

# Survey of the Impact of COVID-19 on Pediatric Orthopaedic Surgeons Globally

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**Background:** The coronavirus disease 2019 (COVID-19) pandemic required rapid, global health care shifts to prioritize urgent or pandemic-related care and minimize transmission. Little is known about impacts on pediatric orthopaedic surgeons during this time. We aimed to investigate COVID-19-related changes in practice, training, and research among pediatric orthopaedic surgeons globally.

**Methods:** An online survey was administered to orthopaedic surgeons with interest in pediatrics in April 2020 and a follow-up was administered in February 2021. The surveys captured demographics and surgeons' self-reported experiences during the pandemic. Participants were recruited from web media and available email lists of orthopaedic societies over a 2-month period. Descriptive statistics were used to analyze results, stratified by the severity of local COVID-19-related measures.

**Results:** A total of 460 responses from 45 countries were collected for initial survey. Of these, 358 (78.5%) respondents reported lockdown measures in their region at time of survey. Most (n=337, 94.4%) reported pausing all elective procedures. Surgeons reported a reduction in the average number of surgeries per week, from 6.89 (SD=4.61)

prepandemic to 1.25 (SD=2.26) at time of survey (mean difference=5.64; 95% confidence interval=5.19, 6.10). Average number of elective outpatient appointments per week decreased from 67.89 (SD=45.78) prepandemic to 11.79 (SD=15.83) at time of survey (mean difference=56.10, 95% confidence interval=5.61, 60.58). In total, 177 (39.4%) surgeons reported using virtual modes of outpatient appointments for the first time. Of 290 surgeons with trainees, 223 (84.5%) reported implementation of systems to continue training such as webinars or virtual rounds. Of 192 respondents with research, 149 (82.8%) reported continuing research activities during the pandemic with most reporting either cessation (n=75, 64.15%), or reduction (n=25, 29.9%) in participant recruitment. A total of 111 responses from 28 countries were collected during follow-up. Surgeons described policy and circumstantial changes that facilitated resumption of clinical work.

**Conclusions:** The COVID-19 pandemic and its related counter measures have had significant impacts on pediatric orthopaedic practice and increased uptake of technology to provide care continuity. Rigorous epidemiological studies are needed to assess impacts of delayed and virtual care on patient outcomes.

**Key Words:** pandemic, COVID-19, global health care, survey, cross-sectional, orthopaedic surgery

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The first case of coronavirus disease 2019 (COVID-19) was identified in December 2019 as severe respiratory illness caused by the severe acute respiratory syndrome coronavirus 2.<sup>1</sup> The virus has since created an unprecedented pandemic and disrupted health care systems globally. In response to increasing transmission and burden on health care resources, many health authorities prioritized pandemic-related care and minimized human contact through postponing elective surgeries, suspending outpatient clinics, and triaging personnel involved in urgent care.<sup>2-4</sup> Furthermore, many jurisdictions limited on-site attendance for nonclinical staff and restricted visitors.<sup>5</sup>

In light of these changes, orthopaedic surgeons have experienced significant impacts on their ability to provide timely and high-quality surgical care, training, and research. Recent COVID-19 guidelines for pediatric orthopaedic

surgeons suggested focus on urgent care and triaging cases to postpone elective surgeries and clinic appointments, with transition to virtual-based care when appropriate.<sup>6-10</sup> However, many pediatric orthopaedic surgeons complete a high volume of elective cases and provide follow-up care on a regular basis. In addition, most pediatric orthopaedic conditions require timely treatment and follow-up to minimize complications and severity later in life.<sup>11,12</sup> As such, some care providers have sought innovative, virtual ways to provide care continuity.<sup>6</sup> Shifts towards urgent care and virtual care, while delaying elective cases, represent significant changes that many pediatric orthopaedic surgeons must navigate during the COVID-19 pandemic. Yet, little is known about specific impacts on practice during this time.

It is important to understand practice changes during the pandemic, and to capture innovative methods of continuing care, to inform planning for future health system disruptions. To assess these impacts, we conducted a survey to capture experiences of pediatric orthopaedic surgeons globally during the COVID-19 pandemic, across 4 main areas of focus: clinical care, training, research, and surgeon wellness.

### METHODS

An international online survey of orthopaedic surgeons was conducted from April to May 2020 and repeated as a follow-up survey in February to March 2021. Upon ethics approval at our institution, participants were recruited through web media and email lists of orthopaedic societies across the globe (Appendix A, Supplemental Digital Content 1, <http://links.lww.com/BPO/A361>). The initial survey link and invitation to participate was shared with organizations via email, with request for dissemination throughout their networks. Participants were contacted directly for follow-up using contact information provided at initial survey. The follow-up survey was also opened to additional respondents through orthopaedic societies. Participants were pediatric orthopaedic surgeons, or orthopaedic surgeons with interest in pediatrics, who were practicing in the field during or immediately before the COVID-19 pandemic in March 2020. Participants were excluded if they could not read/write in English or were not practicing immediately before pandemic.

The survey was developed by the study team and included closed-ended and open-ended questions regarding demographics, patient care, hospital guidelines, and impacts on training, research and wellness during the COVID-19 pandemic. Participants were also asked about their use of virtual technologies. Additional questions were added to the follow-up survey to capture detail on local state of pandemic and other long-term changes. Data were collected using REDCap electronic data capture tools<sup>13,14</sup> hosted at our center's Research Institute.

Continuous variables were summarized by means and SDs, or medians and interquartile ranges depending on observed distribution. Categorical variables were summarized as frequencies and percentages. Where appropriate, groups were compared with 2 sample *t* tests (or Mann-Whitney for skewed data) for continuous variables

and  $\chi^2$  tests for categorical, with mean differences, or risk ratios and corresponding 95% confidence intervals, respectively. Analyses were conducted in Excel and R statistical software,<sup>15</sup> version 3.6.3. Responses were included if participants submitted the final survey page. Due to survey structure, not all questions were answered by each participant (ie, additional probing questions appeared based on response to previous questions). As such, data is presented as a percentage of total responses per question. See Appendix B for an overview of "yes" responses across multiple survey variables (Supplemental Digital Content 2, <http://links.lww.com/BPO/A362>).

### RESULTS

#### Initial Survey April to May 2020

##### Demographics

A total of 460 responses from orthopaedic surgeons across 45 countries were collected. Table 1 describes demographics and surgical practice setting. Most (n=414/451, 91.8%) surgeons completed orthopaedic subspecialty training in pediatrics (n=390/412, 94.7%). Most (358/456, 78.5%) respondents reported their region was in total lockdown/stay home orders at time of survey, where only essential services or businesses could operate outside the home. Other restrictions included suggested stay-home guidelines (but

**TABLE 1.** Participant Demographics and Setting of Their Orthopaedic Practice

Demographics	Median (Interquartile Range)
No. years postqualification (n=455)	13 (6, 24)
Percentage of surgical practice that is pediatric (n=457)	100 (80, 100)
No. respondents (N=446), n (%)	
Country of practice	
United States of America	184 (41.3)
India	67 (15.0)
Canada	27 (6.0)
United Kingdom	30 (6.7)
Australia	18 (4.0)
Other (mainly Europe)	120 (26.9)
No. respondents (N=453), n (%)	
Practice setting	
Rural	23 (5.1)
Urban	416 (91.8)
Other	14 (3.1)
No. respondents (N=453)	
Practice location	
General hospital managing adult and pediatric patients	93
Tertiary care center managing both adult and pediatric patients	136
Pediatric speciality hospital	230
Private clinic/nursing home or independent clinic	79
Other (military, freelance, orthopaedic urgent care)	3

nonessential work was permitted) (n = 114), mandatory curfews (n = 46), schools closed/online only (n = 270), social distancing (n = 279), limitations on group gathering size (n = 249) and/or other (n = 13) such as mask requirements. Only 3 (0.7%) respondents reported no restrictions in place in their region.

### Clinical Practice

Surgeons reported a reduction in number of surgeries, decreasing from an average of 6.89 (SD = 4.61) weekly surgeries pre-pandemic to 1.25 (SD = 2.26) at time of survey [mean difference = -5.64; 95% confidence interval (CI) = -6.10 to -5.19]. A total of 123/454 (27.1%) respondents indicated the pandemic affected their ability to provide urgent/emergent care.

Cancellation of elective procedures differed based on lockdown measures; 337/358 (94.1%) respondents in total lockdown had completely stopped elective procedures, compared with 69/96 (71.9%) of those not under total lockdown, indicating a 30% increase in cancellations among those reporting lockdown; relative risk = 1.30 (95% CI = 1.15, 1.49,  $P < 0.001$ ). To manage delay of elective procedures, respondents requested permission to see patients on a case-by-case basis (n = 291/448, 65.0%), took a break until lockdown eased (n = 168/448, 37.5%), and/or employed other measures (n = 34/448, 7.6%), such as updating clinic layouts to minimize contacts.

Respondents also reported reduction in outpatient appointments during the pandemic. Average number of elective outpatient appointments per week decreased from 67.89 (SD = 45.78) pre-pandemic to 11.79 (SD = 15.83) at time of survey (mean difference = -56.10, 95% CI = -60.58 to -5.61).

### Employer Guidelines

At time of survey, 353/452 (78.1%) respondents were not required to go to their hospital/clinic daily, and 419/454 (92.3%) had rearranged working practices, such as limiting physical contact with patients. Only 51/452 (11.3%) respondents had been reassigned to a nonorthopedic duty, such as COVID-19-related care, triaging or screening patients, or hospital leadership.

Most (n = 434/450, 95.8%) participants reported their hospital/clinic regularly communicated COVID-19 information. In total, 393/452 (86.9%) respondents received guidelines regarding surgery on patients with COVID-19. However, only 219/453 (48.3%) surgeons reported their workplace screened patients for COVID-19 before surgery. At time of survey, 398/452 (88.1%) respondents indicated that personal protective equipment (PPE) was available at

their hospital/clinic, but 43/452 (9.5%) were expected to acquire PPE at their own expense.

### Technology

During the pandemic, 177/449 (39.4%) respondents began using virtual modalities for outpatient appointments for the first time, while 163 (36.3%) used these much more than before the pandemic. Only 53 (11.8%) respondents did not conduct virtual appointments at all; of these respondents, 23 (43.4%) reported virtual appointments were unavailable in their region. Surgeons in India represented 15/23 (65.2%) of those reporting not available in their region.

Where applicable, participants reported conducting a mean of 11.95 virtual appointments per week during pandemic (median = 8.5, SD = 12.92). Formats included phone calls (n = 241), video calls (n = 157), telehealth/e-health (n = 167) and/or other (n = 20). Some (103/387, 26.6%) respondents were able to record virtual appointments, and 112/387 (29.1%) could provide scanned prescriptions. Many surgeons (264/384, 68.8%) indicated they could charge for virtual appointments, but only 115/263 (43.7%) were able to bill the same amount as an in-person appointments; 98 (37.3%) could bill less. Despite challenges, 329/448 (73.4%) respondents indicated they would continue using virtual appointments after the pandemic.

### Wellness

In total, 281/452 (62.2%) surgeons reported changes to their income due to the COVID-19 pandemic; 210/281 (74.7%) reported a significant decrease, and 67 (23.8%) reported a small decrease. However, only 163/443 (36.8%) reported reduced full-time equivalent working hours due to pandemic. Some reported reduced full-time equivalent for mid-level provider/clinical staff (197/443, 44.5%), and/or their administrative and research staff (n = 185, 41.8%) due to the pandemic.

Nearly half (n = 224/451, 49.7%) of respondents reported that their hospital/department implemented wellness activities for faculty and staff specific to the pandemic. A total of 353/452 (78.1%) respondents reported their hospitals had an emergency operation center/COVID-19 task force. Implementation of wellness activities was over 7 times more likely if the hospital/employer also had a task force (relative risk = 7.25, 95% CI = 4.03, 13.0). Respondents also reflected on how they felt their health care systems were handling the pandemic by rating responses on a scale of 0 (strongly disagree) to 10 (strongly agree). Responses varied by country (Table 2).

**TABLE 2.** Average Ratings of Surgeon's Own Health Systems' Response to Coronavirus Disease 2019 Pandemic, Where 0 = Strongly Disagree and 10 = Strongly Agree

Country	Australia	Canada	India	UK	USA	Other
My health care system is equipped to deal with this pandemic [median (interquartile range)]	8.00 (7.00, 9.00)	7.00 (6.00, 8.00)	4.00 (2.00, 6.00)	7.00 (5.00, 8.00)	8.00 (5.00, 9.00)	6.00 (4.00, 8.00)
My expertise is being utilized during this pandemic	5.00 (2.25, 8.00)	5.00 (2.50, 6.75)	2.00 (0.00, 4.00)	4.00 (2.00, 7.00)	5.00 (2.00, 8.00)	4.00 (1.00, 6.25)
I would like to contribute more during the pandemic	5.00 (5.00, 7.00)	6.00 (4.25, 7.00)	6.00 (4.00, 8.00)	5.00 (4.00, 7.00)	7.00 (5.00, 9.00)	5.00 (5.00, 8.00)

## Teaching/Training

Participants were asked to report impacts on clinical teaching/training activities for medical students, residents, or fellows, if applicable; 290/460 (63.0%) completed this section. Most (223/264, 84.5%) respondents reported systems were in place to continue training during the pandemic, including webinars (n = 169), virtual rounds (n = 114), online access to journals/textbooks (n = 104) and/or continued in-person training (n = 97). Importantly, 272/289 (94.1%) surgeons believed trainees had a role in the ongoing pandemic.

## Research

Respondents were asked to report impacts on their research activities, if applicable; 44.8% (n = 192/437) completed this section. Most respondents (149/180, 82.8%) were continuing research activities during the pandemic. However, 105/127 (82.7%) respondents reported research personnel were not working on-site at hospital/clinic at time of survey. For 117 surgeons whose research involved patient recruitment, most reported either cessation (n = 75/117, 64.15%), or reduction (n = 40, 34.2%) in recruitment.

## Follow-up Survey February to March 2021

A total of 111 orthopaedic surgeons across 28 countries completed the follow-up survey. Key questions from each section above were analyzed. See Appendix C for additional variables from the follow-up survey (Supplemental Digital Content 3, <http://links.lww.com/BPO/A363>).

## Clinical Practice

Participants reported completing an average of 4.85 (SD = 3.63) elective surgeries and 3.13 (SD = 5.51) urgent surgeries in the past week. On average, surgeons reported 59.8 (SD = 44.2) outpatient appointments in the past week.

## Employer Guidelines

Participants indicated that resumption of clinical practice was dependent on lifted lockdowns (n = 43), updated clinical protocols to meet public health guidance (n = 43), reductions in case numbers in their region (n = 36), and/or increased clinical demands (n = 24). Adaptions required to resume practice included limiting patient chaperones (n = 80), PPE requirements (n = 77), reduced number of surgeries (n = 40), and/or other (n = 23) changes such as COVID-19 tests for patients/visitors.

## Technology

A total of 86/110 respondents reported using telehealth/virtual appointments for new patients (n = 41), follow-up patients (n = 79) and/or postoperative appointments (n = 56). Similar to initial survey, most (77/110; 70.0%) indicated they will continue using telehealth to provide care.

## Wellness

Most (95/110, 85.6%) respondents indicated their hospital routinely screened patients for COVID-19 before surgery, suggesting an increase from initial survey. A total of 93/111 (83.8%) surgeons reported that they took holiday or vacation days during the pandemic; most indicated this was less time off (n = 48/109, 44.4%) or about the

same (n = 41, 37.6%) compared with typical years pre-pandemic. A total of 26/111 (23.4%) reported taking a leave of absence at some point during the pandemic.

## Teaching/Training

Most (72/98, n = 73.5%) respondents who engaged in teaching and training activities indicated they had lost training opportunities due to the pandemic.

## Research

A total of 68 (61.3%) respondents were continuing research activities at time of follow-up. Of 48 surgeons whose research involved patient recruitment, most reported reduction (n = 30) or cessation (n = 4) of recruitment, similar to initial survey.

## DISCUSSION

Surgeons reported impacts of COVID-19-related restrictions on care, wellness, training and research. We found significant interruptions in patient care, alongside substantial uptake of virtual technologies to maintain some care continuity that persisted even at follow-up a year later. The international reach of this survey allowed us to capture impacts on a global scale, in light of clear differences in disease spread and pandemic responses across jurisdictions. Despite variation in number of cases per country, our results demonstrated common challenges and impacts across the globe.

Surgeons reported regional restrictions and lockdown measures that underscored necessary shifts in clinical practice toward urgent/emergent procedures and care, with a reduction of in-person appointments that continued through follow-up a year later. This aligned with published recommendations from the American College of Surgeons<sup>7,10</sup> and others.<sup>6,8,9</sup> Importantly, the reported decrease in postoperative patient appointments reported at initial survey may be a result of lowered volume of surgeries, rather than lack of follow-up for patients who received surgery.

Given the importance of timely care in pediatric orthopaedics, it is unsurprising that most respondents reported providing some care continuity through virtual modalities (telemedicine) which continued throughout the pandemic.<sup>16-19</sup> Telemedicine provides care while minimizing disease transmission, and has been widely used during the COVID-19 pandemic.<sup>16,17,20</sup> Uptake of telemedicine has even been described as a positive outcome of the pandemic,<sup>21</sup> as it can reduce financial and travel burden on patients while improving access to care for vulnerable and remote communities.<sup>22,23</sup> Our findings align with existing literature; respondents maintained care continuity with telemedicine and were interested in use during everyday health care in the future. Many participants continued using telemedicine at follow-up, demonstrating this shift to integration of telemedicine in regular care. However, we found challenges to virtual care, including inability to bill equivalent to an in-person appointment, and inability to provide prescriptions. While

these were not identified as reasons for not using telemedicine, it is plausible such challenges may dissuade continuation of use. Surgeons who did not offer virtual care explained lack of resources or training as main barriers. Regional infrastructure and technological uptake are other known barriers to telemedicine.<sup>17,24</sup>

Participants did not report the same uptake in use of virtual technologies for clinical training activities initially or at follow-up, which may indicate importance of in-person training and the value of trainees in clinical care, even throughout a pandemic.<sup>25–27</sup> Implementation of wellness activities was far more likely if the hospital developed a task force. This may indicate importance and utility of such designated bodies during large scale stresses on health care systems.

As expected, many participants reported reduction or discontinuation of research activities at time of initial survey, likely due to prioritization of patient care and reduction of nonessential activities at many health care facilities.<sup>5</sup> This continued at follow-up despite reported increase in nonessential activities, suggesting additional factors may have prevented return to prepandemic levels.

## Limitations

Our study relied on self-report, so recall bias is an inherent a limitation. Furthermore, selection bias may limit generalizability of our findings; those with greater case load, stress, or challenges from the pandemic may have been less likely to participate due to other demands on their time. Small sample size within global context is another limitation. This study captured a wide range of respondents with an international focus, and thus may not be generalizable in any single local context. Importantly, we completed most data collection during the initial wave of the pandemic in April to May 2020, with only a small sample for follow-up in February to March 2021. Thus, changes in clinical practices, guidelines, and policies that evolved as new information emerged and regional case numbers shifted may not have been captured. Attrition may be due to survey fatigue, increased clinical workload, or other factors. A larger longitudinal assessment is needed to fully capture impacts on pediatric orthopaedic practice across the entirety of the pandemic.

## Lessons Learned

We found significant impacts on pediatric orthopaedic patient care during the COVID-19 pandemic. Telemedicine provided many surgeons an opportunity to continue care despite local restrictions; building and maintaining infrastructure to support virtual care is vital to be better prepared for future health system disruptions. Regular communications and formation of task forces in hospitals/clinics helped support surgeon wellbeing during this time. Long-term, epidemiological evaluations of clinical outcomes are needed to determine impact of care delays on patients. In-depth evaluation of patient and surgeon experiences with virtual care is needed to optimize use of telemedicine.

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