

One Year On: Learning Characteristics of Emergency Surgical Services During Covid-19 Pandemic for the Future planning

Quffa L¹, Morgese C², Karandikar S³, Hendrickse C³, Richardson M³, Dilworth M³, Rooney M¹ and Gao F^{1,4}

¹Department of Anaesthesia, Birmingham Heartlands Hospital, University Hospitals of Birmingham NHS Foundation Trust, Birmingham, United Kingdom

²Department of Anaesthesia, Queen Elizabeth Hospital, University Hospitals of Birmingham NHS Foundation Trust, Birmingham, United Kingdom

³Surgery Division, Birmingham Heartlands Hospital, University Hospitals of Birmingham NHS Foundation Trust, Birmingham, United Kingdom

⁴Birmingham Acute Care Research Centre, Institute of Inflammation and Ageing, University of Birmingham, Edgbaston, Birmingham, United Kingdom

*Corresponding author:

Fang Gao,
Birmingham Acute Care Research Centre, Institute of Inflammation and Ageing, University of Birmingham, Edgbaston, Birmingham, United Kingdom, E-mail: f.gaosmith@bham.ac.uk

Received: 02 May 2022

Accepted: 26 May 2022

Published: 30 May 2022

J Short Name: COS

Copyright:

©2022 Gao F. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and build upon your work non-commercially.

Citation:

Gao F. One Year On: Learning Characteristics of Emergency Surgical Services During Covid-19 Pandemic for the Future planning. Clin Surg. 2022; 7(10): 1-6

Keywords:

Emergency surgery; Pandemic; Covid-19; Service evaluation

1. Abstract

1.1. Purpose

The aim of this article is to evaluate the characteristics of emergency surgical services during Covid-19 pandemic for future planning.

1.2. Methods

Data were collected prospectively and integrated into the Electronic Patient Record. The project examined all emergency procedures performed in a University Hospital Trust, England, between 1st March 2020 and 28th February 2021 during the height of the Covid-19 pandemic (pandemic period) and compared this to data between 1st March 2019 and 29th February 2020 (pre-pandemic period). Characteristics of emergency surgical services included: case volume, types of surgical specialties, monthly changes, age group, post-operative Intensive Care Unit (ICU) admissions, ICU mortality and 30 day post-operative mortality.

1.3. Results

There was a 25.6% reduction in case volume from 9,365 pre-pandemic to 6,964 pandemic periods ($p < 0.01$). However, compared with pre-pandemic period, obstetric (1,616 vs 1,115, $p < 0.01$) and

vascular (631 vs 489, $p < 0.01$) significantly increased case volume despite reductions in all other specialties. Month by month reduction coincided with “peaks” of Covid-19 infection. Reduction was more remarkable in patients under 18 or above 80 years old than 19-79 years old ($p < 0.01$). Post-operative ICU admissions were significantly reduced during the pandemic (5.6% vs 7.3%, $p < 0.01$). Nevertheless, post-op ICU (16.9% vs 17.3%) and 30day mortality (2.2% vs 2.2%) remained unchanged during pandemic vs pre-pandemic periods respectively.

1.4. Conclusion

The pandemic reduced emergency surgical activity significantly with extensive restructuring of surgical services and a reduction in post-operative ICU admissions. It was reassuring to see that 30day mortality rates were within expected ranges during the pandemic.

2. Introduction

The Covid-19 pandemic has led to unmitigated pressure on global healthcare resources, particularly in emergency and critical care. Emergency surgical service was prioritised to continue throughout the pandemic, though under challenging conditions. Align with the global health policy, we have now entered the recovery of surgical services in the post-pandemic era in England. Emergency surgery,

regarded as “high value surgery”, will become the cornerstone of post-pandemic surgery during 2020-2025, in terms of procedure selection, use of technology, minimising complications, and maximising throughput [1]. One year on, learning characteristics of emergency surgical services during Covid-19 pandemic is essential for the future planning. There have been large studies [2,3] on yearly descriptions of emergency laparotomies and the emergency surgical volume during the pandemic in England and Wales. However, there has been an information gap on the characteristics and features of all types of emergency surgery during the entire year of Covid-19 pandemic peaks in England. University Hospitals of Birmingham (UHB), including four sites: Queen Elizabeth (QE), Birmingham Heartlands (BHH), Good Hope (GHH) and Solihull (SH) Hospitals, is one of the largest teaching hospitals in England, treating over two million population per year. BHH and GHH have traditionally delivered typical emergency services and deliver more babies than anywhere else in Europe since 1996. This study aims to evaluate the case volume, types of surgical specialties, monthly changes of one year, age groups, post-operative ICU admissions, ICU mortality and 30 day post-operative mortality of emergency surgical services at Birmingham Heartlands and Good Hope hospitals, England, in order to shine the lights on the future planning.

3. Methods

3.3. Project Design and Setting

The project did not meet the definition of research by the UK Policy Framework for Health and Social Care Research [4], was deemed a service evaluation (Registration No: 17761) and therefore did not require research ethics committee approval. This is a prospective cross-section population data-based study to evaluate emergency surgical service during pandemic period compared with the pre-pandemic period. “Pandemic period” was based on the definition of the World Health Organization for the height of the Covid-19 pandemic waves between 1st March 2020 and 28th February 2021 [5]. “Pre-pandemic period” referred to the corresponding period between 1st March 2019 and 29th February 2020. The project aimed to examine all emergency procedures performed in Acute Care hospitals: Birmingham Heartlands and Good Hope, University Hospitals Birmingham, England between the pandemic period and compared with the pre-pandemic period. The characteristics of emergency surgical services included case volume, types of surgical specialties, monthly changes, age group, post-operative ICU admissions, ICU mortality and 30 day post-operative mortality.

3.4. Data sources and Processing

The operating theatre data and ICU data were collected prospectively into the Dendrite Health Systems, integrated into the Electronic Patient Record and viewed through the hospital’s Concerto system (Orion Health). An emergency flag is raised if the patient has been admitted under an emergency pathway and then sub-

sequently had an operation. Code “urgency of procedure” consisted of elective and non-elective cases. Only non-elective, or emergency, cases were included in this service evaluation project analysis. Data within Microsoft Excel were double checked by LQ and MR against surgical specialty, codes of urgency of procedure and corresponding to the listed name of the procedure to ensure accuracy. In cases of mismatched information, LQ rechecked the source of the information and manually amended as required. The data were exported into a Microsoft Access database for combination and filtering. Graphs and tables were generated using Microsoft Excel along with further analysis.

3.5. Statistical Analysis

Categorical data were presented as frequencies and percentages and analysed using 2-tailed χ^2 tests or the Fisher exact test. Relative risks (RR) with 95% CIs were calculated using the log-binomial model for the categorical variables. All statistical tests were 2-sided and a P value less than 0.05 was considered to be statistically significant.

4. Results

4.1. Case Volume

During pre-pandemic and pandemic periods from 1st March 2019 to 28th February 2021 there were a total of 48,032 surgical procedures performed in operating theatres, and 16,329 procedures (34.0%) were emergency cases. Of the 16,329 emergency cases, 57.4% were undertaken during the pre-pandemic period compared with 42.6% in the pandemic period (9,365 vs 6,964 cases respectively, $P < 0.01$) with a 25.6% reduction in emergency surgery activity during the pandemic.

4.2. Surgical Specialties

From 1st March 2019 to 28th February 2021, the most frequently performing surgical specialties (in descending order) were: general surgery, trauma and orthopaedic surgery (T&O), obstetric surgery, vascular surgery, gynaecology, urology, thoracic surgery and ear/nose/throat surgery (ENT). Table 1 shows the case volume for each of these surgical specialties during the pandemic and pre-pandemic periods, with a percentage increase/decrease value. Almost all specialties experienced a decrease in surgical activity during the pandemic, although thoracic surgery and T&O saw the most substantial reduction (73.7% and 66.1% respectively). Obstetric surgery and vascular surgery however, saw an increase in surgical activity (44.9% and 29.0% respectively).

4.3. Monthly Changes

The data were examined on a month by month basis. As shown in Figure 1, during April 2020, procedures performed fell dramatically from a pre-pandemic average of 780 cases per month to 294 cases, before recovering by September 2020 with 724 cases. Cases fell again in January and February 2021. Figure 2 illustrates the monthly activity of the most frequently performing surgical specialties during pre-pandemic and pandemic periods. T&O ser-

vice made alterations between Queen Elizabeth and Birmingham Heartlands sites during the pandemic period whilst thoracic sur-

gery was reconfigured into Queen Elizabeth after August 2020.

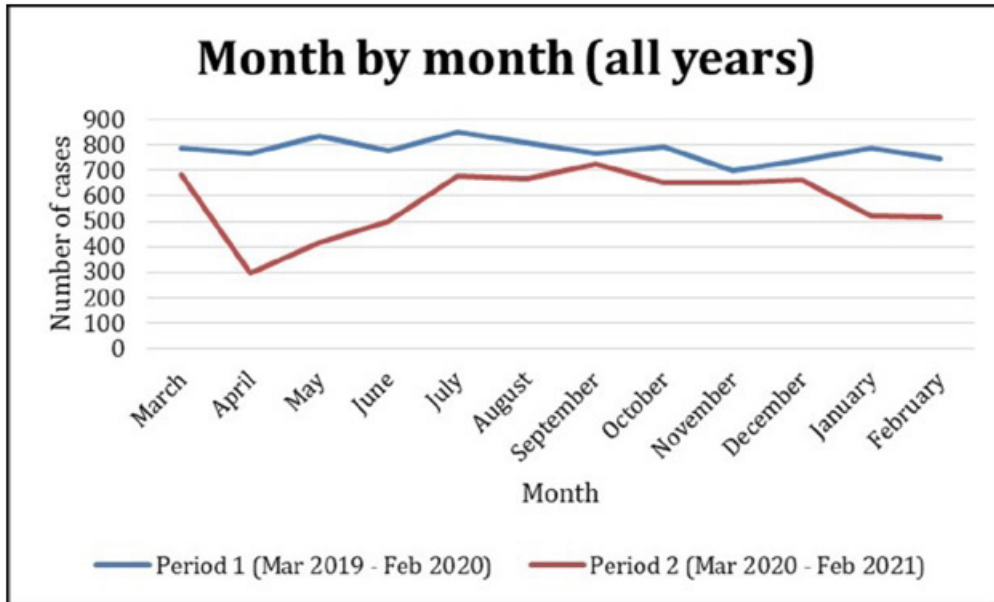


Figure 1: Month by month comparison of case volume during pandemic and pre-pandemic periods.

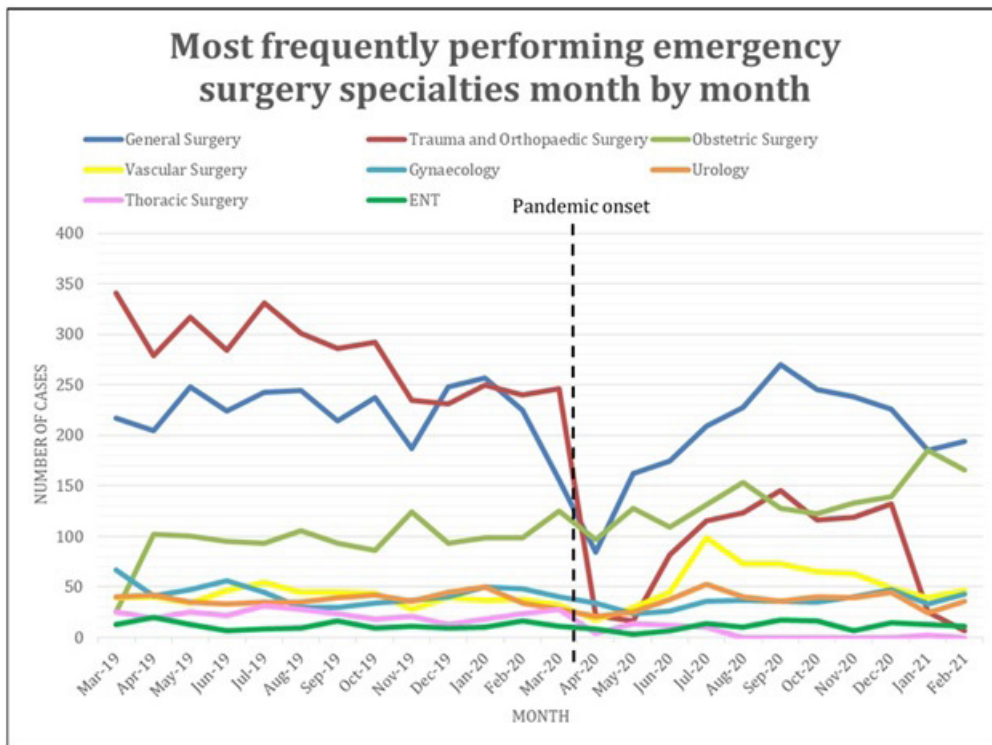


Figure 2: Month by month comparison of case volume by surgical specialty between March 2019 and February 2021.

Table 1: Case volume by surgical specialty during pandemic and pre-pandemic periods.

Specialty	Pandemic		Pre-pandemic		Percentage increase ↑ / decrease ↓
	No. of cases	Percentage of cases (%)	No. of cases	Percentage of cases (%)	
General surgery	2,372	34.1	2,749	29.4	13.7% ↓
T&O	1,148	16.5	3,387	36.2	66.1% ↓
Obstetric surgery	1,616	23.2	1,115	11.9	44.9% ↑
Vascular surgery	631	9.1	489	5.2	29.0% ↑
Gynaecology	430	6.2	525	5.6	18.1% ↓
Urology	425	6.1	466	5.0	8.8% ↓
Thoracic surgery	70	1.0	266	2.8	73.7% ↓
ENT	132	1.9	141	1.5	6.4% ↓

Table 2: Age groups during pandemic and pre-pandemic periods.

		Pandemic	Pre-pandemic	Percentage increase ↑ / decrease ↓	P value
Total number of cases	48,032				
Total number of emergency cases	16,329				
Emergency cases during each period		6,964	9,365	25.6% ↓	P<0.01
Age	<18 years old	572	978	41.5% ↓	P<0.01
	18-79 years old	6,004	7,033	14.6 ↓	P<0.01
	≥80 years old	388	1,354	71.3% ↓	P<0.01

Table 3: 30 day mortality by surgical specialty during pandemic and pre-pandemic periods.

		Pandemic N / total cases (%)	Pre-pandemic N / total cases (%)	Relative risk [Confidence interval lower and upper limits]
Number of 30 day mortality cases by specialty	ENT	9/132 (6.8%)	6/141 (4.3%)	1.60 [0.59,4.38]
	Gastroenterology	2/24 (8.3%)	4/27 (14.8%)	Insufficient data
	General surgery	60/2,372 (2.5%)	60/2,749 (2.2%)	1.16 [0.81,1.65]
	Urology	8/425 (1.9%)	3/466 (0.6%)	Insufficient data
	Vascular surgery	33/631 (5.2%)	35/489 (7.2%)	0.73 [0.46, 1.16]
	Other procedures	11/3,380 (0.3%)	0/5,493 (0.0%)	Insufficient data
	All specialities	152/6,964 (2.2%)	203/9,365 (2.2%)	1.01 [0.82,1.24]

4.4 Age Groups

In each age groups there were significant reductions during the pandemic compared with pre-pandemic period (Table 2). There was 41.5% reduction under 18 years old group (from 978 to 572, P<0.01), 14.6% reduction in patients 18 to 79 years old (from 7,033 to 6,004, P<0.01). The most reduction, 71.3%, occurred in patients 80 years old and above from 1,354 to 388 (P<0.01).

4.5. Post-operative ICU Admissions

In total, there were 1,073 patients admitted to ICU post-operatively between March 2019 and February 2021 (6.6% of emergency cases). During the pandemic there were 390 post-operative admissions to ICU (5.6%) compared to 683 admissions pre-pandemic

(7.3%). The majority of ICU admissions were from general surgery and vascular surgery specialties during the pandemic, prior to the pandemic a significant proportion came from T&O.

4.6. ICU Mortality

ICU mortality rates for post-operative ICU admissions were similar during the pandemic compared to pre-pandemic period (16.9% vs. 17.3% respectively).

Thirty day mortality In the pre-pandemic period, post-operative 30-day mortality was 2.2% (203 deaths of the 9,365 patients). During the pandemic, 152 of the 6,964 patients undergoing an emergency procedure died within 30 days after surgery, signifying a mortality rate of 2.2%. When T&O and thoracic surgery were ex-

cluded, the pandemic 30day mortality remained 2.1% (123 deaths in 5,746 patients). During the study periods, post-operative 30 day mortality was higher in patients 80 years old and above (8.2%), compared to those aged 18-79 years old (1.6%). There were 0 deaths in patients under the age of 18 years old. Table 3 describes percentage changes in 30-day mortality during the pandemic compared to pre-pandemic levels of surgical specialties. Specialties such as gastroenterology, urology and other procedures had too few deaths to calculate relative risk (RR) and confidence intervals (CIs). Although RR could be calculated for ENT, general surgery and vascular surgery, the CIs contain 1.0 which suggest that the results are not significant.

5. Discussion

5.1. Case Volume

The key finding in this service evaluation was the 25.6% reduction in number of emergency surgery cases performed in the pre-pandemic period compared to the pandemic (9,365 vs. 6,964 cases). This is comparable to findings from other studies which saw reduced emergency surgical activity during the pandemic, ranging from 13.4% to 28.0% reduction [2,3,6]. At the start of the pandemic one emergency theatre team at BHH and GHH was operating, their cases divided into 'Covid confirmed' and 'Covid not confirmed' theatres. As the pandemic progressed, BHH was able to increase up to two emergency theatre teams during normal working hours, and this has continued to this day. The overall reduction in the number of emergency cases is likely to be multifactorial. Elective surgery was cancelled to create vital capacity for medical patients admitted to hospital with Covid-19 infection, theatre teams were redeployed to critical care and therefore fewer staff were available for emergency procedures. It is possible that patients were more reluctant to present to hospital for fear of becoming infected with Covid-19. We have also seen certain surgical pathology favouring conservative management (e.g. appendicitis) during the pandemic, rather than its usual surgical management [7].

5.2. Surgical Specialties

There were restructuring of surgical services during the pandemic, in particular, T&O and thoracic surgery were moved to other hospitals. Almost all other specialties saw a reduction in the number of their emergency cases during the pandemic except for obstetric surgery and vascular surgery (44.9% and 29.0% increase respectively). The increase in vascular surgery was as a result of BHH becoming the main vascular hub for the Birmingham and surrounding areas, and a reduction in elective major vascular procedures, e.g. abdominal aortic aneurysm; this allowed vascular surgery to utilise theatre space and staff for emergency procedures, e.g. revascularisation of ischaemic limbs. With respect to obstetric surgery, although crude birth rate in England was reduced during 2020 compared to 2019 (10.3 vs 10.8), hospitals within UHB had a higher emergency caesarean section rate than the national average (20.0% vs 17.5% during 2019-2020) [8,9].

5.3. Monthly Changes

Our service evaluation has shown that the month by month reduction in number of emergency surgery cases coincided with the peaks of Covid-19 infection in the UK. The first 'wave' of Covid-19 existed between March and May 2020 and the second 'wave' peaked in January 2021; this is where emergency surgery cases were the lowest [10]. Despite the reduction in Covid-19 positive cases after January 2021, emergency surgical activity did not return to levels prior to the pandemic. It is likely that Covid-19 infected patients remained admitted in hospital, took time to recover before being discharged and creating space for more surgical admissions. This would also have occupied staff caring for these patients as opposed to returning to normal duties in theatre.

5.4. Age Group

Our project showed that during the pandemic fewer patients aged 80 years and above were undergoing emergency surgery (5.6% vs. 14.5% cases), several reasons are attributed to this, but in particular, the Royal College of Surgeons (RCS) England, directed increased 'threshold' changes for emergency operations in patients over 70 years old in England [11]. It is also known that patients 75 years old and above had the highest rate of hospital admissions and deaths due to Covid-19 infection compared to other age groups [12]. Hypothetically, this group of patients could have been suffering from Covid-19 infection rather than acute surgical pathology requiring emergency surgery. Elderly patients were also advised to self-isolate during the pandemic and may have avoided presenting to hospital.

5.5. Post-Operative ICU Admissions

Our service evaluation shows a 23.3% reduction in the number of post-operative ICU admissions during the pandemic compared to the pre-pandemic period. Unsurprisingly, this was because ICU capacity was used by medical patients with Covid-19 infection and therefore less able to accommodate post-operative surgical patients. The National Emergency Laparotomy Audit (NELA) interim report also showed a slight reduction in the percentage of high-risk patients admitted to ICU following an emergency laparotomy during the pandemic compared to the pre-pandemic period (82.0% vs. 86.4%).

5.6. ICU Mortality

The 30 day mortality rate in post-operative ICU admissions was similar during the pandemic to the pre-pandemic period (16.9% vs. 17.3%). The exact reason is unclear, whether intra-operative or post-operative management was different for these patients, whether more patients undergoing surgery were fitter during the pandemic, or more patients requiring emergency surgery died from complications before presenting to hospital.

5.7. Thirty Day Mortality

Our findings showed an overall unchanged 30 day mortality rate of 2.2% both during the pandemic and pre-pandemic periods. One

would expect that the introduction of a new and deadly virus to be more likely to result in higher 30 day mortality after surgery, but our data did not demonstrate this. This probably is for several reasons. Our data showed an overall reduction in the number of cases during the pandemic, and during the peaks of the pandemic (April 2020 and January 2021), there were very few cases of 30-day mortality compared to other months. There was a Royal College of Surgeons England directed change in patient selection for emergency operations, an increased threshold for emergency surgery [11]. The Trust moved to consultant delivered care for anaesthetics and surgery, potentially patients presenting for operations may have been sicker but managed by more senior clinicians. Specialties with moderate mortality rates, like thoracic surgery and T&O, had moved to Queen Elizabeth Hospital in the Trust. However, the 30-day mortality remained 2.1% without taking T&O and thoracic into account. Nevertheless, with small numbers of deaths in these specialties, the findings need to be interpreted with caution. The interim National Emergency Laparotomy Audit (NELA) report in 2021 [2] showed that 30 day mortality was higher in Covid-19 positive patients compared to Covid-19 negative patients (12.5% vs. 7.2%) during the pandemic. In this NELA dataset the average 30 day mortality rate is 9.9%, and comparatively similar to the mortality rate of 9.0% pre-pandemic. Although our service evaluation did not differentiate 30 day mortality between Covid-19 positive and negative patients, it did, like NELA, show that 30 day mortality rates did not differ dramatically between pre-pandemic and pandemic periods with the possible reasons discussed. Our study found there were no deaths within 30 days of an emergency obstetric procedure during pandemic period although this was the same as the pre-pandemic period. The Royal College of Obstetricians and Gynaecologists (RCOG) report 20% of the most critically ill with Covid-19 infection were unvaccinated pregnant patients [13]. It would be possible for the poor obstetric outcomes to occur later than our study period, and it would be prudent to revisit this.

6. Limitations

This was a retrospective analysis of a large amount of data, but there were several limitations associated with the collection and processing of these data. Surgical case information is collected prospectively by theatre staff using a Dendrite based database (Dendrite Clinical Systems) customised for theatre information. The data are accessed through the hospitals Electronic Patient Record system provided by the Concerto system (Orion Health). Mortality and ICU data are collected prospectively through similar Dendrite databases. Some theatre information is added on listing the patient for the operation, other information is added during or following the operation. Errors can occur on recording information and sometimes information is omitted, particularly during peak activity. The treatment speciality recorded may have reflected the original admission but was often not updated to the current surgical speciality. Urgency of operation recorded was not always

accurate. Time was spent cleaning and correcting the data. The surgical operation note was not included as part of the downloaded data but was used for manual verification. Difficulty exists in capturing data across specialties, for example, the change in threshold for operation, and those patients who might be offered emergency surgery but declined this. The information we used in our service evaluation included: number of cases, patient age, hospital site, surgical specialty, post-operative ICU admissions and 30 day mortality. It is not an extensive list. It is possible that by collecting more information about these cases, e.g. patient co-morbidities, concurrent Covid-19 infection, length of stay, this could have enhanced results and discussion. Nor does this project examine in detail the causes of such findings, we only speculate on potential factors contributing to outcomes. In conclusion, our project has evaluated the characteristics of emergency surgical services during Covid-19 pandemic within the Acute Care service Trust in England. The pandemic reduced emergency surgical activity significantly with extensive restructuring of surgical services and a reduction in post-operative ICU admissions. It was reassuring to see that overall 30 day mortality rates were within expected ranges during the pandemic. We hope that these findings will aid planning ahead for future pandemics.

References

1. COVID Surg Collaborative. Recovery of surgical services in the post-pandemic era: Surgery 2020- 2025. Version. 1.1. 2020.
2. NELA. The impact of Covid-19 on emergency laparotomy – an interim report of the National Emergency Laparotomy Audit. 23 March 2020-30 September 2021. London: RCOA. 2021
3. Dobbs TD, Gibson JAG, Fowler AJ. Surgical activity in England and Wales during the COVID-19 pandemic: a nationwide observational cohort study. *BJA*. 2021; 127(2): 196-204.
4. Health Research Authority. HRA Decision Tools. 2022.
5. Wu F, Zhao S, Yu B. A new corona virus associated with human respiratory disease in China. *Nature*. 2020; 579(7798): 265-9.
6. Rashdan M, Al-Taher R, Al-Qaisi M. The impact of the Covid-19 pandemic on emergency surgery in a tertiary hospital in Jordan. A cross sectional study. *Annals of Medicine and Surgery*. 2021; 66.
7. Lotfallah A, Aamery A, Moussa G, Manu M. Surgical versus conservative management of acute appendicitis during the COVID-19 pandemic: a single-centre retrospective study. *Cureus*. 2021; 13(3): e14095.
8. NHS Digital. NHS maternity statistics, England. 2020-21.
9. UHB NHS Foundation Trust. 2020-21.
10. ONS. Coronavirus (COVID-19) infection survey technical article: waves and lags of COVID-19 in England, June. 2021.
11. Royal College of Surgeons. Updated Intercollegiate General Surgery Guidance on COVID-19. March. 2020.
12. ONS. Coronavirus (COVID-19) latest insights: deaths. 2021.
13. RCOG. RCOG News. 2021.