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# A SWOT analysis of medical school adaptations to COVID-19: A national survey of deans in Taiwan

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## Abstract

**Introduction:** The COVID-19 pandemic forced medical schools worldwide to transition online. While there are ample reports about medical education adaptations to this crisis, there are limited studies evaluating the impact.

**Methods:** This study includes a case study of how Taiwanese medical school deans maintained in-person education during the COVID-19 pandemic. Additionally, it demonstrates how SWOT analyses can help medical educators reflect on adaptations during the COVID-19 pandemic and future crises. This study employed two online surveys and a semi-structured interview regarding curricular adaptations. Eligible participants were deans or associate deans of all medical schools in Taiwan.

**Results:** Through a SWOT analysis, this study identified Strengths as strong leadership, prior experience with SARS, and ability to promptly adapt curriculum; Weaknesses as lack of faculty confidence in online education, limited numbers of administrative staff, and inability to rapidly add new topics; Opportunities as centralised anti-epidemic policies, inter-institutional collaborations, and educational innovations; and Threats as concerns from parents, patients, and teaching hospitals. It is reported that the quality of education was maintained as students' evaluations of courses, performances in written exams, clerkship supervisors' assessments, national OSCE, and national board exams remained comparable to pre-COVID times. Strengths and Opportunities such as strong leadership and centralised anti-epidemic policies can overcome Weaknesses and Threats, such as lack of confidence in online education and familial pressure to suspend hospital-based education.

**Conclusion:** This study recommends that medical school leaders conduct SWOT analyses as early as possible to plan strategies to continue safe and quality medical education during COVID-19 and future crises.

**Keywords:** SWOT Analysis, Adaptation, Medical School, COVID-19, Pandemic, National Survey, Medical Education, Taiwan

## Practice Highlights

- Medical school deans in Taiwan documented critical observations made during a global pandemic.
- SWOT analysis can help us reflect on medical education adaptations during the pandemic and crises.
- Strong leadership and centralised anti-epidemic policies can aid in overcoming weaknesses/threats.
- Schools can benefit from using SWOT analyses to plan for continuing education during emergent crises.

## I. INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) outbreak in Wuhan, China at the end of December 2019 evolved rapidly into a global pandemic and upended

almost every aspect of our lives, including school closures across the world (UNICEF, 2021; Zhu et al., 2020). Medical schools are no exception (B. Choi et al., 2020; Harries et al., 2021). Almost all medical schools in the United States transitioned to online teaching by mid-

March 2020 and tried to restart teaching on campuses and in hospitals safely in Fall 2020 (Frieden, 2020). There is a growing literature on how to transition medical education online during the COVID-19 pandemic (Ahmed et al., 2020; Al-Balas et al., 2020; Journal of the Association of American Medical Colleges, 2021; Keegan & Bannister, 2021; Medical Education, 2020). Medical education associations also developed websites and offered webinars to share best practices and innovations focused on online education rather than in-person education (Association for Medical Education in Europe, 2020; Association of American Medical Colleges, 2021; International Association of Medical Science Educators, 2020). Most of the literature reflects the important perspectives of teachers and students with voices from medical school leadership and the forces impacting their decisions relatively limited (Abbas et al., 2020; Al-Balas et al., 2020; Compton et al., 2020; Gordon & Cleland, 2021; Lazarus et al., 2021; Soled et al., 2020). Furthermore, most of the publications are based on lessons learned from English-speaking countries. As non-English-speaking countries encountered COVID-19 and started to reopen medical schools earlier than English-speaking countries, lessons from non-English-speaking medical schools can be valuable to the global medical education community. This study addresses the above gaps in literature by surveying Taiwanese medical school deans on how they adapted their curricula and continued face-to-face medical education on campus and in hospitals amid this historical moment.

Located 81 miles from mainland China, and with over a hundred daily flights in between, Taiwan was predicted to have the second highest number of COVID-19 cases according to early modeling in January 2020 (Gardner, 2020). Having learnt a hard lesson from the severe acute respiratory syndrome (SARS) epidemic in 2003, the Taiwanese government, health system, general public, and medical educators were better prepared to respond to this new pandemic early and proactively (Wang et al., 2020). Before the first confirmed case in Taiwan, the Taiwan Centers for Disease Control began to monitor passengers returning from Wuhan, China, since on January 21, 2020 and set up the Central Epidemic Command Center to coordinate responses to COVID-19, including surveillance and testing, border control, community transmission control, medical system response, personal protective equipment (PPE) and other medical supplies stockpile and distribution, as well as health education and disinformation management (Taiwan Center for Disease Control, 2020).

In contrast to medical schools around world closing campus in the spring semester due to the COVID-19

pandemic, Taiwanese medical schools stayed open except for delaying the start of spring semester one or two weeks later than the originally scheduled date of February 17, 2020.

In addition to exploring how Taiwanese medical schools adapted their curriculum to continue on-campus and workplace-based education at the program level during the COVID-19 pandemic, this study addresses the gap in the literature regarding evaluation of these programmatic changes (Reid & Sam, 2021). This study employed a SWOT analysis (Ghazinoorya et al., 2011; Topor et al., 2018), a method widely used to analyse an organisation's internal strengths and weaknesses, as well as external opportunities and threats in the environment to examine what medical education leaders critically consider in order to maintain in-person medical education amid the COVID-19 pandemic. This study surveyed and interviewed Taiwanese medical school deans in order to answer the following four research questions:

1. What curricular adaptations have been made in response to the COVID-19 pandemic?
2. What were the impacts of the curricular adaptations?
3. What were the strengths, weaknesses, opportunities, and threats of the curricular adaptations?
4. What are the lessons learned to be applied to the future?

## II. METHODS

This study consists of two online surveys and a follow-up individual semi-structured interview. Eligible participants were deans or associate deans of all 13 medical schools in Taiwan. To encourage participation, we emailed invitations with information about study purpose, data confidentiality, and a weblink to the online survey. Participation was voluntary without incentives offered. Following the initial email, reminders were sent periodically. If the dean of a medical school was not available to complete the survey, we invited the associate dean to do so. We collected survey responses and conducted interviews about curricular adaptations between April 29 and May 18, 2020. A follow up survey on the impacts of curricular adaptation was conducted between August 27 and September 10. The online written surveys and follow-up semi-structured interviews were conducted in Chinese (written) and Mandarin (spoken) and translated to English by the first author (MJH). This study was approved as exempt by the Georgetown University Institutional Review Board (STUDY00002812). Since the study poses no greater than minimal risk to subjects, a waiver of written consent was granted, and verbal consent was obtained before data

collection began. All methods were carried out in accordance with relevant guidelines and regulations.

### A. Study Design

The survey questions were developed based on a review of relevant literature and consultations with international research collaborators in Italy, Japan and Korea, where similar surveys will be conducted. Open-ended survey questions can be found in Supplemental Digital Appendix 1.

In addition to the online survey, each participant was offered an opportunity to be interviewed by the first author (MJH) videoconference in the ensuing two weeks to provide further details about their survey responses. If a participant accepted the interview invitation, a semi-structured interview was conducted, in which the participant was prompted to elaborate on their answers in the surveys. Clarifying questions were asked for survey responses as needed. For example, a participant responded to a survey question by stating that an OSCE exam had been cancelled. During the ensuing interview, the interviewer asked “In the survey, you wrote that an OSCE was cancelled. What was the OSCE for? How did you make up for the cancelled OSCE?”

### B. Data Analysis

The free text responses to the open-ended questions in the survey, as well as recordings of the interviews, were analysed by the researchers using a qualitative thematic analysis approach (Braun & Clarke, 2006). One researcher identified themes that emerged from the qualitative data; then, a second researcher determined if they agree or disagree with the analysis. For each point of disagreement, the two researchers discussed the data and reached consensus. Data analysis was initially inductive. After the themes emerged, we used a SWOT analysis framework to group themes into four categories: strengths internal to the institution, weaknesses internal to the institution, opportunities external to the institution, and threats external to the institution (Ghazinoorya et al., 2011; Topor et al., 2018).

## III. RESULTS

All 13 medical schools in Taiwan completed the survey for a response rate of 100%. Eleven deans and two associate deans filled out the survey. Three deans and one associate dean agreed to participate in a follow-up interview by videoconference. Characteristics of the medical schools are listed in Table 1. In the first part of results, we will describe curricular adaptations and present themes with representative quotes of curricular adaptations in Table 2. Then Table 3 will summarise the SWOT analysis followed by descriptions of key themes in strengths, weaknesses, opportunities, and threats.

Characteristic	No. Respondents (%)
<b>Class size</b>	
1-49	4 (30.8)
50-99	1 (7.7)
100-149	5 (38.5)
150-199	3 (23.1)
<b>Ownership</b>	
Public	4 (30.8)
Private	9 (69.2)
<b>Curriculum</b>	
6 years after high school	13 (100)
4 years after college	1 <sup>a</sup> (7.7)

Table 1. Characteristics of Survey Schools

<sup>a</sup>One medical school had both 6-year program for high school graduates and 4-year program for college graduates.

Themes	Quotes
<b>Curricular adaptations</b>	

Pre-clinical	<p>“We followed the government regulation to stop indoor gathering of more than 100 people. Because each class is 150 students, the lectures are changed to online live stream by Google Meet enhanced by IRS mobile app.”</p> <p>“The lectures are not cancelled because each class has only 40 students. However, students and teachers are required to wear masks and keep social distance.”</p> <p>“Although it’s safe to keep the live lectures going at this moment, the teachers are prepared to move lectures online. “</p>
Clinical	<p>“Everything as usual, except not letting students rotate on wards with suspected COVID patients.”</p> <p>“ER has different zones: Red, Yellow, and Green according to risks for COVID-19. Students can only go to Green zone.”</p> <p>“Overseas and domestic exchange programs are suspended.”</p>
Assessment	<p>“Students wear masks and keep social distance during exams. Office of Medical Education arranged more classrooms to keep social distance.”</p> <p>“Evaluations involving risky hands-on practices were canceled or replaced by simulation.”</p> <p>“Admissions examination followed social distancing guidelines: empty seats between students in lecture hall, line up 6 feet apart, laboratory exams with acrylic partition plates between students sitting face-to-face on lab benches.”</p>
Counseling	<p>“We created a group chat using LINE to reduce students’ anxiety.”</p>

Table 2. Themes and quotes of curriculum adaptations

SWOT Analysis	Strengths	Weaknesses
	<i>What do you do well? What resources do you have within your control?</i>	<i>What needs to be enhanced to increase program success? What intrinsic factors place your program at a disadvantage?</i>
	1. Strong leadership	1. Lack of faculty confidence in online education
	2. Prior experience with SARS	2. Limited number of administrative staff
	3. Ability to rapidly adapt the curriculum	3. Inability to rapidly add new topics
Opportunities	Opportunity – Strength Strategy	Opportunity – Weakness Strategy
<i>What external factors could benefit your program?</i>	<i>How can strengths be used to take advantage of opportunities?</i>	<i>How can you minimise/overcome weaknesses by using opportunities?</i>
1. Centralised anti-epidemic policies	Strong leadership to enact centralised anti-epidemic policies	Opportunities for innovations minimised faculty lack of confidence in online education
2. Inter-institutional collaborations		
3. Educational innovations		
Threats	Threat – Strength Strategy	Threat-Weakness Strategy
<i>What factors beyond your control place the program “at risk?”</i>	<i>How can you use program strengths to minimise threats?</i>	<i>How can you use threats to minimise weaknesses and use weaknesses to avoid threats?</i>
1. Parental pressure to remove students from clinical settings	Strong leadership and communication mitigated parental pressure to stop work-based education	Hospital infection control measures limited in-person clinical education and forced faculty to transit to online education
2. Decrease in patient volume		

Table 3. SWOT Analysis<sup>b</sup>

<sup>b</sup> This table is created using the blank SWOT form from Topor et al.<sup>21</sup>

### A. Curricular Adaptations

#### 1) Pre-clinical curriculum adaptations:

Taiwanese medical schools rapidly adapted their curricula to comply with government policy on social distancing prohibiting indoor gatherings of more than 100 individuals. Whereas a school with a small student body and sufficient classroom capacity did not have to transition online, a school with a large student body and insufficient classroom capacity moved almost all pre-clinical classes online. Some schools went partially online, converting only lectures with more than 100 students to online learning and capping the number of students in the classroom, with live stream available for those not in the classroom. While schools adapted different modalities for lecture-based courses, all schools made efforts to keep laboratory courses face-to-face. Some schools shared how they adjusted laboratory sessions to maintain social distance, including simultaneously using more lab rooms or holding lab sessions in different time slots.

#### 2) Clinical curriculum adaptations:

In contrast to approaches in the United States suspending clinical rotations in spring semester recommended by AAMC (Association of American Medical Colleges, 2021), all medical schools in Taiwan continued clinical rotations while protecting the safety of students. Several strategies were implemented rapidly: Orientation to clinical rotations articulated pandemic prevention and included online modules required by the hospital. Clinical students were provided with surgical masks. In the emergency room, students were given N95 respirators each day. Exposure to suspected and confirmed COVID-19 cases was avoided for students replacing rotations in specialties with high risk of COVID-19 exposure. To prevent cross infection, inter-institutional and overseas exchange programs were cancelled. Students rotated in only one of the affiliated hospitals. Social distancing is also mentioned in clinical rotation adjustments. Several respondents mentioned that the number of students in outpatient clinics, in classrooms, and in conferences was reduced. One school reported an increase of clinical teachers to meet social distancing demands.

#### 3) Assessment adaptations:

Eight schools replied that they did not change the assessment of students by written examinations in

classrooms but arranged empty seats between students to keep social distance and protected students from airborne droplet transmissions by requiring everyone to wear a mask. Some schools decreased the use of written exams in classrooms by substituting reports, reflections, online exams, online presentations, and other approaches. Some evaluations involving hands-on practices were cancelled or replaced by simulation. One school reported that their admission exams included tests in laboratories. To prevent face-to-face transmission of airborne droplets, transparent acrylic partitions were installed on the benches in front of each student.

### B. Impact of curricular adaptations

Medical school deans tried to evaluate the impact of curricular adaptations by comparing student performance in the 2020 spring semester with previous years. Most deans reviewed the passing rate of courses and reported no statistical differences. They also reported monitoring students' performances in national board exams in July and national OSCE clinical skills exam held before graduation. The deans were relieved to see that the national exam scores were comparable to previous years and felt that curricular adaptations didn't impact student competencies negatively.

### C. Strengths

The strengths of Taiwanese medical schools' responses to COVID-19 can be summarised into three themes: strong leadership, prior experience with SARS, and ability to rapidly adapt the curriculum.

1) *Strong leadership*: The key strength most Taiwanese deans cited in their medical schools' response to COVID-19 is the strong leadership in the early deployment of epidemic prevention measures. The guidelines from the Central Epidemic Command Center were implemented on each campus, including requiring students to wear masks, to maintain social distance, to monitor temperature and symptoms of COVID-19, and to quarantine international students in separate dormitory areas. Communication also was highlighted by respondents as manifesting strong leadership. Furthermore, two deans made videos in collaboration with students to promote anti-epidemic measures (Chang Gung University, 2020; Fu Jen Catholic University, 2020).

2) *Prior experience with SARS*: Another strength most respondents noted was the experience of SARS. When

COVID-19 spread to Taiwan, most clinical teachers had experienced SARS and were able to share critical lessons to face new emerging infectious diseases with the younger generation. The experience of SARS also prepared medical educators to deal with professionalism and ethics issues such as distribution of limited medical resources. Many participants mentioned that SARS had a great impact on the medical education system in Taiwan because it exposed the lack of primary care workforce with medical school graduates entering specialty training directly after medical school. After SARS, a postgraduate year program was established with one year of required general medicine training prior to specialty training programs with the goal of producing more physicians competent in general medicine to respond to emergent infectious diseases.

3) *Ability to rapidly adapt the curriculum:* All schools reported rapid curricular adaptations when spring semester started one or two weeks later than the scheduled time. Different strategies were employed in pre-clinical and clinical curricula to prevent and control the spread of COVID-19 as described in 3.1 curricular adaptation.

#### D. Weaknesses

The weaknesses of Taiwanese medical schools' responses to COVID-19 can be summarised into three themes: lack of faculty confidence in online education, limited number of administrative staff, and inability to rapidly add new topics.

1) *Lack of faculty confidence in online education:* All respondents mentioned online teaching as challenging to teachers. Many voiced concerns about the effectiveness of online learning and found assessment of online learning challenging. Online learning is also considered challenging to students. Some respondents mentioned that online learning requires self-directed learning, which is not a strength of Taiwanese students since didactic teaching and rote memorisation is the norm of the K-12 education system.

2) *Limited number of administrative staff:* In response to the question about weaknesses of their medical schools' responses to the COVID-19 pandemic, administrative challenges were mentioned frequently. Although Taiwan did not experience high burdens of COVID-19, all schools were preparing for large-scale outbreaks with frequent scenario planning, describing these planning activities using the military metaphor of "military sand table planning" and "early deployment."

3) *Inability to rapidly add new topics:* The pandemic also revealed the need for medical educators to engage in

some topics traditionally not articulated in medical curricula. It was challenging to add new topics in the ongoing 2020 spring semester curricula but respondents suggested to add the following topics in the future: infectious disease control, emergent infectious disease, crisis management and communication, public policy and ethical issues related to pandemics such as distribution of medical resources, and government control and restrictions on human rights vs quarantine policy.

#### E. Opportunities

Taiwanese medical school deans highlighted three opportunities which enabled them to continue to open medical schools during the COVID-19 pandemic: centralised anti-epidemic policies, collaborations among medical schools, and educational innovations.

1) *Centralised anti-epidemic policies:* Taiwanese deans all reported that the policies from the central government are helpful in their implementation of anti-epidemic measures. Several deans shared the policy guidelines issued by the Ministry of Education with clear guidelines to follow the principles of infection containment. Although each university has the flexibility to decide how to comply with the guidelines, there was external oversight to ensure compliance. For example, when a teaching hospital had an intra-hospital transmission of COVID-19, the medical school had to work with the Central Epidemic Command Center and Ministry of Education in its response.

2) *Inter-institutional collaborations:* Collaborations among medical schools through the Taiwan Association of Medical Education (TAME) also helped Taiwanese medical school deans to adapt to COVID-19. For instance, the deans worked together at TAME to ensure that final-year students graduated on time. Every year, TAME organises a national OSCE examination required for graduation for final year Taiwanese medical students. Medical schools and teaching hospitals collaborated to administer these exams at OSCE centers in selected teaching hospitals with infection mitigating measures.

3) *Educational innovations:* All respondents mentioned that the COVID-19 pandemic provided opportunities to engage in innovations in medical education, especially online education. Online education was quickly implemented in some schools because access to internet is prevalent in Taiwan and they utilised the technology developed before the pandemic. One school reported an innovation using the Interactive Response System (IRS) developed three years ago and is now applied to enhance online teaching amid COVID-19. Another school adapted communication software instead of face-to-face counseling meetings. One school reported using "LINE"



(a messaging app widely used in Taiwan) for a group chat for students to reduce student anxiety related to COVID-19.

#### F. Threats

Three themes were identified during the COVID-19 pandemic as threats to medical education, but external to medical schools: parental pressure to remove students from clinical settings, decrease in patient volume, and hospital infection control measures limited educational opportunities.

1) *Parental pressure to remove students from clinical settings:* Several deans mentioned that students' parents reached out to them, pressuring them to discontinue clinical rotations. One respondent stated, "Parents are more worried than teachers and students. They are concerned that clinical rotations in the hospitals are risky for students. However, parents accepted our explanation that clinical rotations will not proceed unless there is adequate PPE and infection control measures."

2) *Decrease in patient volume:* Another threat commonly mentioned was the decrease in patient volume. A participant explained, "Our hospital experienced a 30% decrease in patient volume. It is inconvenient for patients to come to the hospital due to tightened entrance control. The restriction on patients' family visits is another factor. We are not letting students rotate on wards with suspected COVID-19 patients." The limited patient encounters are perceived as potential threat to students' clinical competence.

3) *Hospital infection control measures limited educational opportunities:* Finally, another threat reported was associated with infection control measures by the teaching hospitals. Deans expressed concerns that students' clinical learning opportunities were compromised during the pandemic due to cancelled bedside teaching in high-risk specialties, cancelled presentations in conferences, cancelled interdepartmental grand rounds, and suspension of exchange programs both domestically and internationally. Some mentioned that reduced clinical exposures might result in less role modeling.

## IV. DISCUSSION

During this historical event, medical schools around the world are challenged to navigate a path forward to meet missions of education, research, and patient care during an ongoing pandemic. As many countries are loosening or tightening restrictions after their curves of infection have flattened or resurged, medical schools globally are at various stages of deliberating when and how to resume campus-based and hospital-based medical education

(Blaaza et al., 2020; Cleland et al., 2020; Tolsgaard et al., 2020). A systematic rapid review of published reports of medical educational developments in response to the COVID-19 pandemic concluded that most papers lacked evaluation data and focused on transitioning online and removing students from the clinical contexts (Gordon et al., 2020). The review suggested that medical schools learn from a few postgraduate papers reporting how face-to-face patient contact could be maintained while mitigating risk using PPE and social distancing (G. Choi et al., 2020; Hanel et al., 2020; Kang et al., 2020). Our study of medical school deans in Taiwan on how they continued in-person medical education throughout the COVID-19 pandemic offers lessons for the medical education community to engage medical students in campus-based and workplace-based learning with evaluation of impacts.

This study offers a conceptual advance by demonstrating how SWOT analysis can help us reflect on medical education adaptations to COVID-19 pandemic and future crises. Our analysis of the strengths, weaknesses, opportunities and threats in Taiwanese medical school adaptations to COVID-19 highlights certain strategies to leverage strengths and opportunities to overcome weaknesses and threats. A critical factor in the decision to continue face-to-face medical education, clearly identified by the opportunity-strength strategy in Table 3, was the early deployment of epidemic prevention measures under centralised government policies and strong medical school leadership. Epidemic prevention measures were deployed at all levels of schools in Taiwan as students returned to campus for spring semester in February 2020. To enact anti-epidemic policies in different contexts, this study presented various preventive measures to keep the recommended social distance in classrooms, laboratories, and teaching hospitals. To implement these measures, transparent communication and administrative support from medical school leadership are essential.

SWOT analysis on opportunity-weakness and threat-weakness strategies offers lessons on how to overcome the weakness of lack of faculty confidence in online education. Although online education is an important curricular adaptation to maintain social distance in campus-based medical education, our survey shows that respondents found online teaching challenging to faculty and are concerned about the effectiveness of online education. Strategies identified to overcome this weakness is to take advantage of the educational technology readily available and to transform the threats from hospital infection control to suspend hospital-based education into opportunities for integrating innovative online education. It is important to leverage innovative

online education in workplace learning in the context of reduced patient case exposures before the pandemic subsides (B. Choi et al., 2020; Lo et al., 2020). There is sufficient evidence in the education literature that well-designed online education is as effective as traditional classroom teaching and shows equivalent or better learning outcomes (George et al., 2014; Jung & Rha, 2000; Khalil et al., 2020). We hope that the evaluations reported in the fall semester survey showing equivalent outcomes of online adaptations during COVID-19 would encourage medical educators to take advantage of innovations reported by this study, existing literature on online education in general, and the growing literature about innovative online medical education (Ahmed et al., 2020; Medical Education, 2020).

This study highlighted that another enabling factor for Taiwanese medical educators to continue face-to-face medical education was the experience of SARS. The Taiwanese population became accustomed to anti-epidemic measures, including wearing masks after SARS, which facilitated the implementation of anti-epidemic measures in schools during COVID-19. Taiwanese health providers were severely challenged during the 2003 SARS epidemic. 103 of 318 confirmed cases (Centers for Disease Control and Prevention, 2003) and 11 of 60 deaths (including two first-year residents) (Taiwan Centers for Disease Control, 2013) were healthcare workers. Medical education leaders had a difficult decision to make regarding the final year students who were working as interns in hospitals (Lai, 2020). Following closures of clinics and resignation of healthcare providers, there were heated debates about physician duties to treat patients while being at risk of exposure to a deadly infectious disease and of being stigmatised by society (Lee, 2003). After SARS, not only were curricula on ethics and infection control strengthened, but the medical education system was reformed to convert the final-year of medical school to a formal post-graduate year program (Ho et al., 2017). In addition, as articulated by the respondents of the survey, SARS prepared Taiwanese medical educators and clinical teachers to be confident and competent to perform their educational and clinical duties in the time of COVID-19.

Although this study has many lessons to offer both conceptually and practically, there are some limitations to be considered. We conducted the survey with open-ended questions to explore diverse perspectives. The reported theme frequencies should be considered with caution since some respondents record more comprehensive answers than others. While the most frequently mentioned themes might be most important to the respondents, the least frequently given answer might

be valuable due to its innovative nature. Another limitation of an open-ended questionnaire is that respondents might not have the time to enter answers in detail. To overcome this limitation, we invited the respondents to participate in a follow-up interview. However, only about one-third of deans were available to be interviewed during the study period. The four interviews conducted nonetheless enriched the study with more context and details. Finally, this study only surveyed medical school deans. It would be interesting to conduct further studies comparing these results to the perspectives of students and faculty members.

## V. CONCLUSION

This nationwide study of all medical schools in Taiwan documents critical observations of top medical school leaders during an active pandemic. This case study demonstrated that strengths and opportunities such as strong leadership and centralised anti-epidemic policies can overcome weaknesses and threats such as faculty lack of confidence in online education and parental pressure to stop hospital-based education. We recommend that medical school leaders conduct SWOT analyses as early as possible to plan strategies to continue safe and quality medical education during COVID-19 and forthcoming emergencies. Similar to the impact of SARS, which led to reform of the Taiwanese postgraduate training system, there is hope that thoughtful reflection on medical education adaptations to the COVID-19 pandemic will improve medical education in general and lead to better preparation for future crises.

## Notes on Contributors

MH contributed to the conception, acquisition and analysis of data, drafted the article, and approved the final version; YC contributed to the design, acquisition and analysis of data, drafted the article, and approved the final version; SK contributed to analysis and interpretation of data, revised the article critically, and approved the final version.

## Ethical Approval

This study was approved as exempt by the Georgetown University Institutional Review Board (STUDY00002812). Since the study poses no greater than minimal risk to subjects, a waiver of written consent was granted. We emailed invitations with information about study purpose, data confidentiality, and a weblink to the online survey. A verbal consent was obtained before data collection began. Participation was voluntary without incentives offered. All methods were carried out in accordance with relevant guidelines and regulations.



## Data Availability

It is not possible to share data since we did not get consent from participants to share all data collected. They agreed to have results reported in a summary format with selected quotes.

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## Declaration of Interest

The authors declare that they have no competing interests.

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**Supplemental Digital Appendix 1: Survey Questions**

1. How are you adjusting your medical school curriculum in response to the COVID-19 pandemic?
  - 1.1. What are the adaptations in clinical curriculum?
  - 1.2. What are the adaptations in basic science curriculum?
  - 1.3. What are the adaptations in student evaluation?
  - 1.4. What are the adaptations in student counseling?
2. What are the major challenges to your medical school due to the COVID-19 pandemic?
  - 2.1. What are the challenges from students (e.g. not following social distancing guidelines), parents (e.g. requesting to stop clinical activities), patients (e.g. refusing to be seen by students), and government (e.g. issuing guidelines to stop gatherings of more than 10 people) in response to COVID-19?
  - 2.2. Did the COVID-19 pandemic bring special challenges to professionalism and ethics education?
3. What are the opportunities for medical education reform arising from the COVID-19 pandemic?
  - 3.1. Which curriculum adaptations would be continued after the pandemic is contained?
  - 3.2. Has this pandemic changed your opinions about medical education, such as strengths/weaknesses of previous approaches, future trends?
4. Have previous pandemics, such as SARS or AIDS, impacted medical education in your country?
5. What are the lessons you want to share with medical educators around the world regarding how your medical school responded to the COVID-19 pandemic?
6. Regarding the impact of COVID-19 on medical education, do you have other thoughts to share?
7. If you are willing to be interviewed to follow up on this survey, please provide your email address.

**Follow Up Survey Questions in the Fall**

1. What are the impacts of curricular adaptations to COVID-19 in the spring semester? How do you evaluate?
2. Do you continue the adaptations implemented in the spring semester?