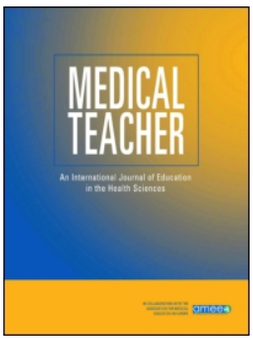

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Coordinated responses of academic medical centres to pandemics: Sustaining medical education during COVID-19

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ABSTRACT

Background: The Corona Virus Disease-19 (COVID-19) has been declared a pandemic by the World Health Organization (WHO). We state the consolidated and systematic approach for academic medical centres in response to the evolving pandemic outbreaks for sustaining medical education.

Discussion: Academic medical centres need to establish a 'COVID-19 response team' in order to make time-sensitive decisions while managing pandemic threats. Major themes of medical education management include leveraging on remote or decentralised modes 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 activities based on pandemic risk alert levels. These core principles must be applied seamlessly across the various fraternities of academic centres: undergraduate education, residency training, continuous professional development and research. Key decisions from the pandemic response teams that help to minimise major disruptions in medical education and to control disease transmissions include: minimising inter-cluster cross contaminations and plans for segregation within and among cohorts; reshuffling academic calendars; postponing or restructuring assessments.

Conclusions: While minimising the transmission of the pandemic outbreak within the healthcare establishments is paramount, medical education and research activities cannot come to a standstill each time there is a threat of one.

KEYWORDS
e-Learning/computers; undergraduate; general; public health

Background

The 2019 novel coronavirus (SARS-CoV-2) was first identified by the Chinese Centre for Disease Control and Prevention from a throat swab of a patient in Wuhan, Hubei province of China on 7 January 2020 (Huang et al. 2020; World Health Organization 2020a). This infection began to spread to many countries, and by January 30, the World Health Organization (World Health Organization 2020a) declared this a 'Public health emergency of international concern.' The disease was subsequently designated as the Corona Virus Disease 19 (COVID-19) by WHO (Sahin et al. 2020) and declared a pandemic on 11 March 2020.

The first case of COVID-19 in Singapore was confirmed by the Ministry of Health (MOH) on 23 January 2020 (Ministry of Health Singapore 2020a). The patient was a tourist from Wuhan. By 7 February, Singapore had 33 confirmed cases with evidence of limited local transmission with four confirmed cases having no apparent contact history (Ministry of Health Singapore 2020a). In response to this, Singapore health ministry elevated its risk assessment from disease outbreak response system condition (DORSCON) yellow to DORSCON orange (Ministry of Health Singapore 2014). The DORSCON framework (Figure 1) essentially enables a whole-of-government response to an infectious outbreak and serves as a guidance to intensify responses according to the severity of a pandemic (Ministry of Health Singapore 2020b).

Practice points

- Academic medical centres need to setup a 'pandemic response team' at the first instance of a threat of an outbreak.
- Key central decisions should be transparent, consolidated and in line with the disease outbreak alert levels.
- Core principles include minimising cross contaminations between clusters and among faculty, staff and students, and reshuffling of the academic calendar.
- Medical education delivery needs to be sustained with decentralised, remote and technology-enabled formats.
- Patient contact components of medical education need to be restructured and enhanced with appropriate standards for learning and assessment.

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Phases of Response & Alert levels	Response Phases		
	Alert	Containment	Mitigation
GREEN	Prevent importation, if disease is mainly overseas (high virulence, no/ limited transmissibility)	Stop spread from imported case(s), if any	Reduce impact through patient management (similar or lower virulence and transmissibility as seasonal influenza)
YELLOW	Prevent importation, if disease is mainly overseas (high virulence but low transmissibility)	Stop spread from imported case(s), if any	Reduce impact through vaccination and patient management (low virulence but high transmissibility)
ORANGE High virulence and transmissibility	Prevent importation, if disease is mainly overseas	Stop or limit the spread from local cases/ clusters	Selective mitigation measures may be activated as necessary
RED High virulence and transmissibility			Reduce impact through social distancing to counter widespread transmission

Figure 1. Disease outbreak response system condition (DORSCON). This figure shows a framework guiding a whole-of-government response titrated to outbreak severity. Social distancing refers to observing a 1-2 metres spacing between individuals.

As Singapore transited to DORSCON orange, the following directives were implemented to minimise the risk of infectious outbreaks within healthcare institutions:

- Stepping up of personal protective equipment (PPE) use in high risk healthcare areas, for example, triage areas of emergency medicine departments, isolation/intensive care rooms with suspect/confirmed cases
- Nationwide restriction of healthcare staff movement between healthcare institutions

During pandemics, academic medical centres have two key responsibilities. First, ensuring the safety of the stakeholders (patients, students, faculty, and staff) by implementing appropriate infection control measures (Chang et al. 2020). Second, minimising disruptions to curricula with necessary modifications of education activities to align with prevailing infection control measures.

Nationwide enhanced pandemic responses (Lim et al. 2009) have a significant impact on the provision of medical care with effects on medical education activities (Eccleston-Turner et al. 2019). The effects of severe acute respiratory syndrome (SARS) (Patil and Yan 2003) and Middle Eastern respiratory syndrome (MERS, World Health Organization 2019) pandemics on medical education are well known (Sherbino and Atzema 2004). We present our experience from the perspective of the National University Health System (NUHS) in Singapore. NUHS is a university academic medical centre with 1 tertiary hospital, 3 regional/community hospitals, and an affiliated primary care medical centre group (National University Health System 2020). The 5-year undergraduate medicine program is the largest in the country, with yearly cohorts of 250–300 students. There are close collaborative links with undergraduate medical and dental programs, nursing and allied health sciences education under the National University of Singapore (NUS).

Principles of consolidated academic centre response

Our experiences from the pandemic preparedness during the SARS (Lim et al. 2009; Ministry of Health Singapore 2014) pandemic and subsequent threats from potential pandemics like MERS have evolved into a robust system of coordinated approaches (Rieder et al. 2004) for academic and healthcare establishments (Tay et al. 2010). Core principles that should govern academic medical centres' responses to pandemic outbreaks include:

Making time-sensitive key organisational decisions

Key organisational decisions have implications for the university and functioning of the clinical and academic teaching locations, continuation of the curricular timetables and restrictions to rotations and movement of learners across clusters. With the first information of a potential threat of a

pandemic, academic medical centres need to make timely decisions about:

- Minimising inter-cluster cross contaminations and plans for segregation within and among cohorts
- Reshuffling academic calendars and shifting the term breaks forward
- Postponing assessments and modifying it to suit pandemic preparedness

Central system for management of processes: NUS COVID-19 response team

The NUS medicine COVID-19 response team was established when the first occurrence of an outbreak was announced. The team consisted of the Vice Dean of education, education directors of various departments, and educational administrative units. The chief objectives of the response team were to coordinate directives from the ministry of health and ministry of education with the university and health systems' administrative teams to make timely consolidated decisions. These included announcements on the level of pandemic alerts (DORSCON), current uniform standing on student activities that involve patient or contact with clinical staff, redesigning local & overseas electives, clinical postings, small and large group teaching. Vital decisions included postponement of formative assessments, revised format of high-stake assessments (such as final professional examinations) and making a university level decision to reshuffle the academic calendar and prepone the term breaks so as to avoid the peak periods of disease transmissions. The decisions and concerns were relayed both ways to the representations from the student medical bodies and the response team.

Setting up the academic response team helps to:

- Relay health information and disease status updates from health authorities
- Decide the level and spectrum of coordinated responses
- Regulate department/specialty/cohort-specific workflows
- Collate feedback, inputs and information from care locations upon implementation

Executing the decisions of this response team facilitates several processes of an academic medical centre in preparing for a coordinated system of action:

Systematic process of disseminations of information and updates

Once a pandemic response team was set up, the dissemination of information and updates were established through communication portals that were in place in the individual institutions. Institutional email system, mobile based message, and broadcasting services with interactive responsive communication platforms (e.g. message status 'read') were reinstated.

Preventing duplications, delays, and misinformation/ miscommunications

Setting up pandemic response centres and establishing a coordinated systematic communication process helped in minimising delays in dissemination of vital information in an efficient manner. This eliminated the need for developing separate action plans for the hospital (clinical) and academic university settings with seamless collaborations between them and thereby reducing duplication of efforts with less confusion from misinformation.

Reporting issues and challenges

COVID-19 hotline, a 24-h support system for manging challenges that evolve during the implementation of the coordinated actions was established. Chief objectives were to provide *timely and accurate information*, especially to address communication breakdowns or disintegration of planned systematic actions. The learning points, ground issues and recommendations were disseminated in a timely manner to all units to minimise risk of repeat occurrences of the same events (e.g. missed infective precautions and subsequent infection in healthcare staff).

Maintaining transparency and trust in the system

Transparency in pandemics refer to the system of providing accurate information about the evolving pandemic in the community and within the academic centre by the health authorities (Ministry of Health Singapore 2020a) and academic medical centres (National University Health System 2020). These included the information about the actual number of new cases, the severity of their illness, the proven or most likely transmission modes, the actual risks for the staff, healthcare teams, students, educators, patients and the society. This in turn enhanced the compliance to directives from the COVID-19 response team and facilitated rapid implementation of planned policies as the pandemic evolved.

Safety and preventive measures for the welfare/ wellbeing of all stakeholders

Common public health precautions and the principles of minimising person-to-person transmissions were broadcasted and implemented (World Health Organization 2020b) in the first instance of the declaration of a pandemic threat. These included:

- Enhancing provisions (stocking supplies, securing, distribution) for hand sanitation
- Screening for fever and other symptoms by regulating entry points
- Instituting visitor registration systems across all entry points to facilitate contact tracing
- Enhancing decontamination of common point sources for pandemic transmissions (e.g. periodic cleaning of hand railings, elevator controls)
- Minimising non-essential face-to-face interactions among faculty, medical staff and students across clusters and institutions
- Providing protective masks, individualised screening devices such as thermometers
- Providing travel advisories (Mateus et al. 2014)

- Reinforcing importance of compliance to home quarantine and self-monitoring of symptoms for suspect cases and close contacts of confirmed cases
- Providing extended leave of absence for close contacts of confirmed cases (World Health Organization 2020a)

Alignment to evidence-based practice

As pandemics evolve, information and knowledge tend to change with time. Academic centres must set up an expert panel such a COVID-19 work group at the earliest instance of a pandemic. This workgroup with representations from key stake holders, would ascertain the accuracy of information collated from local and international sources, appraise current evidence that is evolving as the pandemic unwinds and decide on the best practices and responses. The scientific recommendations from the workgroup are then relayed to the COVID-19 response team for further deliberations before implementation.

Incentivising early reporting of symptoms

One of the vital responses coordinated by the health ministry of Singapore to COVID-19 outbreak was the initiation of highly subsidised (by 80%) primary health care for the management of patients with respiratory symptoms via more than 800 designated Primary Health Preparedness Clinics (PHPC) (Ministry of National Development 2019). This incentivised early reporting of symptoms amongst those who were unwell. Clinicians were also given discretion to issue extended medical leave (5 days) for patients, university faculty, administrative staff and students with milder upper respiratory tract symptoms that do not fulfil the criteria to be screened for COVID-19. This significantly reduced the disease transmission from asymptomatic careers. Extensive epidemiological support for contact tracing were also in place (Kit and Mahmud 2020). This facilitates early case detection, isolation and management and helped in identifying and quarantining the currently sporadic occurrences among healthcare staff and hospital employees. Singapore as a nation, with these measures had successfully controlled the outbreak with the very low number of confirmed cases (less than 200) for up to 6 weeks with no mortality till the first week of March 2020.

Operationalising a coordinated system across the academic medical centre

Academic medical centres need to have a systematic approach to address evolving challenges in measures for reduction of disease transmission (Wong et al. 2020) and operationalise contingency plans for undergraduate education, residency training, continuing professional development, and research activities. Core principles that govern the consolidated responses for academic medical centres are stated in Table 1.

The planning and operationalisations at our institute were done with active solicitations and in consultations with the student bodies. The university student council (for all faculties) and the undergraduate medicine student bodies were both consulted at various stages. Chief inputs included the student preferences on the most familiar/suitable virtual platforms for learning, suggestions/concerns for sequential escalation of transition to web-based teaching and perceived efficacy of learning. The staged transitions were executed over 2–4 weeks while in campus, such that, when a full lock-down with complete cessation of university activities were imposed from April 2020, all fraternities had tested, and completed trouble shooting their online platforms. Hence, the overall process was smooth, and the experience was rated favourably by both the faculty and students.

The faculty needed support and guidance for transforming all learning to online platforms within a very short span of time. Transition to full flipped classroom models with embedded pre-reading before the collaborative learning sessions through video conferencing calls needed systematic planning. The educational technology team experts were available through mobile based support services (Edutech hotline) for faculty and students to familiarise with the platform, the portals, the capabilities and issues with interface during the entire period of transition.

The university had successfully completed the final professional exams for undergraduate examinations after the pandemic evolved with improvisations using simulated and standardised patients and elimination of direct contact between patients in wards, the clinicians and medical students. Extended planning and coordination were needed between the curriculum committees, phase directors, specialty content experts and assessment board for revising the curricular guidelines on high stakes assessment, enhancing the validity of assessments and for uniform conduct. The student cohorts were given adequate time and guidance for adapting to this new challenge as high stake summative clinical examinations in the past were mostly patient based.

In alignment with the nationwide restriction of staff movement between healthcare institutions, there was a need to:

- Leverage on remote or decentralised modes of medical education delivery and to
- Restructure patient-contact components of education and formative & summative assessments while maintaining assessment standards

These core principles needed to be applied seamlessly across the various components of academic medical centres: undergraduate education, residency training, continuous professional development and research.

Undergraduate education

Undergraduate education included mandatory large group (interactive lectures) and small group teaching. Small group teaching consisted of laboratory and simulation-based learning, problem-based learning, team- based learning and other collaborative learning platforms. We adapted staged responses to pandemic preparedness by minimising cross-cluster student mixing, reducing large group sessions to less than 50 per group, and reducing the number of small group learning sessions. Pre-pandemic existing initiatives for digital transformations included the conversion and streaming of learning materials into web-based

eLearning platforms (Entrada; Panopto, Seatle, WA; Liu et al. 2020). These were ramped up when early pandemic alerts were declared and were coupled with online support and tutorials for faculty and students to learn and familiarise with the teaching platforms. Table 2 summarises the changes made.

Pandemics pose significant delays and disruption to the existing packed teaching schedules and intended curricular progression. Early discussions, staged rescheduling and revisions to the conventional curriculum are needed. Where possible the planned summer and term breaks need to be brought forward to provide a *state of academic quarantine* with minimal omissions to the timetable and loss of clinical and teaching spaces. We have brought forward the 6-week term break from summer 2020 to February–March 2020 to reduce the risk of COVID-19 transmissions when it is at its peak. Student electives were redesigned, and the institute elective support capacities were enhanced to accommodate the student loads when international travel restrictions were levied, and overseas elective postings were deferred (Mateus et al. 2014). Continuing education within the electives was provided with interactive digital learning avenues with active faculty feedback.

Table 1. Principles of consolidated academic centres response.

- Central coordination and management of processes
  - Setting up a COVID-19 response team for decision making
  - Dissemination of information and updates in a timely manner
  - Enhancing coordinated responses through mass communication portals
  - Relaying directives between health authorities and academic health centres
- Time sensitive key decision making
  - Reshuffling academic calendars and shifting the term breaks forward
  - Postponing assessments and modifying it to suit pandemic preparedness
- Maintaining transparency and trust in the system
  - Enhancing compliance
  - Implementing rapid action plans
- Alignment to evidence-based practices
  - Setting up expert panels
  - Disseminations of information based on evolving current evidence
  - Developing policies based on best practices
- Safety and preventive measures for the welfare/wellbeing of various stakeholders
- Incentivising early reporting of symptoms
  - Facilitating early detection, isolation and management

This table summarises the principles that govern the coordinated decision-making process of academic medical centres during pandemic preparedness.

Assessments and response to pandemics

The conduct of formative and high-stakes summative assessments were considered under three categories. First, *written examinations with no direct interactions* between candidates and examiners/patients (e.g. short-answer questions) were conducted in a decentralised manner, and scripts were transmitted in secured digital means for remote grading. Second, *examinations that require examiner and candidate interactions* (e.g. viva voce) were conducted via teleconferencing. The encounters were recorded for asynchronous moderation with a different examiner. Last, *examinations involving all three stakeholders* (candidate, patient, examiner) were modified to minimise patient participation These were achieved using task-trainers or simulations with mannequins and hybrid simulations (Egenberg et al. 2017) or simulated patients. Where patient participation was crucial, candidates were instructed to follow prevailing infection control guidelines with the use of PPE during the assessment. These instances were minimised during the recent final professional examinations with majority of the assessments designed within the first two categories. Table 3 shows how we modified and operationalised our high-stakes assessments.

There are two main principles in how assessments were conducted included: *decentralisation* to multiple locations to minimise congregation of large number of candidates and utilisation of teleconferencing and the use of *interactive web-based platforms* (Zoom, San Jose, CA; MS Teams, Microsoft Inc. 2017) to minimise candidate-examiner interactions with hospital-based examiners. The construct and conduct of high stake OSCE in COVID-19 pandemic is outlined in a recent publication from Singapore (Boursicot et al. 2020).

Informal feedback from students, faculty and educational administrative teams were sought. It showed that overall, the conduct of high stakes assessments, the transitions and two-way communication were smooth and successful. Faculty and students had expressed their anxiety about not having real patients with actual pathological findings, stating that to be a possible concern when they

Table 2. Undergraduate education activities according to pandemic alert levels.

	DORSCON status		
Academic component	Yellow	Orange	Red
Lectures	Routine with self-reporting of sickness.	Online streaming with interactive components.	Online streaming with interactive components.
Small group teachings	Routine with self-reporting of sickness.	Conversion to web-based when possible. Teachings conducted with smaller student numbers, with university faculty instead of healthcare institution-based faculty or invited faculty.	Conversion to entirely web based.
Clinical postings	Routine with self-reporting of sickness and temperature monitoring.	Postponed and student term breaks brought forward.	Postponed. Web based virtual patient or screen-based scenarios.
Clinical assessments	Postponed. Written component to continue as usual.	Postponed. Simulated or hybrid simulations explored for complementing it.	Postponed.
High-stakes summative assessments	Written component to continue as usual. Clinical component postponed or modified.	Postponed. Simulated components explored. Need blueprinting, standardisation and amendments.	Postponed.

This table shows the transformation in undergraduate teaching, learning and assessments with evolving pandemic alert status.
DORSCON: disease outbreak response system condition.

Table 3. Conduct of assessments & minimising infection transmission.

Type	Modifications	Operationalisation
Multiple choice questions	Online mode, decentralised to multiple venues and time-synchronised.	Additional administrative staff required for each examination venue. Secured answer scripts for remote marking.
Short-answer questions	Written or online mode, decentralised to multiple venues and time-synchronised.	Additional administrative staff required for each examination venue. Conversion of written scripts to digital copies for secured transmission for remote marking and moderation.
Viva voce	Viva voce done via teleconferencing between candidate and examiner.	Encounter recorded for moderation by a different examiner (calibration).
Simulation/objective structured clinical examinations	Modify patient contact stations to simulated patients, task-trainers and hybrid simulations.	Needs multiple simultaneous space and faculty coordination. PPE to be used if patient interaction still required.
Components requiring patient contact	PPE to be used for these stations. Examiner can view and grade the interactions remotely.	Needs multiple simultaneous space and faculty coordination. Factor in delays with PPE and changes in workflows.

This table shows the modifications with to the conduct of assessment with evolving pandemic alert states.
PPE: personal protective equipment.

are to practice as interns after completion of the examinations. The absence of personalised face-to-face interactions was stated as 'unfamiliar' in terms of inability to efficiently observe or demonstrate soft skills during clinical examinations and presentations.

Student support and academic centres roles

The university support systems were enhanced during this phase of transition. Students that were returning from overseas travel or were in quarantine were identified for social support. The student volunteers, care buddies or peer support systems were activated, and faculty mentors engaged with the students, made visits to the university student accommodation centres (within regulated distancing), provided educational, emotional and utilities support services and comfort packages. Web-based calls and active engagement was part of the disease surveillance, social support and the main system of continuing education.

The student responses to the rapidity of change needed to be guided through a steady and protracted process of coaching, supporting and then through layering of the support systems that are in place. The student bodies had representation from every phase/year of the medical school. Each phase had multiple sub-cohorts or clinical groups with student leaders coordinating them. These formed the system of student networks. The scheme of digital transformations, the student expectations, administrative requirements such as logging-in and roll call, the digital code of conduct and support systems that were available were discussed and clarified through the student networks. These networks also paved the way to provide feedback to the COVID-19 response team about queries, concerns, suggestions and practice improvements from the end user of these proposed changes, the students.

Residency training

There were specific considerations in planning for coordinated responses in residency training. First, the chance of patient contact was higher for the residents and the period of exposure to the potential outbreak is more protracted. Second, the implications of cross infections were more wide-ranging in today's medical care landscape where multidisciplinary collaboration is commonplace. Finally, as residents were integral to medical teams in the provision of care, training & education tend to become less of a priority than pandemic preparedness. Hence, academic quarantine and enhanced leave of absence to minimise transmissions were not feasible in residency training.

Team-based segregation of work force with rest and active teams were in place to reduce cross-cohort contamination. This enhanced the scope of allowing vital medical services to continue in the event of flooding of care locations with caseloads from infectious outbreak. While group learning sessions were suspended, residency units adapted to it and planned for web-based discussions, academic sessions through cloud-based platforms and video-enabled web discussions with faculty participations. Large group activities (e.g. conferences) or those requiring multidisciplinary participations (e.g. team-based simulation training) were generally deferred or cancelled. (see Table 4).

There are some limitations to residency training during periods of pandemic preparedness. First, their *clinical experience (volume of practice)* may be curtailed during this period. This could be due to deliberate reduction of elective clinical load to preserve hospital bed capacity, from segregation of clinical teams with more work-rest cycles to minimise cross infections or from deferment of clinical rotations to external specialty healthcare institutions. Second, they may not meet the requirements for *protected training time*. The health ministry approved an exemption during this period of crisis. Clinical team segregation by staggered work-rest cycles may afford residents with protected time for self-learning during the rest phases. Third, national level *educational sessions were conducted remotely, or decentralised* to the respective healthcare institutions. Limited availability of technological resources and unfamiliarity of faculty were the main challenges. Last, residency summative *examinations were restructured* and decentralised.

Residency summative examinations are conducted (usually once or twice a year) at a national level and involved inter-cluster mixing of candidates. The principles of restructuring these examinations were akin to undergraduate examinations: decentralisation and minimising examiner-candidate contact (see Table 3). The challenges of examination restructuring were chiefly in Objective Structured Clinical Examinations (OSCEs), and other procedure-based examinations (Boursicot et al. 2020). An alternative option would be to reorganise these as viva voce examinations.

Table 4. Residency/postgraduate training activity according to pandemic alert levels.

	DORSCON status		
Academic component	Yellow	Orange	Red
Lectures	Continue as routine.	Decentralise, or convert to remote/web-based learning.	Convert to remote/web-based learning.
Small group teaching	Continue as routine.	Continue within respective institution. No cross-cluster mixing.	Convert to remote/web-based learning.
Ward rounds/bedside case discussions	Continue as routine.	Continue within respective institution. No cross-cluster mixing.	Convert to remote/web-based learning.
Formative assessments	Continue as routine.	Continue within respective institution. No cross-cluster mixing.	Convert to web-based assessment.
Basic & advance life support certifications	Continue as routine. Enhance fomite precautions.	Convert to web-based eLearning.	Convert to web-based eLearning.
Team based simulation training	Continue as routine.	Defer or cancel. Explore game based platforms.	Virtual or web scenario based learning. Pre-recorded scenarios, virtual team discussions.
Continuing professional development events/conferences	Continue as routine. Enhanced screening, contact precautions.	Defer or cancel.	Defer or cancel. Explore virtual CPD training & accreditations.

This table shows the residency training activities and changes with pandemic alert responses.
DORSCON: disease outbreak response system condition.

However, these were generally a less popular option, given the threats to assessment validity and standardisation. Cancellation of the examinations (like during SARS 2003) would be undertaken if time or resource limitations prevents the reorganisation, especially when the clinical services are overwhelmed.

Continuing professional development

For a academic medical centres this segment of learning, education and update for all healthcare personnel is affected first when pandemic evolves. Continuing professional development (CPD) included department level activities such as journal clubs, morbidity & mortality reviews, peer-reviewed learning, interdepartmental meetings such as special interest groups (e.g. transplant), institute level clinical meetings such as townhall meetings and grand rounds, specialty based regional and national meetings and international forums that require overseas travel. Though large-scale meetings were discontinued to minimise the person-to-person transmission, CPD learning activities were sustained through online web-based learning modules. This transition needed appropriate CPD accreditation from course accrediting bodies such as medical councils and CPD governing units. A revision was made by the Singapore Medical Council (2020) (SMC) to allow practitioners to fulfil all their CPD requirements via online or distance learning resources.

Research activities

The impact of potential COVID-19 pandemic on status of research activities was addressed in 5 main categories:

1. *Educational/clinical research without subject contact*: These included web-based surveys and research that involve no person-to-person contact. These proceeded with no restrictions even as the pandemic evolved.
2. *Educational research with subject contact:* All research that include subject contact such as interviews, surveys, focus group discussions were suspended as pandemic evolved to DORSCON Orange or were converted into web-based or video-conferenced formats of data collection.
3. *Non-interventional clinical research involving patients:* This type of research was suspended during DORSCON-orange to reduce non-essential patient contact, as these patients often require additional study visits for assessment.
4. *Interventional clinical trials involving patients:* Trials continued with prevailing enhanced infection control measures. The rationale was not to deprive patients of potential therapeutic benefits, especially in areas of cancer therapies. However, substantial efforts required to minimise infectious outbreak risks included:
   a. Segregation of research teams by healthcare institutions. For multi-centre research, all research team members (from investigators to study coordinators) were segregated by healthcare institutions.
   b. Suspension of non-essential monitoring visits by external stakeholders (e.g. sponsors) and alignment to prevailing enhanced infection control measures for essential monitoring visits. These included having a dedicated room for the study monitor, registering for contact tracing purposes and reinforcing basic hygiene measures.
   c. Conversion of research meetings to remote meetings via teleconference and alignment to prevailing enhanced infection control measures for essential physical visits such as site initiation visits.
5. *Retrospective studies, systematic reviews & Metanalysis:* These studies pose minimum threat for cross contaminations and were continued. Adequate precautions were taken to minimise face-to-face meetings within research team and to conduct all discussions through cloud-computing.

Should DORSCON status be elevated to Red, all research activities requiring subject/patient physical contact would be suspended to further minimise mingling of personnel and study subjects/patients. Table 5 summarises our research activities according to pandemic alert levels.

Table 5. Research activities and pandemic alert levels.

	DORSCON status		
Activity type	Yellow	Orange	Red
Educational/clinical research without subject contact, for example, surveys, exam outcomes assessments	Continue.	Continue.	Continue.
Educational research with subject contact, for example, focus group discussions	Continue with prevailing pandemic/ infection control measures.	Convert physical contact to remote teleconference if possible, otherwise suspend.	Convert physical contact to remote teleconference if possible, otherwise suspend.
Non-interventional clinical research with patient contact, for example, serial dementia assessments in postsurgical patients	Continue with prevailing pandemic infection control measures.	Suspend.	Suspend.
Interventional clinical research with patient contact, for example, randomised controlled trial with cancer immunotherapy	Continue with prevailing pandemic infection control measures.	Continue with prevailing pandemic infection control measures.	Suspend.
Retrospective studies, systematic reviews & meta-analysis	Meetings to continue, simple hand hygiene.	Minimise face to face meetings, transition to web-based discussions.	Research work and discussions to web-based platforms and forums.

This table shows the research activities and changes with pandemic alert and responses.
DORSCON: disease outbreak response system condition.

Strengths, limitations, and practice advisories

There are strengths in this system of providing coordinated pandemic responses. There is better adaptability among faculty and students when the approach is centralised and uniformly applied across the participating cohorts & clusters. There is a need to leverage on technology for decentralised or remote modes of education delivery during potential pandemic outbreaks. This facilitates a progressive transition to more innovative ways of conducting educational activities even when the outbreaks resolve.

There are limitations that come to the fore (Rieder et al. 2004) when central coordinated approach is planned and rapidly implemented across specialties and faculties. A central top-down approach may not be sufficiently nimble to react to changes on the ground, especially if the flow of information is largely unilateral or not time-sensitive. Also, implemented action plans may pose significant challenges, particularly in the training and assessment domains due to lack of resources and difficulty in ascertaining the integrity and standards of the modified training and assessment activities. Accountability and credibility of the outcomes of revised high stakes assessments might be contentious.

There were several issues when virtual learning modalities were implemented. The platform was unstable when virtual participants were commuting, and internet connectivity can be sketchy even though it was through 4G networks. The level of activity and engagement of online participants could not be easily moderated. While learner analytics show the nature of usages of the platform and digital interactions, the lack of personal touch in teaching, supervision and mentoring capacities were seen. As not all participants engage through video log-in, to avoid participants being silent we used periodic audience response and invited participants to engage in regular video check-in while posting a query and create short discussions. While there are issues with online behaviours, use of proxy and fake identities were minimised by encouraging institute log-in for students and faculty. Where possible, the sessions were recorded and were available offline to enable students to revise the content discussed and to learn at their own pace.

Assessments that could be converted into non-patient based simulated encounters were possible in the initial phases of the outbreak until community and/or person-to-person transmission were reported. While formative assessments were postponed, summative high stakes assessments that needed career progression (to enhance the larger pool of junior manpower, interns) had to be conducted. Though the credibility and authenticity of the revised assessments were ensured with elaborate discussions and recommendations from medical education experts, the faculty and students speculate its effectiveness to be not on par with conventional patient based clinical high-stake examinations.

Resource poor academic organisations

The general principles of establishing a coordinated response team that is a relay centre for planning, evaluation of the effectiveness and feedback is outlined. Our institute had the structured system in place evolved from academic and financial disruptions from the past pandemics. Centres with limited organisational capabilities or expertise might consider the proposed system that are described. While not all components of the response are possible in every academic centre, establishing a pandemic response team is paramount. Affordable portals for communications and platforms for web-based interactions need to be explored ahead of time before the full lock-down is initiated. A lot depends on the affordances of the system in supporting a band width and internet connectivity to host, upload, stream and receive academic content in high definition while keeping the learner engagement and interaction with video imaging capabilities. Testing the system on 'simulated lock-down' while they are in early phases of pandemic outbreaks resolves most of the issues and enables seamless transition when the need arises. Irrespective of resource or organisational capabilities it is *the time-sensitiveness and*

speed of planning & implementations of a staged pandemic response contingency plan is what makes it effective in sustaining medical education.

Conclusions

While minimising the adverse clinical outcomes of a pandemic outbreak within healthcare establishments are paramount, medical education and research activities cannot come to a standstill each time there is a threat of one. Academic medical centres need to develop a coordinated approach attuned to the severity of the outbreak and make key time-sensitive decisions.

Major themes for coordinated responses for academic medical centres include leveraging on remote or decentralised modes of medical education delivery, maintaining integrity of formative and summative assessments while restructuring patient-contact components, and developing action plans for sustenance of continuing professional development and essential research activities.

While academic establishments that had prior pandemic readiness plans in place could cope rapidly and systematically, resource limited organisations might need to adapt efficiently. Having a COVID-19 response team, making core decisions about the learning and assessment platforms, and establishing support systems for the faculty and students would be vital in avoiding disruptions in curriculum.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

Glossary

COVID-19: Coronavirus Disease 2019 (previously called 2019 novel coronavirus (2019-nCoV))

MERS: Middle East respiratory syndrome

PPE: Personal protective equipment; includes the use of protective gloves, gown, mask and splash proof gear

SARS: Severe acute respiratory syndrome

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