Evidence check

18 June 2020

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

The impact of COVID-19 on clinical education and training

Evidence check questions

In light of the COVID-19 pandemic,

1. What has been the impact on the mode and content of clinical education*, and what has been trialled and/or recommended to address the impact?
2. How has the clinical training of postgraduate trainees† been affected?

In brief

Question 1

- Due to the COVID-19 pandemic, many medical education programs suspended onsite activities such as clinical rotations, clerkships, and in-person lectures and examinations.
- Innovations and changes often relate to virtual distance-learning formats, such as videoconferencing, live streamed ward rounds, pre-recorded lectures, podcasts, and online surveys, and discussion forums.
- Conceptual frameworks and strategies used to guide the transition to virtual teaching formats include: task analysis (to break down in-person clinical assessments into individual tasks prior to virtual formatting); functional task alignment (to convert a simulation-based course in geriatrics into distance-learning); communities of practice and adult learning theory (to develop collaborative 'socially distanced' medical genetics education); educational environment theory (to develop an online general practice training course); and a social learning and cognitive apprenticeship framework (to develop a collaborative virtual clerkship curriculum).(1-4)
- Students, faculty, and simulation staff report high satisfaction with a remote learning approach, especially where it has facilitated greater collaboration and engagement with peers, patients, and teachers around workplace problems.(4) Other benefits include cost-saving and enhanced

* Defined as education or teaching as part of an undergraduate or graduate medical degree program (i.e. pre-internship or residency).

† Defined as those who have completed a professional medical degree program (e.g. MD, MBBS) and are at the pre-accreditation training stage of their career. (Also known as registrars, residents, interns, fellows, or junior doctors or medical officers)

participation of students and training simulation staff.(1, 5) Reported challenges include difficulties around conducting simulated and remote physical examinations. (1, 2)

- Some authors reported on changes being made to *the content of* undergraduate medical education in light of COVID-19. These include: the integration of non-clinical COVID-19-related volunteer work (e.g. conducting evidence reviews) towards academic credit in year 3 medical students, and the inclusion of virtual bedside rounds on clinically managing patients with COVID-19.(6, 7)
- In Australia and New Zealand, COVID-19 forced a rapid transition to entirely online teaching for junior medical students.(8) However, clinical placements continue as previously, with appropriate safeguards in place, to avoid disruptions to student education and impacts on the medical workforce. This is in line with the Medical Deans of Australia and New Zealand, state and territory health authorities, and the Australian Health Protection Principal Committee. (9-11)
- Examinations and assessment of medical students' clinical skills, which are typically done in-person with simulated patients, have been converted to a remote format, as in the case of the objective structured clinical examinations (OSCEs), or suspended temporarily, as in the case of the United States Medical Licensing Examination Step 2 Clinical Skills.(1, 12). In the UK, Imperial College London trialled unsupervised, open-book online examinations for final year medical students due to social distancing measures.(13)

Question 2

- For postgraduate trainees, evidence on disruptions to clinical training have been primarily gathered from grey literature sources (e.g. announcements from professional accreditation or assessment bodies) or anecdotal evidence from scientific and grey sources.
- Frequently reported impacts of COVID-19 on medical training include:
    - mid-training deployment of trainees to COVID-19 related critical care
    - de-specialisation of trainees, except those in 'essential' or 'core' specialties relating to COVID-19 or oncology
    - minimisation of patient contact due to social distancing measures, cancellation of elective surgeries and cancellation or minimisation of clinical rotations, including within and extramural placements. Rationing of personal protective equipment (PPE) has meant some residents may not be in the operating room
    - disruption of traditional education and curriculum due to social distancing, including cancellation of lectures, group learning activities such as surgical simulations, and in-person conferences
    - requiring training to use novel methods of service delivery including telehealth
    - disruption to accreditation and career progress (e.g. not meeting minimum number of cases, not feeling sufficiently prepared or trained, change in assessment of competency and extension of training programs)
    - changes to psychological and mental well-being, fatigue
    - risk to physical wellbeing in case of deployment to COVID-19 patient care.
- Frequently reported responses to these impacts of COVID-18 include:
    - implementing virtual distance education as well as virtual conferences and meetings using synchronous and asynchronous methods, such as videoconferencing and file sharing

platforms and other specialty-specific software, websites, and apps and increased use of online resources. In some specialties new resources have been developed to support virtual learning
    - reducing the number of patient visits or encounters. Some specialties reported rosters or operational schedules that supported one group on active duty while one group worked remotely
    - modifying accreditation processes by the Accreditation Council for Graduate Medical Education (ACGME) for residency or fellowship programs
    - (possible) extension of training programs.

- Responses to the safety and wellbeing of trainees during the pandemic include:
    - implementing shift work (shifts between minimum number of residents or fellows) (14)
    - requiring that trainees have access to appropriate safety equipment when interacting with COVID-19 patients (15)
    - requiring approval for trainees to work in COVID-19 patient care (16)
    - enforcing social distancing, cancelling group gatherings including lectures, simulations, clinical rotations, elective surgeries, etc. and moving curriculum to online format
    - fostering a sense of community through virtual group activities and interactions (17)
    - recommending access to counselling, having open communication, and implementing lenient policies around attendance, assessment, and assignment submissions to address trainee anxiety. (18)

Limitations

Evidence on this topic is emerging rapidly. The impact of COVID-19 on medical education and training varies widely depending on the location of the institution. Studies were often found to be context specific and the impact of COVID-19 on medical education and strategies to address this were dependent on the prevalence of COVID-19 in the country and its medical education model and curriculum.

Topics relating to the rapid deployment or fast-tracking of senior undergraduate medical students into the clinical workforce, while widely discussed in literature, are beyond the scope of this evidence check and were excluded.(10, 19-30)

Topics relating to independent research or information seeking by students outside of the formal medical curricular structure or degree program (e.g. peer learning and knowledge exchange through social media) were also excluded.(31-33)

Methods (Appendix 1)

An initial PubMed search was conducted on 21 May 2020 and updated on 2 June 2020. Google and snowball sampling were conducted on 25 and 26 May 2020 (Question 1), and on 8 and 9 June (Question 2). Australian and international medical education, professional and licensing organisation websites were reviewed for updates and guidance on the topic.

Searching was limited to general medical education at the undergraduate (e.g. MBBS) or graduate (e.g. MD) levels for Question 1, and clinical training at the postgraduate level, including registrar training, residencies, fellowships, and junior doctor training (e.g. registrars, junior medical officers, interns) for Question 2. Search was also limited to studies from Organisation for Economic Co-operation and Development (OECD) countries, English-language documents, and publication between

2019 and 2020 (timeline of COVID-19 pandemic). Peer-reviewed studies were included if they described the impact of COVID-19 on current medical education and implemented and/or evaluated innovations or policies to address this impact. Studies were also included if they discussed evidence-based recommendations or strategies to address the ramification of the pandemic on medical education.

Results

Table 1: Impact of COVID-19 on undergraduate medical education

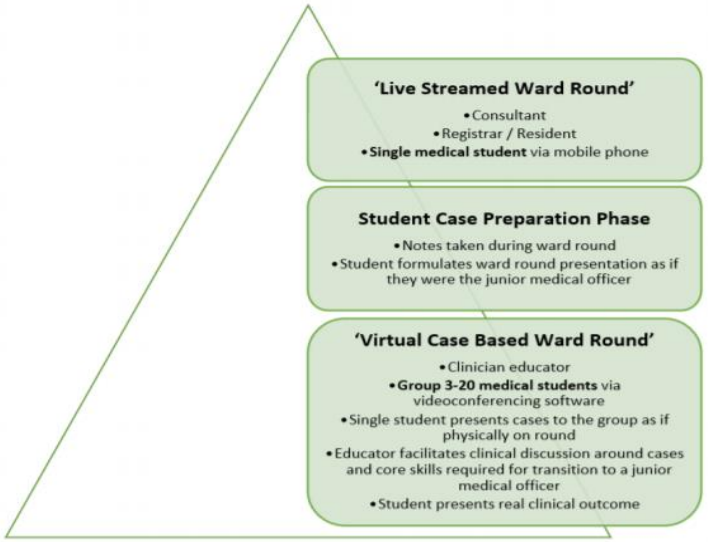
Source	Summary
Peer reviewed sources	
COVID-19 implications on clinical clerkships and the residency application process for medical students Akers, et al. 2020 (34)	• This review assesses governing medical bodies' recommendations regarding undergraduate medical education in the USA during the COVID-19 pandemic and how this may impact preparation for residency. In the USA, clinical rotations generally start in the third year of medical school and are a vital component of undergraduate medical education. • The authors discuss that based on current recommendations and policies, COVID-19 will likely impact undergraduate medical education in the suspension of clinical rotations, alterations in grading, suspension or elimination of away rotations, changes in medical licensing exams, and ramifications on mental health. • The authors highlight policies by medical specialty governing bodies that ensure 'uniformity and equitable opportunity for students applying to all specialties in the upcoming [residency matching] cycle', citing examples of emergency medicine and obstetrics and gynaecology governing bodies that have recommended implementing more lenient requirements for the upcoming residency application cycle such as reducing the required number of away rotations, and postponing application deadlines and interviews.
Pilot virtual clerkship curriculum during a pandemic: podcasts, peers, and problem-solving Geha, et al. 2020 (4)	• During the COVID19 pandemic, new instructional approaches were necessary when student clerkships were suspended at the University of San Francisco, and students were shifted online. Administrators still aimed to advance students' thinking as novice physicians rather than increasingly sophisticated classroom students. • A virtual clerkship curriculum (VCC) was created. The objective of VCC was to advance internal medicine knowledge and three clinical reasoning skills: schema construction (formulating frameworks for clinical problems, e.g. anaemia), written diagnostic arguments (articulating prioritised differential diagnoses for cases), and verbal presentations of those arguments.

	• The conceptual frameworks for VCC were social learning and cognitive apprenticeship. • A learning community was created through twice daily interactive sessions with students and teachers via videoconferences. Students remotely attended two resident-level case conferences daily. • Assigned readings were minimised and students were given more opportunities to hear physician dialogue using conversation-style medical podcasts. Students listened to a daily podcast to learn about a topic. They analysed 11 cases (from podcasts or worksheets) and submitted diagnostic schemas and diagnostic assessments for each case. Assignments involved peer collaboration and feedback. To reinforce lessons from assignments, podcasts, and case conferences, the authors held 30-60 minute 'rounds' each morning. • A post-VCC survey was administered. Students cited 'major improvements' in their diagnostic assessments and schema construction and 'moderate improvement' in oral presentations. They reported on improved level of feedback and collaboration with their classmates.
Integrating COVID-19 volunteer response into the Year 3 MD curriculum Haines, et al. 2020 (6)	• The University of British Columbia Faculty of Medicine suspended clinical rotations for medical students on 14 March 2020 due to the COVID-19 pandemic. At that time 291 year 3 medical students were engaged in clerkships across British Columbia and urgently needed an academic pathway to advance to year 4 on schedule. • A student-led volunteer organisation partnered with the Flexible Enhanced Learning (FLEX) program to allow year 3 students to claim curricular hours and receive academic credit for approved COVID-19 volunteer work and advance to year 4. • 160 year 3 students participated in volunteer work with the potential for FLEX project integration, including: Rapid Literature Reviews, a student taskforce serving the infection prevention and control groups of two major Vancouver health authorities; and Connecting with Compassion, in which students used videoconferencing to enable social connections for older adults isolated in long-term care due to COVID-19, and worked with geriatricians to study the impact of this service on patients and their families.
Clinical placements for medical students in the time of COVID-19 Halbert, et al. 2020 (11)	• Reports on the decision by Flinders University in Australia to continue clinical placement of their medical students in healthcare settings, in alignment with the recommendations of the Medical Deans of Australia

	and New Zealand, all state and territory health authorities and the Australian Health Protection Principal Committee. • The university addressed anxiety surrounding the rapidly changing impact of the virus and subsequent differences in opinions among clinical supervisors as to the merits of continuing clinical placements by writing and widely distributing clear guidelines for clinical placements in partnership with medical students and healthcare provider partners. • In some high-risk placements such as endoscopy and other aerosol-generating procedures, the university encouraged the clinical supervisors and students to negotiate appropriate activities that do not increase the risk of COVID-19 exposure to either the student, other staff or the patients while still allowing the student to learn in the clinical environment.
Training disrupted: practical tips for supporting competency-based medical education during the COVID-19 pandemic Hall, et al. 2020 (35)	• Reviewing medical education literature, the authors offer guidance on how to adapt medical education programs within the constraints of the pandemic landscape, stressing the need for communication, innovation, collaboration, flexibility, and planning within the era of competency-based medical education. 1. Anticipate impact 2. Keep learner and patient safety top of mind 3. Focus on wellness and monitor for trainee and educator burnout 4. Keep what you can: maximise existing clinical teaching experiences 5. Change what you have to: innovate in the new environment 6. Adapt academic sessions to enhance learning and connections using novel technologies 7. Consider adaptive strategies for learning 8. Recognise the increased need for coaching and individualised learning plans 9. Collaborate creatively to maximise efficiency for academic sessions 10. Keep on assessing 11. Accept flexibility in progression and certification decisions while ensuring demonstration of competence 12. Prepare for post-pandemic catch up.

Objective structured clinical examination: from exam room to zoom breakout room Hannon, et al. 2020 (1)	• In-person curricular activities were suspended at the University of Utah during the COVID-19 pandemic. • Medical program administrators converted in-person OSCEs to a remote format. • Task analysis was used to break down each in-person OSCE element and develop remote solutions with necessary resources. • Digital resources were used such as Qualtrics (for note entry and checklists) and Zoom teleconference platform (e.g. breakout rooms for patient encounters). Students and standardised patients were given training on how to conduct virtual exams. Physical assessments were converted to a narrative physical exam. This was done for the surgery, internal medicine and neurology clerkships, during one remote OSCE per day (11-19 students per clerkship) with 4-6 students per round for 49 total students. • The remote format was found to be feasible, cost saving and useful. The school decided to proceed with their other four clerkship 2-station OSCEs and scale up to administer their 6-station end-of-year 3 OSCE during ongoing COVID-19 constraints on in-person examinations. • However, remote testing negatively impacted physical examination assessment as administrators were unable to assess student ability to accurately perform physical exam manoeuvres. Students felt the narrative physical exam flow was awkward and about half of the students (53%, 25) thought the remote OSCE was not as good as the in-person OSCE for assessing clinical skills.
Virtual bedside teaching rounds on patients with COVID-19 Hofmann, et al. 2020 (7)	• Educators at University of California, Irvine School of Medicine aimed to provide medical students first-hand knowledge of caring for COVID-19 patients, while mitigating risk for infection and addressing concerns about limited PPE. They implemented virtual bedside rounds using video conferencing tools to successfully engage students in learning the diagnosis and treatment of COVID-19. • Zoom videoconferencing was used to connect students to verbally consenting COVID-19 patients and the care team. The attending physician set expectations and communicated goals with students. • Students were able to see and hear the physician-patient encounter. Students asked patients questions, and patients shared their perspective of the pandemic. Institutional policy for infection prevention was followed.

	• In post-rounds survey of 14 students, 92.85% strongly agreed that this experience improved their knowledge of COVID-19, 92.85% strongly agreed that they felt engaged, and 92.85% strongly agreed that they would like to continue participating in virtual COVID-19 rounds. All students strongly agreed that they would recommend COVID-19 rounds.
Rapid transition to online assessment: practical steps and unanticipated advantages Mooney, et al. 2020 (5)	• Medical educators at the University of Rochester converted a multi-day, formative, comprehensive assessment experience into a fully digital platform to accommodate 105 second-year medical students. • Three standardised patient encounters, mapped to expected clinical competencies, were developed and administered through a telehealth format in Zoom, and recorded to facilitate student reflection. Students were assessed for medical knowledge, communication, information synthesis, and professionalism. Reflection on feedback was further fostered through daily self-reflection assignments and faculty-facilitated Zoom groups (3 students each). • This change had unanticipated advantages such as: expanding capacity for simultaneous assessment of learners; efficiency; increased standardised patient diversity and lower programmatic costs (eliminating distance and transport); increased recruitment of simulation staff including those who are older; and faculty, student, and standardised patient satisfaction with the fidelity of cases and overall assessment quality were high. • This assessment format will be adapted for use in other classes.
Daily medical education for confined students during COVID-19 pandemic: a simple videoconference solution Moszkowicz, et al. 2020 (36)	• The authors, educators from the University of Paris, sought to set up a daily medical education procedure for surgical students confined to their homes. They report a simple and free teaching method intended to replace daily lessons performed in the surgery department with Google Hangouts videoconferencing application. This method can be applied to clinical as well as anatomy lessons. • Benefits: The app is free of cost and accessible to all Gmail users. A webcam and a microphone are required on the workstation. A working group is then created using their email addresses. Similar to regular lessons, an appointment is given to students, allowing them to connect at the right time. Up to 10 students can access the live lesson at the same time. They can see and hear the teacher and ask questions that are audible to the whole group. There is no time limitation.

Live streamed ward rounds – a tool for clinical teaching during the COVID-19 pandemic Pennell, et al. 2020 (37)	• The clinical teaching team from the University of Newcastle at John Hunter Hospital in Australia developed live-streamed ward rounds to address the challenge of maintaining the clinical clerkship model of education while students are excluded from the hospital for several months during the early years of clerkship training. • Live-streamed ward rounds have three phases. 1. The student observation phase where one student is engaged via mobile phone to observe the live stream. 2. The student preparation phase where the student formulates case presentations. 3. The student case presentation phase where the student sequentially presents each patient to a group of 3-20 students who are engaged simultaneously via secure videoconferencing software. A clinician educator is present to facilitate nuanced clinical discussion around specific cases, as well as core skills required for the transition from medical student to the junior medical officer. Figure 1. The three phases of the 'Live Streamed' ward round 

Medical genetics education in the midst of the COVID-19 pandemic: Shared resources Regier, et al. 2020 (38)	• The authors used communities of practice and adult learning theory, or andragogy, to guide the development of socially-distanced medical education in genetics. • For medical students, the authors created a picture-based Zoom lecture of dysmorphology cases. The students used the chat function to compete in identifying abnormal features in the pictures. The anonymity of the chat function was even more effective than previous live lectures as it allowed for more inclusive participation.
Provision of e-learning programmes to replace undergraduate medical students' clinical general practice attachments during COVID-19 stand-down Roskvisk, et al. 2020 (3)	• The authors, medical educators from The University of Auckland Department of General Practice & Primary Health Care, developed an online course to replace clinical placements in general practice for year 4 and year 5 medical students due to COVID-19. • They used educational environment theory to guide the development of this course, which incorporates relational, organisational, and personal goal aspects of the theory: asynchronous discussion forums, a symposium facilitating social interactions and teacher presence, and a learning portfolio facilitating personal goal aspects and reflecting the organisational domain. • The authors present the various elements of the online learning program and their alignment with the multi-theories model of adult learning, along with the student and program roles that occur at each stage.

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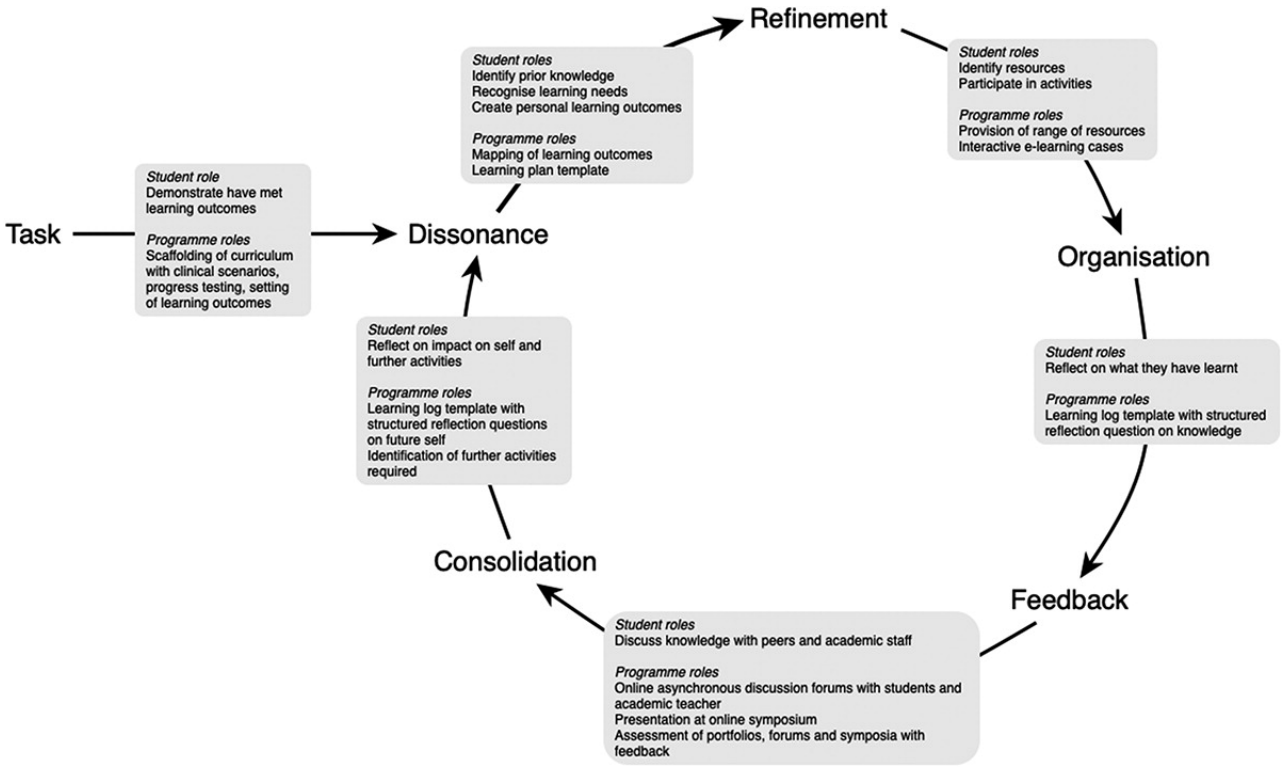
<td> 
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<td>Twelve tips for rapidly migrating to online learning during the COVID-19 pandemic

Sandars, et al. 2020 (39)</td>
<td>• The authors, who are members of the Association of Medical Education in Europe) Technology Enhanced Learning Committee, present their collective experience and findings from a survey of the last two decades, as well as their insights on rapidly managing the implementation of educational technology in organisations. They emphasise the key principles and practical insights for frontline educators to optimise the potential of online learning in their educational environment during this pandemic.

Organisational level

1. Anticipate and move through the change management stages.
2. Use the current learning management system.</td>
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	Online learning modalities 3. Optimise the potential of online lectures. 4. Optimise online small groups using intentional design. 5. Optimise the potential of asynchronous online tutorials. 6. Optimise the potential of online videos. 7. Optimise the potential of social media. 8. Optimise the potential of online reflection. General online tips 9. If you can't teach the whole task, start with part-task online training. 10. Simplify the massive online world for learners. 11. Encourage and support co-creation of online resources and activities. 12. Demonstrate the value for active clinicians of the shift to online learning.
Curriculum delivery in medical education during an emergency: a guide based on the responses to the COVID-19 pandemic Taha, et al. 2020 (40)	• Through a review of literature, the authors recommend the following systematic approach for the successful implementation of the transition to an online or distance learning approach. ○ Establishing a sense of urgency ○ Establishing working teams ○ Conducting needs assessments ○ Developing implementation plans ○ Communicating the curriculum content ○ Capacity building ○ Managing students' stress ○ Finding tools to be used ○ Managing student engagement and motivation ○ Considering student assessment ○ Anticipating challenges and planning for how to overcome them ○ Monitoring and evaluation of curriculum implementation and continuous improvement.

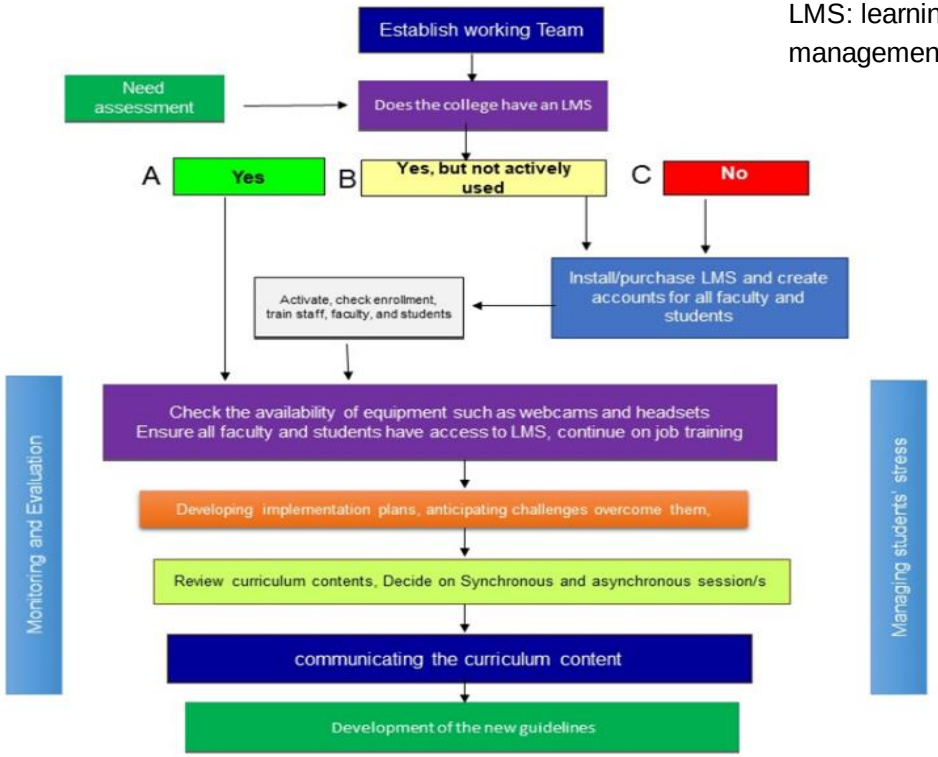
	Figure 1. Guidelines for the implementation plans for three scenarios (A) if the college has an LMS; (B) if the college has a non-functional LMS; and (C) if the college has no LMS  LMS: learning management system
[How we make choices and sacrifices in medical education during the COVID-19 pandemic](#) Tolsgaard, et al. 2020 (41)	• It is problematic that a whole generation of medical students and residents may be affected by missing or reduced training opportunities due to COVID-19. This will disrupt the supply chain of specialists in the long run and should be avoided. • The authors propose a framework which can help medical educators consider the short and longer-term consequences of educational decisions related to COVID-19 (Table a).

Table a. Mapping out the choices and sacrifices in medical education during the COVID-19 pandemic

Triage	**How**	**Impact**	**Agency**	**Implementation and evaluation**
What must continue intact no matter what?	How can it/Will it continue?	What is the impact of continuing these activities? What happens if we do not?	To what extent can we ensure that we can continue? What are the limits and dependencies of continuing?	What worked? What did not work? What can we learn? What were the unintended consequences?
What can be postponed but will still need to happen 'as is'?	How can it/Will it be postponed?	What is the impact of postponing these activities? What happens if we do not?	What opportunities and constraints do we face in postponing? How much freedom do we have to postpone and in what ways?	What worked? What did not work? What can we learn?
What can be adapted, changed, or remediated (run in a different way)?	How can it/Will it be adapted, changed, or remediated?	What is the impact of adapting, changing, or remediating these activities? What happens if we do not?	What options do we have to adapt, change, or remediate what we do? What are our limitations in doing so?	What worked? What did not work? What can we learn?
What can be dropped or minimized?	How can it/Will it be dropped or minimized?	What is the impact of dropping or minimizing these activities? What happens if we do not?	What options do we have to drop or minimize what we do? What are our limitations in doing so?	What worked? What did not work? What can we learn?

	<table><tr><td>What needs to be added?</td><td>How can it/Will it be added?</td><td>What is the impact of adding these activities? What happens if we do not?</td><td>What options do we have to add things? What are our limitations in doing so?</td><td>What worked? What did not work? What can we learn?</td></tr></table>
Transition to on-line is possible: solution for simulation-based teaching during pandemic Torres, et al. 2020 (2)	• Polish universities suspended all on-site activities due to the SARS-CoV-2 pandemic. As a result, administrators at the Medical University of Lublin were faced with the problem of how to convert a simulation-based course in geriatrics into distance-learning. • They used functional task alignment to guide the process. • Mock simulation sessions helped training and discovery of several technical issues. The resulting online simulation environment consisted of patient's room with SimMan 3G (Laerdal), a technician (substituting for students' hands), patient's monitor (shared as separate screen when a closer view was required, e.g. 12-leads ECG), standardised patients, instructor and students who participated through Zoom. Free web-services provided sounds (auscultatory, cough) that were played while examination was performed on the mannequin. Zoom chat was used for file transfer (e.g. medication chart). • In this intervention, participants found that the preservation of functional and psychological resemblance to on-site conditions were possible. In terms of physical resemblance, visual and auscultatory perceptions were attainable, whereas the tactile sensation needed to be described as actions were ordered by the student and then executed by a technician. This was a challenge.
Grey literature sources	
Guidance on medical students' participation in direct patient contact activities Association of American Medical Colleges, 2020 (42)	• The Association of American Medical Colleges acknowledges that the impact of COVID-19 continues to vary widely among medical schools in the USA depending on location. • This document provides guidance to medical schools regarding medical students' participation in direct patient contact activities and is based on public health considerations, PPE needs, and COVID-19 testing availability. Based on these considerations, the guidance recommends the following.

	• For medical schools in locales in which there is significant, active current or anticipated COVID-19 community spread, and/or limited availability of PPE and/or limited availability of COVID-19 testing.
	  ○ Unless there is a critical healthcare workforce need locally, it is strongly suggested that medical students not be involved in any direct patient care activities.
	• Regarding medical student participation in direct patient contact activities as part of required clerkships or other required clinical experiences in the MD-degree program core curriculum when there is not significant, active current or anticipated COVID-19 community spread AND when both PPE and COVID-19 testing become readily available locally.
	  ○ Medical schools ensure that reasonable safeguards are in place to minimise medical students' risk of contracting COVID-19, and medical student participation in these required clinical experiences should align with the school's educational program objectives.

Principles to support medical students' safe and useful roles in the COVID-19 health workforce Medical Deans of Australia and New Zealand 2020 (9)	• The Medical Deans of Australia and New Zealand recommend that immersive and experiential learning opportunities such as clinical placements continue for senior medical students, with appropriate supervision and support, as well as flexibility and adaptability from the whole health workforce. • In light of the COVID-19 pandemic, they emphasise that 'medical students need not be on the front-line of care for patients with COVID-19'; instead, senior students 'can make useful contributions in the routine aspects of care that will continue on hospitals wards, in outpatient and community settings, in operating theatres and birthing suites.' • They recommend that students are able to do so under the following principles: safety (availability of appropriate PPE and consideration of pre-existing risks), role clarity and indemnity, competency, supervision, student choice, monitoring and support, and remunerated (for non-learning placements).
Medical students take final exams online for first time, despite student concern Tapper, et al. 2020 (13)	• Many universities in the UK are struggling with the problem of how to assess students, particularly those due to graduate this year. Universities are being forced to consider new ways of assessing final-year students during the coronavirus shutdown.

	• In March 2020, 280 sixth-year medical students at Imperial College London took unsupervised (or open-book) online exams from home for what could be the first time. Open-book exams allow students access to any resource material they may need during the exam. • Students were assessed on their ability to diagnose a patient's condition. They were presented with a patient and given their history, findings from clinical examination and data from investigations such as blood tests. They then had to answer 150 questions in three hours, meaning they had 72 seconds to answer each one. The order of questions was randomised to minimise cheating.
USMLE suspending step 2 clinical skills examination United States Medical Licensing Examination, 2020 (12)	• USMLE step 2 clinical skills is a nation-wide assessment of clinical skills taken by senior medical students. Passing this exam is a requirement for application to many residency programs across the US. • The step 2 clinical skills exam is done in person between examinees and simulated patients. • In May 2020, in response to the COVID-19 pandemic, the USMLE suspended Step 2 clinical skills test administrations for the next 12-18 months. This decision may have significant impact on examinees in terms of their progression through education, training and medical licensure.

Table 2 Impact of COVID-19 on clinical training by specialty and vocation

Note on Australian clinical trainees

- Ahpra (Australian Health Practitioner Regulation Agency) and the national boards, together with the Australian Government and the Health Professions Accreditation Collaborative Forum, have set national principles for clinical education to guide decisions of professions, accreditation authorities, education providers and health services about student clinical education during the COVID-19 pandemic response.(43)
- They have outlined the following National principles for clinical education during COVID-19.(43)
    1. **Safety** – the safety of patients, students and staff working in health services, and the provision of high-quality care to patients is paramount.

        1.1 The roles and tasks assigned to students should be as safe as possible.

        1.2 Students must be trained in using PPE.

1.3 Students must have access to appropriate PPE, at the level recommended by their clinical supervisor or jurisdictional guidelines.

1.4 Students, or their regular contacts, at higher risk of COVID-19 require special consideration.

1.5 Safety of the longer-term workforce is also an important consideration.

2. **Continuation** – continue clinical education, including placements, as much as possible to balance quality learning opportunities for students with the short and long-term health needs of the population, and service providers' priorities.
3. **Outcome focussed** – accreditation standards support flexible approaches to clinical education with a focus on achievement of learning outcomes within the dynamic context of the pandemic.
4. **Collaborate and innovate** – effective clinical placements are a collaboration between students, supervising clinicians, health services and educational organisations. This requires close communication with all stakeholders. Sharing resources and innovative responses to the COVID-19 pandemic across sectors is encouraged.
5. **Prioritise** – students closest to graduation can contribute most to patient care, and their timely graduation and registration is critical to workforce sustainability.
6. **Capacity** – use clinical education arrangements to extend capacity and consider where students could use their existing skills in the health system and community with different supervision models and away from the frontline COVID-19 response. This would release staff and resources for COVID-19 work and can also provide quality learning opportunities.
7. **Identify, monitor and manage risks** to students, education providers and health services according to pandemic data and service demands as they change.
8. **Maximise recognition of appropriate clinical experience** – education providers and accreditation authorities to maximise the recognition of relevant learning gained by registered students in paid employment as appropriate to individual professions, within jurisdictional contexts.

- Other considerations
  - Where services are reduced or suspended for safety reasons in certain professions, weighing up the capacity of clinicians to manage students and the ability for students to achieve learning outcomes may be necessary.
  - Putting aside competition to secure placements will help service providers and the community, as well as students and education providers.

  - Education providers and health services are encouraged to implement mechanisms to ensure students adhere to placement protocols, their supervisors' directions and government instructions regarding the pandemic, for example, by social distancing and limiting travel for placements.

- **Junior medical officers** – term two 2020 clinical rotations were suspended for junior medical officers (interns) in NSW.(44) They will remain at the same site as their term one rotation. The Medical Board of Australia have advised that they will waive the usual rotation requirements for interns in 2020. The Board will accept the following supervised clinical experience for general registration.
  - At least 40 weeks full-time equivalent service (a reduction of seven weeks to allow for isolation or sick leave, etc.)
  - The clinical experience can take place in accredited and non-accredited positions
  - The requirement for the usual rotations of medicine, surgery and emergency medical care is waived. The Board will accept clinical experience in any supervised rotations.(45)

Specialty	Summary
Anesthesiology	• The ACGME Review Committee on anesthesiology acknowledges that the COVID-19 pandemic will 'very likely… result in a reduction in the number of procedures performed by the residents/fellows in our programs for the foreseeable future'. They state that it is possible that some programs will find it necessary to extend the period of residency or fellowship for some residents or fellows. They stress that '[e]xtension of the educational program as a result of the current circumstances must not be viewed as reflecting poorly on the affected residents/fellows in any way.' ACGME also emphasises that the case logs of an anesthesiology program's graduates who were on duty during the pandemic (particularly those in their final years of the program) will be judiciously considered in light of the impact of the pandemic on that program.(46)
Adolescent health and pediatric medicine	• Impact of COVID-19 pandemic on adolescent health programs. ○ Rapid changes disrupting standard operations within clinical care, teaching and research. ○ Out-of-necessity patient and clinical care needs are being prioritised. ○ Challenge of finding balance between delivery of patient care with trainee's educational needs.

	○ All of the fellowship programs moved their fellowship seminars and case conference sessions to online learning, reflecting policies instituted by the universities and hospital systems. (47)
Cardiology	• Due to required social distancing measures, traditional model of person-to-person educational didactics, lectures, and chalk talks were reported to be compromised. ○ Continued fellowship education and weekly conferences held virtually using a combination of Zoom and Microsoft Teams have facilitated collaboration, a sense of community, and been an effective learning method.(17) • A survey of 14 interventional cardiology fellowship programs in New York found a significant reduction in cardiac catheterisation laboratory procedural volumes, reducing training time and impeding fellowship education. Trainees reported having severe concerns about their training and career prospects due to this disruption.(48) • In the UK, as hospitals restructure in response to COVID-19, cardiology trainees have temporarily suspended their speciality training to help. Trainees report feeling inadequately trained and anticipate their training time being extended.(49)
Dermatology	• In the USA, ACGME describes overall reductions in dermatology procedures, visits. (50) • Redeployment of dermatology residents to critical services (USA) but most are reportedly working in dermatology practices impacted by pandemic (50, 51). • ACGME recommends residents to keep accurate logs of dermatology procedures during this time. Case logs of program graduates will be judiciously evaluated by ACGME, and impact from pandemic will be considered.(50) • Some educators recommend immediately implementing teledermatology workflows that incorporate residents, especially patient assessment and care planning, to avoid disruption to education and to facilitate troubleshooting while patient volume is low.(51)
Dentistry	• Most dental schools in the USA have suspended clinical activities except for dental emergencies (for active patients that are seen by faculty or residents), and some are practicing social distancing in their preclinical simulation laboratory activities.(18).

	• The Commission on Dental Accreditation mandates that it must be notified in writing of any interruptions in education arising from COVID-19 "that may compromise the quality and effectiveness of education". The institution must provide a comprehensive plan of how this disruption will be addressed. (52)
	• Iyer and colleagues recommend some approaches to addressing disruptions in dental education.
	  ○ Develop and implement quality virtual distance education using asynchronous and synchronous methods, flipped classroom strategy, and problem-based learning as appropriate.
	  ○ Train faculty on remote education methodology.
	  ○ Have open communication about policy changes and decisions between schools and students.
	  ○ Reduce psychological stress (e.g. counselling).
	  ○ Modify attendance and grading policies, as well as assignment submission to reduce anxiety.(18)
	• Tattar and Roudsari recommend the use of personal development plans for dentistry trainees in the UK to identify and fulfil the loss of clinical experience due to pandemic, with the support of their educational supervisors.(53)

Emergency medicine	• The ACGME Emergency Medicine Review Committee emphasises the three main requirements of the ACGME for residency programs in emergency medicine.
	  1. No change in work hour requirements (max 80 hours/week) and ensure adequate rest in between shifts.
	  2. Ensure adequate resources and training (for COVID-19 patient care).
	  3. Have adequate supervision.(54)
	• It also stresses that program directors retain the sole authority to determine:
	  ○ Whether individuals have met the competency requirements to successfully complete the program and enter independent practice
	  ○ how the curriculum is structured and delivered. The committee acknowledges that innovations will be required during this pandemic.(54)

Family medicine	• In Australia, the Australian Medical Association outlined these potential impacts of COVID-19 on general practice registrars.
	  ○ Practices moving heavily towards telehealth service delivery
	  ○ Trainees being redeployed to other practices and clinical areas to meet care needs
	  ○ Training and work (hours, patient load and case mix) will be significantly impacted
	  ○ Significant level of concern and worry in registrars.(15)
	• The Association thus recommends the following to support general practice registrars during the COVID-19 pandemic.
	  ○ If trainees do not have access to PPE, they should not be involved in the care of patients in quarantine or under investigation or with suspected or confirmed COVID-19 infection.
	  ○ Enabling greater flexibility to access leave and progress through training.
	  ○ Provision of adequate training in telehealth service delivery.
	  ○ Enabling timely access to Medicare Provider Numbers.
	  ○ Ensuring that practices are supported to retain their registrars, and where this is not feasible, to ensure that registrars can be deployed to other training practices.(15)
	• The ACGME in the USA also recognises that trainees may not be able meet the minimum required patient visits for accreditation or certification in light of the pandemic. It leaves flexibility for the program directors to 'to assess the competence of an individual resident as one part of the determination of whether that individual is prepared to graduate and enter the unsupervised practice of medicine.' It also permits residents to participate in the use of telemedicine during COVID-19, with appropriate supervision, and outlines that the program director and the designated institutional official must approve any requests for residents to care for patients affected by COVID19.(16)

General surgery	• In the UK, potential disruptions to junior doctor training include: de-specialisation of all junior doctors, apart from core specialties central to the COVID-19 response; rotations being cancelled; academic and out-of-

	program trainees being asked to return to clinical practice; and trainees deployed to work in COVID-19 related critical care, with some trepidations about COVID-19 patient care.(55, 56)
	• In a survey of general surgery residents in the USA, trainees reported being prepared for deployment, but had concerns around possibility of transmission to family and patients.(14)
	• In the USA, most surgical facilities are minimising staffing in any operation to essential personnel only, limiting or cancelling clinical rotations to minimise transmission, cancelling or postponing elective operations, and implementing general social distancing measures in surgical departments.(57, 58) As a result, residents are seeing a decrease in case volume and patient exposure.(58) ACGME has discussed the possibility of extending the residency or fellowship period in some surgical programs, as a result of the pandemic.(59)
	• Innovative strategies to mitigate this disruption to clinical education have been implemented by Chick and colleagues (2020).
	  ○ Flipped virtual classroom model
	  ○ Online practice questions
	  ○ Academic conferences via teleconference
	  ○ Telehealth clinics with resident involvement
	  ○ Facilitated use of surgical videos (58)
	• Coe and colleagues also recommend the delivery of multi-faceted virtual education including the use of operative video-based education, virtual lectures, online resources, and virtual simulations (with real-time feedback using videoconferencing).(57)

Internal medicine	• The authors identified five topics chief residents can consider to guide their program's response to the demands of COVID-19; maintaining core values, managing communication, maintain community, evolving roles of chief residents and creating a sense of normalcy.(60) • The elimination and reduction of most elective procedures has inevitably jeopardised the development of specialist skills, at least temporarily. Postgraduates and fellows from medical areas such as gastroenterology have been redistributed. Some continued their rotations but organisation charts were

	reviewed to minimise overlapping team members with a weekly schedule. Digital online platforms were used for training, education and assessment.(61) • The overarching message is that the ACGME trusts designated institutional officials, program directors, and faculty members to make the changes necessary to care for patients during this crisis.(62)
Medical genetics	• In the USA, online resources and learning are being used. Educators have worked to identify ways to create web-based interactive learning activities. A curriculum was created directly relating to patient care as a result of guidance that medical students should not be involved in direct patient care.(38)
Neurology and neurosurgery	• Six US publications include: • In-person didactics are cancelled and surgical volume is significantly reduced and there is an inadequate supply of PPE. Clinic visits have transitioned to telemedicine where possible, decreasing resident exposure to outpatient encounters. Plans for online education. (63) • Changes included removing residents from outpatient services, minimizing the number of residents on inpatient services, deploying residents to medicine services and medical intensive care units, converting continuity clinic patient visits to virtual options, transforming didactics to online platforms only, and maintaining connectedness in an era of social distancing. (64) • Changes included alterations to the methods for educating residents and the clinical care duties of residents. Face to face have been shifted to video conferencing. Most programs have reduced resident COVID-19 exposure risk by reducing the number of residents in the hospital at one time and by reducing the number of days per week that each resident works. (65) • All in-person conferences such as grand rounds, resident education conferences, and multidisciplinary board meetings have been replaced by video teleconferences. Only the minimal number of residents and/or fellows required for patient care are allowed to come to the hospital. Rotating resident schedules have been devised to minimize resident viral exposure and burnout. (66) • We have been streamlining our resident services to reduce exposure to patients potentially infected with COVID-19. For example, our neurosurgical spine service was subdivided into 2 working teams; each team

	has 2 attending neurosurgeons, 1 resident, and 1 advanced-practice provider. Telemedicine visits were also used. (67) • Restricting non elective surgery has reduced surgical opportunities for residents, rationing of PPE has meant they may be banned from the operating room. Many programs have reduced the number of in-house residents and some may be redeployed. Web based educational platforms have begun and online resources developed. (68)
Nuclear medicine	• Each medicine program is encouraged to proactively evaluate the potential impact of the changing environment on resident education, to make plans to mitigate any limitations, and to innovate in the learning environment and pathways for its residents. (69)
Nursing and midwifery	• The Nursing and Midwifery Board of Ahpra (NMBA) and the Australian Nursing and Midwifery Accreditation Council (ANMAC) report that some students may be unable to complete their clinical placements because they have been paused or cancelled due to COVID-19.(70) They advise that it is at the discretion of education providers and health services to determine whether it is safe and possible for clinical placements to proceed at this time, with consideration for the safety of students, practitioners and the public in line with the COVID-19 guidance in their state or territory. • The NMBA and ANMAC provide the following guidance to students and education providers of NMBA-approved nursing and midwifery undergraduate programs. ○ **Extension of programs:** The NMBA and ANMAC understand that the ongoing and changing situation surrounding COVID-19 may mean that students are not able to attend classes or clinical placements and that extensions to the length of programs to enable students time to complete may be required. ○ **ANMAC accreditation of programs:** Program accreditation is continuing, there may be a requirement to postpone or cancel site visits. In this circumstance, alternatives such as video or teleconferencing or virtual site visits will be organised.

	○ **Professional experience programs (PEPs):** Where possible, PEP should continue, preference should be given to students in the final year of their program to ensure that the program requirements and the relevant NMBA standards for practice can be met for registration. ○ **Current training and education:** For all accredited nursing and midwifery programs it is important that education providers continue to offer the curriculum and that students continue to attend unless otherwise informed by their education provider. Education providers are transferring as much theory online as possible. At this stage skills labs and clinical placements will proceed as advised by the education provider. • In Australia, the *Midwife Accreditation Standards 2014* outline the minimum supervised midwifery practice experience requirements that a student must achieve in order to successfully complete a midwifery entry to practice program. The ANMAC outlines guidance for midwifery students in the current difficulties surrounding these continuity of care requirements: (71) ○ In Standard criterion 8.11 (a), the Midwife Accreditation Standards state that woman-centred care is the focus of continuity of care experiences. The student is required to provide midwifery care under the supervision of a midwife. ○ The student must be supported to establish a professional relationship with a minimum of 10 individual women though pregnancy, labour and birth, and the post-natal period. This is regardless of model of care. ○ For each of the 10 women, the student must attend four antenatal visits and two postnatal visits. Recognising that for a variety of reasons students might not be able to attend labour and birth of all 10 women, the standards require that students must attend a majority i.e. at least six (6) of the labour and births. ○ The current COVID-19 restrictions have resulted in limited opportunities for some students to attend antenatal and postnatal clinics and to attend the labour and birth of their continuity of care women. ○ ANMAC recommends that education providers consider the following options for students to optimise their opportunities to meet the requirements for Standard 8.11 (a):

	○ students can attend ante and postnatal visits remotely via the use of their phone. This would require the agreement of all parties (woman, midwife, or obstetrician, and education provider) ○ where students miss out on engaging with a woman during labour and birth experience due to precipitous birth or exclusion from birthing suite (or operating theatre) because of COVID-19 distancing rules, the student could connect with the woman as soon as possible afterwards to discuss and reflect on her experience. It is preferable that this interaction is face to face but in current circumstances, if the woman agrees, this could be via phone. ANMAC acknowledges that some women may not wish to participate in this immediately after the birth.
Orthopedic surgery	In the USA • Many departments have adopted a residency surge plan where a portion of the residents are assigned to hospital duties and the remainder are quarantined to their home environment. Orthopedic surgery residents are already being redeployed to intensive care units and emergency departments. Virtual learning including for meetings and conferences. Independent study continues and surgical simulation. (72) • In response to the COVID-19 pandemic, the authors developed and implemented a modified operational schedule and remote curriculum in the orthopaedic surgery department of their health system.(73) • 5 tenants support a two-team system, whereby the residents are divided into cycling active duty and working remotely factions. Active duty residents participate in in-person surgical encounters and virtual ambulatory encounters, whereas remotely working residents participate in daily video-conferenced faculty-lead, case-based didactics and pursue academic investigation, grant writing, and quality improvement projects.(74) In the UK • Specialty registrars of various training levels had come from five different rotations. A roster for redeployment is managed by a senior trainee and overseen by the clinical lead of the department. Teleconferencing was used.(75)
Osteopathic neuromuskuloskeletal medicine	• The authors encourage programs to report on the impact and the changes necessitated by the pandemic. The expectation to log patient encounters and meet established minimums has not been waived by the

	Review Committee. It may be necessary for some programs to extend the period of residency for some residents.(76)
Otolaryngology, head and neck, oral and maxillofacial surgery	• Many residency programs have created teams in which a portion of the residents are assigned to clinical activities while others are to abstain. At Southern Illinois University, a research curriculum has been implemented. The non-clinical resident's video conference with their research mentor weekly to develop a plan. At the end of each week, a virtual research meeting is held for all residents. One resident provides an in-depth update on their project. The research techniques and statistical analyses specific to that project are reviewed in detail.(77) • Redeployment of otolaryngology residents is a new reality for many otolaryngology residents. As these residents are being called to the front lines, it is important to ensure their safety, with appropriate PPE, supervision, and adherence to duty hour requirements.(77, 78) • In less than one month, otolaryngologists have implemented technology for the delivery of education, a nationwide didactic curriculum, virtual sessions for social connectedness, and new research curricula. (77)
Pain medicine	• Understanding revisions in ACGME policies, use of technology to promote remote learning opportunities, and providing trainees with opportunities to alleviate their anxieties and encourage mental health are beneficial strategies to implement.(79, 80)
Pharmacy	• Teleconferencing and virtual communication is essential in order to achieve rotational goals and objectives. (81)
Physical medicine and rehabilitation	• The ACME Review Committee for Physical Medicine and Rehabilitation determined it is up to the program director, with input from the program's Clinical Competency Committee, to assess the procedural competence of an individual resident.(82)
Preventive medicine	• Details specific work that will count as direct patient care during COVID-19. Provides options such as deferring, other activities for non-clinical resident activities that may be impacted.(83)

Radiation oncology	• As a result of the COVID-19 pandemic and its effects on radiation oncology, it is certainly possible that some programs will find it necessary to extend the period of residency for some residents. Case logs of a graduate on duty during the pandemic will be judiciously considered.(84)
Radiology	• The ACGME in the USA outlines details required for residents to complete and some solutions e.g. that breast imaging and nuclear medicine rotations may include telemedicine for senior residents impacted by COVID-19. If, due to COVID-19, a resident is unable to complete the intensive care unit rotation, they must complete an intensive care unit rotation during the interventional radiology-independent residency. If, due to COVID-19, an Early Specialisation in Interventional Radiology resident receives an emergency assignment (redeployment) to serve in an intensive care unit for one month, that service would satisfy the Early Specialisation in Interventional Radiology curriculum intensive care unit requirement.(85) • In the USA strategies to find a balance between on-site and remote learning, residents are encouraged to develop research projects, residents may be redeployed, participate in drills. ACGME has suspended accreditation activities so that programs can focus on response to the pandemic.(86) • In the USA, strategies include virtual platforms including virtual rounds, innovative approaches for educational needs such as weekly quiz.(87) • A USA study described a residency program in three stages, business as usual, increased clinical demand where some trainees may shift to pandemic related duties and emergency status where all other common program requirements are suspended. Remote learning solutions are described and include the importance of patient wellbeing.(88) • Areas of impact include: staffing, interpretation, patient interactions, clinical redeployment, supervision, didactic learning, research, credentialing, safety, social and financial. Solutions include infrastructure for remote interpretation, rotations with distancing and backup, adequate PPE, provision of training in CT interpretation, soliciting volunteers for defilement, distribution of educational resources, and reviewing trainee competency criteria.(89) • In the USA solutions include maintaining the educational mission through teleconferencing, reassignment of trainees and staff.(90)

Rheumatology	• A study from NSW describes that all lectures and tutorials are now delivered online and there is a move to also deliver the clinical course work online. Some students completing MD research projects have had to re-scope their projects. The divisional clinical examination for basic physician trainees has been postponed until next year. The junior medical staff (including rheumatology trainees) face redeployment to other clinical roles.(91)
Urology	• In the USA, a residency programs framework outlines resident coverage and a revised curriculum during COVID-19 including daily virtual learning.(92) • A survey in the USA, saw that in some programs because reserve staffing had started, patient contact time decreased and redeployment, residents would not meet case minimums. Video conferencing had started to be used.(93) • A residency program in the USA employed temporary residency program restructuring, this included; use of telemedicine, simulation to improve PPE access and decrease transmission, training in areas outside of urology.(94) • In Italy, a survey saw the proportion of residents routinely involved in clinical and surgical activities decrease from 79.8% to 87.2% and from 49.3% to 73.5%, respectively. To address this challenge, strategies aiming to increase the use of telemedicine, smart learning programs and tele-mentoring of surgical procedures, are warranted.(95) • In Italy, new smart learning technologies such as pre-recorded videos, webinars, social media, podcasts, clinical virtual rounds and simulations have been described to limit the impact of COVID-19 on residents.(96)

Appendix

PubMed search terms*

((((("Education, Medical, Undergraduate"[Mesh]) OR "Students, Medical"[Mesh]) OR "Education, Medical/methods"[Mesh]) OR ((((medical[Title/Abstract]) OR medicine[Title/Abstract])) AND (((undergraduate*[Title/Abstract]) OR under-graduate*[Title/Abstract]) OR student*))) AND ((2019-nCoV[title/abstract] or nCoV*[title/abstract] or covid-19[title/abstract] or covid19[title/abstract] OR "covid 19"[title/abstract] OR "coronavirus"[MeSH Terms] OR "coronavirus"[title/abstract] OR sars-cov-2[title/abstract] OR “severe acute respiratory syndrome coronavirus 2”[Supplementary Concept]))

Google and Twitter search terms

Google scholar

- medical education COVID-19
- COVID-19 clinical training junior doctors
- Junior medical officer COVID-19
- Junior doctors COVID-19
- Clinical training COVID-19 residents

Google

- The impact of COVID-19 pandemic on medical education
- Impact of COVID 19 on nursing education

References

1. Hannon P, Lappe K, Griffin C, Roussel D. Objective Structured Clinical Examination: From Exam Room to Zoom Breakout Room. Med Educ. 2020.
2. Torres A, Domańska-Glonek E, Dzikowski W, Korulczyk J, Torres K. "Transition to on-line is possible: solution for simulation-based teaching during pandemic". Med Educ. 2020.
3. Roskvist R, Eggleton K, Goodyear-Smith F. Provision of e-learning programmes to replace undergraduate medical students' clinical general practice attachments during COVID-19 stand-down. Educ Prim Care. 2020:1-8.
4. Geha R, Dhaliwal G. Pilot virtual clerkship curriculum during a pandemic: pod casts, peers, and problem-solving. Med Educ. 2020.
5. Mooney CJ, Peyre SE, Clark NS, Nofziger AC. Rapid transition to online assessment: practical steps and unanticipated advantages. Med Educ. 2020.
6. Haines MJ, Cm Yu A, Ching G, Kestler M. Integrating COVID-19 Volunteer Response into the Year 3 MD Curriculum. Med Educ. 2020.
7. Hofmann H, Harding C, Youm J, Wiechmann W. Virtual Bedside Teaching Rounds on Patients With COVID-19. Med Educ. 2020.

*PubMed search string relating to ‘medical education’ was referenced from Uygur and colleagues (2019). 97. Uygur J, Stuart E, De Paor M, Wallace E, Duffy S, O’Shea M, et al. A Best Evidence in Medical Education systematic review to determine the most effective teaching methods that develop reflection in medical students: BEME Guide No. 51. Medical Teacher. 2019;41(1):3-16.

8. Torda AJ, Velan G, Perkovic V. The impact of COVID-19 pandemic on medical education. The Medical Journal of Australia. 2020:1.
9. Principles to support medical students' safe and useful roles in the COVID-19 health workforce [press release]. Medical Deans Australia and New Zealand, 20 March 2020 2020.
10. Medical Students' contribution to the health workforce response to COVID-19 [press release]. Australia: Medical Deans of Australia and New Zealand, 19 March 2020 2020.
11. Halbert J, Jones A, Ramsey L. Clinical placements for medical students in the time of COVID-19. The Medical Journal of Australia. 2020:1.
12. United States Medical Licensing Examination. USMLE Suspending Step 2 Clinical Skills Examination United States: USMLE; 2020 [Available from: https://covid.usmle.org/announcements/usmle-suspending-step-2-clinical-skills-examination/.
13. Tapper J, Batty D, Savage M. Medical students take final exams online for first time, despite student concern. The Guardian. 2020 22 March 2020.
14. He K, Stolarski A, Whang E, Kristo G. Addressing General Surgery Residents' Concerns in the Early Phase of the COVID-19 Pandemic. J Surg Educ. 2020:S1931-7204(20)30118-5.
15. Australian Medical Association. Supporting General Practice registrars during the COVID-19 pandemic. ACT: AMA; 2020 9 April.
16. Accreditation Council for Graduate Medical Education. Review Committee for Family Medicine Notice and Guidance to Programs. Chicago, Illinois: ACGME; 2020 31 March.
17. Almarzooq ZI, Lopes M, Kochar A. Virtual Learning During the COVID-19 Pandemic: A Disruptive Technology in Graduate Medical Education. J Am Coll Cardiol. 2020;75(20):2635-8.
18. Iyer P, Aziz K, Ojcius DM. Impact of COVID-19 on dental education in the United States. Journal of Dental Education. 2020;84(6):718-22.
19. Basky G. All hands on deck as cases of COVID-19 surge. Cmaj. 2020;192(15):E415-e6.
20. COVID-19: early provisional registration for final year students [press release]. London, UK: BMA, 12 May 2020 2020.
21. Kalet AL, Jotterand F, Muntz M, Thapa B, Campbell B. Hearing the Call of Duty: What We Must Do to Allow Medical Students to Respond to the COVID-19 Pandemic. Wmj. 2020;119(1):6-7.
22. Klasen JM, Meienberg A, Nickel C, Bingisser R. SWAB team instead of SWAT team - students as front-line force during the COVID-19 Pandemic. Medical Education. 2020;n/a(n/a).
23. Kottasová I. Thousands of medical students are being fast-tracked into doctors to help fight the coronavirus: CNN; 2020 [updated 20 March 2020. Available from: https://edition.cnn.com/2020/03/19/europe/medical-students-coronavirus-intl/index.html.
24. Lapolla P, Mingoli A. COVID-19 changes medical education in Italy: will other countries follow? Postgraduate Medical Journal. 2020:postgradmedj-2020-137876.
25. Menon A, Klein EJ, Kollars K, Kleinhenz ALW. Medical Students Are Not Essential Workers: Examining Institutional Responsibility During the COVID-19 Pandemic. Acad Med. 2020.
26. Guidance for postgraduate medical and dental trainees – redeployment to NHS Nightingale Hospitals [press release]. UK, April 2020 2020.
27. Rasmussen S, Sperling P, Poulsen MS, Emmersen J, Andersen S. Medical students for health-care staff shortages during the COVID-19 pandemic. Lancet. 2020;395(10234):e79-e80.
28. Sharif SP. UK medical students graduating early to work during the COVID-19 pandemic. Psychol Med. 2020:1-.
29. Wang JH-S, Tan S, Raubenheimer K. Rethinking the role of senior medical students in the COVID-19 response. Medical Journal of Australia. 2020;212(10):490-.e1.
30. Lapolla P, Mingoli A. COVID-19 changes medical education in Italy: will other countries follow? Postgrad Med J. 2020.
31. Finn GM, Brown MEL, Laughey W, Dueñas A. #pandemicpedagogy: using twitter for knowledge exchange. Medical Education.n/a(n/a).
32. Huddart D, Hirniak J, Sethi R, Hayer G, Dibblin C, Rao BM, et al. #Med StudentCovid - How social media is supporting students during COVID-19. Med Educ. 2020.
33. Rastegar Kazerooni A, Amini M, Tabari P, Moosavi M. Peer mentoring for medical students during COVID-19 pandemic via a social media platform. Med Educ. 2020.

34. Akers A, Blough C, Iyer MS. COVID-19 Implications on Clinical Clerkships and the Residency Application Process for Medical Students. Cureus. 2020;12(4):e7800.
35. Hall AK, Nousiainen MT, Campisi P, Dagnone JD, Frank JR, Kroeker KI, et al. Training disrupted: Practical tips for supporting competency-based medical education during the COVID-19 pandemic. Medical Teacher. 2020:1-6.
36. Moszkowicz D, Duboc H, Dubertret C, Roux D, Bretagnol F. Daily medical education for confined students during COVID-19 pandemic: A simple videoconference solution. Clin Anat. 2020.
37. Pennell CE, Chen SQ, Kluckow H, Wisely KM, Walker BL. Live streamed ward rounds–a tool for clinical teaching during the COVID-19 pandemic. The Medical Journal of Australia. 2020:1.
38. Regier DS, Smith WE, Byers HM. Medical genetics education in the midst of the COVID-19 pandemic: Shared resources. Am J Med Genet A. 2020;182(6):1302-8.
39. Sandars J, Correia R, Dankbaar M, de Jong P, Goh PS, Hege I, et al. Twelve tips for rapidly migrating to online learning during the COVID-19 pandemic. MedEdPublish. 2020;9(1).
40. Taha MH, Abdalla ME, Wadi M, Khalafalla H. Curriculum delivery in Medical Education during an emergency: A guide based on the responses to the COVID-19 pandemic. MedEdPublish. 2020;9.
41. Tolsgaard MG, Cleland J, Wilkinson T, Ellaway RH. How we make choices and sacrifices in medical education during the COVID-19 pandemic. Med Teach. 2020:1-3.
42. Guidance on Medical Students' Participation in Direct Patient Contact Activities [press release]. Washington DC, 14 April 2020 2020.
43. Ahpra and National Boards. National principles for clinical education during the COVID-19 pandemic Melbourne, Victoria: Ahpra; 2020 [updated 29 April 2020. Available from: https://www.ahpra.gov.au/News/COVID-19/National-principles-for-clinical-education-during-COVID-19.aspx.
44. Suspension of term two 2020 JMO rotations [press release]. Workforce Planning and Talent Development, 6 April 2020 2020.
45. Medical Board of Australia responses to COVID-19 pandemic [press release]. MBA, 30 March 2020.
46. Accreditation Council for Graduate Medical Education. From the Review Committee for Anesthesiology. Chicago, Illinois: ACGME; 2020 20 March.
47. Emans SJ, Ford CA, Irwin CE, Jr., Richardson LP, Sherer S, Sieving RE, et al. Early COVID-19 Impact on Adolescent Health and Medicine Programs in the United States: LEAH Program Leadership Reflections. J Adolesc Health. 2020:S1054-139X(20)30186-5.
48. Gupta T, Nazif TM, Vahl TP, Ahmad H, Bortnick AE, Feit F, et al. Impact of the COVID-19 pandemic on interventional cardiology fellowship training in the New York metropolitan area: A perspective from the United States epicenter. Catheterization and Cardiovascular Interventions.n/a(n/a).
49. Mamas M. COVID-19: What's the Impact on Junior Doctors? Medscape. 2020 11 April 2020.
50. Accreditation Council for Graduate Medical Education. Review Committee for Dermatology Notice and Guidance to Programs. Chicago, Illinois: ACGME; 2020 27 March.
51. Oldenburg R, Marsch A. Optimizing teledermatology visits for dermatology resident education during the COVID-19 pandemic. Journal of the American Academy of Dermatology. 2020;82(6):e229.
52. Commission on Dental Accreditation. Guidelines for Reporting an Interruption of Education During COVID-19. Chicago, Illinois: CODA; 2020 3 April.
53. Tattar R, Roudsari RV. COVID PDPs. British Dental Journal. 2020;228(10):735-6.
54. Accreditation Council for Graduate Medical Education. Review Committee for Emergency Medicine Notice and Guidance to Programs. Chicago, Illinois: ACGME; 2020 27 March.
55. Hourston GJM. The impact of despecialisation and redeployment on surgical training in the midst of the COVID-19 pandemic. Int J Surg. 2020;78:1-2.
56. Jeyabaladevan P. COVID-19: an FY1 on the frontline. Medical Education Online. 2020;25(1):1759869.
57. Coe TM, Jogerst KM, Sell NM, Cassidy DJ, Eurboonyanun C, Gee D, et al. Practical Techniques to Adapt Surgical Resident Education to the COVID-19 Era. Annals of Surgery. 2020;Publish Ahead of Print.

58. Chick RC, Clifton GT, Peace KM, Propper BW, Hale DF, Alseidi AA, et al. Using Technology to Maintain the Education of Residents During the COVID-19 Pandemic. J Surg Educ. 2020.
59. Accreditation Council for Graduate Medical Education. COVID-19: Special Communication to Surgical Program Directors, including Case Log Guidance. Chicago, Illinois: ACGME; 2020 2 April.
60. Rakowsky S, Flashner BM, Doolin J, Reese Z, Shpilsky J, Yang S, et al. Five Questions for Residency Leadership in the Time of COVID-19: Reflections of Chief Medical Residents From an Internal Medicine Program. Academic medicine : journal of the Association of American Medical Colleges. 2020:10.1097/ACM.0000000000003419.
61. Barberio B, Massimi D, Dipace A, Zingone F, Farinati F, Savarino EV. Medical and gastroenterological education during the COVID-19 outbreak. Nature Reviews Gastroenterology & Hepatology. 2020.
62. Accreditation Council for Graduate Medical Education. Review Committee for Internal Medicine. Chicago, Illinois: ACGME; 2020 16 April.
63. Bambakidis NC, Tomei KL, . Editorial. Impact of COVID-19 on neurosurgery resident training and education. 2020:1.
64. Agarwal S, Sabadia S, Abou-Fayssal N, Kurzweil A, Balcer LJ, Galetta SL. Training in neurology: Flexibility and adaptability of a neurology training program at the epicenter of COVID-19. Neurology. 2020:10.1212/WNL.0000000000009675.
65. Pennington Z, Lubelski D, Khalafallah AM, Ehresman J, Sciubba DM, Witham TF, et al. Letter to the Editor "Changes to Neurosurgery Resident Education Since Onset of the COVID-19 Pandemic". World Neurosurgery. 2020.
66. Eichberg DG, Shah AH, Luther EM, Menendez I, Jimenez A, Perez-Dickens M, et al. Letter: Academic Neurosurgery Department Response to COVID-19 Pandemic: The University of Miami/Jackson Memorial Hospital Model. Neurosurgery. 2020;87(1):E63-E5.
67. Bray DP, Stricsek GP, Malcolm J, Gutierrez J, Greven A, Barrow DL, et al. Letter: Maintaining Neurosurgical Resident Education and Safety During the COVID-19 Pandemic. Neurosurgery. 2020.
68. Tomlinson SB, Hendricks BK, Cohen-Gadol AA. Editorial. Innovations in neurosurgical education during the COVID-19 pandemic: is it time to reexamine our neurosurgical training models? 2020:1.
69. Accreditation Council for Graduate Medical Education. From the Review Committee for Nuclear Medicine. Chicago, Illinois: ACGME; 2020 27 April.
70. Nursing and Midwifery Board APHRA. COVID-19 guidance for nurses and midwives Melbourne, VIC: APHRA; 2020 [updated 21 May 2020. Available from: https://www.nursingmidwiferyboard.gov.au/Codes-Guidelines-Statements/COVID19-guidance.aspx.
71. Australian Nursing and Midwifery Accreditaiton Council. Continuity of Care Experiences during COVID19 pandemic 2020. ANMAC; 2020 22 April 2020.
72. Kogan M, Klein SE, Hannon CP, Nolte MT. Orthopaedic Education During the COVID-19 Pandemic. J Am Acad Orthop Surg. 2020;28(11):e456-e64.
73. Sabharwal S, Ficke JR, LaPorte DM. How We Do It: Modified Residency Programming and Adoption of Remote Didactic Curriculum During the COVID-19 Pandemic. J Surg Educ. 2020.
74. Schwartz AM, Wilson JM, Boden SD, Moore TJ, Jr., Bradbury TL, Jr., Fletcher ND. Managing Resident Workforce and Education During the COVID-19 Pandemic: Evolving Strategies and Lessons Learned. JBJS Open Access. 2020;5(2).
75. Aljabi YF, Divani K, Ray PS. Management of Orthopaedic Trainees' Roster During COVID-19: Lessons Learned.
76. Accreditation Council for Graduate Medical Education. From the Review Committee for Osteopathic Neuromusculoskeletal Medicine. Chicago, Illinois: ACGME; 2020 22 April.
77. Crosby DL, Sharma A. Insights on Otolaryngology Residency Training during the COVID-19 Pandemic. Otolaryngology–Head and Neck Surgery. 2020:0194599820922502.
78. Cai Y, Jiam NT, Wai KC, Shuman EA, Roland LT, Chang JL. Otolaryngology Resident Practices and Perceptions in the Initial Phase of the U.S. COVID-19 Pandemic. The Laryngoscope.n/a(n/a).
79. Kohan L, Moeschler S, Spektor B, Przkora R, Sobey C, Brancolini S, et al. Maintaining high quality multidisciplinary pain medicine fellowship programs: Part I: Innovations in pain fellows'

education, research, applicant selection process, wellness and ACGME implementation during the Covid-19 pandemic. Pain Medicine. 2020.
80. Kohan L, Sobey C, Wahezi S, Brancolini S, Przkora R, Shaparin N, et al. Maintaining High-Quality Multidisciplinary Pain Medicine Fellowship Programs: Part II: Innovations in Clinical Care Workflow, Clinical Supervision, Job Satisfaction, and Postgraduation Mentorship for Pain Fellows During the COVID-19 Pandemic. Pain Medicine. 2020.
81. Louiselle K, Elson EC, Oschman A, Duehlmeyer S. Impact of COVID-19 pandemic on pharmacy learners and preceptors. American Journal of Health-System Pharmacy. 2020.
82. Accreditation Council for Graduate Medical Education. From the Review Committee for Physical Medicine and Rehabilitation. Chicago, Illinois: ACGME; 2020 20 March.
83. Accreditation Council for Graduate Medical Education. Review Committee for Preventive Medicine Guidance to Residency Programs in Response to the COVID-19 Pandemic. Chicago, Illinois: ACGME; 2020 20 March.
84. Accreditation Council for Graduate Medical Education. From the Review Committee for Radiation Oncology. Chicago, Illinois: ACGME; 2020 20 March.
85. Accreditation Council for Graduate Medical Education. Special Communication to Diagnostic Radiology Residents, Interventional Radiology Residents, Subspecialty Radiology Fellows, and Program Directors. Chicago, Illinois: ACGME; 2020 17 April.
86. Chong A, Kagetsu NJ, Yen A, Cooke EA. Radiology residency preparedness and response to the COVID-19 pandemic. Academic Radiology. 2020.
87. Slanetz PJ, Parikh U, Chapman T, Motuzas CL. Coronavirus Disease 2019 (COVID-19) and Radiology Education-Strategies for Survival. J Am Coll Radiol. 2020;17(6):743-5.
88. England E, Kanfi A, Flink C, Vagal A, Sarkany D, Patel MD, et al. Radiology Residency Program Management in the COVID Era - Strategy and Reality. Academic radiology. 2020:S1076-6332(20)30273-7.
89. Alvin MD, George E, Deng F, Warhadpande S, Lee SI. The Impact of COVID-19 on Radiology Trainees. Radiology. 2020:201222.
90. Prabhakar AM, Glover MIV, Schaefer PW, Brink JA. Academic Radiology Departmental Operational Strategy Related to the Coronavirus Disease 2019 (COVID-19) Pandemic. Journal of the American College of Radiology. 2020;17(6):730-3.
91. Cai K, He J, Wong PK, Manolios N. The impact of COVID-19 on rheumatology clinical practice and university teaching in Sydney, Australia. Eur J Rheumatol. 2020.
92. Vargo E, Ali M, Henry F, Kmetz D, Drevna D, Krishnan J, et al. Cleveland Clinic Akron General Urology Residency Program's COVID-19 Experience. Urology. 2020;140:1-3.
93. Rosen GH, Murray KS, Greene KL, Pruthi RS, Richstone L, Mirza M. Effect of COVID-19 on Urology Residency Training: A Nationwide Survey of Program Directors by the Society of Academic Urologists. Journal of Urology.0(0):10.1097/JU.0000000000001155.
94. Kwon YS, Tabakin AL, Patel HV, Backstrand JR, Jang TL, Kim IY, et al. Adapting Urology Residency Training in the COVID-19 Era. Urology.
95. Amparore D, Claps F, Cacciamani GE, Esperto F, Fiori C, Liguori G, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. Minerva Urol Nefrol. 2020.
96. Porpiglia F, Checcucci E, Amparore D, Verri P, Campi R, Claps F, et al. Slowdown of urology residents' learning curve during the COVID-19 emergency. BJU International. 2020;125(6):E15-E7.
97. Uygur J, Stuart E, De Paor M, Wallace E, Duffy S, O'Shea M, et al. A Best Evidence in Medical Education systematic review to determine the most effective teaching methods that develop reflection in medical students: BEME Guide No. 51. Medical Teacher. 2019;41(1):3-16.