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**Impact of COVID-19 on orthopaedic specialist training:  
a nationwide survey of orthopaedic residents in Singapore**

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**Singapore Med J 2022, 1–16**

<https://doi.org/10.11622/smedj.2022013>

Published ahead of print: 27 January 2022

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## INTRODUCTION

The coronavirus disease 2019 (COVID-19) has challenged medical specialist training worldwide.<sup>(1-7)</sup> Although Singapore's robust infectious disease control measures and whole-of-government approach to reign in the outbreak were lauded by the World Health Organization,<sup>(8)</sup> an initial oversight of the migrant worker dormitories as potential hotbeds for infection transmission has led to a second surge in COVID-19 cases (Appendix: Supplementary Figure- 'Dorm Residents' curve). The deluge of cases has resulted in cross-specialty mobilisation of healthcare workers to frontline care, and orthopaedic surgery residents are no exception. At the time of writing (22nd May 2020), Singapore has had 30 426 cases, with 790 warded in hospitals, 8 in the intensive care unit, 16 650 in community care facilities, and 23 deaths.<sup>(9)</sup> Our extensive COVID-19 testing capabilities of 2500 tests per hundred thousand people<sup>(10)</sup> has enabled a high capture rate of cases, low case fatality rate of <0.1%,<sup>(9)</sup> and good patient outcomes.

Six-year ACGME-accredited orthopaedic residency training programmes in Singapore are offered by three national healthcare clusters—National University Health System (NUHS), National Healthcare Group (NHG), and SingHealth Services (SHS), across eight restructured hospitals.<sup>(11)</sup> With interhospital residency rotations and mass in-person teaching activities suspended, skeletonisation of the practice has curtailed orthopaedic-specific patient-contact and hands-on surgical exposure, upending these key tenets of residency training. Hence, clinical educators need to modify teaching strategies to maintain continuity of residency training.<sup>(1-7)</sup>

With COVID-19, residents now 1) become stewards of infection control measures, 2) face new threats of infection transmission, and 3) face changes and uncertainty in their residency programmes. All these, coupled with limited time to acclimatise, have severely affected their specialist training. However, existing studies on COVID-19's impact on orthopaedic specialist training are few, and are only qualitative, anecdotal or brief. Thus, our

study aims to *quantitatively* delineate the impact COVID-19 has had on orthopaedic specialist training in Singapore, highlighting the more severely affected areas of specialist training that are more pressing to address through developing resilient contingency plans and upholding sustainable teaching pedagogies, even in the face of crises.

## **METHODS**

All second to sixth year (R2-R6) orthopaedic residents in Singapore (23 NUHS, 30 NHG, and 28 SHS) formed the study population (recruited 13th-20th May 2020). This anonymous, cross-sectional, self-administered, questionnaire-based study assessed the impact of COVID-19 on specialist training. First year residents, who have not assumed orthopaedic-specific clinical roles, were excluded. Approval from the national ethics board (NHG Domain Specific Review Board, Singapore) was obtained (reference number: 2020/00550).

The 62-item questionnaire was designed by two orthopaedic surgeons – A.B. and H.H.W.D. (Appendix: Questionnaire Form). A prior pilot study had been conducted on 25 non-orthopaedic residents to obtain feedback for improvement.

Questions encompassed demographics and assessed all aspects of residents affected by COVID-19. Twenty-three questions compared residency training before and during COVID-19 in terms of clinical roles, teaching activities, teaching methods and residency timelines. Six questions assessed the involvement of orthopaedic residents in COVID-19 patient care, and 19 questions on preparedness of residents, healthcare institutions, and Singapore for COVID-19. Finally, nine questions assessed residents' well-being, in terms of their worries, quality-of-life (QOL), stressors, and coping mechanisms.

Questionnaire responses were tabulated using Microsoft Excel for Mac 2020, v16.35. Statistical analysis was conducted using IBM SPSS Statistics for Mac, v22.0 (IBM Corp., Armonk, N.Y., USA). Continuous variables (means  $\pm$  standard deviation [SD]), nominal

variables (frequencies with percentages) and ordinal variables on a 5-point Likert scale (medians with interquartile ranges [IQR]) are tabulated in the Results section, with corresponding questionnaire questions reflected. Paired t-tests with difference of means and 95% confidence intervals (95%CI) for paired parametric continuous data, Wilcoxon signed-rank tests for paired ordinal and non-parametric continuous data, and McNemar tests for paired nominal data, compared the orthopaedic residency programme before and during COVID-19. Statistical significance was set at  $p$ -value $<0.05$  throughout.

## RESULTS

Of the 81 R2-R6 orthopaedic residents in the entire nation, 77 (68 males, 9 females; response rate of 95.1%; 4 male non-responders) returned questionnaire responses. Mean age is  $32.5 \pm 2.1$  years (Table I).

Before COVID-19, residents most commonly spent 11-12h/day (54.6%) on orthopaedic-related activities, as compared to 7-10h/day (48.1%) during COVID-19, significantly decreasing by 21.6h/week (95%CI, 17.1-26.0;  $p<0.001$ ) (Table II), comprising decreases in emergency trauma care services/duties ( $p=0.028$ ), outpatient clinics ( $p<0.001$ ), operating theatre (OT), lectures ( $p<0.001$ ), and clinical demonstrations/case discussions ( $p<0.001$ ). The percentage of time spent decreased for OT ( $p<0.001$ ), but increased for emergency trauma care services/duties ( $p<0.001$ ). Many residents have been reallocated to perform duties outside of orthopaedics (88.3%), with 66.2% providing  $12.4 \pm 18.2$ h/week of COVID-19 care (Table III), such as screening cases at fever clinics/emergency departments (62.7%) and at community screening facilities (33.3%). Final year residents ( $n=19$ ) have had their residency duration extended (47.4%) and exit exams postponed (100%). Overall, weekly working hours (residency-related activities + COVID-19 patient care) has decreased by 9.1 hours (95%CI, 3.9-14.4;  $p<0.001$ ).

Teaching methods have shifted from lectures ( $p<0.001$ ), journal club ( $p<0.001$ ), clinical demonstration/case discussion ( $p<0.001$ ), and symposia ( $p=0.008$ ), to webinars/online symposia ( $p<0.001$ ), telecasting of recorded lectures ( $p=0.007$ ) and surgery videos with discussion by faculty ( $p=0.012$ ) (Table II). More commonly adopted teaching methods were rated more useful, with the exception of journal club, which was the second most used teaching method prior to COVID-19, but scored the least useful.

Before COVID-19, most residents were certified in basic cardiac life support (BCLS) (96.1%), advanced cardiac life support (ACLS) (83.1%), advanced trauma life support (ATLS) (92.2%), and intensive care practice (57.1%) (Table IV). This translated into confidence in monitoring and providing initial life support to critically ill patients (56.3%). In view of COVID-19, 72 residents (93.5%) received training, of which 41.6% was mandatory, most commonly for intensive care (43.8%) and use of personal protective equipment (PPE) (43.8%), thereby increasing intensive care certification/training rates from 59.4% to 84.4% ( $p=0.008$ ).

Interestingly, after mandatory training, residents' self-perceived confidence in managing critically ill patients decreased, with fewer residents confident in monitoring and providing initial, or advanced, life support (56.3% decreased to 37.5%, 31.3% decreased to 25.0%, respectively;  $p=0.008$ ) (Table IV). On assessment of institutional preparedness, 92.2% had formal outbreak guidelines, providing at least daily updates (77.9%), most commonly via emails (81.8%), resulting in high resident satisfaction (median score 4/5 [IQR 4-5/5]), with 67.5% believing in the need for formal protocols and drills. Preparedness of and satisfaction with our nation scored high as well at 4/5 (IQR 4-5/5).

Lastly, common stressors from COVID-19 were family health (67.5%), uncertainty of residency timeline (61.0%), and insufficient residency training/education/research (53.2%) (Table V). Coping methods most commonly used were regular exercise (67.5%) and

entertainment from television/Internet (66.2%). A significant decrease in self-rated QOL from 80/100 to 70/100 (IQR 70-87.5/100, IQR 60-80/100, respectively;  $p < 0.001$ ) was found.

## DISCUSSION

Residents' time spent in orthopaedic clinical duties and teaching activities during COVID-19 has markedly decreased by 21.6h/week. Most significantly, OT time has been reduced as elective surgical cases have all been postponed. Even semi-urgent surgical cases where surgery is necessitated, such as in trauma, infection, tumour, and spinal emergencies, aerosol-generating procedures of intubation and mechanical ventilation for patients pose significant infection control risks,<sup>(12)</sup> and residents have been excluded to minimise OT headcount to mitigate this risk. Time spent on emergency trauma care services/duties has decreased by a smaller extent, as such cases require urgent attention and are less likely postponed. Thus, residency programmes need to replace these lost clinical hours. A greater focus on supplementing OT experience, could be achieved through providing more surgical simulation practices, and reallocation of departmental roles after normal clinical training resumes, to give residents more OT opportunities, with less time spent on emergency care, which has decreased by a smaller extent during this period. While orthopaedic-related activities have decreased, many residents (88.3%) are now reallocated to the frontlines to assist in testing suspect COVID-19 patients at fever clinics, EDs, and community screening facilities, and provide care to stable, confirmed cases.

With nationwide social-distancing measures in place,<sup>(13)</sup> a shift from in-person teaching activities to new-age collaborative platforms, such as Zoom and Microsoft Teams, has occurred, similarly implemented in other countries.<sup>(1-6)</sup> Live chat functions enable two-way communication, stimulating discussion and critical thinking through inquiry, collaborative learning, and Socratic questioning,<sup>(14)</sup> simulating the traditional teaching setting. They have

also bridged vast geographical distances, allowing for international collaboration through hosting of free-access online panel discussions, conferences and lectures by thought leaders,<sup>(2)</sup> offering a cornucopia of learning opportunities, and reducing opportunity costs of time away from work and family, as well as travel and accommodation costs.

Some newer teaching methods (e.g. telecasting recorded orthopaedic surgery videos with discussion by faculty) have even been rated as more useful than past methods (e.g. journal club;  $p < 0.001$ ). This may highlight the need to revamp residency programmes and replace outdated teaching methods with newer ones, such as telecasting recorded orthopaedic surgery videos with discussion by faculty, which was utilised for only 14.3% of the residents during COVID-19 despite being rated highly-useful. This will improve resident engagement and adapt to their evolved learning styles. Furthermore, instead of working in silos to create new teaching material for online learning, local residency programmes can collaborate to provide centralised teaching sessions and new online learning material. Existing online archives of surgical videos can also be tapped on.<sup>(1,15)</sup> However, traditional teaching methods should not be completely replaced in the long run, especially so for orthopaedic surgery, as kinaesthetic learning and real-case experiences are still invaluable.

Most residents (88.3%) are involved in frontline care, taking on varied roles. Thus, residency training should be tailored. For example, remote learning through recorded lectures and surgical videos with individualised timetabling of simulation sessions may be more effective teaching strategies during weekdays, when residents have differing job allocations and schedules. On the other hand, interactive online teaching sessions between teaching faculty and residents may be more feasible after-office-hours, when finding common times for virtual meetings is more feasible.

Moreover, being a 'good' surgeon transcends specialty-specific knowledge and skillsets. The COVID-19 pandemic can impart real-life lessons on resource optimisation in the

setting of limited PPE and COVID-19 test kits, practical infection control and triage skills, critical care management, systems-based practice of healthcare, and resilience in the face of uncertainty and challenges. Faculty can further facilitate learning through engaging residents in reflective practices to gain deeper introspection.<sup>(16)</sup> Decreased total work time observed may be attributed to hospitals practicing two-team systems, rotating residents between active duty and self-isolated remote working, as well as underestimates of total work time as other areas of work, such as administrative and research, might have been unaccounted for. Nevertheless, this finding still reflects that residents are now more involved in other forms of work, such as training new skillsets, hence broadening their knowledge base.

Reassuringly, with the high proportion of orthopaedic residents involved in COVID-19 patient care, a high proportion of them have also been similarly provided with training for life support, intensive care management and PPE to equip them with the necessary skills and means to protect themselves from infection transmission. Unexpectedly, residents who underwent mandatory training became less confident in management of critically ill patients despite more being intensive care-certified. This seemingly paradoxical finding could be attributed to the Dunning-Kruger effect.<sup>(17)</sup> Hence, COVID-19 has helped residents gain recognition of their incompetency in critical care management, encouraging them to build on these skillsets, as demonstrated by the majority believing that all orthopaedic residents should be provided such training.

Overall, residents were satisfied by their institutions' and Singapore's management of COVID-19, likely facilitated by a high proportion of institutions having formal guidelines to tackle infectious outbreaks and frequent COVID-19 updates. Maintaining active communication channels with residents through COVID-19 will reduce uncertainty, thereby ameliorating fears of inadequate PPE supplies, deployment to care for COVID-19 patients, and inability of the institution to manage COVID-19, as illustrated by lower rates of these stressors.



In our study, family's health was the most significant stressor, similar to a study by He et al.<sup>(3)</sup> Residency programmes can consider providing adequate well-fitted PPE, offering routine swab tests to check for asymptomatic carriage of SARS-CoV2, and consider providing alternative accommodations, thereby reducing residents' concerns of the risk they pose to their family members. The extension of residency duration and postponement of exit exams have likely magnified existing worries and uncertainty amongst residents in terms of the residency programme timeline and training adequacy. Thus, residency programmes can draft out specific contingency plans on how structured learning and completion of residency will pave out, and provide regular updates, reducing ambiguity, and building organisational resilience among residents.<sup>(18)</sup>

Residents rated their QOL during COVID-19 significantly lower than before. Most had no prior experience working in an outbreak (87.0%), and COVID-19 poses new challenges to a demanding residency programme.<sup>(19-22)</sup> Thus, faculty should establish appropriate avenues for help-seeking and psychological support.<sup>(23,24)</sup> In Singapore, helplines manned by trained counsellors have been established in all healthcare clusters, and are effective forms of support.<sup>(25)</sup> Psychiatry departments can also promote such resources to their colleagues on the frontline, exemplified by the Singapore Psychiatric Association's initiative promoting the National Care Hotline through a comic strip.<sup>(26)</sup>

With COVID-19 in constant flux, our findings are most representative of the peak of the pandemic, when orthopaedic residents have been reallocated to manage the high volume of COVID-19 cases from migrant worker dormitories in Singapore; observations at other timepoints may differ. In addition, questionnaire responses pertaining to changes in residency timeline and residents' participation in orthopaedic-related activities could have been confounded by differences in information dissemination to, and perception by, the residents. Although retrospective assessment of the orthopaedic residency programme prior to COVID-

19 may introduce recall bias, this could not be mitigated as COVID-19 could not have been pre-empted for a prospective study to be conducted instead. Despite our small cohort size, it already represents 95.1% (n=77) of the entire orthopaedic resident population in our small island-nation, and is thus significantly relevant, with non-respondents likely to be random.

Residents nationwide have been similarly galvanised to provide frontline support.<sup>(1,27-30)</sup> Hence, our observations and conclusions can likely be generalised to other residency programmes, especially surgical disciplines. Quantifying the impact of COVID-19 on orthopaedic residents has highlighted the more affected areas that are important to address. Thus, we have discussed strategies residency programmes can consider adopting to address the more pressing needs, especially since we are still in it for the long-haul.

“A pessimist sees the difficulty in every opportunity; the optimist sees the opportunity in every difficulty”— Winston Churchill. Although COVID-19 has posed road bumps along the path of orthopaedic residency education, if navigated well, these challenges can instead improve teaching methods, uncover inefficiencies in current systems, and develop more holistic and resilient residents. Thus, clinical educators should recognise the timely opportunities presented to residency education, and not neglect training of residents, even in times of crisis. If done correctly, this COVID-19 pandemic may instead be a seminal moment to revolutionise the way specialist training is conducted.

## **ACKNOWLEDGEMENTS**

We would like to acknowledge the three Residency Directors, A/Prof Joseph Thambiah (National University Health System), Dr Muhd Farhan (National Healthcare Group), and A/Prof Inderjeet Singh (SingHealth Services), for their support of this study and unwavering commitment shown to all our orthopaedic residents.

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**Table I: Demographics of questionnaire respondents (n=77).**

Qn	Demographic	Frequency (%)
1	Age (mean $\pm$ SD)	32.5 $\pm$ 2.1
2	Gender	
	Male	68 (88.3)
	Female	9 (11.7)
3,4	Other occupants within the same household	
	Spouse & children	55 (71.4)
	Elderly	24 (31.2)
	Extended family	17 (22.1)
	Alone	4 (5.1)
	Friends/colleagues in own residence/rented apartment	1 (1.3)
	Living in university resident quarters	0 (0.0)
5	Hospital type	
	Public, university affiliated	56 (72.7)
	Public, non-university affiliated	21 (27.3)
6	Current year of residency	
	2	11 (14.3)
	3	12 (15.6)
	4	15 (19.5)
	5	20 (26.0)
	6	19 (24.7)
7	Previous experience working in an outbreak	10 (13.0)

*SD = standard deviation*

**Table II:** Comparison of orthopaedic residency training before and during the COVID-19 pandemic (n=77).

	Before COVID-19, Frequency (%)	During COVID-19, Frequency (%)		Difference <sup>†</sup> (95% CI)	p-value
Hours per day in the orthopaedic residency program	Q8	Q21			<0.0001*
≤3h	1 (1.3)	5 (6.5)			
4-6h	1 (1.3)	22 (28.6)			
7-10h	29 (37.7)	37 (48.1)			
11-12h	42 (54.6)	9 (11.7)			
13-15h	4 (5.2)	4 (5.2)			
Hours per week in the orthopaedic residency program (mean ± SD)	Q9 64.6 ± 12.5	Q22 43.0 ± 18.8		-21.6 (-26.0 to -17.1)	<0.0001*
Hours per week in emergency trauma care services/duty	Q10	Q23			0.028*
≤6h	20 (26.0)	30 (39.0)			
7-12h	22 (28.6)	22 (28.6)			
13-24h	22 (28.6)	16 (20.8)			
25-48h	12 (15.6)	7 (9.1)			
49-72h	1 (1.3)	0 (0.0)			
>72h	0 (0.0)	2 (2.6)			
Hours per week in the orthopaedic outpatient clinic	Q11	Q24			<0.0001*
Orthopaedic clinics are closed	0 (0.0)	3 (3.9)			
≤2h	0 (0.0)	8 (10.4)			
3-5h	2 (2.6)	14 (18.2)			
6-10h	21 (27.3)	29 (37.7)			
11-15h	31 (40.3)	15 (19.5)			
>15h	23 (29.9)	8 (10.4)			
Hours per week in the OT	Q12	Q25 elective OT	Q26 emergency OT		
None	0 (0.0)	21 (27.3)	0 (0.0)		
≤2h	0 (0.0)	9 (11.7)	9 (11.7)		
3-5h	1 (1.3)	26 (33.8)	32 (41.6)		
6-10h	19 (24.7)	10 (13.0)	21 (27.3)		
11-15h	27 (35.1)	9 (11.7)	7 (9.1)		
16-20h	22 (28.6)	0 (0.0)	3 (3.9)		
>20h	8 (10.4)	2 (2.6)	5 (6.5)		
Hours per week attending lectures	Q13	Q27			0.057
None	0 (0.0)	9 (11.7)			
≤2h	6 (7.8)	39 (50.7)			
3-5h	61 (79.2)	27 (35.1)			

6-10h	10 (13.0)	2 (2.6)		
>10h	0 (0.0)	0 (0.0)		
Hrs per week attending clinical demonstrations/case discussions	Q14	Q28		<0.0001*
None	0 (0.0)	38 (49.4)		
≤2h	40 (51.9)	33 (42.9)		
3-5h	33 (42.9)	5 (6.5)		
6-10h	4 (5.2)	1 (1.3)		
Percentage of time spent in _____. (mean ± SD)	Q15	Q29		
Emergency trauma care services/duties	18 ± 9	23 ± 14	5 (2 to 8)	0.00028*
Orthopaedic outpatient clinics	31 ± 11	29 ± 15	-2 (-5 to 1)	0.118
OT	30 ± 9	23 ± 13	-7 (-10 to -5)	<0.0001*
Lectures	11 ± 4	12 ± 5	1 (-0.3 to 2)	0.146
Clinical demonstration/case discussions	11 ± 3	12 ± 4	1 (-1 to 1)	0.442
Teaching methods used	Q16	Q30		
Lectures by faculty	73 (94.8)	24 (31.2)		<0.0001*
Journal club	69 (89.6)	19 (24.7)		<0.0001*
Clinical demonstration/case discussion	35 (45.5)	12 (15.6)		<0.0001*
Telecasting recorded lectures	12 (15.6)	27 (35.1)		0.0071*
Symposia	9 (11.7)	1 (1.3)		0.0078*
Webinars/online symposia	8 (10.4)	59 (76.6)		<0.0001*
Telecasting recorded orthopaedic surgery videos with discussion by faculty	2 (2.6)	11 (14.3)		0.012*
Usefulness of teaching methods (scored 1 least - 5 most) (median [IQR])		Q31		
Lectures by faculty		3 (3-4)		
Journal club		3 (2-3)		
Clinical demonstration/case discussion		4 (3-5)		
Telecasting recorded lectures		3 (2-4)		
Symposia		3 (2-4)		
Webinars/online symposia		3 (3-4)		
Telecasting recorded orthopaedic surgery videos with discussion by faculty		4 (3-4.5)		
Q36 Residency duration extended (n=19)‡		9 (47.4)		
Q37 Residency exit exam postponed (n=19)‡		19 (100)		
Q38 Residency exit exam preponed (n=19)‡		0 (0.0)		

COVID-19 = coronavirus disease 2019, SD = standard deviation, OT = operating theatre, IQR = interquartile range.

‡ Difference in means, with their 95% confidence intervals, were calculated for continuous variables.

\* p-value<0.05 is significant. ‡ Only residents in the final year of residency were surveyed for this question.



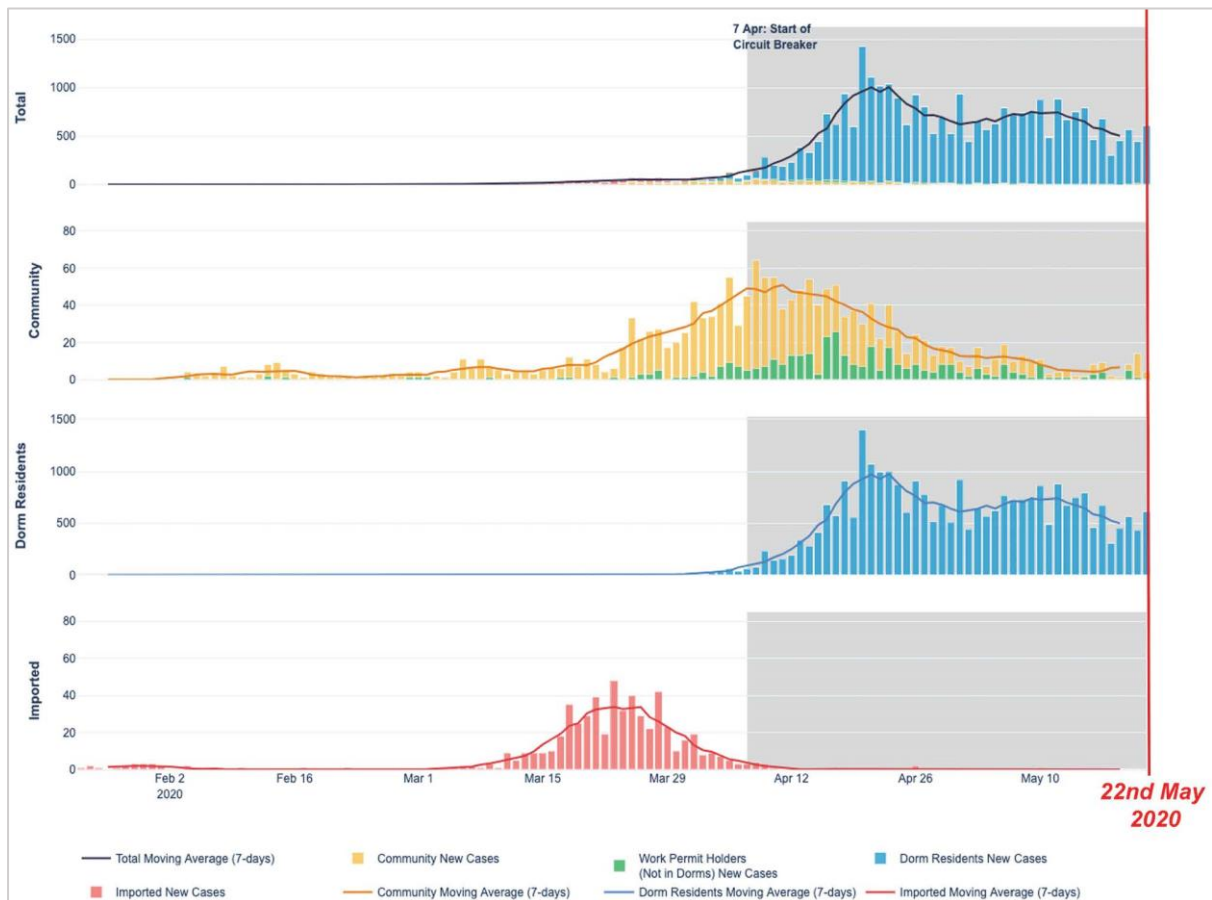
**Table III:** Additional responsibilities of orthopaedic residents during COVID-19 (n=77).

Qn	Responsibility	Frequency (%)
32	Performing duties outside of orthopaedics	68 (88.3)
35	Involved in COVID-19 duties	51 (66.2)
33	Hours per day caring for COVID-19 patients (n=51) (mean $\pm$ SD)*	2.6 $\pm$ 3.3
34	Hours per week caring for COVID-19 patients (n=51) (mean $\pm$ SD)*	12.4 $\pm$ 18.2
35	Nature of COVID-19 work (n=51)*	
	Fever clinic/ED	32 (62.7)
	Community screening	17 (33.3)
	Ward	15 (29.4)
	ICU patients not on ventilator	4 (7.8)
	Orthopaedic procedures for COVID-19 patients	3 (5.9)
	ICU patients on ventilator	2 (3.9)
22 + 34	Hours per week spent working (mean $\pm$ SD)	55.4 $\pm$ 23.7

*COVID-19 = coronavirus disease 2019, SD = standard deviation, ED = emergency department, ICU = intensive care unit.*

*\* Only data of the 51 residents who had direct contact with confirmed COVID-19 patients were analysed.*

## APPENDIX 1



**Supplementary Fig. S1** Epidemiology curves of the daily incidence of COVID-19 cases in Singapore, further stratified into Community, Work Permit holders (Not in Dorms), Dorm Residents and Imported Cases; the red vertical line corresponds to cases at the time of writing (22<sup>nd</sup> May 2020).(9)

## APPENDIX 2

### Questionnaire Form

**\*Required**

#### A. GENERAL DEMOGRAPHICS

- 1 Age in years (at the time of answering this survey) \*
- 2 What is your gender? \*  
*Choose only one option.*
  - Male
  - Female
- 3 Which of the following best describes your place of stay during your residency? \*  
*Choose only one option.*
  - With own family (spouse and children)
  - With own family including extended family
  - Alone in own residence or rented apartment
  - With friends or colleagues in own residence or rented apartment
  - In University resident quarters
- 4 Do you live with elderly (>60 years old) at home? \*  
*Choose only one option.*
  - Yes
  - No
- 5 Which of the following best describes the nature of the institution/hospital where you are currently doing your residency? \*  
*Choose only one option.*
  - Public (government) University affiliated hospital/college
  - Public (government) Non-University hospital
- 6 Which year of residency (based on the stated number of training years required) are you currently in? \*
- 7 Have you worked in the capacity of a doctor offering medical care during any of the following public health outbreaks in the past? \*  
*Choose all that apply.*
  - Severe Acute Respiratory Syndrome (SARS)
  - Middle East Respiratory Syndrome (MERS)
  - Ebola
  - No previous experience
  - Others: \_\_\_\_\_

## **B. DETAILS ON RESIDENCY PROGRAM (BEFORE COVID-19)**

Questions 8 to 20 must be answered considering the normal course of events during your residency program, before the implementation of changes after the onset of the COVID-19 pandemic.

- 8 What was the average number of hours you spent per day in the orthopaedic residency program at your institution/hospital, before the COVID-19 pandemic? \*

*Choose only one option.*

- ≤3 hours
- 4-6 hours
- 7-10 hours
- 10-12 hours
- 12-15 hours
- >15 hours

- 9 What was the average number of hours you spent per week in the orthopaedic residency program at your institution/hospital, before the COVID-19 pandemic? \*

- 10 What was the average number of hours you spent per week in the emergency trauma care services/duties, before the COVID-19 pandemic? \*

*Choose only one option.*

- ≤6 hours
- 7-12 hours
- 13-24 hours
- 25-48 hours
- 49-72 hours
- >72 hours

- 11 What was the average number of hours you spent per week in the orthopaedic outpatient clinics, before the COVID-19 pandemic? \*

*Choose only one option.*

- ≤2 hours
- 3-5 hours
- 6-10 hours
- 11-15 hours
- >15 hours

- 12 What was the average number of hours you spent per week operating theatre (observing, assisting and/or performing elective and emergency orthopaedic surgeries, before the COVID-19 pandemic? \*

*Choose only one option.*

- None
- ≤2 hours
- 3-5 hours
- 6-10 hours
- 11-15 hours
- 16-20 hours
- >20 hours

13 What was the average number of hours you spent per week participating in lectures, before the COVID-19 pandemic? \*

*Choose only one option.*

- None
- ≤2 hours
- 3-5 hours
- 6-10 hours
- >10 hours

14 What was the average number of hours you spent per week participating in clinical demonstrations (including bedside clinics) or clinical case discussions by faculty, before the COVID-19 pandemic? \*

*Choose only one option.*

- None
- ≤2 hours
- 3-5 hours
- 6-10 hours
- >10 hours

15 What was the average distribution of time you spent per week in each of the following activities (out of a total of 100%), before the COVID-19 pandemic? \*

*(Values chosen should have a cumulative sum of 100%)*

*Choose only one option per row.*

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Emergency trauma care services/duties	•	•	•	•	•	•	•	•	•	•
Orthopaedic outpatient clinics	•	•	•	•	•	•	•	•	•	•
Operating theatres	•	•	•	•	•	•	•	•	•	•
Lectures	•	•	•	•	•	•	•	•	•	•
Clinical demonstrations/ Clinical case discussions	•	•	•	•	•	•	•	•	•	•

16 Which of the following methods were normally used by your institution to teach orthopaedic residents, before the COVID-19 pandemic? \*

*Choose all that apply.*

- Lectures delivered by faculty
- Clinical demonstrations by faculty
- Journal clubs
- Symposia
- Webinars or online symposia
- Telecasting recorded lectures
- Telecasting recorded videos of orthopaedic surgeries with discussion by faculty

### **C. LEVEL OF TRAINING FOR MANAGEMENT OF PATIENTS WITH CRITICAL MEDICAL ILLNESSES (BEFORE COVID-19)**

17 What was your level of expertise with regards to offering medical care to critically ill patients with medical illnesses in the Emergency Department or Critical Care Unit, before the COVID-19 pandemic? \*

*Choose only one option.*

- I am not trained to monitor a critically ill patient with a serious medical illness.
- I can monitor a critically ill patient and alert the medical team when intervention is needed.
- I can monitor a critically ill patient and provide the initial life support before the medical team arrives.
- I can monitor a critically ill patient and provide advanced life support, including intubation and putting the patient on ventilatory support.

18 Have you acquired valid training with certification in any of the following, before the COVID-19 pandemic? \*

*Choose all that apply.*

- Basic cardiac life support (BCLS) training
- Advanced cardiac life support (ACLS) training
- Basic trauma life support (BTLS) training
- Advanced trauma life support (ATLS) training
- Any certified training program for life support skills, conducted and certified by your country, such as the National Emergency Life Support (NELS)
- No prior training in any of the above

19 Do you still have a valid intensive care training certification (including intubation and managing patients on ventilators), before the COVID-19 pandemic? \*

*Choose only one option.*

- Yes
- No

20 If you have chosen any of the options from Q20, do you renew your training periodically to keep your certification alive? \*

*Choose only one option.*

- Yes
- No

### **D. CHANGES IN THE RESIDENCY PROGRAM DURING THE COVID-19 PANDEMIC**

When answering the following questions, take into consideration how your residency routine has changed during the COVID-19 pandemic.

21 What is the average number of hours you spend per day in the orthopaedic residency program at your institution/hospital, during the COVID-19 pandemic? \*

*Choose only one option.*

- ≤3 hours
- 4-6 hours
- 7-10 hours

- 10-12 hours
- 12-15 hours
- >15 hours

22 What is the average number of hours you spend per week in the orthopaedic residency program at your institution/hospital, during the COVID-19 pandemic? \*

*(Answer none if you are not working in the orthopaedic department and have been recruited to the wards or other hospitals to take part in COVID-19 patient care)*

23 What is the average number of hours you spend per week in the emergency trauma care services/duties, during the COVID-19 pandemic? \*

*Choose only one option.*

- ≤6 hours
- 7-12 hours
- 13-24 hours
- 25-48 hours
- 49-72 hours
- >72 hours

24 What is the average number of hours you spend per week in the orthopaedic outpatient clinics, during the COVID-19 pandemic? \*

*Choose only one option.*

- Orthopaedic outpatient clinics have been closed during the COVID-19 pandemic
- ≤2 hours
- 3-5 hours
- 6-10 hours
- 11-15 hours
- >15 hours

25 What is the average number of hours you spend per week in the operating theatre (observing, assisting and/or performing **elective** orthopaedic surgeries), during the COVID-19 pandemic? \*

*Choose only one option.*

- None
- ≤2 hours
- 3-5 hours
- 6-10 hours
- 11-15 hours
- 16-20 hours
- >20 hours

26 What is the average number of hours you spend per week operating theatre (observing, assisting and/or performing **emergency** orthopaedic surgeries), during the COVID-19 pandemic? \*

*Choose only one option.*

- None
- ≤2 hours
- 3-5 hours
- 6-10 hours

- 11-15 hours
- 16-20 hours
- >20 hours

27 What is the average number of hours you spend per week participating in lectures, during the COVID-19 pandemic? \*

*Choose only one option.*

- None
- ≤2 hours
- 3-5 hours
- 6-10 hours
- >10 hours

28 What is the average number of hours you spend per week participating in clinical demonstrations (including bedside clinics) or clinical case discussions by faculty, during the COVID-19 pandemic? \*

*Choose only one option.*

- None
- ≤2 hours
- 3-5 hours
- 6-10 hours
- >10 hours

29 What is the average distribution of time you spend per week in each of the following activities (out of a total of 100%), during the COVID-19 pandemic? \*

*(Values chosen should have a cumulative sum of 100%)*

*Choose only one option per row.*

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Emergency trauma care services/duties	•	•	•	•	•	•	•	•	•	•
Orthopaedic outpatient clinics	•	•	•	•	•	•	•	•	•	•
Operating theatres	•	•	•	•	•	•	•	•	•	•
Lectures	•	•	•	•	•	•	•	•	•	•
Clinical case demonstrations/ Clinical case discussions	•	•	•	•	•	•	•	•	•	•

30 Which of the following methods have been used by your institution to teach orthopaedic residents, during the COVID-19 pandemic? \*

*Choose all that apply.*

- Lectures delivered by faculty
- Clinical demonstrations by faculty
- Journal clubs



- Symposia
- Webinars or online symposia
- Telecasting recorded lectures
- Telecasting recorded videos of orthopaedic surgeries with discussion by faculty

31 In your opinion, how useful are the following methods for the teaching of orthopaedic residents? \*

(1 being the least useful and 5 being the most useful)

Choose only one option per row.

	1	2	3	4	5
Lectures delivery by faculty	•	•	•	•	•
Clinical demonstrations by faculty	•	•	•	•	•
Journal club	•	•	•	•	•
Symposia	•	•	•	•	•
Webinars and online symposia	•	•	•	•	•
Telecasting recorded lectures	•	•	•	•	•
Telecasting recorded videos of orthopaedic surgeries with discussion by faculty	•	•	•	•	•

32 Are orthopaedic residents being recruited to perform duties outside of your orthopaedic or at another hospital, to take part in the clinical care of COVID-19 patients due to short-staffing? \*

Choose only one option.

- Yes
- No

33 What is the average number of hours you spend per day caring for COVID-19 patients? \*  
(Choose a value from 0-24 hours)

34 What is the average number of hours you spend per week with work related to COVID-19 patient care/screening? \*  
(Choose a value from 0-100 hours)

35 What is the nature of the work you are required to perform when providing COVID-19 patient care? \*

- Caring for clinically stable COVID-19 patients in the wards
- Caring for critically ill COVID-19 patients in the Intensive Care Units (not on ventilators)

- Caring for critically ill COVID-19 patients on ventilatory support
- Screening patients for COVID-19 in the institution's outpatient fever clinics/emergency department
- Screening patients for COVID-19 in the community
- Not involved in COVID-19 patient care

**Questions 36 to 38 only apply to final year orthopaedic residents.**

36 Is the duration of your residency extended due to the current COVID-19 pandemic?

*Choose only one option.*

- Yes
- No

37 Has your specialist exit exam/University exam/certification exam been postponed due to the COVID-19 pandemic?

*Choose only one option.*

- Yes
- No
- Not applicable

38 Has your specialist exit exam/University exam/certification exam been preponed (by relaxation of regulations), so as to enable you to take part in the care of patients due to a shortage of doctors tackling the COVID-19 pandemic?

*Choose only one option.*

- Yes
- No
- Not applicable

**E. ASSESSMENT OF THE PREPAREDNESS OF RESIDENTS, INSTITUTION AND COUNTRY FOR THE COVID-19 PANDEMIC**

39 Based on your institution's policy, was it mandatory for you to acquire training before being posted to care for COVID-19 patients? \*

*Choose only one option.*

- Yes
- No

40 If you answered 'Yes' to Q39, which of the following training have you undergone?

*Choose only one option.*

- Informal training imparted by the institution, without certification
- Training imparted by the institution, with certification
- National training program, formulated specifically for COVID-19 by your country's health authority, without certification
- National training program, formulated specifically for COVID-19 by your country's health authority, with certification

41 If you answered 'Yes' to Q39, which of the following best describes the training that was provided to you, so as to enable you to manage COVID-19 patients?

*Choose all that apply.*

- Basic cardiac life support (BCLS) training
- Advanced cardiac life support (ACLS) training
- Intensive Care (cardiopulmonary resuscitation and ventilatory support) training
- None of the above

42 If you answered 'Yes' to Q39, how confident are you in offering medical care to critically ill patients with a medical illness in the Emergency Department or Critical Care Unit, after receiving additional training on managing COVID-19 patients?

*Choose only one option.*

- I am not confident in dealing with critically ill patients with a medical illness
- I can monitor a critically ill patient and alert the medical team when intervention is needed
- I can monitor a critically ill patient and provide the initial life support before the medical team arrives
- I can monitor a critically ill patient and provide advanced life support, including intubation and placing the patient on ventilatory support

43 Do you feel that a structured basic and/or advanced life support training should be included in the orthopaedic residency curriculum, so as to better tackle future crises such as pandemics or natural disasters? \*

*Choose only one option.*

- Yes
- No

44 Do you feel that orthopaedic residents should be trained to perform intubation and learn basic principles of managing patients on ventilatory support, so as to better tackle future crises such as pandemics or natural disasters? \*

*Choose only one option.*

- Yes
- No

45 Were you satisfied with the level of Personal Protective Equipment (PPE) given to orthopaedic residents when posted to care for COVID-19 patients? \*

*(Rate on a scale of 1 to 5, with 1 being not satisfied and 5 being the most satisfied)*

*Choose only one option.*

1	2	3	4	5
•	•	•	•	•

46 Were you imparted training in donning and doffing PPE before being posted to care for COVID-19 patients?

*Choose only one option. \**

- Yes
- No

47 Does your institution have formal guidelines to tackle such outbreaks? \*

*Choose only one option.*

- Yes
- No

48 How often does your hospital/institution provide updated information on the current COVID-19 pandemic, newly-imposed institutional regulations/guidelines, current availability of PPE and ventilators for the management of COVID-19 patients? \*

*Choose only one option.*

- Several times a day
- Once a day
- $\geq 2$  times per week
- Once a week
- Does not provide regular updates

49 Which of the following platforms has your hospital/institution adopted to convey updates on the current COVID-19 pandemic, newly-imposed institutional regulations/guidelines, current availability of PPE and ventilators for the management of COVID-19 patients? \*

*Choose all that apply.*

- Physical meeting of the institution head with the heads of departments
- Teleconference
- Email
- Text message
- Circulation of notices
- Automated voice messages by phone
- Official messenger group of the institution

50 Do you feel that formal protocols need to be developed, with mock drills conducted periodically, to be able to better tackle such public health problems? \*

*Choose only one option.*

- Yes
- No

51 How satisfied are you with the way the COVID-19 pandemic has been tackled by your institution? \*

*(Rate on a scale of 1 to 5, with 1 being not satisfied and 5 being most satisfied)*

*Choose only one option.*

1	2	3	4	5
•	•	•	•	•

52 How would you rate the preparedness of your country's health system in handling the COVID-19 pandemic? \*

*(Rate on a scale of 1 to 5, with 1 being not prepared and 5 being well prepared)*

*Choose only one option.*

1	2	3	4	5
•	•	•	•	•

53 How satisfied are you with the way the COVID-19 pandemic has been tackled by Singapore? \*  
(Rate on a scale of 1 to 5, with 1 being not satisfied and 5 being most satisfied)  
Choose only one option.

1	2	3	4	5
•	•	•	•	•

## F. ASSESSMENT OF THE PSYCHOSOCIAL IMPACT OF COVID-19

54 How worried are you about the effect of the COVID-19 pandemic on your own health? \*  
(Rate on a scale of 1 to 5, with 1 being not worried and 5 being most worried)  
Choose only one option.

1	2	3	4	5
•	•	•	•	•

55 How worried are you about the effect of the COVID-19 pandemic on your family's/relatives' health? \*  
(Rate on a scale of 1 to 5, with 1 being not worried and 5 being most worried)  
Choose only one option.

1	2	3	4	5
•	•	•	•	•

56 How worried are you about the effect of the COVID-19 pandemic on your residency? \*  
(Rate on a scale of 1 to 5, with 1 being not worried and 5 being most worried)  
Choose only one option.

1	2	3	4	5
•	•	•	•	•

57 How worried are you about the acceptance of doctors in the society if you are infected by COVID-19? \*  
(Rate on a scale of 1 to 5, with 1 being not worried and 5 being most worried)  
Choose only one option.

1	2	3	4	5
•	•	•	•	•

58 Have you or your family been treated indifferently due to the fact that you are a frontline worker caring for COVID-19 patients, for fear of you infecting the community? \*  
Choose only one option.

- Yes
- No

59 Which of the following are the most important stressors for you from the COVID-19 pandemic? \*  
Choose up to 5 options.

- Personal health
- Family health
- Insufficient training, education and research during orthopaedic residency
- Uncertainty of the timeline until resumption/completion of the normal residency program
- Delay in completion of residency program due to postponement of exams
- Concerns about the ability of the institution to admit and manage COVID-19 patients
- Fear of being deployed to direct care of COVID-19 patients
- Fear of the lack of adequate PPE for those caring for COVID-19 patients
- None
- Others: \_\_\_\_\_

60 What methods do you adopt to cope with the stress? \*

*Choose up to 3 options.*

- Listen to music and reading books
- Regular exercise
- Yoga and meditation
- Avoid listening to news frequently
- Self-isolate and spending time with family
- Entertainment from television or the Internet
- Spending more time on research/academics

61 On average, how do you rate your overall quality of life (physical and mental health) before the COVID-19 pandemic? \*

*(Rate on a scale of 0 to 100, with 0 being the worst and 100 being the best quality of life)*

62 On average, how do you rate your overall quality of life (physical and mental health) during the COVID-19 pandemic? \*

*(Rate on a scale of 0 to 100, with 0 being the worst and 100 being the best quality of life)*