



Impact of the COVID-19 Pandemic on Clinical Practice, Medical Education, and Research: An International Survey

Impact de la pandémie de COVID-19 sur la pratique clinique, la formation médicale et la recherche: une enquête internationale

Salem A Beshyah^{1,2}, Wanis H Ibrahim³, Issam M Hajjaj⁴, Faika Ben Mami⁵, Mona Arekat⁶, Dima K Abdelmannan¹

1. Department of Medicine, Dubai Medical College, Dubai, UAE,

2. Department of Endocrinology, Mediclinic Airport Road Hospital, Abu Dhabi, UAE,

3. Department of Medicine, Hamad Medical Corporation, Doha, Qatar,

4. Department of Medicine, Faculty of Medicine, University of Tripoli, Tripoli, Libya.

5. Service of Diabetology and Disorders of Nutrition C, National Institute of Nutrition, Tunis, Tunisia.

6. Department of Internal Medicine, College of Medicine and Medical Sciences, Arabian Gulf University, Manama, Bahrain.

RÉSUMÉ

Objectifs: En raison des mesures sanitaires obligatoires instituées pendant la pandémie de COVID-19, nous nous sommes proposés de décrire les nouvelles pratiques cliniques, éducatives et de recherche d'un échantillon international de médecins.

Méthodes: Nous avons utilisé un questionnaire en ligne, soumis à des médecins de 40 pays différents portant sur les trois domaines sus cités. 424 des 456 répondants ont fourni des réponses complètes.

Résultats: La plupart des répondants pratiquait des spécialités médicales (51,5%) et chirurgicales (11,8%). Plus de la moitié des répondants exerçait dans des centres universitaires et un cinquième dans le secteur privé. La pandémie a induit des changements dans la pratique médicale, avec des consultations moins chargées (34,9%) et l'utilisation de la télémédecine (31,3%). Une perturbation importante des activités de formation médicale a été observée, ce qui a entraîné l'annulation de nombreuses activités telles que les grandes visites, les réunions de comités multidisciplinaires et les staffs d'étude de cas, avec un recours croissant aux séances éducatives virtuelles. L'encadrement et la formation des résidents ont été perturbés. Près de 16% des répondants ont participé à des travaux de recherche sur la pandémie de coronavirus tandis qu'un tiers a poursuivi ses activités de recherche habituelles, mais la moitié n'était impliquée dans aucune recherche au moment de l'enquête.

Conclusions: La pandémie de COVID-19 a favorisé de nouvelles pratiques telles que le recours à la télémédecine, aux webinaires et à la recherche centrée sur le COVID-19 et a ouvert de nouvelles perspectives de préparation des futurs médecins à ces modes d'exercice et d'apprentissage de la médecine.

Mots clés : COVID-19, télémédecine, éducation, formation

SUMMARY

Objectives: Because of the mandatory sanitary measures established during the Covid-19 Pandemic, we have proposed to describe the new clinical, educative, and research practices of an international sample of doctors.

Methods: We have used an online electronic survey of a convenient sample of doctors from 40 countries using a multiple-choice online questionnaire, including three domains. 424 out of 456 respondents provided adequate responses.

Results: Most respondents were from medical (51.5%) and surgical (11.8%) specialties. Over half of the respondents practiced in academic centers and one fifth in the private sector. Coronavirus pandemic induced frequent changes in practice, such as seeing fewer patients in clinics than usual (34.9%) and utilization of telemedicine (31.3%). A significant disruption in medical education activities and residents' training was observed, resulting in the cancellation of many activities such as grand rounds, departmental and multidisciplinary meetings, and case conferences with over-reliance on virtual and on-demand educational sessions. The residents' supervision and support were significantly reduced. Almost 16% of respondents were involved in research work on coronavirus pandemic while a third continued their usual research activity, but half were not involved in any research at the time of the survey.

Conclusions: The COVID-19 pandemic has promoted new practices in the field as the recourse to telemedicine, virtual conferences, and thematic researches on COVID-19. The unexpected situation has opened new prospects for future doctors' preparation for these new means of practice and learning of medicine.

Keywords: COVID-19, Telemedicine, Education, Training

Correspondance

Salem A Beshyah

1-Department of Medicine, Dubai Medical College, Dubai, UAE,

2. Department of Endocrinology, Mediclinic Airport Road Hospital, Abu Dhabi, UAE,

beshyah@yahoo.com

INTRODUCTION

In early 2020, the world experienced an unprecedented health crisis, namely the coronavirus disease 2019 (COVID-19) pandemic declared by the World Health Organization in February 2020 (1,2). To date, there is no evidence of any effective treatment. Mild/moderate cases can be managed at home with self-isolation, symptomatic treatment, and follow-up if the disease worsens.^[3-6] COVID-19 brought with it sudden and dramatic changes to everyday life since the control strategy was essentially that of physical distancing.

Doctors and health care professionals in general at various levels of training are at the frontline in the battle against the on-going coronavirus pandemic. This unprecedented situation mandated different measures that could affect clinical practice, medical education, and academic work. Various factors are operative such as physical distancing, doctors' need to continue care provisions at times of high need, work in unaccustomed conditions, possible need to learn new skills in a short time, and the need of young doctors to be deployed safely and be supervised to sustain their training. We conducted this online survey to explore the professional and academic impact of the on-going coronavirus pandemic on physician's clinical practice, medical education, and research activities in international convenience sample of doctors at the peak of the pandemic (April-May 2020).

METHODS

Study design

We conducted a quick cross-sectional electronic questionnaire-based study between 17th April and 4th May 2020. For the creation, dissemination, and analysis of the questionnaire, Survey Monkey® (SVMK Inc., San Mateo, California, USA) was used. The questionnaire was electronically sent to a convenience sample of physicians available on the authors' database. The databases have international medical contacts accumulated from previous studies with a preponderance of respondents of the Middle East and Africa. An initial invitation e-mail explained the study. Reminders were sent twice-weekly to both the non-responders and partial responders. The survey service automatically blocked repeat submissions from the same internet protocol address. The invited participants only included senior and mid-grade physicians, excluding any

responses from medical students and residents (8) and all other health professionals such as nursing, dentistry, and pharmacy.

Survey questionnaire

The questions were developed de novo to cover the objectives of the study (Table 1). The questions were constructed in three domains to address the impacts of COVID-19 pandemic on clinical practice (4), medical education (4), and research work (2). The questionnaire was in the form of multiple-choice questions, including a single response, multiple responses, and a grid. Since the questions were sent to a large pool of potential participants, additional questions (8) were used to characterize the respondents' demographic and professional profiles, as described in our previous studies.^[7,8]

Table 1. Contents of the survey questionnaire*

| |
|--|
| <p>A. Profile</p> <p>Age, sex, years of practicing medicine, specialty, professional-grade, type of your main clinical practice, region of practice and country.</p> <p>B. Clinical Practice</p> <p>P1. What is the most significant change you are experiencing now in your practice due to the coronavirus pandemic?</p> <p>P2. What additional health risk do you believe COVID-19 represents to the patients in your care?</p> <p>P3. Impact of COVID-19 on your day to day clinical practice:</p> <p>P4. have you been asked to change your specialty (i.e. usual discipline or line of practice)?</p> <p>C. Education</p> <p>E1. Which of the following best describes how you plan to participate in education in your field over the next few months?</p> <p>E2. Effects of the pandemic on the resident's/junior supervision and support:</p> <p>E3. Have your residents (trainees) been asked to change their rotations from the previously planned?</p> <p>E4. Impact of corona pandemic on specific medical educational activities in your institution on Grand rounds, Case conferences, Department meetings, MDT meetings grid [Grid option: Continued. Cancelled. Online]</p> <p>D. Research</p> <p>R1. In an age of increased telemedicine and digital collaboration with colleagues, which of the following best describes how you plan to participate in education in your field over the next few months?</p> <p>R2. If you chose that you are involved in COVID-19-Related research. What type of research were you involved in?</p> |
|--|

* Response options are elaborated in detail in the results section.

Data management and statistical analysis

Survey responses were anonymously collected and stored electronically by the survey service, accessible in a password-protected manner. No data were captured on those who did not respond, declined to participate, or provided incomplete responses. The survey management service tools were used for the initial examination of results and descriptive analysis. Summary statistics were prepared for responses to each question. Since not every participant answered all questions, the percentage adjustment was used for respondents providing a given answer was calculated individually for each question, using the number of respondents to that question as the denominator. Data are presented for the whole group of respondents and stratified by region. We used data from the two components of the Middle East and North Africa regions and the rest of the world (RoW) for these comparisons. Differences were explored using the Chi-Square test for independent variables by applying the test to individual questions using 3x3, 4x3, or 5x3 as necessary. Details of the Chi-square statistic and level of significance are provided in the footnotes of the tables.

RESULTS

Profiles of respondents:

A total of 3900 doctors were invited; of these, 456 consented to participate, and 424 respondents from 40 countries, representing 10.9% of the total, met the inclusion criteria, which formed the basis of the study. The demographic and professional profiles of respondents are presented in Table 2. No data were available on non-respondents, non-consenters, and those with incomplete responses. 58.9% of respondents practiced in the Middle East and 19.8% in North Africa with smaller contributions from other regions (Table 2). Two-thirds were males (65.8%); two-thirds were between 41-60 years of age, and one fifth was above or below this age range with the corresponding duration of clinical experience as shown in Table 2; 84.2% were senior doctors and 54.5% of the respondents practiced in academic or tertiary centers, and 19.4% were in private practice (Table 2). Internal medicine and its subspecialties represented 51.5% of the respondents, followed by surgery and subspecialties (11.8%).

Table 2. The demographic, professional, and practice characteristics of the respondents.

| Variable | Details | Results |
|------------------------------------|----------------------------|--|
| Age (Years) (421) | Up to 40 | 62 (14.7%) |
| | 41-60 | 274 (65.1%) |
| | Over 60 | 65 (20.2%) |
| Sex (421) | Male/Female | 277/ 144 (65.8%/34.2%) |
| Years of practicing medicine (421) | 1-10 | 39 (9.3%) |
| | 11-20 | 107 (25.4%) |
| | 21-30 | 148 (35.2%) |
| | 31-40 | 102 (24.2%) |
| | 40+ | 25 (5.9%) |
| Speciality (423) | Medical specialties | 226 (51.5%) |
| | Surgical specialties | 49 (11.8%) |
| | Family/General practice | 36 (8.5%) |
| | Pediatrics | 30 (7.1%) |
| | Obstetrics & gynaecology | 16 (3.8%) |
| Other specialties | | 64 (15.5%) |
| | Experience (Grades) (424) | Senior / Middle grade 357/67 (84.2%/15.8%) |
| Type of clinical practice? (422) | Academic/University | 230 (54.5%) |
| | Regional/District hospital | 110 (26.1%) |
| | Private (independent) | 82 (19.4%) |
| Region of practice (424) | Middle East | 248 (58.5%) |
| | North Africa | 84 (19.8%) |
| | Rest of the World (RoW) | 92 (21.7%) |

Impact on clinical practice

The responses to questions in this domain are presented in Table 3. The most significant changes experienced in practice due to the COVID-19 pandemic were seeing fewer patients in clinics than usual (34.6%) and using telemedicine to conduct patient visits (31.3%) (Table 3). The additional health risks of COVID-19 to their patients vs. the typical healthy population under the respondents' care were considered significant or moderate by 52.4% and 38.1% of respondents, respectively (Table 3). The impact of COVID-19 on day to day clinical practice was variable. 26.9% were directly involved with COVID19

patients. 56.0% were not directly involved with COVID19 patients, but some were prepared to get trained for such a role as needed (31.6%), whereas others were only prepared to play a supporting role (24.4%). The remainder (17.2%) were not directly involved with COVID-19 patients, nor were they prepared to undertake any role as they thought they could not contribute to the care. At the time of the survey, the majority of respondents (83.0%) were not asked to change specialty (i.e., their usual discipline or line of practice). 15.1% were asked to join the front line in the fight against COVID-19 (Table 3). Changes in clinical practice between regions were similar in some but not all aspects, as detailed in Table 3.

Table 3. Impact of COVID19 pandemic on the respondents' clinical practice. Results are presented for the whole group and stratified by regions.

| Questions and response options (respondents) | All | Middle East | North Africa | RoW |
|--|-------------|-------------|--------------|------------|
| P1. What is the most significant change you are experiencing in your practice due to the COVID-19 pandemic? (402, 233, 76, 91)* | | | | |
| a. I am seeing more patients outside my clinics. | 37 (9.2%) | 30 (12.9%) | 1 (1.3%) | 6 (6.6%) |
| b. I am seeing fewer patients in my clinics | 139 (34.6%) | 70 (30.0%) | 28 (35.9%) | 41 (45.1%) |
| c. I am using telemedicine to conduct patient visits | 126 (31.3%) | 81 (34.8%) | 17 (21.8%) | 28 (30.8%) |
| d. I have reduced my clinic hours | 33 (8.2%) | 11 (9.7%) | 14 (18.0%) | 8 (8.8%) |
| e. I am not seeing any significant changes in my practice | 19 (4.7%) | 13 (5.6%) | 3 (3.9%) | 3 (3.3%) |
| f. I am off work for COVID-19-related reasons. | 31 (7.7%) | 18 (7.7%) | 10 (12.8%) | 3 (3.3%) |
| g. I am off work for reasons unrelated to COVID-19. | 17 (4.2%) | 10 (4.3%) | 3 (3.9%) | 2 (2.3%) |
| P2. What additional health risk do you believe COVID-19 represents to patients in your care? (402, 234, 78, 90)** | | | | |
| a. Significant risk vs. typical healthy population | 210 (52.4%) | 117 (50.0%) | 40 (51.3%) | 53 (58.9%) |
| b. Moderate risk vs. typical healthy population | 153 (38.1%) | 94 (40.0%) | 31 (39.7%) | 28 (31.1%) |
| c. No risk vs. typical healthy population | 16 (4.0%) | 10 (4.3%) | 2 (2.6%) | 4 (4.4%) |
| d. Not sure | 23 (5.7%) | 13 (5.6%) | 5 (6.4%) | 5 (5.6%) |
| P3. Impact of COVID-19 on your day to day clinical practice? (402, 234, 78, 90)*** | | | | |
| a. I am directly involved in the care of COVID19 patients. | 108 (26.9%) | 71 (30.3%) | 8 (10.3%) | 29 (32.2%) |
| b. I am not directly involved in corona patients, and I am prepared to be retrained for such a role as needed. | 127 (31.6%) | 77 (32.9%) | 26 (33.3%) | 24 (26.7%) |
| c. I am not directly involved in corona patients, and I am prepared to be retrained to play a supporting role only. | 98 (24.4%) | 51 (21.8%) | 23 (29.5%) | 24 (26.7%) |
| d. I am not directly involved in corona patients, nor am I prepared to undertake such a role. I do not think I can contribute much. | 69 (17.2%) | 35 (15.0%) | 21 (26.9%) | 13 (14.4%) |
| P4. Have you been asked to change your specialty? (404, 235, 79, 90)**** | | | | |
| No | 336 (83.0%) | 181 (77.0%) | 74 (93.7%) | 81 (90.0%) |
| Yes, to join front line. | 61 (15.1%) | 50 (21.3%) | 3 (3.8%) | 8 (8.9%) |
| Yes, to move to infectious disease services. | 7 (1.7%) | 4 (1.7%) | 2 (2.5%) | 1 (1.1%) |

Statistical significance of the difference between regions was tested using Chi-Square (χ^2) test.

* $\chi^2=23.59.57$, $p<0.003$; ** $\chi^2=3.05$, $p<0.08$; *** $\chi^2=17.97$, $p<0.007$; **** [$\chi^2=15.57$, $p<0.0005$ for No vs Yes].

Impact on medical education

Participants were asked to outline the impact on continuous medical education (CME) and residency training programs in their field over the following few months. Virtual and on-demand sessions from professional societies and congresses were the preferred options for CME (40.3%) followed by virtual sessions hosted by institutions on relevant topics (literature review, case studies, etc.) (37.0%) (Table 4). Impact of the COVID-19 pandemic on specific medical education activities within the institutions varied between cancelations, continuation, and change to online (Table 5). Grand Rounds seemed to suffer

more cancelations than other activities such as case conferences, departmental meetings, and multidisciplinary team meetings (Table 4). 46.8% of the respondents indicated that trainees had been asked to change rotations from those previously planned. Due to work-pressure, residents' supervision was reduced markedly according to 30.0% of the respondents or slightly according to 21.0% (Table 4). Responses from the Middle East, North Africa, and the rest of the world are shown in Table 4. The responses were statistically significantly different for responses to question E1 (Chi-square = 18.0587, $P < 0.03$) and question E2 (Chi-square = 16.3678, $P < 0.02$) and was not significant for responses to question E3.

Table 4. Impact of COVID19 pandemic on the respondents' educational activities: Results are presented for the whole group and stratified by regions.

| Questions & responses (respondents' number) | Results* | | | |
|--|-------------|-------------|--------------|------------|
| | All | Middle East | North Africa | RoW |
| E1. How do you plan to participate in education in your field over the next few months? (400, 233, 76, 91) | | | | |
| Virtual and on-demand sessions from professional societies and congresses. | 161 (40.3%) | 91(39.1%) | 32 (42.1%) | 38 (41.8%) |
| Virtual sessions hosted by my institution on topics. | 148 (37.0%) | 90 (38.6%) | 20 (26.3%) | 38 (41.8%) |
| I will likely review less material until live meetings are held again. | 31 (7.8%) | 23 (9.9%) | 3 (4.0%) | 5 (5.5%) |
| On-demand programming from journals, publishers, medical press. | 32 (8.0%) | 15 (6.4%) | 10 (13.2%) | 7 (7.7%) |
| None of the above or I am not sure. | 28 (7.0%) | 14 (6.0%) | 11 (14.5%) | 3 (3.3%) |
| E2. Have your residents (trainees) been asked to change their rotations from the previously planned? (391, 226, 74, 91) | | | | |
| Yes, they were. | 183 (46.8%) | 102 (45.1%) | 35 (47.3%) | 46 (50.6%) |
| Not applicable. I have no residents currently | 96 (24.6%) | 66 (29.2%) | 14 (18.9%) | 16 (17.6%) |
| No, they were not asked to change | 70 (17.9%) | 29 (12.8%) | 17 (23.0%) | 24 (26.4%) |
| I do not know, or I am not sure | 42 (10.7%) | 29 (12.8%) | 8 (10.8%) | 5 (5.5%) |
| E3. Effects of the pandemic on the residents'/juniors' supervision and support (390, 225, 75, 90) | | | | |
| Markedly reduced due to time and work pressure. | 117 (30.0%) | 56 (24.9%) | 29 (38.7%) | 32 (35.6%) |
| Not applicable. I have no residents currently | 112 (28.7%) | 78 (34.7%) | 17 (22.7%) | 17 (18.9%) |
| Slightly reduced due to time and work pressure | 82 (21.0%) | 47 (20.9%) | 12 (16.0%) | 23 (25.6%) |
| Continued «business as usual» | 43 (11.0%) | 26 (11.6%) | 7 (9.3%) | 10 (11.1%) |
| Discontinued completely | 36 (9.2%) | 18 (8.0%) | 10 (13.3%) | 8 (8.9%) |

Differences of responses from the Middle East, North Africa and Rest of the world were statistical significantly for responses to question E1 (Chi-square = 18.0587, $P < 0.03$) and question E2 (Chi-square = 16.3678, $P < 0.02$) and was not significant for responses to question E3.

Table 5. Impact of COVID19 pandemic on the respondents' different types of educational activities. Results are presented for the whole group and stratified by regions.

| Types of activity | All | Middle East | North Africa | RoW |
|--|-------------|-------------|--------------|------------|
| Grand rounds (380, 221, 75,84) * | | | | |
| Continued | 44 (11.6%) | 19 (8.6%) | 12 (16.0%) | 13 (15.5%) |
| Cancelled | 244 (64.2%) | 163 (73.8%) | 36 (48.0%) | 45 (53.6%) |
| Online | 92 (24.2%) | 39 (17.7%) | 27 (36.0%) | 26 (30.9%) |
| Case conference (381, 224,74, 83) ** | | | | |
| Continued | 31 (8.1%) | 15 (6.7%) | 4 (5.4%) | 12 (14.5%) |
| Cancelled | 200 (52.5%) | 135 (60.3%) | 30 (40.5%) | 35 (42.2%) |
| Online | 150 (39.4%) | 74 (33.0%) | 40 (54.1%) | 36 (43.4%) |
| Departmental meetings (385, 226,73,86)*** | | | | |
| Continued | 57 (14.8%) | 28 (12.4%) | 11 (15.1%) | 18 (20.9%) |
| Cancelled | 164 (42.6%) | 97 (42.9%) | 37 (50.7%) | 30 (34.9%) |
| Online | 164 (42.6%) | 101 (44.7%) | 25 (34.3%) | 38 (44.2%) |
| Multidisciplinary team meetings: (373, 221, 72,80) **** | | | | |
| Continued | 53 (14.2%) | 34 (15.4%) | 6 (8.3%) | 13 (16.3%) |
| Cancelled | 170 (45.6%) | 102 (46.2%) | 36 (50.0%) | 32 (40.0%) |
| Online | 150 (40.2%) | 85 (38.5%) | 30 (41.7%) | 35 (43.8%) |

c2 was calculated for a 3x3 model for differences between regions for each type of educational activity: *c2=21.57, P<0.003; ** c2=18.28, P<0.002; ***c2=6.88, P=0.14= Not significant; ****c2=3.53, P=0.47 = Not significant

Impact on medical research

When asked which of the following best describes how respondents plan to participate in research over the following few months, 11.5% stated that they are involved in COVID-19-related research as collaborators/co-investigator and 4.6% were involved in COVID-19-related research as a core-investigator. However, half declared that they are nor currently involved in any research (51.2%), and one third (32.8%) continued their usual research activities with no change (Table 6). Research activities varied from basic, translational, and epidemiological research to studies on patients' and professionals' perceptions and practices during the pandemic (Table 6). There was a numerical trend for differences in the pattern of the changes between the three regions, but it did not reach statistical significance (Question R1: Chi-square = 11.8148. The p= 0.06623. (Table 6).

DISCUSSION

The difficult balance between the priority treatment of patients with COVID-19 and other patients without the infection who require treatment for other conditions has become a major challenge.^[1-3] About a third of doctors surveyed reported utilizing telemedicine to conduct clinic visits since the beginning of the pandemic. Telemedicine has many advantages in such critical situations. Besides its role in reducing the risk of exposure, it can prevent overcrowding in emergency departments, provide the care that cannot be directly delivered, improve access to services, improve professional education, and reduce health-care costs. Nevertheless, telemedicine is never better than a personal or face-to-face relationship and can result in a breakdown in the relationship between health professionals and patients, a breakdown in the relationship between health professionals, and organizational and

Table 6. Impact of COVID19 pandemic on the respondents' research activities. Results are presented for the whole group and stratified by regions.

| Questions and response options (Respondents' numbers) | Results* | | | |
|--|-------------|-------------|--------------|------------|
| | All | Middle East | North Africa | RoW |
| R1. In an age of increased telemedicine and digital collaboration with colleagues, which of the following best describes how you plan to participate in research over the next few months? (393, 228, 76, 89) | | | | |
| I am not currently involved in research | 201 (51.2%) | 124 (54.4%) | 43 (56.6%) | 34 (38.2%) |
| I continued my usual research activities (no change) | 129 (32.8%) | 67 (29.4%) | 21 (27.6%) | 41 (46.1%) |
| I am involved in COVID-19-related research as collaborator/co-investigator** | 45 (11.5%) | 28 (12.3%) | 9 (11.8%) | 8 (9.0%) |
| I am involved in Covid-19-related research as a core-investigator** | 18 (4.6%) | 9 (4.0%) | 3 (4.0%) | 6 (6.7%) |
| R2. Type of research for those who indicated involvement in research [63, 37, 17, 14]** | | | | |
| Epidemiological research | 31 (49.2%) | 17 (46.0%) | 6 (50.0%) | 8 (57.1%) |
| Professionals' perceptions and practices | 29 (46.0%) | 18 (48.7%) | 7 (58.3%) | 4 (28.6%) |
| Patients' perceptions and practices | 18 (28.6%) | 13 (35.1%) | 2 (16.7%) | 3 (21.4%) |
| Basic research | 16 (25.4%) | 7 (18.9%) | 2 (16.7%) | 7 (50.0%) |
| Translational research | 12 (19.1%) | 8 (21.6%) | 0 (0%) | 4 (28.6%) |

* Results are presented as the numbers (%).

** Responses are not mutually exclusive.

There was a numerical trend for differences in the pattern of changes between the three regions, but it did not achieve statistical significance (Question R1: $\chi^2 = 11.8148$. The $p = 0.06623$)

bureaucratic difficulties.^[9] Telemedicine use seems to be surging in the current COVID 19 pandemic. A multimodal telemedicine network activated in Western China immediately after the first outbreak in January 2020 was feasible, acceptable, and effective, and allowed for significant improvements in health care outcomes.^[8,9] Some regulatory bodies have temporarily waived certain licensure and other restrictions to permit greater utilization of telemedicine services during this public health crisis.^[11,12] However, recent concerns were expressed regarding the medicolegal aspects of telemedicine in the context of the COVID-19 pandemic.^[13] Over a third of doctors in the current survey reported fewer patients in their clinics during the pandemic than in the pre-pandemic time. In agreement with this finding, studies from different parts of the world have reported a significant reduction in inpatient admissions during the pandemic period compared to

previous years resulting in a flat rate for empty beds and, consequently, reduced hospital revenue. Another study analyzing the effects of COVID-19 pandemic on orthopedic and trauma surgery clinics over five weeks reported a significant decrease in hospital admissions and a great deficit in revenue.^[12] In an international survey on the impact of the coronavirus pandemic on orthopedic surgical practice involving 1163 orthopedic surgeons and representing 85 countries, Meraghni et al. reported significant cancellation of orthopedic surgical activities including emergency and trauma surgeries as well as cancellation of all outpatient visits.^[14] Other reports from urology specialties also documented progressively reduced operating capacity and operational activities, changes in patients' and surgical scheduling, cancellation of elective surgeries, and staff recruitment from different medical and surgical specialties in managing and treating

COVID-19 infected patients.^[15] Another survey revealed that most neurosurgeons worldwide reported work reorganization and practices that respond to current international guidelines. The authors attributed differences in practice to the perception of the pandemic and significant differences in the health systems.^[16]

Besides the effects on clinical practice, the current survey has reported significant disruption in medical education activities and resident's training caused by the corona pandemic. Despite attempting a non-stop learning via online teaching, there seems to be a significant cancellation of many activities such as grand rounds, departmental and multidisciplinary meetings and case conferences with over-reliance of virtual and on-demand educational sessions. Furthermore, almost half of the residents had rotations from the previously planned in response to the pandemic. The effects of pandemics on medical education have been recognized in the past. Clinical teaching was suspended during the 2003 SARS outbreak in Hong Kong when 17 medical students got infected with the virus after visiting a medical ward with the yet unknown index case. The outbreak of SARS then provided an opportunity to introduce information technology into the teaching and problem-based learning methods in the country, and lectures were made available online.^[17] In the past decade, the development of user-friendly and accessible videoconferencing applications and the widespread usage of smartphones and stability of 4G networks have made videoconferencing an effective option in transiting postgraduate medical education to virtual platforms.^[18] During the current coronavirus pandemic, many countries have adapted online educational programs for doctors.^[19] China and Singapore were among the first countries to adopt such a learning system during the current pandemic. Online comprehensive educational programs that utilize online lectures, learning tutorials and self-study skills were made available. ^[17,20]

Nevertheless, there are many challenges encountered during the application of such online programs. Firstly, some clinical medicine courses, such as surgery and activities that entitle clinical procedures, are not suitable for online study. In such situations, even simulation training cannot achieve a real-world effect. Second, many medical institutions in different parts of the world cannot afford the high cost of the technologies required for such online programs such as the use of computers or software required to conduct online teaching courses,

record teaching videos and prepare teaching materials such as text, picture, audio, and animation. This is particularly challenging for students living in rural areas with underdeveloped networks and inadequate hardware facilities ^[17].

The lack of proper junior doctors' supervision and support caused by the pandemic as reported by the majority of respondents in this survey is alarming and can have serious consequences on patients' safety now and in the future. Because of the unprecedented situation for many institutions, many junior doctors are being requested to take on roles that may be unfamiliar or have not been trained for, mainly where the pressure is high. Such practice should be discouraged, and junior doctors should not be asked to do anything outside of their competence levels, and adequate supervision should be provided in such situations.^[18] In recognition of the impact of inadequate resident's supervision on patient's safety during the pandemic, the Accreditation Council of Graduate Medical Education (ACGME) in the USA issued a statement highlighting that any resident or fellow who provides care to patients will do so under the appropriate supervision for the clinical circumstance and the level of education of the resident/fellow.^[21]

The COVID-19 pandemic has resulted in a significant loss in scientific research. In China, fundamental experiments, scientific conferences, funding applications, and other activities have been postponed or suspended because of the pandemic situation. Shutdowns of pharmaceutical companies, closures of laboratories, and the suspension of research have also contributed to the loss in scientific research.^[17]

The present study has notable strengths. First, it provided a comprehensive survey of the impact of the on-going COVID-19 pandemic on the three main aspects of medical life; clinical practice, education, and research. Second, the survey involved doctors from 40 countries, albeit not uniformly distributed, reflect the global impact of the pandemic on these parameters. However, a notable limitation of the study is the low overall response rate, probably due to the health staff's hectic nature during the current pandemic and the comprehensive nature of the survey. Furthermore, the severity of the outbreak was not the same in all countries, so the measures are taken by governments and health institutions regarding changes in clinical practice, medical education, and research activities

are predictably different. Considering the higher response rate from the Middle Eastern countries may introduce the potential for bias.

In conclusion, the present study highlighted the impact of the on-going coronavirus pandemic on clinical practice, medical education, and research activities. The COVID-19 pandemic promoted increased recourse to telemedicine, virtual conferences, and thematic research on COVID-19. There is an urgent need to prepare health systems and medical faculties for the new modes of practice and medical education in the post-COVID-19 phase. Also, continued critical appraisal of the new practices to strike a balance between the different aspects of medical life, address any medicolegal concerns, and safeguard the quality of care and training. Collaboration and sharing experiences between institutions will reduce cost, effort, and time particularly between countries north and south.

Acknowledgments

We are grateful for all colleagues who shared their perceptions and experiences by participating in this survey.

Conflict of interest.

The authors have nothing to disclose.

REFERENCES

- Pascarella G, Strumia A, Piliago C, Bruno F, Del Buono R, Costa F, et al. COVID-19 diagnosis and management: a comprehensive review. *J Intern Med.* 2020 29th April. DOI: 10.1111/joim.13091. [Epub ahead of print]
- Harapan H, Itoh N, Yufika A, Winardi W, Keam S, Te H, et al. Coronavirus disease 2019 (COVID-19): A literature review. *J Infect Public Health.* 2020 May;13(5):667-673. DOI: 10.1016/j.jiph.2020.03.019. Epub 2020 8th April.
- Mash B. Primary care management of the coronavirus (COVID-19). *S Afr Fam Pract (2004).* 2020 Mar 31;62(1):e1-e4. DOI: 10.4102/safp.v62i1.5115.
- Zhang C, Huang S, Zheng F, Dai Y. Controversial treatments: An updated understanding of the coronavirus disease 2019. *J Med Virol.* 2020 26th March. DOI: 10.1002/jmv.25788. [Epub ahead of print]Ali & Alharbi, 2020;
- Ali I, Alharbi OML. COVID-19: Disease, management, treatment, and social impact. *Sci Total Environ.* 2020 22nd April;728:138861. DOI: 10.1016/j.scitotenv.2020.138861. [Epub ahead of print]
- Li H, Liu SM, Yu XH, Tang SL, Tang CK. Coronavirus disease 2019 (COVID-19): current status and future perspectives. *Int J Antimicrob Agents.* 2020 Mar 29;105951. DOI: 10.1016/j.ijantimicag.2020.105951. [Epub ahead of print]
- Beshyah SA, Al-Saleh Y, El-Hajj Fuleihan G. Management of osteoporosis in the Middle East and North Africa: a survey of physicians' perceptions and practices. *Arch Osteoporos.* 2019 7th June;14(1):60.
- Beshyah SA, Sherif IH, Chentli F, Hamrahian A, Khalil AB, Raef H, El-Fikki M, Jambart S. Management of prolactinomas: a survey of physicians from the Middle East and North Africa. *Pituitary.* 2017 Apr;20(2):231-240.
- Hjelm NM. Benefits and drawbacks of telemedicine. *J Telemed Telecare.* 2005;11(2):60-70. DOI:10.1258/1357633053499886
- Hong Z, Li N, Li D, et al. Telemedicine During the COVID-19 Pandemic: Experiences From Western China. *J Med Internet Res.* 2020;22(5):e19577. Published 2020 8th May. DOI:10.2196/19577
- Rockwell KL, Gilroy AS. Incorporating telemedicine as part of COVID-19 outbreak response systems. *Am J Manag Care.* 2020;26(4):147-148. DOI:10.37765/ajmc.2020.42784
- von Dercks N, Körner C, Heyde CE, Theopold J. How badly is the coronavirus pandemic affecting orthopaedic and trauma surgery clinics? An analysis of the first 5 weeks [published online ahead of print, 2020 20th May]. *Orthopade.* 2020;10.1007/s00132-020-03926-4. DOI:10.1007/s00132-020-03926-4
- Salem NH, Ouelha D, Gharbaoui M, Saadi S, Ben Khelil M. Medico-legal aspects related to Telemedicine in Tunisia in the context of the covid-19 pandemic. *La Tunisie Medicale* 2020; 98(6): 423-433.
- Meraghni N, Bouyoucef H, Benkaidali R, Hamza A. Impact of the COVID-19 pandemic on orthopedic surgical practice: international study. *Research Square;* 2020. DOI: 10.21203/rs.3.rs-26258/v1.
- Naspro R, Da Pozzo LF. Urology in the time of corona. *Nat Rev Urol.* 2020;17(5):251-253. doi:10.1038/s41585-020-0312-1
- Fontanella MM, De Maria L, Zanin L, Saraceno G, Terzi di Bergamo L, Servadei F, et al. Neurosurgical practice during the SARS-CoV-2 pandemic: a worldwide survey. *World Neurosurg.* 2020 4th May. pii: S1878-8750(20)30914-1. DOI: 10.1016/j.wneu.2020.04.204. [Epub ahead of print]
- Patil NG, Chan Y, Yan H. SARS and its effect on medical education in Hong Kong. *Med Educ.* 2003;37(12):1127-1128. DOI:10.1046/j.1365-2923.2003.01723.x
- Wang S, Dai M. Status and situation of postgraduate medical students in China under the influence of COVID-19 [published online ahead of print, 2020 13th May]. *Postgrad Med J.* 2020;postgradmedj-2020-137763. DOI:10.1136/postgradmedj-2020-137763
- Rimmer A. Covid-19: what do trainees need to know?. *BMJ.* 2020;368:m1276. Published 2020 27th March. DOI:10.1136/bmj.m1276
- The Accreditation Council of Graduate Medical Education (ACGME). ACGME Response to the Coronavirus (COVID-19). Available from: <https://acgme.org/Newsroom/Newsroom-Details/ArticleID/10111/ACGME-Response-to-the-Coronavirus-COVID-19>. Accessed My 22nd, 2020.
- Kanneganti A, Sia CH, Ashokka B, Ooi SBS. Continuing medical education during a pandemic: an academic institution's experience [published online ahead of print, 2020 13th May]. *Postgrad Med J.* 2020;postgradmedj-2020-137840. DOI:10.1136/postgradmedj-2020-137840