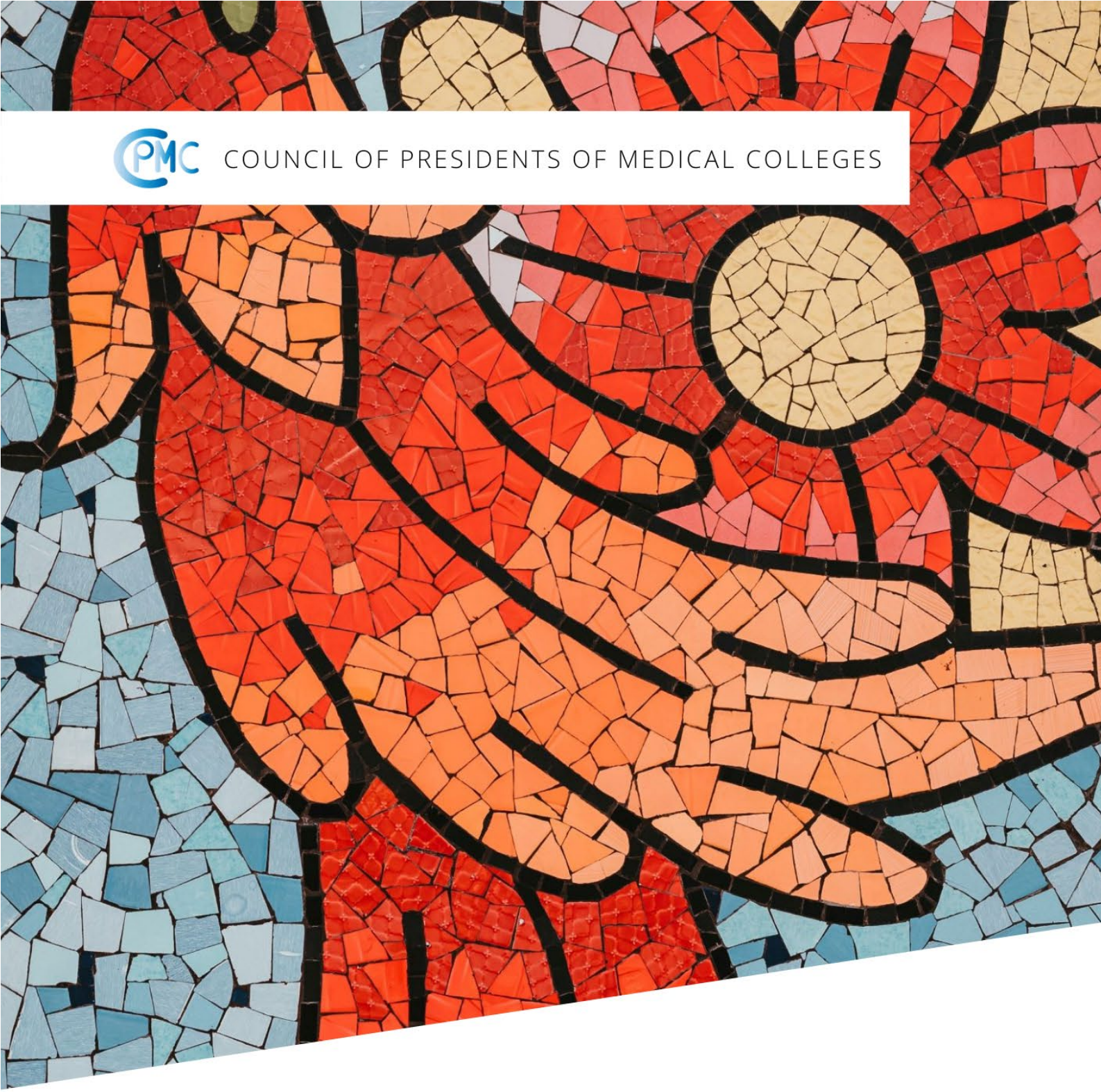

COUNCIL OF PRESIDENTS OF MEDICAL COLLEGES

EFFECTING REFORMS TO AUSTRALIA'S SPECIALIST MEDICAL TRAINING AND ACCREDITATION SYSTEM POST COVID-19

LITERATURE REVIEW: COVID-19 IMPACTS ON POSTGRADUATE MEDICAL EDUCATION

JAN 2021

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1. ABSTRACT

This literature review is intended to explore the available evidence about the impacts of the COVID-19 pandemic on postgraduate medical education worldwide. It is the first deliverable of a Council of Presidents of Medical Colleges (CPMC) project to examine the impacts of COVID-19 on postgraduate medical training in Australia to guide enduring reform.

Findings were grouped under four key themes: clinical practice, education delivery, training requirements and wellbeing.

Impacts on clinical practice include redeployment, segregated rostering, increased use of telehealth, decreased clinical exposure and reduction in procedures. There was significant concern expressed about the negative impacts on trainee skill, confidence, and progression.

There were also unforeseen positive impacts like more opportunities for self-study and research and unplanned learning opportunities in leadership, disaster management, critical care, collaborative team-based care, health care systems, and telehealth.

Many training programs quickly moved education online. Positive impacts included improved access, more chances to give and receive feedback and questions, more equitable access to experts, and more opportunities for sharing and collaboration. Improved attendance was reported by many.

Some authors highlight the inherent challenges of maintaining the quality of education with so many resources moving online, for example because it is largely unregulated.

In many countries training requirements were relaxed, postponed or extended. Many specialty boards and colleges cancelled or postponed exams. In combination with the reduction in procedural work, this creates a risk of trainees not progressing or meeting requirements.

In response, there is some discussion about altering standard evaluation processes of trainees or finding new ways to bridge gaps, such as through telehealth, reviewing case logs, evaluation reports, simulation assessments, and 360° evaluations.

Anxiety and psychological distress was reported to increase in trainees during the pandemic. Several reasons are provided including seeing a high number of deaths; risk of exposure to self, family and others; difficulties in obtaining PPE; and uncertainty around employment and meeting training requirements.

Some papers describe efforts of training programs and institutions to respond to wellbeing needs, including informing trainees about wellbeing strategies, providing counselling and holding workshops.

2. INTRODUCTION

Initial reports of an illness caused by novel coronavirus first emerged in December 2019, believed to have originated in Wuhan, China. The World Health Organisation declared a global COVID-19 pandemic three months later. At the time of writing in January 2021, there have been over 93 million cases and over 2.1 million deaths across the globe (https://covid19.who.int/).

In September 2020, the Council of Presidents of Medical Colleges (CPMC) established a project to examine the impacts of COVID-19 on postgraduate medical training in Australia, to identify challenges, responses and key learnings to inform enduring educational reform.

The project, entitled *Effecting Reforms in Australia's Medical Training and Accreditation System Post COVID-19* is being undertaken in several stages by CPMC and partner organisations. A key outcome is to inform the National Medical Workforce Strategy under development by the Australian Government through the Medical Workforce Advisory Committee.

This literature review is the first deliverable of the project. It is intended to explore the available evidence about the impacts of the COVID-19 pandemic on postgraduate medical education, in addition to identifying key themes to guide subsequent stages.

The second stage will include consultation with key stakeholders about the barriers and obstacles the pandemic has created, or highlighted, in specialist medical training and how stakeholders have responded. The third stage will include further consultation with a smaller group of stakeholders on how training places are determined.

The final stage will include development of policy recommendations, based on the previous outputs and other relevant research, to ensure that Australia has an appropriately trained and supported medical workforce into the future. This will include a consideration of the long-term impacts of the pandemic and high value innovative practices in medical training.

Australia has been relatively spared from the health impacts of the pandemic, with 28,721 cumulative cases and 909 deaths, reported to January 2021. Nevertheless, there have been significant disruptions to daily life.

The initial response focused on screening and restricting overseas travellers. Emergency public health orders were then declared in all states and territories and a range of measures put in place including lockdowns, social distancing, school and business closures, mask wearing requirements, testing, contact tracing, quarantining of cases and isolation of close contacts.

The impacts on health services and hospitals have been substantial. All state or territory health services made changes to infrastructure and service delivery in anticipation of a potential surge in cases. During March 2020, elective surgery and many outpatient clinics were cancelled, with the aims of preserving personal protective equipment (PPE); creating capacity within the workforce to engage in training and other preparation; and reducing risk of exposure and transmission.

Critical care services, including emergency departments and intensive care units, were reconfigured into different zones with the plan to segregate COVID-19 positive patients. Separate medical wards and COVID-19 testing clinics were established, staff underwent training, healthcare staff rosters were reconfigured and telehealth clinics established.

As most specialist medical trainees train in these health services, there have been substantial downstream impacts on the delivery of their education. A summary of initial changes within Australia and potential impacts on specialist medical education is provided in Appendix A.

This has also occurred against a backdrop of education reforms which have been evolving over the last decade, including a move to competency-based and programmatic assessment, online and remote learning, and increased use of learning technologies and simulation.

3. METHODOLOGY

Given that the purpose of the literature review was to provide background information for the project, the search strategy was deliberately broad.

The PUBMED data base was searched for full text articles published in the English language between 1 January 2020 and 21 October 2020, using the search terms "SARS-CoV-2" AND "medical education". All types of publications were included, such as studies, editorials, letters and opinion pieces.

Any articles with a sole or primary focus on medical students, undergraduate medical education, pandemics other than SARS-CoV-2 or health professionals other than medical practitioners were excluded.

The search was supplemented by manually reviewing the reference lists of all included articles, using the 'snowball' method. The search strategy is depicted in **Figure 1**.

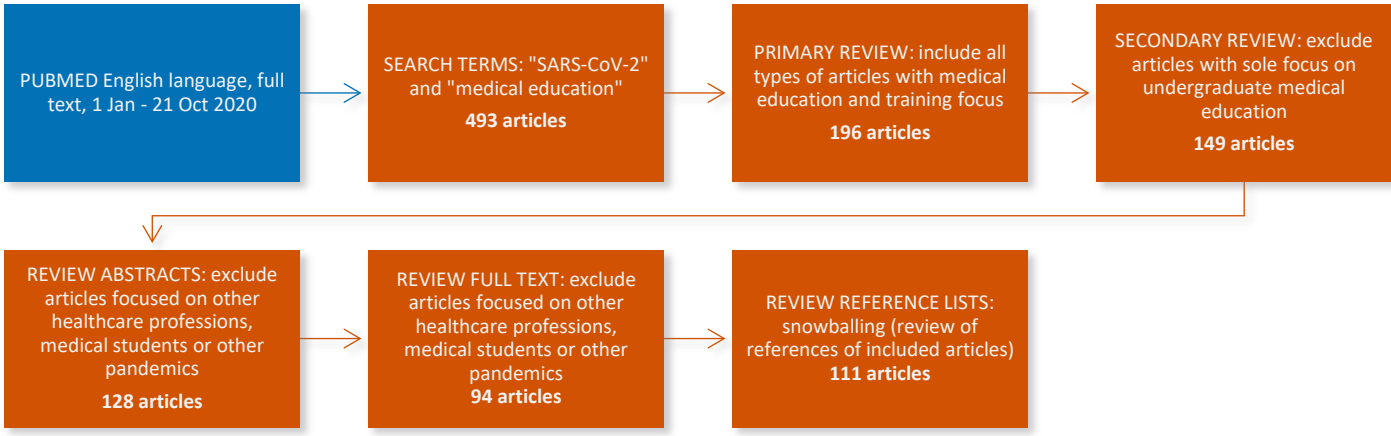

Figure 1: *Summary of search strategy*

Of the 493 titles yielded by the search, a total of 128 abstracts were reviewed, with a further 34 articles culled, leaving 94 articles to review. A further 17 articles retrieved following a manual search of the reference lists of included articles, taking the total to 111.

Additionally, the websites of Australian and New Zealand specialist medical colleges as well as several other relevant domestic and international organisations were searched, seeking information about actions taken in response to impacts of COVID-19 on postgraduate medical education. The list of websites reviewed is depicted at **Appendix B**. Results of information gleaned from the review of websites is provided in summary tables at **Appendices C** and **D.**

4. KEY FINDINGS

A significant number of articles were retrieved in the literature review given the relatively short time frame between the onset of the pandemic and the search. There was, however, a lack of Level 1 evidence. The majority of early publications were opinion pieces, commentaries and letters on author's lived experience of changes to training programs.

One paper was a systematic review of articles exploring the impacts of COVID-19 on medical education published between January and April 2020. Like this report, the authors note the paucity of empirical evidence [24].

There has now been sufficient time for more formal investigations, so cross-sectional studies have started to emerge (see **Appendix D** for more detail). The majority of these are surveys of trainees or those responsible for training programs about impacts of the pandemic on medical education and training. Other studies sought to explore the impacts on trainee wellbeing through measuring levels of psychological distress using validated instruments.

Many articles have a focus on specific training programs, with a comparatively large number being from procedural specialties. **Figure 2** depicts the number of articles by specialty, where it was identified or published within a specialty focused journal.

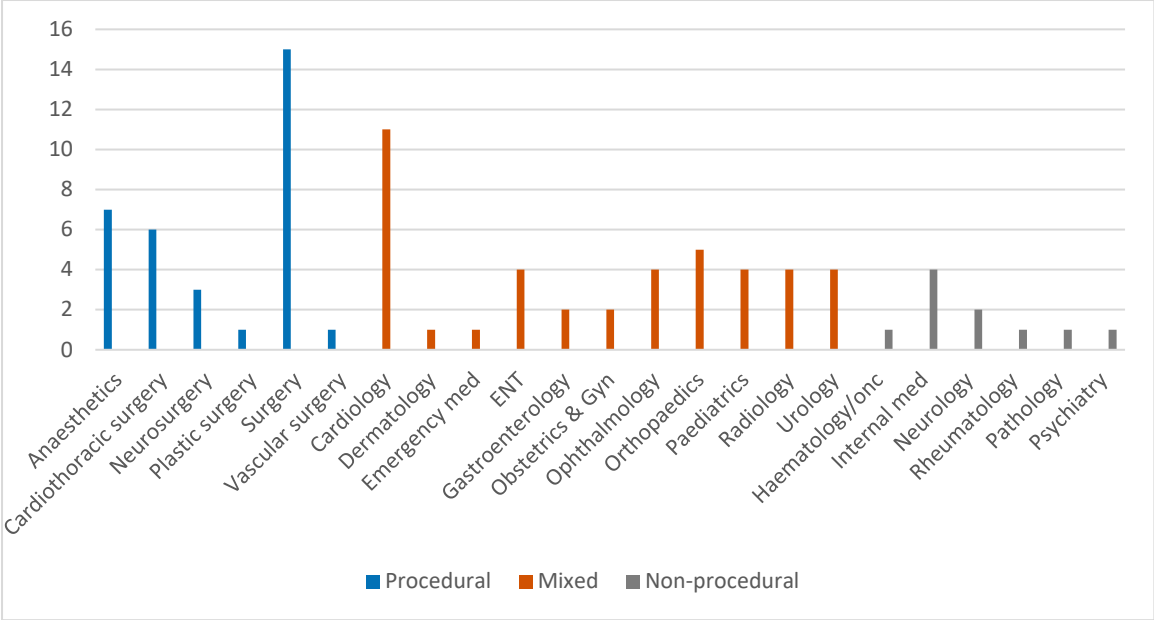

Figure 2: Number of articles by specialty.

A clear majority of articles had a North American focus, particularly the United States (n=63, 56.8%), as shown in **Figure 3**. The next largest group did not relate to a specific health system or setting (n = 16, 14.4%). A small number of articles were from Australia or New Zealand (n=5, 4.5%)

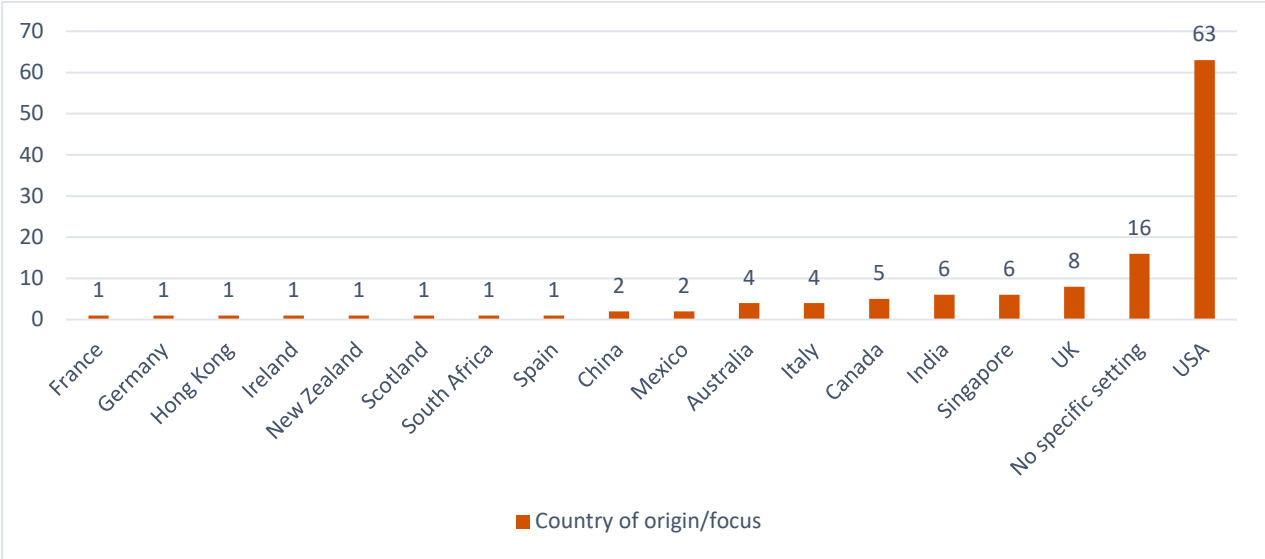

Figure 3: Number of articles by country of origin or focus.

Following a detailed review of the retrieved articles, findings were grouped under four key themes and 37 subthemes, as shown in **Table 1**. Individual articles often covered more than one theme, see **Appendix D** for more detail.

Theme	Subthemes
1. Clinical practice (n = 45)	Rapid adaptation Ceasing rotations (stay in place orders) Redeployment, particularly to critical care areas, COVID-19 wards Segregated rostering Decreased volume of practice Decreased breadth of exposure Most senior person primary operator Changes to other clinical activities Balancing service versus training Unplanned learning opportunities (eg: public health, emergency management, leadership)
2. Education delivery (n = 78)	Rapid transfer on-line Accessibility / capacity for broader reach, including access to expert presenters Forcing innovation and reform Proliferation of online resources Use of new technologies Pros and cons of virtual delivery Opportunities to enhance feedback to trainees with online modalities Uptake of simulation Maintaining quality of material
3. Training requirements (n = 32)	Changes to accreditation requirements Risk of not meeting requirements (volume of practice, logbooks) Exams postponed or moved online Conferences cancelled (lost opportunities for trainees to present) Research impacted (positive and negative impacts) Role of clinical competency committees Bridging gaps in training Areas identified for further training Application processes - move to video interviews Application processes - equity of application process
4. Wellbeing (n = 37)	Measurement of psychological distress, anxiety, depression Dealing with stress and uncertainty Risk of exposure to self, family and friends Inadequate PPE supplies and impacts on trainee wellbeing Financial considerations (including future job prospects) Strategies to address (wellbeing programs, services) Equity (other responsibilities, childcare) Positive impacts (being part of a team, sense of purpose, mission)

***Table 1**: Summary of key themes with subthemes.*

A number of papers explore whether the crisis of the pandemic has accelerated changes in medical education, particularly with respect to moving to competency-based education, on-line delivery, simulation, new assessment modalities and other innovations [19, 31, 36, 39, 41] This is of particular relevance, as this literature review is part of a larger project considering what changes can be made to specialist medical training in Australia.

4.1 CLINICAL PRACTICE

Many changes have been made within health services and hospitals around the globe during the pandemic. These initially included outpatient clinics, move to telehealth consultations, cancellation of elective surgery, and cancellation of meetings, all with significant downstream impacts on both postgraduate training programs and the trainees themselves.

In the first instance, training programs, particularly in those countries with high infection rates, had to move quickly to adapt to the pandemic. Many papers provide commentary on the practical steps taken within training programs regarding redeployment and segregated rostering of trainees; maintaining educational activities in the face of social distancing requirements; and responding to decreased clinical exposure [1,13, 45, 61].

Segregated rosters are described in many papers, whereby services were reconfigured with trainees rostered in discrete teams to minimise the risk of cross infection and provide opportunities for rest and recovery, for example in cardiovascular trainees [32], surgical training programs [43, 67, 73], orthopaedics [54, 88], radiology [7] and gastroenterology [75].

In many cases, segregated rosters meant that trainees were rotated with a week on clinical service followed by a week of working at home, the latter providing opportunities for self-study, working on research, [82, 88] and remote clinical support of services, such as communicating with families or administrative tasks.

Many papers comment on the redeployment of trainees beyond their usual scope of practice, particularly trainees with critical care skills from disciplines where they might usually be involved in elective procedures that had been cancelled or delayed, for example cardiovascular trainees [83], and surgical trainees [4,47]. Some authors developed a conceptual framework for quantifying the potential impacts on thoracic surgical trainees [14].

Many authors highlight the negative impacts of the reduction in elective procedures, particularly in the context of meeting training requirements (volume of practice). While not surprisingly, surgical specialties were impacted, [11, 12], this also extended to other procedural specialties such as cardiology [106]. In a study of urology trainees, 82% of respondents reported surgical activity was significantly reduced to only include urgent cases [74].

There was significant concern expressed about the negative impacts on trainee progression given the reduction in procedures, particularly impacting late-stage trainees, for example in urology [53] and cardiothoracic surgery [17].

In a survey of surgical trainees in Scotland, the authors concluded that with less opportunity to operate as primary surgeon, confidence in performing surgical skills was negatively impacted [51]. In another paper, the authors highlight the risk of deskilling [30].

Given the critical importance of clinical exposure in postgraduate training, many papers highlight concerns regarding the reduction in clinical exposure more generally and some authors have attempted to measure this [89].

In a retrospective observational study comparing clinical exposure of emergency medicine residents between the pre-pandemic and pandemic periods, the authors showed a reduction in exposure through decreased emergency department volumes of 30%, with all areas being affected, but paediatric patients and to a lesser extent trauma, the most affected [61].

Concerns about the reduction of clinical material, particularly in the procedural specialties has led some authors to highlight the importance of embracing every available clinical encounter as an invaluable learning opportunity [17, 88].

Conversely, in another paper the author makes comments about the challenges faced by residents who are reported to have struggled with the sheer volume of patient load, high mortality rate, particularly in the context of limited treatment options and limitations of PPE [15].

In many surgical and procedural disciplines, there was a move toward the consultant being the primary operator [89]. A number of reasons for this were provided including: minimising the risk of exposure of trainees to infection; taking less time and therefore reducing prolonged exposure of theatre staff; reducing pressure and fatigue of a team during a critical period and optimising outcomes in patients [30, 90].

There were also changes to other clinical activities, including outpatient clinics, multidisciplinary team meetings, tumour boards, and other clinical meetings, many of which were transitioned to an online or remote format. One paper described changes to morning report, incorporating a multi-institutional approach using Zoom technology [71].

Some authors argue that telehealth is an area of clinical practice that needs to be strengthened while at the same time acknowledging its limitations with respect to medical education [44, 56].

While there is an emphasis on discussions about the challenges and lost training opportunities due to the pandemic, many authors also highlighted the unplanned learning opportunities including in leadership [1, 60, 89], disaster management [23, 30, 89], critical care [32, 49, 87, 89], collaborative team-based care [32, 73], health care systems [32, 49], and telehealth [87,89]. Other authors emphasize the opportunities brought about by being part of a crisis response such as the sense of purpose and teambuilding, fostering camaraderie, courage and empathy [37, 60].

4.2 EDUCATION DELIVERY

In parallel with the significant changes in clinical services, the pandemic witnessed a rapid transformation to the delivery of postgraduate medical education as training programs responded to public health measures, including social distancing and cancellation of meetings. To maintain the integrity of training, many training programs quickly moved education online [38, 49].

While virtual learning modalities in medical education have been in place for some time, many authors argued in responding to the pandemic, the pace of change and uptake of new technologies and modalities has been accelerated.

Many papers identified the positive impacts on the transition to online delivery including increasing access and available time to attend or view sessions, avoiding duplication of effort, equitable access to expert speakers, transmission to a wider audience, opportunities for cross program and institution collaboration and the development of a national curriculum.

Other authors have highlighted the move to online delivery has resulted in an increase of education time per week, particularly in specialties where elective procedures were cancelled. Examples include paediatric otolaryngology [46], cardiothoracic surgery [59, 63] or where staggered rostering patterns were operating [10].

In one paper, the authors emphasise the importance of social media and transforming education delivery to the on-line environment, especially webinars. They audited publicly accessible,

postgraduate plastic surgery training webinars to determine if they met the Joint Committee on Surgical Training (JCST) requirement of 2 hours of formal facilitated teaching per week. They found that weekly total running time for active webinars amounted to 8hrs 30 minutes with 4hrs and 30 minutes being plastic surgery specific [3].

Improved attendance was reported in many programs across several disciplines, for example gastroenterology [75] orthopaedics [53] and neurosurgery [77]. One paper described a multiprogram journal club in rheumatology, which they report was attended by three times as many participants as a typical journal club and included specialists from other cities [57].

The use of technology also allows for remote delivery of expert teaching to a large number of trainees at once [3, 30,] and a number of papers highlight the benefits of cross program and institution access, collaboration and resource sharing [18, 40, 35, 65, 85, 103]. As expressed in one paper, virtual lectures, operative video-based education and simulation in surgical education presents *'a golden opportunity to embrace systemic change by developing and delivering collaborative educational content, forever leaving behind the limitations imposed by institutional silos*' [21].

One unanticipated impact of the move to telehealth in education delivery is the opportunity for increased feedback of trainees by their supervisors [25]. In one paper on telehealth use by developmental behavioural paediatric trainees, it was reported that both trainees and supervisors believed that trainees were more closely supervised and observed more intensively in the new format and that feedback was more enriched [44].

Authors also argue that online sessions are more engaging than anticipated which they attributed to features of the application that foster active learning such as polling, chat and easy sharing of articles [5]. One editorial reported that anecdotally Fellows now appear more proactive in asking questions using the chat function compared with traditional face to face methods [63].

The use of new technologies and delivery of education and training programs is promoted by authors across a range of specialty training programs including cardiology [5], obstetrics and gynaecology [49], surgery [50], urology [79] ophthalmology [18, 68] and radiology [99]. In another study of medical haematology/oncology Fellows, the majority felt comfortable to move to a fully online learning environment in the future [93].

Several papers provided examples of innovations and reforms in the delivery of education, such as the establishment of the National Remote Obstetrics and Gynaecology Didactic Program [6], and a "Quarantine curriculum" in psychiatry [86].

In a paper on surgical education, the authors propose solutions including a flipped virtual classroom model, online practice questions, academic conferences via teleconferences, telehealth clinics with resident involvement and facilitated use of surgical videos [19].

The enhanced role of simulation and other online modalities, particularly given the loss of procedural training opportunities due to the reduction in elective surgery, also received some attention. For example, in one paper, the authors discuss image guided eLearning in surgery [98] and in another, the use of simulation in leading codes, through the use of Bluetooth headphones or baby monitors, with competency assessments based on body camera video recordings [65]. One Obstetrics and Gynaecology program in Singapore have used archived videos and live telemonitoring by experienced staff [49]. The role of surgical simulators is also highlighted in several disciplines [50, 68].

Several authors discuss the pros and cons of online learning in the context of the pandemic, highlighting the importance of orienting all users to the application [5], faculty development [65] and guidance on etiquette [5, 10]. In a study of orthopaedic residents it was reported that trainees found it more difficult to maintain attention online, compared to traditional face to face teaching [13].

Some authors point out the inherent challenges of maintaining the quality of education in the context of this explosion of online content, which unlike peer reviewed literature is largely unregulated [91]. The same authors call for the role of peer review and industry in addressing some of these challenges [91] and curating resources [70].

4.3 TRAINING REQUIREMENTS

A turning point for the global medical education community was the decision in early March 2020 by Italy to fast-track final year medical students to junior doctor appointments [58]. This was a clear signal that long-held practices and traditions in the medical training continuum could change. Singapore followed suit and final year medical students were also fast-tracked to internship to assist with the anticipated surge in patients [92] and in the UK, foundation year trainee rotations were suspended [27]. By the latter stages of 2020, most postgraduate medical training and related organisations in many countries had relaxed, postponed or extended postgraduate training requirements.

Many specialty boards and colleges have cancelled or postponed exams [11,100] and research activities have been suspended [42, 69], thereby creating a risk of trainees not meeting requirements. This is an area of significant concern and some authors make comments about the potential negative impacts on trainee progression and the training pipeline [94].

Many papers reference the changes announced by the Accreditation Council for Graduate Medical Education (ACGME) which sought to classify 3 stages of a response for training programs in North America, a country experiencing the worst outbreaks of the pandemic. Details of the 3 stages are provided in **Table 2**.
Importantly, in emergency status, 4 overriding requirements remain: (1) respect for work hour limits, (2) provision of adequate resources and training, (3) maintenance of adequate supervision, and (4) potential for Fellows to function as attendings in their core speciality.

	Stage	Definition	Requirements in Effect
Stage 1	Business as usual.	No significant disruption of patient care and educational activities; planning underway for increased clinical demands.	Governed by the Common and specialty-specific Program Requirements.
Stage 2	Educational activities are suspended and some fellows shifted to patient care duties outside of Fellowship area.	Some residents/fellows need to shift to patient care duties; some educational activities are suspended.	Governed by the Common and specialty-specific Program Requirements and variances addressed in the Stage 2: Increased Clinical Demands Guidance.
Stage 3	'Pandemic emergency status' - deployment of most fellows to patient care areas outside of normal fellowship scope and	Most or all residents/fellows need to shift to patient care; majority of educational activities are suspended.	Governed by four overriding requirements: Work hour limit requirements.

	suspension of most educational sessions.	Resources and training requirements Supervision requirements Fellows allowed to function in core specialty.

Table 2: Accreditation Council for Graduate Medical Education (ACGME) Three stages of Graduate Medical Education (GME) During the COVID-19 Pandemic (Source: www.acgme.org)

Accreditation of programs was also compromised with visits postponed or being made virtual. One paper focused on changes to program accreditation in the US [80].

Significant concern was expressed by many authors about the impacts of reduction in procedural work and the risk of trainees not meeting volume of practice requirements [29, 42, 48]. The worst impacts were believed to be on trainees in latter stages of training [14, 48, 68, 77, 81] or those on shorter training programs, with some arguing that disruptions to clinical experience on longer programs can generally be overcome [80].

There is some discussion in the literature about the enhanced role of Clinical Competency Committees in making decisions about trainee progression, particularly in the face of lower volume of practice numbers [29, 39, 45] with the suggestion that standard evaluation processes of trainees may be altered in response to changes in clinical practice, through decreased procedures and clinics [55] and highlighting the importance learning plans to support identified gaps due to decreased exposure [43].

One paper provides a competency assessment check list for residents using telehealth and argues that while once peripheral, telehealth is now taking on a much more important place in some training programs and trainees should be appropriate trained and assessed in its use [56].

In one study, authors administered a survey to explore concerns of general surgery chief residents regarding the impact of the pandemic on readiness to complete training and transition. They reported that the most significant concerns were a potential delay in date of board examinations, not feeling adequately prepared for board examinations, delays in graduation date, not having enough cases for Fellowship or to meet job or ACGME requirements [110].

On the other hand, some authors highlighted that the reduction in clinical volumes led to trainees having more time to complete other training requirements such as research, quality improvement initiatives, studying for board examinations or applying for post-fellowship positions [40].

Other authors expressed concern about research requirements given the suspension of clinical research activities in many institutions [3], while others highlight that trainees have had more time to catch up on research tasks or papers [30, 53].

Several authors address the importance of bridging identified gaps in training. In one paper, authors provide practical recommendations to maximize thoracic surgery resident education during the pandemic [14].

In another paper, authors suggest other mechanisms to address gaps such as reviewing case logs, evaluation reports, simulation assessments, 360° evaluations of clinical and technical skills, onboarding process assessment and specific interventions to assist with transition [110]. Other practical suggestions, particularly for doctors making the transition to consultant practice impacted by the reduction in volume of practice, include mentoring, precepting, proctoring and other support mechanisms [25, 56, 57, 81, 83]. Several areas were highlighted as requiring further education given

the changes to clinical practice during the pandemic. These include training in PPE and telehealth consultations [18, 53, 56, 64, 78 111].

Although most papers published on application processes were excluded due to this project's exclusion criteria (focus on medical students), there were several papers included in this series which discussed impacts on application and selection processes of Fellows. In North America in particular, public health measures such as stay at home orders, lockdowns and travel restrictions impacted trainees' ability to attend face-to-face interviews. Many programs moved to on-line interviews and several authors highlight the merits of reduced travel, cost and time [40, 55, 65]. One author discussing otolaryngology Fellowship interviews argued that the use of videoconferencing was a viable alternative, suggesting that it may be the way of the future [72] while another argues for the development of national guidelines for application processes during the pandemic [40].

4.4 WELLBEING

Many papers include consideration of the impacts of the pandemic on trainee wellbeing and several articles have a sole focus on the potential mental health implications on trainees and strategies to support them [2, 48].

Several authors report on the increase in anxiety and psychological distress in trainees during the pandemic [33, 37] across a range of specialities and training levels including in pain fellowships [55], neurosurgery residents [77], and medicine and surgery residents [82]. Several reasons are provided for the increased levels of anxiety, including concerns about the risk of exposure to self, family and others [13, 38, 62], difficulties in obtaining PPE [17, 38,62] and uncertainty meeting training requirements [54]. Other authors have raised the issue of the psychological burden in dealing with a disease with a high number of deaths and argue that this has the potential for short- and long-term psychiatric morbidity [28].

As frontline healthcare workers, the threat of infection to self is serious, with one study reporting residents who became ill with COVID-19 [8] and in another paper, a report of a resident who succumbed to the disease [30]. In one study of cardiothoracic surgical trainees, one third of respondents to the survey reported having to take time off due to COVID-19 [1]. In a paper from Scotland, one third of trainees in a survey reported being unaware of support services [51].

Several papers explored the issue of PPE shortages in more detail. In one study across 5 orthopaedic residency training programs in the US (with a response rate of 82%), 35% of respondents reported experiencing situations in which they were unable to access institutionally recommended PPE [8]. In another paper on urology trainees, those who perceived shortages of PPE experienced higher levels of psychological distress [53].

Many studies emerged which have attempted to formally measure levels of psychological distress, anxiety and depression in trainees. In one study of Ophthalmologists and ophthalmologists- in training in India, the authors reported high rates of psychological distress as measured by the Patient Health Questionnaire-9 (PHQ-9) with over half of the survey respondents believing that COVID-19 would impact their training or professional work [52]. The authors concluded that a significant number would require mental health intervention or support [52].

In another study from China on psychological impacts on medical staff (which included senior doctors, trainees and nurses), the authors concluded that anxiety was increased by the fear of contracting the disease and passing onto family and argued for support and interventions to mitigate these risks [62].

Broader concerns regarding financial issues and job security are also reported as contributing reasons for increased psychological distress and anxiety [7]. Some papers highlight that trainees with children and families have additional burdens associated with school closures, childcare and working from home [55,82].

Some papers describe efforts of training programs and institutions in responding to wellbeing needs of the workforce, including practical interventions, and argue that providing support and appropriate strategies mitigates or lowers the risk of anxiety and psychological distress [5,100].

In one paper, authors provide a comprehensive summary of initiatives across 3 areas: basic needs; communications; and psychological and mental health support [84]. In another paper, the authors emphasise the importance of those responsible for training programs educating trainees about safety and wellbeing strategies [103].

Segregated rosters to provide more time for self-care [67] or manage rest and recovery, in addition to minimising the risk of exposure in trainees, particularly in health services with high volumes of COVID-19 patients [16] were reported. The same authors stress the importance of support and social networks, frequent check-ins and provision of more practical support such as weekend meals, care packages, complimentary access to hotel rooms, use of car services and childcare as practical interventions to address wellbeing issues [16].

In one Canadian paper, the authors argue for the provision of support systems such as wellness office resources, therapists and online accessibility of counselling [65]. In another paper describing interventions for anaesthetic trainees across 6 countries, including Australia, the authors report that in Melbourne, trainees have access to senior mentors, welfare workshops, mindfulness and meditation, debriefing sessions and stress management strategies [94].

One paper describes the approach taken in a paediatric training program through adapting Maslow's hierarchy of needs and includes a summary table with examples of potential interventions under each of the five needs: including physiologic, safety, sense of belonging, esteem and self-actualisation [102]. However, several authors highlight some of the positive impacts of being part of a crisis response team is having a sense of purpose or mission [15, 37] and working in solidarity with colleagues in other specialities [7].

5. DISCUSSION

The pace of change in medical education has traditionally been slow. Several papers have raised the question of whether the pandemic has been a catalyst for exponential change across a number of areas discussed in this literature review, including telehealth, online education, competency-based assessment and an emphasis on trainee wellbeing. [18, 31, 78, 96, 97]. The possibility remains that these changes will revert to old practices in a post-pandemic world. One of these authors [31] describes a conceptual model of understanding crisis-response measures and its relationship to changes to practice in the immediate and long term (see **Figure 5**), in which responses can be ended or amplified, and previous models either let go or restarted. At the time of this writing, it remains unclear what changes in postgraduate medical education brought about by the pandemic will endure beyond the current crisis.

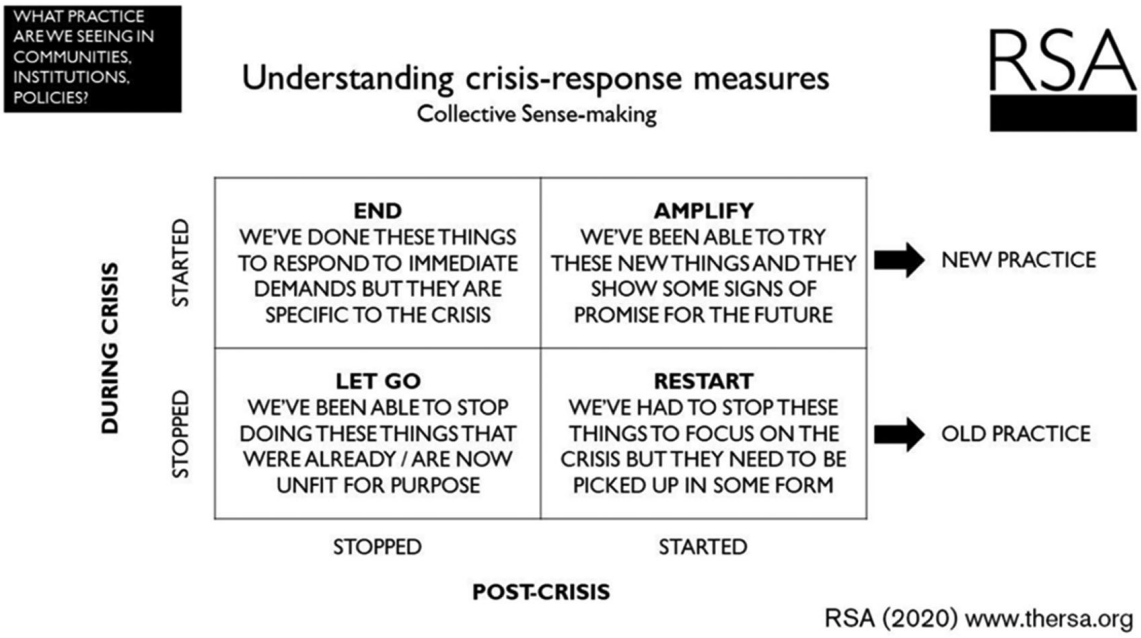

Figure 5: Understanding crisis-response measures
Source: RSA (2020) www.thersa.org in Fuller R, Joynes V, Cooper J et al, 2020 [31]

What can be considered, however, are the findings relating to the first column in Figure 5—those crisis-response measures which have been immediately started or stopped. As our broader project examines the impacts of COVID-19 on postgraduate medical training in Australia to guide enduring reform, it is necessary to first establish an understanding of the crisis response measures in this country. Later stages of the project will issue policy recommendations toward the question of amplifying change to support positive changes, and restarting older practices where value and necessity require.

As discussed previously, our methods (Section 3) have identified a body of literature chiefly published by authors in countries with high infection rates. While thus far, Australia has been relatively spared from high infection rates, the disruptions to training programs have been substantial. As this type of experience—low infection rates, high levels of crisis response—was not seen to be reflected in the literature reviewed, a number of questions for Australasian training providers have emerged from our key findings (summarised in Table 3).

Theme	Questions / lines of enquiry
Clinical practice	• Have there been enduring changes to clinical practice that have impacted trainees and training programs? • Has there been an impact on levels of training (telehealth, PPE)?
Education delivery	• Is there potential for/evidence of collaboration and sharing of resources, moving to a national on-line program? • How can the quality of online material and resources ensured and maintained? Is there a role for Colleges to curate resources (peer reviewed) for trainees?
Training requirements	• What training around telehealth is being done? Is there a need to strengthen this (including assessment)? • What are the impacts of cancelled conferences with respect to trainees' scholarly activities and presentation opportunities? How is this being approached?

	• What are the impacts of cancelled or postponed research activities? How is this being approached? • Which disciplines are most impacted by lost opportunities for training overseas, and how? How is this being approached? • How are Colleges responding to issues with trainee progression - particularly in the transition to consultant practice?
Wellbeing	• What roles are Colleges playing in the delivery of wellbeing resources? • Are there examples of innovation or collaboration between Colleges and health services? • Concerns about long term psychological sequalae in trainees?

Table 3: Potential future lines of enquiry arising from the literature review.

These questions, along with the themes and sub-themes identified by this literature review, will help inform development of an interview guide for the next phase of this project. In the interview phase, we will consult with key stakeholders on issues they have faced during the pandemic, how they have responded, and what can be taken forward to provide a more flexible and responsive system.

The Australian experience may or may not align with the key findings reported in this report. While a dedicated global or country-by-country comparison is beyond the scope of the project, it is worth noting that the origin of the literature reviewed here lies chiefly outside of Australia and New Zealand. This could be due to the database, search terms, and/or dates used in our sampling frame. As countries transition into a "post-pandemic" state, more time and resources may be devoted to researching training-related changes, and Australasian literature in this area may increase. Additionally, there is an inherent gap between individuals and organisations experiencing impacts of an event like the pandemic and reporting this experience in the literature. There will be important learnings published for many months and years after the window used in this report.

A final limitation to be noted is the type of literature included in this review. As this report functions as an informative guide for the interview phrase of the project, it was not appropriate to our methods to employ the techniques of a systematic review or meta-analysis. We can report only on the literature our methods uncovered, almost of which can be categorised as Level 3 evidence. The implications of using such a hierarchy of evidence itself, however, including the epistemological weight accompanying such labels, has recently been called into question—particularly regarding its applicability within the policy-making process [112]. While the terms of this debate lie far afield from the current report, they may be worth considering in analyses of future COVID-impact studies.

6. CONCLUSION

It is clear from the literature that the COVID-19 pandemic has had a significant and far-reaching impact on postgraduate medical training programs across the globe. A stakeholder consultation, including organisations in Australia and New Zealand, will be done as part of the next phase of the *Effecting Reforms to Australia's Specialist Medical Training and Accreditation System Post COVID-19* project.

As a guide to inform consultation, the themes and sub-themes identified in this literature review offer a useful way to categorise and reflect on possible experiences in Australia. Given the unprecedented nature of the pandemic, however, which is characterized inherently by unpredictability, these themes cannot be interpreted as a conclusive judgement on the effects of COVID-19 on the medical training system. Instead, this review reflects only a very early stage of multiple, evolving effects, which will continue to be studied for decades to come.

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APPENDIX A: SERVICE AND TRAINING CHANGES

Change	Organisation level	Potential impact
Cancellation of Term 2 rotations for prevocational trainees and vocational trainees in some states (stay in place orders)	Health services/hospitals	Disruption to training pathways and meeting training requirements, reduction in clinical exposure across clinical year, particularly for early stage trainees
Cancellation or reduction in elective surgery and procedures	Health services/hospitals	Reduction in volume of cases, training opportunities
Cancellation or reduction in outpatient clinics and concomitant move to establishing telehealth clinics	Health services/hospitals	Reduction in volume of cases, training opportunities and clinical exposure, conversely, opportunity for skill development in telehealth
Postponement of exams	Specialist Colleges	Delay in progression to next stage of training
Social distancing measures leading to the cancellation of education activities and clinical meetings, some moved to online delivery	Health services/hospitals Specialist Colleges Other training providers	Disruption to meeting training requirements. Conversely for online delivery, increased accessibility to education sessions for some trainees
Training in PPE and simulation activities, particularly in critical care and operating theatres	Health services/hospitals	Unplanned learning opportunities
Planned or actual deployment to critical care areas, surge wards and testing clinics	Health services/hospitals	Change to scope of practice, decreased exposure to cases. Conversely increased exposure to critical care, public health
Changes to general registration and CPD requirements	Medical Board of Australia	Changes to requirements
Changes to accreditation requirements	Australian Medical Council	Changes to requirements

APPENDIX B: WEBSITES REVIEWED

Australian and New Zealand organisations	
www.ascep.org.au	Australasian College of Sport and Exercise Physicians (ACSEP)
www.acem.org.au	Australasian College for Emergency Medicine (ACEM)
www.acrrm.org.au	Australian College of Rural and Remote Medicine (ACRRM)
www.dermcoll.edu.au	Australasian College of Dermatologists (ACD)
www.anzca.edu.au	Australian and New Zealand College of Anaesthetists (ANZCA)
www.cicm.org.au	College of Intensive Care Medicine of Australia and New Zealand (CICM)
www.racgp.org.au	Royal Australian College of General Practitioners (RACGP)
www.racma.edu.au	Royal Australasian College of Medical Administrators (RACMA)
www.racp.edu.au	Royal Australasian College of Physicians (RACP)
www.surgeons.org	Royal Australasian College of Surgeons (RACS)
www.ranzco.edu	Royal Australian and New Zealand College of Ophthalmologists (RANZCO)
www.ranzcog.edu.au	Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG)
www.ranzcp.org	Royal Australian and New Zealand College of Psychiatrists (RANZCP)
www.ranzcr.edu.au	Royal Australian and New Zealand College of Radiologists (RANZCR)
www.rcpa.edu.au	Royal College of Pathologists of Australasia (RCPA)
www.rnzcgp.org.nz	The Royal New Zealand College of General Practitioners
www.nzcphm.org.nz	New Zealand College of Public Health Medicine
www.amc.org.au	Australian Medical Council
www.medicalboard.gov.au	Medical Board of Australia
International organisations	
www.royalcollege.ca	Royal College of Physicians and Surgeons of Canada
www.rcseng.ac.uk	Royal College of Surgeons of England
www.gmc-uk.org	General Medical Council
www.hee.nhs.uk	Health Education England
www.acgme.org	Accreditation Council for Graduate Medical Education

APPENDIX C: COLLEGE ACTIONS

Actions taken by Australian and New Zealand Medical Specialty Colleges in response to COVID-19							
College	Website	Training requirements	Education delivery	Written exam	Clinical exam	Accreditation	Comment
ACSEP	www.ascep.org.au						No specific information regarding changes to training program available on website
ACEM	www.acem.org.au		College hosted workshops and training events, including ASM cancelled, some replaced by webinars	Fellowship exam scheduled for May 2020 cancelled; Primary written exam moved online (using Clifton's venues)	Fellowship OSCE rescheduled to December 2020. Primary viva exam cancelled.	All accreditation visits until 31 August 2020 deferred and arrangements regarding extension to be considered	Some information password protected
ACRRM	www.acrrm.org.au			Written exams proceeded with social distancing measures	StAMPS assessment conducted using video technology		Specific information regarding other changes not available on website
ACD	www.dermcoll.edu.au	Some consideration given in relation to graduation or progression	Move to development of National Skin School webinars - available to all trainees	Written exams proceeded in examination centres with capacity for online proctored examination in limited circumstances			
ANZCA	www.anzca.edu.au	Consideration of extension to training time requirements and extended employment at the same site, interruption to usual requirement of continuous training allowed, leave					

		provisions to be considered, and increased flexibility with VOP requirements					
CICM	www.cicm.org.au	Some changes to accommodate trainees recalled from external rotations (eg medicine or anaesthesia), as long as the trainee has completed 10 weeks uninterrupted	Move to online delivery including 2020 ASM	Locally run written exams	Exams postponed in March 2020. First part and second part viva exams held in October 2020 using Zoom at Cliftons. Hot cases proceeded with public health measures, including candidates only required for 1 day.	No changes	
RACGP	www.racgp.org.au	Candidates workshops postponed/moved online	Online delivery		Implemented Remote Clinical Exam (RCE)		No further details available of website
RACMA	www.racma.edu.au	Extension to Annual Training Plans. Modified dates and processes for submission of In-Training Reports and Time in Supervised Practice forms. Research proposal submission dates have been extended	Teaching activities, including learning sets, moved online	N/A	Exams rescheduled and completed virtually on Zoom	Details not indicated	
RACP	www.racp.edu.au	12-month extension granted to time limit to complete training program; leave allowances for COVID-19 related sick leave instituted; AT training supervisors able to recommend progression of final year trainees who have not completed training time due to redeployment, other waivers for requirements to be considered	Face to face delivery postponed, cancelled or moved online	Move to online delivery of exams already in place prior to COVID-19.	Divisional clinical exams postponed; long case component delivered online	Capacity to undertake virtual accreditation visits	RACP published overarching education and training principles and a report *COVID-19 Learnings and Opportunities,* Reports on computer-based testing (CBT) password protected
RACS	www.surgeons.org	Extension in training may be necessary in some instances to	All face-to-face courses, and events	Held at Clifton's venues	Fellowship exam postponed then	All hospital training post accreditation	

		allow mandatory requirements to be met	including Annual Scientific Congress cancelled or postponed. Some sessions moved to online delivery		delivered using hybrid face-to-face and remote examiner model. 255 examiners, incl. 78 remote examiners and observers, across 6 cities and 59 venues for 288 candidates.	visits postponed for up to 12 months. Period of accreditation automatically extended as required.	
RANZCO	www.ranzco.edu	6-month extension to meeting training requirements		Written exams rescheduled and delivered online at Clifton's venues	Oral examination moved to online using Zoom technology at Clifton's venues		
RANZCOG	www.ranzcog.edu.au	6-month extension for deadlines within 2020 training year. Where specific requirements unable to be met, waivers may be considered		Written exams rescheduled and then delivered online at Clifton's venues	Oral examination moved to online using Zoom technology at Clifton's venues	Site visits deferred or virtual site visits made on an as needs basis	
RANZCP	www.ranzcp.org	Flexibility for up to 3 months in 6-month rotations if due to disruption caused by the pandemic. Flexibility with transition from Stage 2 to 3.	Many Formal Education Courses moved to online format	Postponed and rescheduled	Postponed	Site visits deferred	Further details not available on website
RANZCR	www.ranzcr.edu.au	Trainees will be permitted up to 12 months additional training time if required.	All face-to-face educational and training activities suspended		Initially postponed, then delivered with modified format	All training site accreditation and reaccreditation visits suspended for 12 months.	
RCPA	www.rcpa.edu.au	Training time to be assessed on individual basis		Initially deferred, then rescheduled to October and November 2020	Initially deferred, then rescheduled to November and December 2020 and held in local training jurisdictions		Some details not available on website (password protected)

APPENDIX D: ARTICLE SUMMARY

#	Authors	Title	Journal	Type	Themes	Country	Comment
1	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; 94: e2608-e2614	Commentary	Clinical practice Education delivery Wellbeing	USA	Describes the adaptations made to a neurology residency program. Some comments about unintended learning opportunities.
2	Al-Ghofaily L, Feinman JW, Augoustides JG.	Fellowship training in adult cardiothoracic anesthesiology: navigating the new educational landscape as a result of the coronavirus crisis	Journal of Cardiothoracic and Vascular Anesthesia, 2020; 34: 2019-2021	Editorial	Training requirements Wellbeing	USA	The purpose of this editorial is to highlight the significant effects of the pandemic on fellowship training in adult cardiothoracic anaesthesiology in the US. The authors suggest some solutions for the program leadership.
3	Ali SR, Dobbs TD, Whitaker IS.	Webinars in plastic and reconstructive surgery training – a review of the current landscape during the COVID-19 pandemic	Journal of Plastic, Reconstructive and Aesthetic Surgery, 2020; 73 (7): 1357 - 1404	Letter	Education delivery	UK	Audit of publicly available webinars for trainees, makes the point that technology allows for expert to reach a large number of trainees.
4	Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, O'Neill N, Iosifidis C, Griffin M, Mathew G, Agha R.	Impact of the Coronavirus (COVID-19) pandemic on surgical practice – Part 1	International Journal of Surgery, 2020; 79: 168 - 179	Analysis	Education delivery Training requirements	UK	The authors review the current evidence and offer recommendations for changes to surgical practice to minimise the effect of the COVID-19 pandemic. The paper includes a section on education and training.
5	Almarzooq ZI, Lopes M, Kochar A.	Virtual learning during the COVID-19 Pandemic. A disrupted technology in graduate medical education	Journal of the American College of Cardiology, 2020;75(20): 2635-2638	Commentary	Education delivery	USA	The authors describe the capabilities, implementation and challenges of virtual learning for cardiology fellows-in-training (FITs) and fellowship programs in the COVID-19 era and beyond.

6	Alvarez RD, Goff BA, Chelmow D, Griffin TR, Norwitz ER, De Lancey JO.	Reengineering academic departments of obstetrics and gynecology to operate in a pandemic world and beyond: a joint American Gynecological and Obstetrical Society and Council of University Chairs of Obstetrics and Gynecology statement	American Journal of Obstetrics and Gynecology, 2020; 223 (3): 383.e1-383.e7	Opinion piece	Education delivery	USA	While mostly about clinical practice in obstetrics and gynaecology during the COVID-19 pandemic, this paper includes some commentary about the impacts on trainees.
7	Alvin MD, George E, Deng F, Warhapande S, Lee SI.	The impact of COVID-19 on radiology trainees	Radiology,2020; 296:246-248	Opinion piece	Clinical practice Education delivery Wellbeing	USA	The authors provide an overview of the major issues raced in radiology training programs during the COVID-19 pandemic and offer some potential solutions to address them.
8	An TW, Henry JK, Igboechi O, Wang P, Yerrapragada A, Lin CA, Paiement GD.	How are orthopaedic surgery residencies responding to the COVID-19 pandemic? An assessment of resident experiences in cities of major virus outbreak	Journal of the American Academy of Orthopaedic Surgeons, 2020; 00(0);1-7	Survey	Clinical practice Education delivery Wellbeing	USA	Survey of five ACGME accredited orthopaedic residency training programs within cities with high rates of about the clinical and curricula changes as well as a survey of residents about their experiences. The authors conclude that there have been unprecedented changes to orthopaedic training, exposures to COID-19 are prevalent and residents have fallen ill. They recommend continued prioritisation of resident safety and necessary accommodations to training.
9	Anderson ML, Turbow S, Willgerodt MA, Ruhnke GW	Education in a crisis: the opportunity of our lives	Journal of Hospital Medicine, 2020; 15(5): 287-289	Perspective	Education delivery Wellbeing	USA	The authors propose some recommendations to assist educational policy makers and those working directly with learners to navigate issues during the pandemic.

10	Ashokka B, Ong SY, Tay KH, Loh NH, Gee CF, Samarasekera DD.	Coordinated responses of academic medical centres to pandemics: sustaining medical education during COVID-19	Medical Teacher, 2020;42(7):762-771	Commentary	Clinical practice Education delivery	Singapore	The authors argue that academic medical centres need to set up a pandemic response team in order to make time sensitive decision. Major themes of medical education management include leveraging on remote or decentralized models of medical education delivery, maintaining the integrity of formative and summative assessments while restructuring patient-contact components, and developing action plans for maintenance of essential medical education activities.
11	Bakshi SK, Ho AC, Chodosh J, Fung A, Chan RV, Ting DS.	Training in the year of the eye: the impact of the COVID-19 pandemic on ophthalmic education	British Journal of Ophthalmology, 2020; 104(9): 1181-1183	Editorial	Clinical practice Education delivery Training requirements	No specific setting	In this editorial, the authors describe changes to ophthalmology training during the pandemic.
12	Bambakidis NC, Tomei KL	Impact of COVID-19 on neurosurgical resident training and education	Journal of Neurosurgery, 2020; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7164320/	Editorial	Clinical practice Education delivery	USA	The authors provide commentary about changes to neurosurgical practice in the response to the COVID-19 pandemic and the subsequent impacts on training.
13	Barik S, Paul S, Kandwal P.	Insight into the changing patterns in clinical and academic activities of the orthopedic residents during COVID-19 pandemic: a cross-sectional survey	Knee Surgery, Sports Traumatology, Arthroscopy, 2020 https://doi.org/10.1007/s00167-020-06274-0	Survey	Clinical practice Education delivery Wellbeing	India	This study focusses on the view point of the orthopaedic residents, reviewing aspects of clinical practice, PPE, online based learning and wellbeing.
14	Boskovski MT, Hirji SA, Brescia AA, Chang AC, Kaneko T.	Enhancing thoracic surgical trainee competence in the coranavirus disease 2019 (COVID-19) era: challenges and opportunities for mentorship	The Journal of Thoracic and Cardiovascular Surgery, 2020;160: 1126-1129	Expert opinion	Clinical practice Education delivery Training requirements	USA	In this paper, the authors discuss the the impacts and challenges of COVID-19 on thoracic surgical training, provide a framework for identifying trainees who are

							most at risk of being impacted, and propose possible solutions to enhance and/or sustain surgical education during the pandemic. Includes a comprehensive table of recommendations and specific examples of ongoing initiatives to optimise surgical training.
15	Brand PL.	COVID-19: a unique learning opportunity if the well-being of learners and frontline workers is adequately supported	Perspectives in Medical Education, 2020; 9: 129-131	Commentary	Wellbeing	No specific setting	While mostly about medical students, the authors also offer some comments about issues facing residents,
16	Bryan DS, Benjamin AJ, Schneider AB, Milner R, Matthews JB, Roggin KK.	Nimble, together: a training program's response to the COVID-19 pandemic	Annals of Surgery, 2020	Opinion piece	Clinical practice Education delivery Welbeing	USA	This paper covers one surgical residency training programs' response to the pandemic, emphasizing segregated rosters, move to online meetings, promoting wellbeing and open communication.
17	Caruana EJ, Patel A, Kendall S, Rathinam S.	Impact of coronavirus 2019 (COVID-19) on training and well-being in subspecialty surgery: A national survey of cardiothoracic trainees in the United Kingdom	The Journal of Thoracic and Cardiovascular Surgery, 2020;160(4): 980-987	Survey	Clinical practice Training requirements Wellbeing	UK	Through a survey questionnaire, the authors sought to establish the impact of the pandemic on the wellbeing, practice and progression of cardiothoracic surgical trainees in the UK.
18	Chen RW, Abazari A, Dhar S, et al	Living with COVID-19: A perspective from New York area ophthalmology residency program directors at the epicenter of the pandemic	Ophthalmology, 2020; 127(8): e47-e48	Commentary	Education delivery	USA	The authors provide commentary on the changes to an ophthalmology residency education program highlighting (1) shared lectures, (2) increased surgical video teaching and simulation and (3) telehealth skills

19	Chick RC, Clifton GT, Peace KM, Propper BW, Hale DF, Alseidi AA, Vreeland TJ	Using technology to maintain the education of residents during the COVID-19 pandemic	Journal of Surgical Education, 2020; 77(4): 729-732	Perspective	Education delivery	USA	The authors propose several innovative solutions utilizing technology to assist in bridging the educational gap for surgical residents during the pandemic.
20	Chiel L, Winthrop Z, Winn AS.	The COVID-19 pandemic and pediatric graduate medical education	Paediatrics, 2020;146(2):e20201057	Commentary	Education delivery	USA	The authors present the collective observations of a resident, fellow and hospitalist, highlighting the challenges and opportunities in trainee education.
21	Coe TM, Jogerst KM, Sell NM, Cassidy DJ, Eurboonyanun C, Gee D, Phitayakorn R, Petrusa E.	Practical techniques to adapt surgical resident education to the COVID-19 era	Annals of Surgery, 2020	Opinion piece	Education delivery	USA	This paper provides recommendations on how surgical residency training programs can adapt to a virtual educational curriculum including educational didactics, operative preparation, and skills development and simulation.
22	Comer BT, Gupta N, Mowry SE, Malekzadeh S.	Otolaryngology education in the setting of COVID-19: current and future implications	Otolaryngology – Head and Neck Surgery, 2020; 163(1): 70-74	Commentary	Education delivery	USA	Outlines the development of the otolaryngology resident education consortiums, including implications for the future.
23	Daodu O, Panda N, Lopushinsky S, Varghese TK, Brindle M	COVID-19 – considerations and implications for surgical learners	Annals of Surgery, 2020; 272(1): e22-e23	Perspective	Education delivery Wellbeing	No specific setting	Provides commentary on implications of COVID-19 on surgical learners and approaches taken by different training programs.
24	Dedeilia A, Sotiropoulos MG, Hanrahan JG, Janga D, Dedeilias P, Sideris M.	Medical and surgical education challenges and innovations in the COVID-19 era: a systematic review	In Vivo, 2020; 34:1603-1611	Systematic review	Education delivery Wellbeing	No specific setting	A review of the literature published between January 2020 and 14 April 2020, exploring existing challenges enforced in medical and surgical education due to the COVID-19 pandemic. . The authors argue that there is

							little empirical evidence and that further research is required.
25	DeFilippis EM, Schmidt ACS, Reza N.	Adapting the educational environment for cardiovascular fellows-in-training during the COVID-19 pandemic	Journal of the American College of Cardiology, 2020; 75(20):2630-2634	Commentary	Clinical practice Education delivery	USA	Authors discuss strategies to support fellows in training in the early stages of the pandemic.
26	Dineen EH, Hsu JJ, Saeed A.	Reinforcing cardiology training during a pandemic. An open letter to our leaders	Circulation, 2020; 142: 95-97	Letter	Clinical practice Education delivery Wellbeing	No specific setting	Provides recommendations on the four themes (1) education; (2) clinical care, particularly volume of practice; (3) research; and (4) wellbeing.
27	Ding A, Zhang Y.	Impact of cancelling foundation year rotations due to the COVID-19 outbreak in the UK	Postgraduate Medical Journal, 2020; 96 (1137): 434-435	Letter	Training requirements	UK	Impact of cancelling rotations on foundation year doctors in the UK
28	Ferrario L, Maffioli A, Bondurri AA, Guerci C, Lazzarin F, Danelli P.	COVID-19 and surgical training in Italy: residents and young consultants perspectives from the battlefield	The American Journal of Surgery, 2020; 220: 850-852	Perspective	Clinical practice Education delivery Wellbeing	Italy	Impacts on surgical education (both undergrad and residents)
29	Fong ZV, Qadan M, McKinney Jr R, Griggs CL, Shah PC, Buyske J, Sachdeva AK, Callery MP, Altieri MS.	Practical implications of novel coronavirus COVID-19 on hospital operations, board certification, and medical education in surgery in the USA	Journal of Gastrointestinal Surgery, 2020; 24:1232-1236	Expert commentary	Education delivery Training requirements	US	Statement of Society for Surgery of the Alimentary Tract (SSAt), US, summarising expert commentary provided in a global webinar held 1 April 2020. Includes a section on challenges, opportunities and innovation in surgical education resulting from the COVID-19 pandemic.
30	Fudulu DP, Angelini GD.	The COVID-19 crisis: reflections on cardiothoracic training	Journal of Cardiac Surgery, 2020; 35:1765-1766	Editorial	Clinical practice Education delivery Training requirements	UK	Implications and opportunities arising from impacts on cardiothoracic training from the COVID-19 pandemic.
31	Fuller R, Joynes V, Cooper J, Boursicot K, Roberts T.	Could COVID-19 be our 'There is no alternative' (TINA) opportunity to enhance assessment?	Medical Teacher, 2020; 42(7): 781-786	Commentary	Training requirements	No specific setting	While the focus is on undergraduate assessment, there is some discussion of postgraduate training, with the

							authors exploring opportunities. Includes a diagram on understanding crisis-response measures.
32	Gallagher M, Bloomingdale R, Berman AD, Williamson BD, Dixon SR, Safian RD.	Strategic deployment of cardiology fellows in training using the Accreditation Council for Graduate Medical Education Coronavirus Disease 2019 Framework	Journal of the American Heart Association, 2020	Analysis	Clinical practice Training requirements	USA	The authors describe the strategic deployment of cardiology fellows in training using the ACGME Framework, with the approach baes on two principles (1) consider the care of patients as a medical mission; and (2) advocate for cardiology fellows in training.
33	Gallagher TH, Schleyer AM	"We signed up for this!" – student and trainee responses to the Covid-19 pandemic	New England Journal of Medicine, 2020; 382: e96(1- 3)	Perspective	Wellbeing	USA	Reports findings of a survey of senior medical students, interns and residents
34	Garcia-Lozano JA, Cuellar-Barboza A, Garza-Rodriguez V, Vazquez-Martinez O, Ocamp-Candiani J.	Dermatologic surgery training during the COVID-19 era	Journal of European Academy of Dermatology and Venerology, 2020	Letter to the editor	Education delivery	Mexico	Impact on dermatology, surgical skills on-line education and simulation
35	Garg T, Shrigiriwar A, Patel K.	Trainee education during COVID-19	Neuroradiology, 2020 https://doi.org/10.1007/s00234-020-02478-w	Letter to the Editor	Education delivery	India, USA	Education delivery on-line in radiology training
36	Gibbs T.	The Covid-19 pandemic: provoking thought and encouraging change	Medical Teacher, 2020; 42(7):738-740 https://doi.org/10.1080/0142159X.2020.1775967	Editorial	Education delivery	No specific setting	Special Edition Medical Teacher
37	Gill D, Whitehead C, Wondimagegn D.	Challenges to medical education at a time of physical distancing	The Lancet, 2020; 396:77-79	Comment	Training requirements	No specific setting	Unplanned learning opportunities
38	Goel S, Sharma A.	COVID-19 pandemic and its impact on cardiology and its subspecialty training	Progress in Cardiovascular Diseases, 2020; 63: 525-526	Letter to the Editor	Training requirements Wellbeing	USA	Impacts on education and training, personal (including $)

39	Goldhamer ME, Pusic MV, Co JP, Weinstein DF.	Can Covid catalyze an educational transformation? Competency-based advancement in a crisis	New England Journal of Medicine, 2020; 383(11): 1003-1005	Perspective	Training requirements	USA	The authors argue that COVID-19 is forcing educators to transform competency based assessment from a largely theoretical concept to a new reality.
40	Hadley MB, Lampert J, Zhang C.	Cardiology fellowship during the COVID-19 pandemic: Lessons from New York City	Journal of the American College of Cardiology, 2020;76(7): 878-882	Commentary	Clinical practice Education delivery	USA	The authors describe the challenges and lessons learned by cardiology fellows in NY city.
41	Hall AK. Nousiainen MT, Campisi P, Dagnone JD, Frank JR, Kroeker KI, Brzezina S, Purdy E, Oswald A.	Training disrupted: practical tips for supporting competency-based medical education during the COVID-19 pandemic	Medical Teacher, 2020 https://doi.org/10.1080/0142159X.2020.1766669	Commentary	Education delivery Training requirements Wellbeing	No specific setting	This paper provides practical tips on how to adapt medical education programs within the constraints of the pandemic, stressing the need for communication, innovation, collaboration, flexibility and planning within the era of competency-based medical education.
42	Hilburg R, Patel N, Ambruso S, Biewald MA, Farouk SS.	Medical education during the coronavirus disease-2019 pandemic: learning from a distance	Advanced Chronic Kidney Disease, 2020; X(X): 1-6	Review	Education delivery Wellbeing	USA	The authors discuss the influence of the pandemic on the existing medical education landscape, outline existing and proposed adaptations and describe the challenges that lie ahead.
43	Hintz GC, Duncan KC, Mackay EM, Scott TM, Karimuddin AA.	Surgical training in the midst of a pandemic: a distributed general surgery residency program's response to COVID-19	Canadian Journal of Surgery, 2020; 63(4): e346-348	Commentary	Clinical practice Education delivery Wellbeing	Canada	This paper describes the challenges of impacts of COVID-19 on resident training in terms of service, education and wellness and provide commentary on a response.
44	Huffman LC, Feldman HM, Hubner LM	Fellows front and center: tele-training and telehealth	Academic Paediatrics, 2020; 20: 764-765	Letter	Clinical practice	USA	The authors describe an educational framework for training fellows in telehealth visits – conclude that the nature of supervision changed – faculty

							observing fellows more intensively, without interrupting, feedback was enriched and there were unexpected learning opportunities
45	Imielski B.	The detrimental effect of COVID-19 on subspecialty medical education	Surgery, 2020; 168: 218-219	Perspective	Training requirements	USA	Perspective of a cardio-thoracic surgical trainee, particularly on VOP requirements
46	Johnson J, Chung M, Stathakios J, Gonik N, Siegel B.	The impact of the COVID-19 pandemic on fellowship training: A national survey of pediatric otolaryngology fellowship directors	International Journal of Pediatric Otorhinolaryngology, 2020; 136: 110217	Survey	Clinical practice Education delivery	USA	A survey of fellowship directors to explore impacts of COVID-19 on current and future paediatric otolaryngology training as well as how the application process was impacted. The authors conclude that there has been a significant impact particularly in the area of clinical and surgical practice.
47	Juprasert JM, Gray KD, Moore MD, Obeid L, peters AW, Fehling D, Fahey TJ, Yeo HL.	Restructuring of a general surgery residency program in an epicenter of the Coronavirus Disease 2019 pandemic: Lessons from New York City	Journal American Medical Association of Surgery, 2020; 155(9): 870-875	Analysis	Education delivery Training requirements	USA	The authors details the methodology used to safely deploy the necessary amount of resident workforce.
48	Kachra R, Brown A.	The new normal: medical education during and beyond the COVID-19 pandemic	Canadian Medical Education Journal, 2020 https://doi.org/10.36834/cmej.70317	Commentary	Education delivery	Canada	The authors offer suggestions for consideration in both medical schools and resident education programs including (1) novel modalities of education delivery should be embedded; (2) Involve learners in the process; (3) recognition of mental health implications; and (4) communication +++.
49	Kanneganti A, Logan S.	Pedagogy in a pandemic – COVID-19 and virtual	Acta Obstet Gynecol Scand, 2020;99:692-695	Special editorial	Education delivery Wellbeing	Singapore	This editorial describes the opportunities, challenges and experiences of an O and G

		continuing medical education (vCME) in obstetrics and gynecology					training program in Singapore during COVID-19.
50	Kanneganti A, Sia CH, Ashokka B, Ooi SB	Continuing medical education during a pandemic: an academic institution's experience	Postgraduate Medical Journal, 2020; 96:384-386	Commentary	Education delivery	Singapore	The authors share their academic institution's experience in mitigating the disruption on the CME program amidst the pandemic.
51	Khan SK, Keay R, McLellan M, Mahmud S.	Impact of the COVID-19 pandemic on core surgical training	Scottish Medical Journal,2020	Survey	Clinical practice Education delivery Wellbeing	Scotland	The aim of this study was to assess the impact of COVID-19 pandemic on core surgical training through a survey of surgical trainees. The authors conclude the pandemic has had an unprecedented negative impact.
52	Khanna RC, Honavar SG, Metla AL, Bhattacharya A, Maulik PK	Psychological impact of COVID-19 on ophthalmologists-in-training and practicing ophthalmologists in India	Indian Journal of Ophthalmology, 2020; 68(6): 994-998	Survey	Wellbeing	India	The aim of this study was to evaluate the psychological impact of the COVID-19 pandemic on ophthalmologist-in-training and practicing ophthalmologists in India. The authors conclude that a strikingly high proportion of respondents to the survey have been psychologically affected and may require personalized mental health care.
53	Khusid JA, Weinstein CS, Becerra AZ, Kashani M, Robins DJ, Fink LE, Smith MT, Weiss JP	Well-being and education of urology residents during the COVID-19 pandemic: results of an American National Survey	International Journal of Clinical Practice, 2020; 74: e13559	Survey	Wellbeing	USA	The authors surveyed trainees in accredited urology programs in the US and evaluated risk factors of perception of anxiety and depression both at work and home and education outcomes.
54	Kogan M, Klein SE, Hannon CP, Nolte MT	Orthopaedic education during the COVID-19 pandemic	Journal of American Academy of Orthopaedic	Commentary	Clinical practice Education delivery	USA	In this article, the authors describe changes to clinical

			Surgeons, 2020; 28: e456-e464		Wellbeing		service, education and training and wellbeing in orthopaedic surgical training programs during the pandemic.
55	Kohan L, Sobey C, Wahezi S, Brancolini S, Przkora R, Shaparin N, Spektor B, Moeschler S, Anitescu M.	Maintaining high quality multidisciplinary pain medicine fellowship programs: Part 1: Innovations in pain fellows' education , research, applicant selection process, wellness and ACGME implementation during the Covid-19 pandemic	Journal of the American Academy of Pain Medicine, 2020	Review	Clinical practice Education delivery Training requirements Wellbeing	USA	Members of the Association of Pain Program Directors provide guidance and formulate recommendations for pain fellowship directors on remote educational activities, research endeavours and trainee wellness.
56	Kohan L, Sobey C, Wahezi S, Brancolini S, Przkora R, Shaparin N, Spektor B, Moeschler S, Anitescu M.	Maintaining high quality multidisciplinary pain medicine fellowship programs: Part 2: Innovations in clinical care workflow, clinical supervision, job satisfaction and postgraduation mentorship for pain fellows during the Covid-19 pandemic	Journal of the American Academy of Pain Medicine, 2020	Review	Education delivery Wellbeing	USA	Part 2 of the above review with a focus on telehealth, clinical staff management and postgraduate related matters. Framework for competency assessment in telehealth included as an appendix in the article.
57	Koumpouras F, Helfgott S.	Stand together and deliver: Challenges and opportunities for rheumatology education during the COVID-19 pandemic	Arthritis and Rheumatology, 2020; 72 (7):1064-1066	Commentary	Education delivery Training requirements	USA	Provides a commentary on challenges and opportunities for rheumatology education, recommending support of trainees and maintenance of education.
58	Lapolla P, Mingoli A.	COVID-19 changes medical education in Italy: will other countries follow?	Postgraduate Medical Journal, 2020; 96:375-376	Editorial	Training requirements	Italy	Commentary on fast tracking of medical students to provisional registration – increase in 10.3% of doctors
59	Lewis, EE, Taylor LJ, Hermsen JL, McCarthy DP, Fiedler AG	Cardiothoracic education in the time of COVID-19: How I teach it	Annals of Thoracic Surgery, 2020; 110: 362-363	Commentary	Education delivery	USA	Changes to education program , "mock orals" – plan to roll out, multi-institutional

60	Liang ZC, Suat SB, Wang,W.	Pandemics and their impact on medical training: Lessons from Singapore	Academic Medicine, 2020	Perspective	Clinical practice Education delivery	Singapore	Impacts and opportunities, also unplanned learning, skills in leadership, and health systems. Authors argue that the pandemic presents an opportune time to evaluate business continuity plans to ensure maintenance of education.
61	Lo HY, Lin SC, Chaou CH, Chang YC, Ng CJ, Chen Sy.	What is the impact of the COVID-19 pandemic on emergency medicine residency training: an observational study	BMC Medical Education, 2020 https://doi.org/10.1186/s12909-020-02267-2	Retrospective observational study	Clinical practice	China	Compared clinical exposure of residents pre and peri pandemic, reduced clinical exposure, especially in paediatrics and trauma
62	Lu W, Wang H, Lin Y, Li L	Psychological status of medical workforce during the COVID-19 pandemic: a cross-sectional study	Psychiatry Research, 2020; https://pubmed.ncbi.nlm.nih.gov/32276196/	Cross-sectional study	Wellbeing	China	The authors conducted a cross-sectional study via an online questionnaire to assess the psychological impact of the COVID-19 pandemic on the medical workforce.
63	Madrazo JA.	New challenges and opportunities for echocardiographic education during the COVID-19 pandemic: a call to focus on competency and pathology	Journal of the American Society of Echocardiography, 2020; 33(8): 1048-1049	Editorial comment	Education delivery Training requirements	USA	Outlines changes to training Formal case review “show and tell” Remote review, ”scan labs”
64	Mallon D, Pohl J, Phatak U et al	Impact of COVID-19 on paediatric gastroenterology fellow training in North America	Journal of Pediatric Gastroenterology and Nutrition, 2020	Survey	Education delivery Training requirements	USA, Canada, Mexico	A survey of paediatric gastroenterology fellowship program directors to explore impacts on fellowship training.
65	McCarthy C, Carayannopoulos K, Walton M.	COVID-19 and changes to postgraduate medical education in Canada	Canadian Medical Association Journal,2020;192(35):e1018-1020	Commentary	Training requirements	Canada	Describes the broad changes to Canadian medical education system during the pandemic.

66	McKechnie T, Levin M, Zhou K, Freedman B, Palter V, Grantcharov T	Virtual surgical training during COVID-19 operating room simulation platforms accessible from home	Annals of Surgery, 2020; 272 (2): e153-e154	Perspective	Education delivery	No specific setting	Provides an overview of the available computer- and phone-based platforms accessible for surgical trainees
67	Meneses E, McKenney M, Elkbuli A.	Reforming our general surgery residency program at an urban level 1 Trauma Center during the COVID-19 pandemic: towards maintaining resident safety and wellbeing	The American Journal of Surgery, 2020; 220: 847-849	Perspective	Clinical practice Training requirements Wellbeing	USA	The authors discuss changes to a surgical residency program at a trauma centre, with a focus on segregated teams and rostering arrangements.
68	Mishra D, Nair AG, Gandhi RA, Gogate PJ, Mathur S, Bhushan P, Srivastav T, Singh H, Sinha BP, Singh MK.	The impact of COVID-19 related lockdown on ophthalmology training programs in India – outcomes of a survey	Indian Journal of Ophthalmology, 2020;68: 999-1004	Survey	Clinical practice Education delivery Wellbeing	India	The aim of this study was to assess the effect of lockdown on ophthalmic training programs across India, through a survey. The authors conclude that the majority of trainees felt adverse impacts on learning, especially in surgical training. Whilst most trainees found online classes and webinars useful, perceived stress levels were higher than normal.
69	Mousa AY, Broce M.	The impact of COVID-19 on vascular training	Journal of Vascular Surgery, 2020; 72 (1): 380-381	Letter	Training requirements	USA	Discusses changes to training requirements
70	Mukhopadhyay S, Booth AL, Calkins SM, Doxtader EE,Fine SW, Gardner JM, Gonzalez RS, Mirza KM, Jiang X.	Leveraging technology for remote learning in the era of COVID-19 and social distancing. Tips and resources for pathology educators and trainees.	Archive of Pathology and Laboratory Medicine, 2020; 144: 10271036	Editorial	Education delivery	No specific setting	In this editorial, the authors provide curated lists of various online learning resources that can be used for virtual learning in pathology; provide tips and tricks; and share their experience with the technologies.
71	Murdock HM, Penner JC.	Virtual morning report during COVID-19: a novel model for case-based teaching conferences	Medical Education, 2020: https://doi.org/10.1111/medu.14226	Letter	Education delivery	USA	Commentary about the move to online multi-institutional morning report, use of chat function and whiteboard. The

							authors report on attendance and participation rates.
72	Nesemeier BR, Lebo NL, Schmalbach CE, Barnes KJ, Vernon D, Ting JY, Shipchandler TZ.	Impact of the COVID-19 global pandemic on the otolaryngology fellowship application process	American Academy of Otolaryngology – Head and Neck Surgery, 2020; 163(4): 712-713	Commentary	Training requirements	USA	Impacts on application process- this paper discusses the challenges of both applicants and institutions and provides some suggestions for improvements.
73	Obaid O, Zimmermann J, Ares G.	Surgical residents in the battle against COVID-19	Journal of Surgical Education, 2020, doi: 10.1016/j.jsurg.2020.07.018	Perspective	Clinical practice Education delivery	USA	Describes a holistic approach to managing the impacts of COVID-19 on a surgical training program, with a focus on the deployment and rostering of trainees.
74	Paesano N, Santomil F, Tobia I.	Impact of COVID-19 on Ibero-American urology residents: Perspective of American Confederation of Urology (CAU)	Int Braz J Urol, 2020; 46(Suppl 1): 165-169	Survey	Clinical practice Training requirements	USA	The aim of this study was to evaluate the impact of the COVID-19 pandemic on training program, through a survey of urology medical residences in Ibero-American countries. The authors conclude that there is a negative impact and argue for technological innovation and allocation of time and resources to generate accessible tools to support training.
75	Palchaudhuri S, Gabre J, Prenner S, Klapproth JM.	Adapting a GI fellowship to a pandemic: novel approaches to accommodating a novel virus	Digestive Diseases and Sciences, 2020 https://doi.org/10.1007/s10620-020-06306-2	Review	Clinical practice Education delivery	USA	The authors describe the response to impacts of COVID-19 on gastroenterology training within a large tertiary care academic medical centre.
76	Pang KH, Carrion DM, Rivas JG, Mantica G, Mattigk A, Pradere B, Esperto F.	The impact of COVID-19 on European health care and urology trainees	European Urology, 2020; 78: 6-8	Editorial	Clinical practice	UK, France, Germany, Italy, Spain	Describes changes to clinical practice and redeployment of urology trainees in 5 countries

77	Pelargos PE, Chakraborty A, Zhao YD, Smith ZA, Dunn IF, Bauer AM.	An evaluation of neurosurgical resident education and sentiment during the coronavirus disease 2019 pandemic: a North American survey	World Neurosurgery, 2020;140: e381-386	Survey	Clinical practice Education delivery	USA, Canada	The aim of this study was to assess the effects of COVID-19 on neurosurgical training programs and residents through a survey of residents.
78	Pitt MB, Li ST, Klein M.	Novel educational responses to COVID-19: What is here to stay?	Academic Paediatrics, 2020; 20(6):733-734	Editorial	Education delivery	No specific setting	Special issue on innovations that highlight novel educational responses to the COVID-19 pandemic.
79	Porpiglia F, Checcucci E, Amparore D, Verri P, Campi R, Claps F, Esperto F, Fiori C, Carrieri G, Ficarra V, Scarpa RM, Dasgupta P.	Slowdown of urology residents' learning curve during the COVID-19 emergency	BJU International, 2020; 125: e15-e17	Comment	Education delivery	Italy	The authors provide commentary on changes to education delivery in urology training during the pandemic, including discussion about different smart learning technologies.
80	Potts JR.	Residency and Fellowship Program Accreditation: Effects of the Novel Coronavirus (COVID-19) Pandemic	Journal of American College of Surgeons, 2020;230 (6): 1094 - 1097	Commentary	Training requirements	USA	The authors describes some of the challenges in response to the COVID-19 pandemic with respect to the accreditation of surgical training programs.
81	Prem A, Anand S, Chandrashekar A.	Impact of COVID-19 on an Academic Pain Fellowship Program	Pain Physician Journal, 2020;23:S433-S437	Letter	Clinical practice Training requirements	USA	The authors discuss the unique challenges of a pain fellowship program in Mississippi, US
82	Rana T, Hackett C, Quezada T, Chaturvedi A, Bakalov V, Leonardo J, Rana S.	Medicine and surgery residents' perspectives on the impact of COVID-19 on graduate medical education	Medical Education Online, 2020 https://doi.org/10.1080/10872981.2020.1818439	Survey	Clinical practice Education delivery Wellbeing	USA	The authors surveyed residents to explore how the COVID-19 pandemic has impacted resident's education and wellbeing.
83	Rao P, Diamond J, Korjian S, Varghese M, Serfas JD, Fraiche A, Kannam J, Reza N.	The impact of the COVID-19 pandemic on cardiovascular fellows-in-training. A national survey	Journal of the American College of Cardiology, 2020; 76(7): 871-875	Survey	Clinical practice Education delivery Wellbeing	USA	Survey of cardiovascular fellows in training to explore evolving daily activities of cardiovascular fellows in training; current strategies to reduce

							occupational risk; and the educational, social and psychological implications of working during the COVID-19 pandemic.
84	Ripp J, Peccoralo L, Charney D.	Attending to the emotional well-being of the health care workforce in a New York City health system during the COVID-19 pandemic	Academic Medicine, 2020; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7176260/pdf/acm-publish-ahead-of-print-10.1097.acm.0000000000003414.pdf	Invited commentary	Wellbeing	USA	The authors describe how the Mount Sinai Health System and Trainee Crisis Support Taskforce used a rapids needs assessment model to capture and respond to concerns of the workforce related to the COVID-19 pandemic. The article includes a comprehensive table of priority areas and deliverables.
85	Rose C, Mott S, Alvarez A, Lin M.	Physically distant, educationally connected: Interactive conferencing in the era of COVID-19	Medical Education, 2020; 54: 758-759	Letter	Education delivery	USA	Emergency Medicine residency program - live conferencing , on-line delivery
86	Ross, DA.	Creating a "Quarantine Curriculum" to enhance teaching and learning during the COVID-19 pandemic	Academic Medicine, 2020	Letter	Education delivery	USA	14 day curriculum in psychiatry – on-line learning and formative feedback on assessment pieces.
87	Sandars J, Patel R	The challenge of online learning for medical education during the COVID-19 pandemic	International Journal of Medical Education, 2020;11:169-170	Editorial	Education delivery	No specific setting	Importance of designing online learning – rapid evaluation and fine tuning
88	Schwartz AM, Wilson J, Boden SD, Moore TJ, Bradbury TL, Fletcher ND	Managing resident workforce and education during the COVID-19 pandemic	Journal of Bone and Joint Surgery, 2020	Commentary	Clinical practice Education delivery	USA	The authors describe changes to team structure and education within an orthopaedic training program.
89	Shafi AM, Atieh AE, Harky A, Sheikh AM, Awad WI.	Impact of COVID-19 on cardiac surgical training: Our experience in the United Kingdom	Journal of Cardiac Surgery, 2020; 1-4 https://doi.org/10.1111/jocs.14693	Review	Clinical practice Education delivery Training requirements Wellbeing	UK	Impacts on clinical care, education, wellbeing, assessment, length of training, opportunities , risk mitigation

90	Shah JP	The impact of COVID-19 on head and neck surgery, education and training	Head and Neck, 2020; 42: 1344-1347	Commentary	Education delivery Training requirements	No specific setting	Focus on head and neck surgery Online Fellowship Course since 2014
91	Shah S, Diwan S, Kohan L, Rosenblum D, Gharibo C, Soin A, Sulindro A, Nguyen Q, Provenzano D	The technological impact of COVID-19 on the future of education and health care delivery	Pain Physician, 2020; 23: S367-S380	Commentary	Education delivery	USA	The authors discuss the changes in medical education, CME, residency and fellowship programs, specialty society meetings and telemedicine, and to consider the value of some of those profound shifts to BAU. Some good points about on-line education, peer review and the role of industry
92	Sia CH, Tan YQ, Ooi SB.	Impact of the coronavirus disease 2019 pandemic on postgraduate medical education in a Singaporean academic medical institution	Korean Journal of Medical Education, 2020; 32(2): 97-100	Commentary	Clinical practice Education delivery Wellbeing	Singapore	Describes the impacts on postgraduate medical education in Singapore. Includes a useful diagram of issues relating to postgraduate medical education that have been impacted by COVID-19.
93	Singhi EK, Dupuis MM, Ross JA, Rieber AG, Bhadkamkar NA.	Medical hematology/oncology fellows' perceptions of online medical education during the COVID-19 pandemic	Journal of Cancer Education, 2020. https://doi.org/10.1007/s13187-020-01863-6	Survey	Education delivery	USA	The authors surveyed haematology / oncology fellows on their attitudes regarding the online-based lecture program to explore its impact.
94	Sneyd JR, Mathoulin SE, O'Sullivan EP, So VC, Roberts FR, Paul AA, Cortinez LI, Ampofo RS, Miller CJ, Balkisson MA.	Impact of the COVID-19 pandemic on anaesthesia trainees and their training	British Journal of Anaesthesia, 2020; 125 (4): 450-455	Commentary	Clinical practice Education delivery Wellbeing	Britain, Ireland, South Africa, Hong Kong (suplementary info from Australia and America	Authors discuss impacts on anaesthetic training. Good point about deliberate practice and the importance of optimising opportunities
95	Stambough JB, Curtin BM, Gililland JM, Guild GN, Kain MS,	The past, present and future of orthopedic education: Lessons	The Journal of Arthroplasty, 2020; 35: s60-s64	Commentary	Education delivery	USA	This article describes the evolution of orthopaedic education since the turn of the

	Karas V, Keeney JA, Plancher KD, Moskal JT	learned from the COVID-19 pandemic					20th century with a focus on the acceleration of changes to training due to the pandemic.
96	Tomlinson SB, Hendricks BK, Cohen-Gadol AA	Innovations in neurosurgical education during the COVID-19 pandemic: is it time to reexamine our neurosurgical training models?	Journal of Neurosurgery, 2020; 133: 14-15	Editorial	Education delivery	USA	The authors provide commentary on several innovations in neurosurgical training (including *The Neurosurgical Atlas*) during the pandemic and argue for continued focus on advances in simulation technology and virtual reality as mechanisms of supplementing hands-on training.
97	Torda, A	How COVID-19 has pushed us into a medical education revolution	Internal Medicine Journal, 2020	Opinion piece	Education delivery	Australia, New Zealand	Focus on on-line learning in medical student teaching but included because of relevance to postgraduate training. Table of pros and cons of on-line learning, arguing that when done well, better than f2f
98	Vazquez AG, Verde JM, Mas FD, Palaermo M, Cobianchi L, Marescaux J, Ballix B, Dallermagne B, Perretta S, Gimenez ME.	Image-guided surgical e-Learning in the post-COVID-19 pandemic era: what is next?	Journal of Laparoendoscopic and Advanced Surgical Techniques, 2020; 30(9): 993-997	Commentary	Education delivery	No specific setting	The authors discuss image guided surgical elearning, including challenges and opportunities, arguing for further development on new learning solutions.
99	Vivarkar M, Jensen C, Javadi S, Saleh M, Bhosale PR.	Radiology education amid COVID-19 pandemic and possible solutions	Journal of Computer Assisted Tomography, 2020; 44(4): 472-478	Commentary	Education delivery	USA	This paper discusses the problems faced by radiology training programs during the pandemic and offers some technology-based solutions.
100	Wald HS	Optimizing resilience and wellbeing for healthcare professions trainees and healthcare professionals during	Medical Teacher, 2020; 42(7): 744-755	Commentary	Wellbeing	No specific setting	The author provides practical tips for medical educators to optimise resilience and wellbeing

		public health crisis – practical tips for an 'integrative resilience' approach					for trainees during the pandemic.
101	Warhadpande S, Khaja MS, Sabri SS.	The impact of COVID-19 on interventional radiology training programs: What you need to know	Academic Radiology, 2020; 27:868-871	Commentary	Clinical practice Training requirements	USA	Discusses impacts of the pandemic on interventional radiology training, includes a summary table of impacts.
102	Weiss PG, Li ST.	Leading change to address the needs and well-being of trainees during the COVID-19 pandemic	Academic Paediatrics, 2020;20(6): 735-741	Expert view	Wellbeing	USA	The authors adapt Maslow's needs framework to systematically address trainee wellbeing needs during the pandemic. The article includes a useful summary table.
103	Weissman G, Arrighi JA, Botkin NF, Damp JB, Keating FK, Menon V, Rose-Jones LJ, Singh HS, Soukoulis V, Kates AM	The impact of COVID-19 on cardiovascular training programs – challenges, responsibilities, opportunities	Journal of the American College of Cardiology, 2020; 76(7): 867-870	Commentary	Education delivery Training requirements Wellbeing	USA	The authors discuss changes to cardiovascular training due to the pandemic and explore potential opportunities.
104	White C.	Response: COVID-19 and challenges to cardiovascular graduate medical education	JACC, 2020; 76 (10): 1269	Letter	Education delivery	USA, Australia	The author argues that the pandemic may be a catalyst for positive change in medical education, particularly in the context of virtual learning.
105	Wong CS, Tay WC, Hap XF, Chia FL.	Love in the time of coronavirus: training and service during COVID-19	Singapore Medical Journal, 2020; 61(7): 384-386	Survey	Clinical practice	Singapore	The aim of this study was to gather feedback about clinical work in locations impacted by the pandemic, identify challenges trainees were facing and make suggestions for improvements.
106	Yadav A.	Cardiology training in times of COVID-19: beyond the present	Indian Heart Journal, 2020; 72: 321-324	Letter to the Editor	Clinical practice Education delivery	India	The authors present an approach for physician training during the pandemic.
107	Yi PK, Gohil S, Kitt A.	Applying to pain fellowships in the time of COVID-19	Pain Medicine, 2020	Letter to the Editor	Training requirements	USA	The authors outline challenges and approaches to application processes in pain fellowship,

							including the argument that one of the challenges is assessment of emotional intelligence, suggesting a formal assessment of EI as part of the selection process.
108	Yu C, The BM, Aung AK.	COVID-19 significantly affects specialty training	Internal Medicine Journal, 2020: 1-2	Letter to the Editor	Clinical practice Education delivery	Australia	Summary of impacts on specialty training - RACP
109	Yuen J, Xie F.	Medical education during the COVID-19 pandemic: perspectives from UK trainees	Postgraduate Medical Journal, 2020; 96 (1137): 432-433	Letter	Clinical practice Education delivery	UK	UK trainee perspectives on impacts, opportunities to learn "soft skills" Radical reforms to medical education system compared with WW2
110	Zheng J, Hundeyin M, He K, Sachs T, Hess DT, Whang E, Kristo G.	General surgery chief residents' perspective on surgical education during the coronavirus disease 2019 (COVID-19) pandemic	Surgery, 2020; 168: 222-225	Survey	Training requirements	USA	Through a survey, the authors explore the education concerns of general surgery chief residents during the pandemic with respect to perceived readiness to complete residency training.
111	Zuzuarregui JR, Bledsoe IO, Brown EG, Dietiker CG, Galifianakis NB.	Medical education in movement disorders during the COVID-19 pandemic	Parkinsonism and Related Disorders, 2020; 77: 11-12	Letter	Education delivery Clinical practice	USA	The authors argue for the importance of providing education to trainees on delivering patient care through telemedicine and consider ways to provide bedside education in a remote environment.