

# Disruption of paediatric orthopaedic hospital services due to the COVID-19 pandemic in a region with minimal COVID-19 illness

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## Abstract

**Purpose** This study was designed to evaluate the impact of the COVID-19 pandemic on paediatric orthopaedic services in a paediatric tertiary hospital in South Australia.

**Methods** A retrospective audit was conducted of orthopaedic activity at a major paediatric tertiary hospital with a Level 1 paediatric trauma centre, where no patients were admitted with COVID-19 illness. Orthopaedic Emergency Department (ED) presentations, outpatient clinics and hospital admissions for the period between 16 March 2020 to 26 April 2020 were studied and compared with the same period in 2019 (18 March 2019 to 28 April 2019). Chi-square tests were performed with  $p < 0.05$  indicating statistical significance.

**Results** In total, 621 patients presented to the ED with orthopaedic complaints during the pandemic (versus 997 in 2019). However, there was minimal change in the number of ED presentations requiring admission (110 in 2020 versus 116 in 2019). Among patients discharged directly from ED, 27.3% received hospital outpatient referral (versus 39.1% in 2019), with the remaining patients referred to community health services or discharged directly.

There was a 509.8% increase in telehealth (video and phone) outpatient consultations compared to 2019 and a 60.6% decline in face-to-face appointments. There was a total of 144 orthopaedic admissions (elective and emergency) compared to 184 in 2019. Admissions for children under seven remained unchanged (32.5% reduction in children aged seven and above).

**Conclusion** Despite an overall decline in all paediatric orthopaedic hospital activity, the number of emergency admissions for musculoskeletal conditions did not change. Elective surgery numbers for children aged under seven were also unchanged. Appropriate planning and hospital resources allocation are necessary to meet this service requirement in future pandemics.

**Level of evidence** IV

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## Introduction

The COVID-19 disease first reached Australia on 25 January 2020 and, as of 31 May 2020, the Commonwealth of Australia reported 7195 confirmed cases of COVID-19 including 103 deaths.<sup>1</sup> Australia has not been significantly affected by previous zoonotic coronavirus outbreaks, experiencing only one case of SARS infection and no cases of MERS infection.<sup>2</sup> Thus, evaluation of the impact of this pandemic could provide valuable lessons for future pandemic planning.

COVID-19 was first declared a public health emergency in South Australia on 15 March 2020 and declared a major emergency a week later.<sup>3,4</sup> A national lockdown was declared, restricting travel and movements within the country and across international borders. Population-based non-pharmaceutical interventions including social distancing, household quarantine and case isolation were enforced by public health authorities in order to flatten the curve and prevent health care systems from being overwhelmed.

On 31 March 2020, the State Coordinator of South Australia made a Direction under the Emergency Management Act 2004 to limit surgery to category 1 (emergency) and urgent category 2 surgery and procedures only, which include those performed for medical conditions where failure to do so will lead to loss of life, loss of limb or permanent disability.<sup>5</sup> These restrictions on hospital services

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**Table 1** Comparison of COVID-19 case load and restrictions in Australia, USA and United Kingdom.<sup>1,19,20</sup>

	Australia	USA	UK
Date of index case	25 January 2020	20 January 2020	31 January 2020
Date of lockdown	20 March 2020	19 March 2020	23 March 2020
Date of cessation of non-urgent elective surgery	25 March 2020	13 March 2020*	15 April 2020
Relaxation of elective surgery restrictions	27 April 2020	Dependent on COVID-19 caseload in area	Minimum three months from date of cessation
Peak number of cases in a day	469 (28 March)	43 438 (6 April)	8719 (12 April)
Number of cases per million population	288	5367	4103
Number of paediatric cases	326	54 291	Not available
Mortality per million population	4.1	316	577

\*American College of Surgeons recommended that non-emergency operations be rescheduled or cancelled as necessary

were put in place to contain COVID-19 infection, as well as to conserve valuable resources such as personal protective equipment (PPE) and surgical appliances in preparation for an anticipated severe outbreak.

In contrast to other developed countries with advanced healthcare systems, such as the USA and UK, Australia has seen rapid control of COVID-19 case numbers with minimal mortality rate, despite initiating lockdown and restricting non-urgent elective surgeries in a similar timeframe (Table 1). However, similar to many healthcare institutions worldwide, Australian hospital services have been impacted by COVID-19 preparations, with a nationwide response and state-based adaptation.

A literature review of previous studies of infection epidemics revealed minimal data regarding the effects of pandemics on hospital services in the field of paediatric orthopaedics. This article aims to provide the first description of the changes in paediatric orthopaedic hospital services as a result of the COVID-19 pandemic. As a direct result of the pandemic, our hypotheses were that (1) Emergency Department (ED) presentations and admissions would remain the same or decrease and (2) elective admissions and outpatient numbers would rapidly decline during the pandemic.

The setting for this study was unique as the hospital has no admitted cases of COVID-19 illness. As such, rather than the effects of the disease itself, this study represents the effects of government restrictions, the associated changes in local departmental policies and the change in patients' healthcare-seeking behaviour due to the pandemic. Musculoskeletal problems are the sixth most common presentation in children and adolescents and a better understanding of the impact of this pandemic provides guidance for planning of resource allocations in the face of future pandemics, or a potential second wave of COVID-19.<sup>6</sup>

## Methods

A retrospective population-based cohort study was conducted in the Department of Paediatric Orthopaedics at

the Women's and Children's Hospital, a major tertiary referral teaching hospital with a Level 1 major paediatric trauma centre in South Australia. Data were sourced for outpatient clinics attendance, ED presentations, musculoskeletal-related hospital admissions and surgeries performed within a six-week period between 16 March 2020 and 26 April 2020 (weeks 12 to 17 of 2020). The study period corresponds to the time period between the initiation of lockdown within the state and the lifting of restrictions on elective surgeries in South Australia. This was compared to the corresponding six-week period (weeks 12 to 17) in 2019 (18 March 2019 to 28 April 2019).

Cases in ED were identified through the electronic ED Information System database by searching keywords (trauma, swelling, pain, fracture and injury). Identified cases were then reviewed for type of injury, subsequent disposition and referral on departure.

Outpatient data included determination of face-to-face appointments versus telehealth consultations (telephone and video conference mediums) with direct communication to patients and/or general practitioners.

All patients admitted to the hospital for paediatric orthopaedic surgery within the study period were identified and reviewed for: demographics, diagnosis, admission category (elective, emergency), type of surgical procedures and length of stay. Patients having simple forearm reductions in the ED under nitrous inhalation/sedation were not formally admitted and as such did not appear in admission data numbers.

Our outcome measures were the number of ED presentations with orthopaedic conditions and their subsequent disposition on departure, number of face-to-face and telehealth outpatient consultations, the number and type of surgical procedures, as well as the total orthopaedic admissions

All data were collated and analysed using Microsoft Excel 2010. Statistical analyses included percentages and Chi-square tests comparing the two time periods (2019 and 2020) on the categorical outcome variables of interest and using  $p < 0.05$  to indicate statistical significance.

## Results

### Emergency presentations

A database search identified 621 children under 18 years old that presented to the ED with musculoskeletal-related issues from 16 March 2020 to 26 April 2020. This represented a 37.7% reduction from 997 presentations in 2019. The types of musculoskeletal presentations between the two periods were similar, with upper limb injuries accounting for more than half the presentations.

There was negligible change in the number of patients who had hospital admission for orthopaedic injuries, with 116 admissions in 2019 and 110 in 2020 (Table 2). During the pandemic, 510 patients presented to the ED who did not require inpatient management, representing a 41.8% reduction from 2019. Among the patients that were discharged, only 27.3% received an outpatient referral within the hospital (including Allied Health), compared to 39.1% in the preceding year. The remaining patients were either referred to external health providers (including general practitioners, community mental health and private health providers) for ongoing management or did not require follow up.

### Outpatients

A total of 982 and 712 appointments (including face to face and telehealth) were scheduled during the study

**Table 2** Comparison of patient management after presentation to ED for the same time periods in 2019 and 2020.

	2019	2020	p-value*
Admitted	116	110	< 0.001
Discharged from ED	877	510	
Follow-up destination from ED (%)			< 0.001
Referral within hospital	343 (39.1)	139 (27.3)	
External health providers	281 (32.0)	186 (36.5)	
Not referred	253 (28.8)	185 (36.3)	
Left before treatment completed	4	1	–
Total ED presentations	997	621	–

\*Statistical analyses included Chi-square tests comparing the outcomes of number of admitted and discharged patients from ED, and their follow-up destination from ED between the two time periods (2019 and 2020). A p-value of < 0.05 was considered statistically significant.

**Table 3** Comparison of outpatient clinic volumes and appointment types for the same time periods in 2019 and 2020.

	2019	2020	Change (%)	p-value*
Total appointments	982	712	-27.5	
Attendance				< 0.001
Attendance	840	565	-32.7	
Non-attendance	142	147	+3.5	
Modalities				< 0.001
Face-to-face	799	315	-60.6	
Telehealth	41	250	+510	

\*Statistical analyses included Chi-square tests to compare the outcomes of number of outpatient appointment attendance and modalities used in outpatient clinics (including face-to-face and telehealth). A p-value of < 0.05 was considered statistically significant.

period in 2019 and 2020 respectively (Table 3). In all, 20.6% of patients failed to attend their appointments in 2020, up from 14.5% in 2019.

There was a 60.6% drop in the number of consultations that were held face to face during the pandemic in comparison to 2019 (Fig. 1). There was an associated 510% increase in the use of telehealth services, up from 41 in 2019 to 250 in the corresponding six-week period in 2020. The Department operates six general orthopaedic clinics and five fracture clinics per week during routine times. The changes in modalities used were especially evident for orthopaedic clinic appointments where telehealth consultations had a 264% increase between the start and end of the pandemic, far surpassing face-to-face consultations. This was distinct from fracture clinic appointments, where face-to-face consultations remained the more common method used, despite an increase in telehealth consultations.

Comparing all attendances, the paediatric orthopaedic outpatient clinic functioned at 67.3% capacity in comparison to 2019.

### Hospital admissions and surgery

There was a 21.7% decrease in the number of total admissions under orthopaedic surgery (elective and emergency) from 184 in 2019 to 144 children in 2020. Elective admissions were halved from 68 in 2019 to 34. Emergency admissions were reduced by 5.2% from 116 to 110. As a result, the ratio of emergency to elective admissions increased to 3:1 during the pandemic from the usual 2:1, showing a shift in total workload towards emergency surgeries. Of the 110 emergency admissions, 40 were surgery for forearm fractures, 13 other upper limb (mainly supracondylar humerus), 26 lower limb, and nine for tumour or infection (Fig. 2). Not all emergency admissions required surgery, with the 'no surgery' columns in Fig. 2 including conditions such as osteomyelitis, cellulitis, spinal injury and injuries requiring elevation and splintage. Upper limb injuries, especially forearm, remained the most common paediatric injuries, with a decreased incidence of lower limb injuries during the pandemic.

However, despite an overall downtrend of hospital admissions, elective and emergency admissions for children under the age of seven did not change during the study period (p = 0.88) (Fig. 3). In contrast, there was a statistically significant difference in admissions of children aged seven and above, especially for elective admissions, decreasing from 41.3% in 2019 to 20.0% in 2020 (p < 0.05).

Bed occupancy for paediatric orthopaedics was noted to have a 39.95% reduction with 3595 hours for the six-week period in 2020, compared to 5987 hours in 2019.

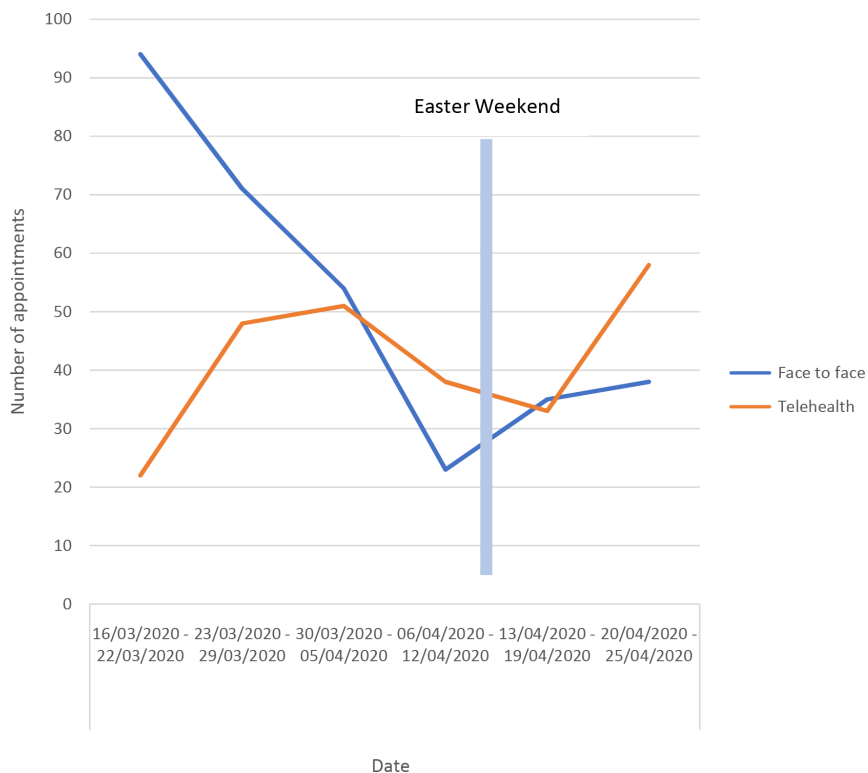


Fig. 1 Changes in numbers of face-to-face and telehealth appointments throughout the study period in 2020.

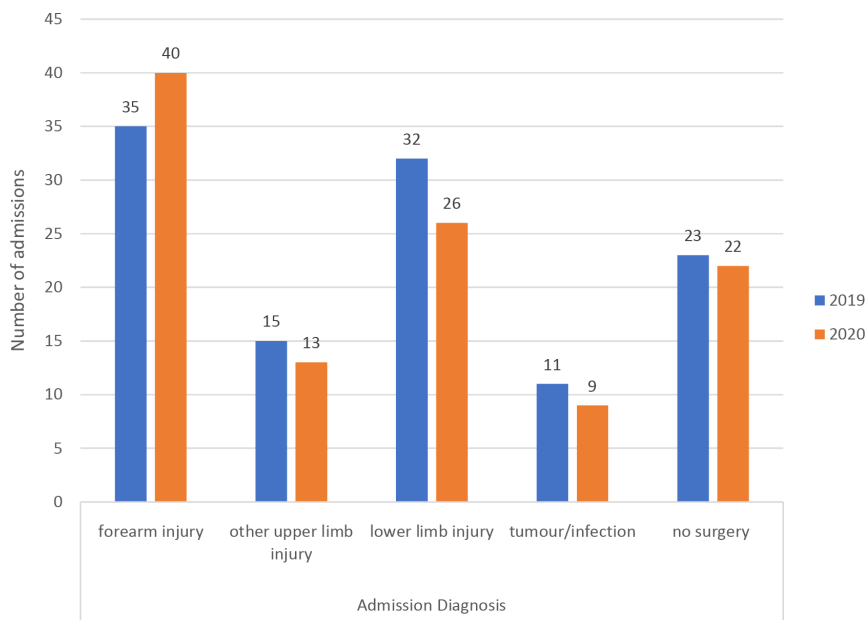
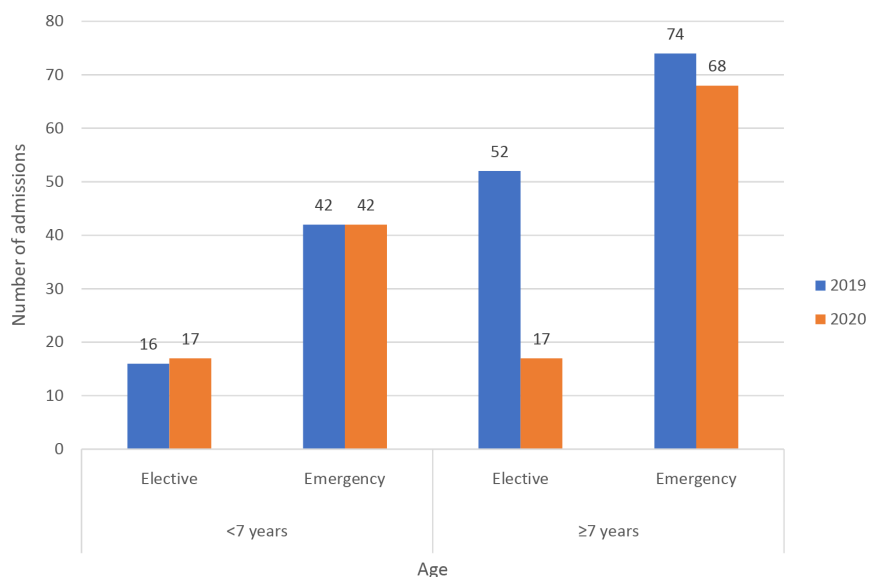


Fig. 2 Comparison of emergency admissions between 2019 and 2020.

### Discussion

Based on existing epidemiological data, children under nine years of age appear to be minimally affected by COVID-19, despite increasing contemporary reports of systemic complications.<sup>7</sup> This clinical picture is in stark

contrast with other respiratory viruses where young children are more at risk of severe disease. However, despite generally having mild clinical manifestations, paediatric patients have been reported to have longer incubation periods and thus are more likely to be carriers.<sup>8</sup>



**Fig. 3** Comparison of elective and emergency admissions in children aged under seven *versus* aged seven and above in 2019 and 2020.

The state of South Australia, with a population of 1.7 million, recorded only 440 cases of COVID-19 and four deaths, as of 31 May 2020. Additionally, the hospital studied had no admitted cases of COVID-19 illness and no deaths. As such, this study is unique as it measures the effect of preparation for a ‘disaster’ scenario rather than the direct burden of large numbers of infected persons on hospital services.<sup>9</sup>

There was a rapid but progressive restriction of activities within the state from 22 March 2020, including indoor and outdoor sporting activities. The requirement for a minimum of 1.5 metres social distancing curtailed organized sport. This is consistent with the 37.7% decline in ED presentations for injury observed in the study during the lockdown period. The decline in lower limb injuries requiring hospital admissions could be attributed to widespread restrictions in team sports such as soccer, netball and Australian football, which are known causes of injuries involving lower extremities.<sup>10</sup>

It is unclear whether activity restrictions resulted in an overall drop in minor injuries or if it could be inferred that minor injuries still occurred in the community, but children did not present to the ED due to social distancing practice and/or parents’ anxiety to avoid hospital attendance. This apparent change in healthcare-seeking behaviour supports the observation of a decreased number of ED presentations, while patients with injuries requiring expert medical care still presented. This contrasts with reports in Italy that described parents with children avoiding hospital in fear of COVID-19 infection, leading to potentially avoidable deaths.<sup>11</sup> This trend is useful for resource allocation in future pandemics for young, healthy patients with mild injuries to be treated in the community and avoid hospital exposure and consumption of resources.

Our data suggest that the rate of injury requiring admission in South Australia did not change despite being in lockdown. It is likely that the proportion of admissions for inpatient forearm fracture reduction was increased by changes in clinical practice during the pandemic. Previously, nitrous oxide/sedation was commonly used in the ED for fracture reduction, however due to the risk of aerosol generation in a less-controlled environment, these forearm reductions were performed in the main operating suite.

In the context of hospital admissions from the ED, our results contrast strongly with UK and New Zealand data, which had a 44% and 48% decrease in musculoskeletal injury requiring hospitalization respectively.<sup>12,13</sup> The lockdown measures in UK and NZ were different, with strict closures of playgrounds, schools and more limitations on outdoor activities in contrast to the progressive restrictions in South Australia. Other regions in Australia had different local measures with the adjacent State of Victoria, with a population of over six million, having a strict lockdown. It is apparent that a continued burden of paediatric orthopaedic injuries remained in our community with its less restrictive lockdown instructions. In terms of future pandemic planning, service provisions for these injury admissions need to be maintained as a minimum.

Additionally, unlike some countries with high population density, Australians tend to have larger areas in their homes and backyards for activities, with many families owning large play equipment and not needing to attend open public facilities such as playgrounds. The increase in popularity of trampolines during the lockdown period has been associated with a rise in trampoline injuries.<sup>14</sup> It has previously been demonstrated that low levels of parental supervision are associated with higher odds of injury



requiring inpatient management.<sup>15</sup> Thus, further emphasis could be placed on raising awareness on injury prevention in home environments, especially since children are spending more time at home in the current pandemic.

Unsurprisingly, outpatient clinic numbers decreased significantly during this period. A contributing factor of this was the reduction in outpatient referrals from ED, in addition to the cancellations of many elective visits. The reduction in number of referrals from ED is likely due to a change in practice: all referrals required discussion with the orthopaedic team prior to referral. In many cases, alternative definitive care outside hospital settings was recommended, such as providing instructions for community health services to remove a cast. This is in line with an audit performed by the team shortly before the pandemic through the Choosing Wisely programme. It was identified that 25% of outpatient fracture appointments were considered unnecessary and either no follow up was required or alternative follow up with local health services would have been more beneficial. As such, the orthopaedic team has renewed enthusiasm for definitive care at point of service and to support hospital avoidance via community care.

Community care has also supported by the addition of new temporary Medicare Benefits Schedule telehealth items since early March 2020.<sup>16</sup> Previous studies have reported telephone calls and virtual outpatient clinics as safe and preferred alternatives to routine clinic follow up post-operatively in adult and paediatric settings.<sup>17,18</sup> The rapid scaling up of the use of telehealth services was supportive in minimizing the risk of COVID-19 transmission to health professionals and patients/families.

Government restrictions permitted surgeries for limb or life-threatening conditions as well as time-sensitive conditions that should be performed within 30 days of decision of need to treat. Clinicians were given the responsibility to determine this, with supervision by hospital administrators and random police checks. Surgery thus consisted mainly of time-sensitive interventions in young children, such as closed reductions for dislocated hips in developmental dysplasia of the hips and clubfoot tenotomies, which in turn facilitated the unchanged numbers of surgeries in children under the age of seven. Whenever surgeries were performed, there was no change in the standard operative management of these conditions. Surgeries for conditions that did not meet the strict criteria, such as removal of implants, non-urgent sports surgery and other non-urgent cases in older children, were not performed during this time. These cancellations will place additional numbers on existing waiting lists and will require careful management to limit any harm to patients.

The observed changes in the number of ED presentations and outpatient appointments has provided a positive

stimulus for clinicians to improve the triaging of referrals during routine times. The changes in practice during the pandemic has allowed our junior orthopaedic team members to be more involved in providing definitive treatments in ED, offering referral from ED to community resources for continued care and assessing both telephone and written outpatient referrals for appropriateness. We anticipate long-term benefits in terms of efficiency and reduced wait times with these changes in the post-COVID era.

## Limitations

The paediatric and combined obstetric hospital studied had no admitted cases of COVID-19 illness, despite community cases and nearby adult hospitals admitting COVID-19 patients. As such, this study did not assess the additional effects COVID-19 patient admissions may have on overall hospital services but is unique in assessing the effect of government restrictions and patients' behaviours during the pandemic in isolation.

Some avoidance of presentation to the ED may have occurred due to travel restrictions, fear of acquiring COVID-19 from hospital attendance and self-initiated sourcing of local management. The hospital also established a COVID-19 testing centre adjacent to the main entrance, which may have deterred attendance.

## Conclusion

This study demonstrated an overall decline in all hospital services provided by the paediatric orthopaedic department. The majority of patients presented to ED did not require admission and were referred to external health providers or discharged directly. However, there was a minimal change in musculoskeletal-related emergency admissions across all age groups. While elective admissions for children aged seven and above decreased markedly, admissions for children aged under seven remained unchanged during the pandemic. These results are distinct from reports in other countries and are potentially unique to the South Australian population. Appropriate planning and hospital resources allotment are necessary to ensure these services are provided as a minimum to the local community in future pandemics.

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**OA LICENCE TEXT**

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**ETHICAL STATEMENT**

**Ethical approval:** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval for this audit was granted by the Women's and Children's Hospital Human Research Ethics Committee (Approval Number 1165A/06/2023).

**Informed consent:** Informed consent was not necessary for this work.

**ICMJE CONFLICT OF INTEREST STATEMENT**

None declared.

**AUTHOR CONTRIBUTIONS**

FLW: Design of the study, Analysis and interpretation of data, Drafting and critical revision of manuscript

GA: Analysis of data, Drafting and critical revision of manuscript.

NW: Design of the study, Drafting and critical revision of manuscript.

PJC: Design of the study, Drafting and critical revision of manuscript.

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