamed all teaching and learning sessions and gave access to students from all semesters to ensure continued education allowing the students to work as temporary residents, ventilator, or nursing assistants. Within two days we managed to shift a major part of the formal teaching and learning activity at our medical school to a digital platform. A limitation was on learning of the clinical handling of measuring visual acuity and the examination of ear, nose and, throat.

The digital platform supported the requirements of the curriculum and allowed the medical students to be online active during the teaching sessions and at any time to revisit the case-based lectures and the case-PBL situations. This minimized the disruption to the medical education and allowed the students to be both actively working on different levels in the pandemic emergency and to continue their pre-graduate education.

There are more than 100 years of experience and benefits of including the medical students during a pandemic or a crisis (6, 15 - 22 It was seen during the influenza epidemic in 1918 (16), the polio epidemic in 1952 (15), and during the SARS epidemic (6,18,19, 21). During the last 20 years, various outbreaks of severe infectious diseases, from Ebola virus infection to SARS, have highlighted the need for a more precise account of the duties and obligations of healthcare professionals (19). During an epidemic, 28 % of health care professionals may abandon work to protect themselves and their families (18). However, they are obliged to participate (20). During the poliomyelitis epidemic during 1952 and 1953 in Copenhagen, Denmark, more than 1000 medical students provided manual positive pressure respiration (15). The medical students made a huge effort, often up to 24 hours in a row. The pay for the physically and mentally stressful work was modest (15), and the students founded the medical students' union that later provided training in assisting ventilator therapy.

Cheng et al..described in 2007 the presence of a large reservoir of SARS-CoV-like viruses in seafood markets as a time bomb ticking, and the need for preparedness should not be ignored (2). Following the 2009 H1N1 Influenza it was concluded by WHO (3) and Fineberg (4) that the world was ill-prepared for a severe pandemic. Wu et al. forecasted February 2020 (1) that outbreaks of COVID-19 in major cities globally were to be expected as a result of the exportation of pre-symptomatic cases and an absence of large-scale public health interventions. The number of infected patients and claimed lives still increase daily at an exponential rate (5) and the revival of outbreaks is emerging emphasizing a continuous need for emergency health care staff.

In our study, more than 95 % of students volunteered for the pandemic emergency within 14 days. In a study from 2007, more than 2/3 of the medical students were prepared and positive towards complying with government requirements, and 1/5 believe that health care academic staff should be penalized for refusal to comply (21). The medical students recognize the obligation and have the motivation to join the pandemic emergency healthcare workforce (24). Although the students may be concerned about the spread of Covid-19 the majority prefer the clerkship in hospital practice (25). The medical students in our study, being temporary residents, provided valuable support to the clinical teams, as Doctor's assistants (26). Especially our senior students chose to work as temporary residents as shown by Pravder (27). Previous studies indicate that medical students are frustrated when not included in the response to major events (11), and closure of the medical school is disruptive for the students and the medical education (22). The medical students' experiences and professional self-esteem may even be improved from participating (17,20). The knowledge we hold at present is limited, and it is uncertain if we can extrapolate results from studies carried out in similar yet contextual different surroundings, to our current situation.

The COVID-19 pandemic may be a stressful event for all people and perhaps even more so for young medical students who aspire to become professional medical doctors and the responsibilities that this transition entails. However, we did not observe this as the medical students were actively prepared to and included in the response, working together with other health care professionals with access to information and continuing education.

We decided not to offer senior medical students to graduate three months early if they agree to work in the pandemic emergency as in New York (28) if they agree immediately to work at NYU Langone Health's Internal Medicine and Emergency Medicine departments. We encouraged and provided additional learning within the existing frame to allow continuing educational activities while contributing to the healthcare workforce. This met needs and responded to the call for healthcare staff and include the medical students in the pandemic emergency workforce.

This priority of using digital platform and streaming, course programs for temporary residents, ventilator therapy assistants and nursing assistants, relocations between the clinical departments, learning and teaching 24/7, and a change in the required portfolio encouraging reflective learning preparing for the exams, combined the requirement for learning with the requirement for a student workforce contribution turning reflection on pandemic work into an opportunity for learning on the action. This supported including medical students in response to pandemic emergencies while continuing the learning activities durng hospital lock-down in emergency mode.

The present study reports a list of priorities and activities to support recruiting and educating medical students for a pandemic emergency. These activities set one way to educate and enroll most medical students in the response should support health-care staff needs in future upbursts of the ongoing pandemic, or the case of a new pandemic.

Acknowledgements

Not applicable.

List of abbreviations

PS	Phillip Sperling
MSP	Mathias Såby Poulsen
SR	Sten Rasmussen
SA	Stig Andersen
JE	Jeppe Emmersen
TR	temporary residents
VTA	ventilator treatment assistants
NA	nursing assistants
ICU	Intensive Care Unit
FADL	The Danish Medical Students Union
SKF	Steen Kåre Fagerberg
TLK	Thomas Lass Klitgaard
SMT	Simon Mæng Tjørnehøj

Declarations

Ethics approval and consent to participate

Due to the study being a survey, ethical approval was not required according to the Danish Act on the Scientific Ethical Committee System (Act no. 593, section 14, subsection 2). https://en.nvk.dk/rules-and-guidelines/act-on-research-ethics-review-of-health-research-projects

Approval was obtained from the Danish Data Protection Agency North Denmark Region (record number 2020-037). The North Denmark Region, Niels BohrsVej30, DK-9220 Aalborg Oest.https://rn.dk/Sundhed/Til-sundhedsfaglige-og-samarbejdspartnere/Forskning/Projektanmeldelse

Consent obtained from the study participants was written.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests. All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare that: no support from any organization for the submitted work;

no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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Author's contribution

Conceptualization: SR, PS, MSP, MSA, SKF, TLK, SMT, SA and JE. Formal analysis: SR and PS. Methodology: SR, PS, MSP, MSA, SKF, TLK, SMT, SA and JE. Project administration: SR and PS. Resources: SR, PS, MSP, MSA, SKF, TLK, SMT, SA and JE. Writing – Original Draft Preparation: SR, PS, MSP, MSA, SA and JE. Writing – Review and editing: SR, PS, MSP, MSA, SKF, TLK, SMT, SA and JE. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. Sten Rasmussen is the guarantor of the study.

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

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