SPECIAL ARTICLE

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Effect of the COVID-19 pandemic first wave and public policy on elective and emergency surgery provision in Southern Queensland

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Abstract

Background: Several public health initiatives in Australia were implemented in March 2020 to contain the spread of COVID-19. The effect of these initiatives on surgical provision is unknown. The primary objective was to determine the effect of public health policies and surgical society guidelines implemented during the pandemic on elective and emergency caseload of surgical specialities operating within South East Queensland.

Methods: This observational study utilized non re-identifiable electronic data to quantify the caseload of surgical specialities across five secondary and tertiary referral hospitals in South East Queensland prior to and during the implementation of such initiatives. All patients undergoing a surgical procedure between 1 March and 24 April 2019 and the same period in 2020 were included. Participants' demographic and clinical information, such as age, the American Society of Anesthesiologists score, surgical date and location, surgical subspecialty and procedure name, was included.

Results: During the 2020 time period, there were 2991 elective cases compared to 4422 surgeries occurring in the same period in 2019 (32.4% reduction). Meanwhile, 2082 emergency surgeries were performed in the 2020 period compared to 2362 in 2019 (12.0% decrease). Ophthalmology and dental/ear, nose and throat/maxillofacial surgery experienced the largest reduction in elective surgeries, whereas emergency caseload increased for vascular and cardiothoracic services, and only slightly decreased for plastics and urology.

Conclusion: The public health initiatives and guidance implemented during the COVID-19 pandemic reduced surgical specialties' elective caseload. However, emergency caseload was not affected to the same extent. This insight helps to guide resource allocation in future waves of the pandemic.

Introduction

Since being declared a public health emergency on 30 January 2020, the SARS-CoV-2, or COVID-19, has caused significant loss of life and had a profound effect on global health systems.[1] Even in Australia, with its relative geographic isolation and lack of international land boarders, COVID-19 has had a measurable impact.[2] Cases of COVID-19 began rising in Australia in early March 2020 leading to the introduction of a number of public health initiatives including federally mandated cessation of all category 3 and 'non-urgent' category 2 elective surgeries on 24 March 2020.[3]

The public health initiatives also included bans on large gatherings, closing of 'non-essential' businesses and a limit on both international and domestic travel. Other policies included 'stay-at-home' measures aimed at limiting the movement of people other than to shop for essentials, receive medical care or travel for essential work or education.[4] Directives and guidelines were also issued by various surgical societies to classify which procedures should continue under the above-mentioned federal guidelines[5–8].

Overseas centres' experience has varied widely under COVID-19 lockdown restrictions. One hospital in the UK found an overall 26% reduction in trauma-related procedures, but no change in the number of hip fractures or assaults.[9] While in Spain, there was a roughly 75% drop in orthopaedic trauma cases during their lockdown period.[10] Meanwhile, a worldwide survey of vascular surgeons demonstrated that 90% experienced a reduction in some, if not all, elective vascular

cases, while 90% reported no change in emergency vascular surgery cases.[11]

The objective of the study was to compare the effect of Australian public health policies on elective and emergency service provision across a large hospital network in South East Queensland. Our aim was to use information from our Hospital and Health Services (HHS) and its 1.16 million residents to study the effect of COVID-19 on both elective and emergency surgery and compare this to data across the same sites in the same period in 2019.[12]

We hypothesized that from 1 March to 24 April 2020, there would be a reduction in the number of emergency cases due to both a reduction in trauma from the public health policies and a reduction in people accessing treatment. We also hypothesize that there would be reduction in elective surgeries performed as compared to the same time period in 2019 (prior to COVID-19), and that this reduction would not be uniform across surgical subspecialties.

Methods

This multicentre observational study utilized the Metro South HHS fully electronic health record. The mirror server, which utilizes Cerner software (Cerner Corporation, North Kansas City, MO, USA), was accessed to generate de-identified, aggregated surgical procedural data. Full ethics approval was obtained from the Metro South Health Human Research Ethics Committee (HREC Reference number: HREC/2020/QMS/64104) and included a waiver of consent. All data accessed was in a non-re-identifiable form. The research team did not access any individual electronic records and data were extracted and provided by the Data Custodian for the HHS.

The study population comprised of all patients who required an operation in the main operating rooms or day surgical procedural units from 1 March to 24 April in 2020 (referred to as the '2020 time frame' in this paper) and all patients undergoing surgeries during the same period in 2019 (1 March to 24 April, referred to as 'the 2019 time frame' in this paper). To maintain patient privacy, only the date of surgery, whether elective or emergency surgery, the American Society of Anesthesiologists physical status classification system (which is a subjective score for assessing the comorbidities and 'fitness' of patients prior to surgery), age, type of operation, surgical specialty and specific hospital which provided the service were accessed. The definition of emergency surgery was a case booked via the 'emergency board' and not booked or arranged to take place in a designated theatre in the days leading up to the date of surgery.

In all, five public health facilities in South East Queensland were included in the study. These facilities include a mixture of secondary and tertiary referral hospitals and include the major trauma referral centre for the HHS.

Descriptive statistics were presented to describe the characteristics of the study population. For continuous variables, measures of central tendencies (mean and median) and distribution (standard deviation and interquartile range (IQR)) were presented. For all normally distributed variables, means and standard deviations were reported. Variables not normally distributed were presented using medians and IQR. Normality was assessed using the Shapiro–Wilk's test. Frequencies and proportions were presented for categorical variables. Due to the overlapping nature of the case mix between the various subspecialty classifications at different hospitals, certain surgical specialties were grouped into larger related groupings, and are outlined here for clarity. Upper gastro-intestinal, hepato-pancreato-biliary, breast and endocrine, colorectal, renal transplant and acute surgical unit were merged together to create 'general surgery', while maxillo-facial, dental and ear, nose and throat (ENT) were merged into 'maxillo-facial/dental/ENT'. Obstetrics and gynaecology were merged into 'obstetrics/gynaecology' and orthopaedics and trauma surgeries were merged as 'orthopaedic/trauma unit'. Respiratory, persistent pain services, psychiatry, cardiology, gastroenterology and liver transplant were classified as 'other' and were not included in the analyses due to low case numbers.

Missing data were included in the reported descriptive statistics; however, they were excluded listwise from quantitative analysis. A Pearson's chi-squared test was used to assess the difference in the proportion of elective versus emergency procedures performed between the 2019 and 2020 time periods; to access the difference in proportion of elective cases across various surgical subspecialties between the 2019 and 2020 time frames; and to examine the statistically significant difference in proportion of emergency cases across various surgical subspecialties from the 2019 and 2020 time periods. The null hypothesis was rejected at two-tailed α of less than 0.05. All analyses were conducted using R (version 3.5.2).[13]

Results

Demographic results

Demographic proportions between the two time periods were largely unchanged including patient age, the American Society of Anesthesiologists score and hospital location. Table 1 presents the descriptive data for the entire study population split by time frame. Median and IQR were used for non-normally distributed variables. For categorical variables, frequencies and relative frequencies were presented.

Overall changes between 2019 and 2020

Of the total number of surgeries conducted in 2019 with non-missing values (n = 6784), 4422 (65.18%) were elective, whereas 2362 (34.82%) were emergency surgeries. This proportion in the 2020 time period changed to 2991 elective (58.96%) and 2082 emergency (41.04%) surgeries. The change in the proportion of elective versus emergency surgery cases between the 2019 and 2020 time frames was statistically significant ($\chi^2_{(1)} = 47.71$, $P < 0.001$). During the period of 1 March to 24 April 2020, there were 2991 elective cases as compared to 4422 cases in the same period in 2019. This equated to a 32.4% decrease in the number of elective cases. There were 2082 emergency cases in 2020 compared to 2362 in 2019, a 12% decrease (Table 2).

Elective cases by surgical specialty

Of the total number of analysed elective cases conducted in 2019 (n = 4130), the majority were general surgery (n = 880; 21.31%)

Table 1 Summary statistics of data

	March–April 2019 (n = 6784)	March–April 2020 (n = 5074)	Total (n = 11 858)
Age			
Mean (SD)	52.17 (20.36)	51.07 (19.85)	51.70 (20.15)
Median (Q1, Q3)	53.00 (35.00, 69.00)	52.00 (35.00, 67.00)	53.00 (35.00, 68.00)
Missing	0.00	0.00	0.00
Hospital location			
BEAH	49.00 (0.7%)	35.00 (0.7%)	84.00 (0.7%)
LGH	1617.00 (23.8%)	1176.00 (23.2%)	2793.00 (23.6%)
PAH	3413.00 (50.3%)	2465.00 (48.6%)	5878.00 (49.6%)
QEH	1082.00 (15.9%)	906.00 (17.9%)	1988.00 (16.8%)
RLH	623.00 (9.2%)	492.00 (9.7%)	1115.00 (9.4%)
Missing	0.00	0.00	0.00
ASA score			
1	1090.00 (16.1%)	737.00 (14.5%)	1827.00 (15.4%)
2	3035.00 (44.8%)	2283.00 (45.0%)	5318.00 (44.9%)
3	2056.00 (30.3%)	1617.00 (31.9%)	3673.00 (31.0%)
4	385.00 (5.7%)	317.00 (6.3%)	702.00 (5.9%)
5	12.00 (0.2%)	10.00 (0.2%)	22.00 (0.2%)
6	3.00 (0.0%)	0.00 (0.0%)	3.00 (0.0%)
Local anaesthetic only	199.00 (2.9%)	107.00 (2.1%)	306.00 (2.6%)
Missing	4.00	3.00	7.00
Type of procedure			
Elective	4422.00 (65.2%)	2991.00 (59.0%)	7413.00 (62.5%)
Emergency	2362.00 (34.8%)	2082.00 (41.0%)	4444.00 (37.5%)
Missing	0.00	1.00	1.00
Surgical subspecialty			
General surgery	1574.00 (23.2%)	1240.00 (24.4%)	2814.00 (23.7%)
Cardiac surgical unit	152.00 (2.2%)	125.00 (2.5%)	277.00 (2.3%)
Maxillo-facial/dental/ENT	490.00 (7.2%)	231.00 (4.6%)	721.00 (6.1%)
Obstetrics/gynaecology	896.00 (13.2%)	772.00 (15.2%)	1668.00 (14.1%)
Neurosurgery	154.00 (2.3%)	123.00 (2.4%)	277.00 (2.3%)
Ophthalmology	416.00 (6.1%)	185.00 (3.6%)	601.00 (5.1%)
Orthopaedic/trauma	1401.00 (20.7%)	1074.00 (21.2%)	2475.00 (20.9%)
Plastics	492.00 (7.3%)	320.00 (6.3%)	812.00 (6.8%)
Urology	690.00 (10.2%)	579.00 (11.4%)	1269.00 (10.7%)
Vascular	150.00 (2.2%)	124.00 (2.4%)	274.00 (2.3%)
Other	368.00 (5.4%)	301.00 (5.9%)	669.00 (5.6%)
Missing	1.00	0.00	1.00

ASA, American Society of Anesthesiologists; BEAH, Beaudesert Hospital; ENT, ear, nose and throat; LGH, Logan Hospital; PAH, Princess Alexandra Hospital; QEH, Queen Elizabeth II Hospital; RLH, Redland Hospital; SD, standard deviation.

Table 2 Descriptive statistics for elective versus emergency surgery cases by year

	Total (%)	March–April 2019, n (%)	March–April 2020, n (%)	Absolute case reduction year on year	Statistics
Elective	7413 (62.52)	4422 (65.18)	2991 (58.96)	1431	$\chi^2 = 47.71$
Emergency	4444 (37.48)	2362 (34.82)	2082 (41.04)	280	$P < 0.001$

followed by orthopaedics/trauma (n = 650; 15.74%), urology (n = 582; 14.09%) and obstetrics/gynaecology cases (n = 546; 13.22%). While the absolute numbers of elective cases decreased across all subspecialties in 2020, the relative proportion of cases across specialties varied between the two time periods. There was a slight increase in the overall proportion of general surgery procedures in 2020 (21.31–23.41%), urology (14.09–17.55%) and obstetrics/gynaecology (13.22–16.24%) in 2020. There was a drop in the proportion of elective procedures performed in orthopaedics/trauma (15.74–13.91%), maxillo-facial/dental/ENT (9.71–7.06%) and ophthalmology (9.44–5.74%) (Table 3). The change in proportion of elective cases between the two time frames across various surgical subspecialties was statistically significant ($\chi^2_{(9)} = 75.19$, $P < 0.001$).

Emergency cases by surgical specialty

Of the total number of emergency cases with non-missing values conducted in 2019 (n = 2284), the majority (751, 32.88%) were performed by orthopaedics and general surgery (694, 30.39%). The proportion of subjects who underwent emergency procedures across various subspecialties did differ by time frame ($\chi^2_{(9)} = 20.8$, $P = 0.01$). This proportion changed between the 2019 and 2020 time frames, with a slight increase in the frequency of orthopaedic/trauma unit (32.88–34.19%), obstetrics/gynaecology (15.32–16.06%) and cardiac (1.84–2.47%). A decline was seen in the proportion of emergency procedures in general surgery (from 30.39% to 29.45%), maxillo-facial/dental/ENT (from 3.90% to 1.83%) and neurosurgery (from 3.42% to 2.92%) in the 2019 versus 2020 time frames

Table 3 Descriptive statistics for elective case by surgical subspecialty in the 55 days in 2019 and 2020

	Total (%)	March–April 2019, *n* (%)	March–April 2020, *n* (%)	Absolute case reduction year on year	Combined statistics
General surgery	1523 (22.15)	880 (21.31)	643 (23.41)	237	$\chi^2 = 75.19$
Cardiac surgical unit	185 (2.69)	110 (2.66)	75 (2.73)	35	$P < 0.001$
Maxillo-facial/dental/ENT	595 (8.65)	401 (9.71)	194 (7.06)	207	
Obstetrics/gynaecology	992 (14.42)	546 (13.22)	446 (16.24)	100	
Neurosurgery	139 (2.02)	75 (1.82)	64 (2.33)	11	
Ophthalmology	549 (7.98)	390 (9.44)	159 (5.79)	231	
Orthopaedic/trauma	1032 (15.01)	650 (15.74)	382 (13.91)	268	
Plastics	646 (9.39)	406 (9.83)	240 (8.74)	166	
Urology	1064 (15.47)	582 (14.09)	482 (17.55)	100	
Vascular	152 (2.21)	90 (2.18)	62 (2.26)	28	

ENT, ear, nose and throat.

Table 4 Descriptive statistics for emergency cases by surgical subspecialty in the 55 days in 2019 and in 2020

	Total (%)	March–April 2019, *n* (%)	March–April 2020, *n* (%)	Absolute case reduction year on year	Combined statistics
General surgery	1290 (29.94)	694 (30.39)	596 (29.45)	98	$\chi^2 = 20.85$
Cardiac surgical unit	92 (2.14)	42 (1.84)	50 (2.47)	+8	$P = 0.01$
Maxillo-facial/dental/ENT	126 (2.92)	89 (3.9)	37 (1.83)	52	
Obstetrics/gynaecology	675 (15.67)	350 (15.32)	325 (16.06)	25	
Neurosurgery	137 (3.18)	78 (3.42)	59 (2.92)	19	
Ophthalmology	52 (1.21)	26 (1.14)	26 (1.28)	0	
Orthopaedic/trauma	1443 (33.5)	751 (32.88)	692 (34.19)	59	
Plastics	166 (3.85)	86 (3.77)	80 (3.95)	6	
Urology	205 (4.76)	108 (4.73)	97 (4.79)	11	
Vascular	122 (2.83)	60 (2.63)	62 (3.06)	+2	

ENT, ear, nose and throat.

(Table 4). Further anecdotal analysis of the raw data demonstrated that there was a reduction in the number of femur fractures, hip dislocations, partial hip replacements and emergency revisions from 80 to 63 (31% decrease). Another injury that also reduced during the period of restrictions in 2020 was mandibular fractures. The number of mandibular fracture surgeries reduced from 24 in 2019 to 9 in 2020 (62.5% decrease).

Discussion

Due to the unforeseen and unprecedented nature of the COVID-19 pandemic, there was no pre-existing evidence on which to base recommendations for the resourcing of surgical services during lockdown. The current study has demonstrated that there was a significant reduction in elective cases across all surgical specialties; however, some surgical specialties continued to experience a high emergency caseload.

Elective trends

The larger decrease in the numbers of elective surgeries performed for maxillo-facial, dental and ENT can possibly be attributed to the respective societies and surgical colleges' guidance to delay elective sinonasal, tonsil and oral cavity surgeries. These mandates were issued as these procedures are believed to expose healthcare workers to aerosolization of virus and a corresponding higher risk of contracting COVID-19.[5–7] Elective ophthalmology cases decreased the most of all surgical specialties, potentially due to guidance from the Royal Australian and New Zealand College of Ophthalmologists that many elective eye cases did not fall under category 1 or 'urgent' category 2 operations,[14] thus leaving only a limited number of elective cases as appropriate throughout the lockdown period.

Orthopaedic elective cases also decreased following the release of the Australian Orthopaedics Association guidelines due to concerns with the risk of drills and saws aerosolizing tissues and the resulting risk to healthcare workers of contracting COVID-19.[8] Meanwhile, the slight decrease in elective cases noted for urology, obstetrics/gynaecology and vascular surgery may have been due to their case mix primarily making up category 1 and urgent category 2 procedures and thus being exempt from the governmental guidelines.

Emergency trends

Interestingly, despite the public health orders to stay at home and limit leisure and travel activities,[4,15] numbers of procedures did not significantly decrease in emergency orthopaedics, plastic surgery or general surgery cases. In orthopaedics, for example, it appeared that the numbers of nail bed and tendon repairs, radius, ulnar and ankle fractures were roughly the same across the two time periods. Our results for hip fracture surgery run contrary to the experience in Spanish and UK hospitals and we speculate that some of the cases of hip fracture in 2019 could be attributed to young people having

high-velocity motor vehicle injuries. One theory that could explain the reduction in mandibular fractures is that with many pubs and bars closed there were less assaults resulting in facial trauma. However, our conclusions are limited as neither of these results were statistically significant and the mode of injury for each surgery was not recorded as part of our data set. We hypothesize that the increase noted in vascular and cardiothoracic emergency caseload during the 2020 time period could be due to re-classification of elective, semi-urgent cases to emergency cases in order to continue to provide surgical services when elective theatres were cancelled. This may also have occurred with other subspecialties to a greater or lesser degree. During the 2019 time period, the opposite may have occurred with the re-classification of emergency cases to elective cases by sending relatively well patients with acute injuries home and bringing them back for 'elective' surgery in a short time frame. This may have had obvious effects on the emergency and elective caseloads between the two different time frames in the study.

Limitations

This is an observational study on a single population in an HHS in Southern Queensland. This may limit the applicability to other parts of Queensland and to other states of Australia. However, it does provide information across multiple facilities for a population of 1.16 million people.[12] There is a possibility that the population within the HHS may have increased from the time period in 2019 compared to 2020. There was a roughly 24 000 population increase in the region (or an increase in 2% of the total population) from 2018 to 2019 and this trend could have continued in 2020, generating a small increase in demand for elective and emergency surgeries during the 2020 period.[16]

It must be noted that, due to changes in the calendar between the years, we are comparing 39 weekdays in 2019 to 40 weekdays in 2020. Without the lockdown, this should have led to more elective operations being performed in the 2020 time period. The timing of Easter and its associated public holidays between the two periods may have also affected the number of procedures. While in 2020 Easter was between 10 and 13 April, in 2019 the Easter public holidays were between from 20 to 22 April. This may have meant the full effect of Easter on the stoppage of elective surgery was not fully captured in our 2019 time frame.

With a decrease in the number of elective surgery cases in the 2020 time period, there should also have been an unquantifiable decrease in the corresponding procedural complications (including 'return to theatre cases' leading to a reduction in the emergency workload of the various surgical specialties in 2020). Our study only included procedures that took place in operating rooms and did not include elective endoscopy or radiology procedures. The likely reduction in these procedures during the 2020 time frame would also have led to a reduction in procedural complications and would require less emergency surgical interventions. This effect on emergency surgery cases in our population is difficult to quantify but likely to be a small.

We did not include the major obstetric or paediatric hospital in our area as they are not within the Metro South HHS. Furthermore, the major obstetric hospital does not utilize electronic health records making the study impossible to perform in that setting. This limits the generalizability of our study to the paediatric and tertiary obstetric surgical services.

Finally, with the reduction in operating during the COVID-19 lockdown, we speculate that there may have been a shift towards palliation of high-risk patients which may have reduced the emergency caseload during the 2020 time period. However, we are not able to quantify or even confirm if this occurred due to the limitations of the data we collected.

Conclusion

The public health initiatives and guidance from the various surgical societies and the Queensland and Federal Governments in the wake of COVID-19 likely led to a reduction in elective surgery caseload. However, these same public health directives to work from home and avoid non-essential travel did not reduce emergency caseload to the same extent. This emergency caseload could prove problematic to resource allocation if a second wave of COVID-19 cases occurs in Queensland, stressing the healthcare system. Adequate resourcing of cardiac, general surgery, obstetrics/gynaecology, orthopaedics/trauma and plastic surgery will be required even in the context of uncontrollable community transmission of COVID-19 in order to save lives and prevent unnecessary morbidity. Public health initiatives to reduce emergency caseload during a COVID-19 surge could free up resources for managing COVID-19 hospitalizations, could preserve valuable personal protective equipment and reduce the risk of hospital-acquired COVID-19 infections. Further research into the patterns of injury sustained during the lockdown could help to direct these public health messages in the future.

Author Contributions

Samuel Fowler: Conceptualization; data curation; investigation; methodology; project administration; writing-original draft; writing-review and editing. **Syeda Zahir:** Data curation; formal analysis; visualization; writing-review and editing. **Warrick Manning:** Data curation. **Allison Kearney:** Formal analysis; resources; writing-review and editing. **David Sturgess:** Resources; supervision; writing-review and editing.

Conflicts of interest

None declared.

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