



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# The impact of COVID-19 on emergency general surgery admissions and operative volumes: A single centre experience

R.M. O'Connell <sup>a,\*</sup>, M.A. Khan <sup>a</sup>, M. Amir <sup>a</sup>, M. Bucheeri <sup>a</sup>, W. Khan <sup>a</sup>,  
I.Z. Khan <sup>a</sup>, K.M. Barry <sup>a,b</sup>

<sup>a</sup> Department of Surgery, Mayo University Hospital, Ireland

<sup>b</sup> Discipline of Surgery, National University of Ireland Galway, Ireland

## ARTICLE INFO

### Article history:

Received 3 June 2020

Received in revised form

11 August 2020

Accepted 21 September 2020

Available online 19 November 2020

### Keywords:

Covid-19

Emergency general surgery

Operative volumes

## ABSTRACT

**Introduction:** The COVID-19 pandemic has placed a significant strain on healthcare resources and utilisation globally. The appearance of the disease in the Republic of Ireland resulted in a broad postponement of scheduled and routine surgical care. The influence of the novel coronavirus, and the associated imposition of public health measures such as school closures and social distancing, on the burden of emergency surgical disease is less clear.

**Aim:** The aim of this study was to examine the impact of COVID-19 on the number of patients presenting to our institution with emergent surgical illnesses or requiring emergency general surgical procedures.

**Methods:** All patients attending our service between March 1st 2020 and April 30th 2020 were identified retrospectively by examining electronic handover and electronic discharge summaries, and data were collected relating to demographics, presenting illness, critical care utilisation, length of stay, operative or endoscopic procedure performed, and in-hospital mortality. Similar data were collected March 1st to April 30th 2019, 2018, and 2017 respectively to allow direct comparison.

**Results:** 151 patients were admitted during the study period, compared to a total of 788 during the preceding three years (mean 2.49 admissions per night versus 4.35 per night, 42.8% reduction,  $p < 0.001$ ). Median age of admitted patients was 51.8 years, compared to 50.3 years formerly ( $p = 0.35$ ). 53 emergency procedures were performed, compared to a median of 70 over the same period in the previous years (mean 0.87 per day versus 1.16 per day, 25.4% reduction,  $p = 0.05$ ).

**Conclusion:** A significant overall reduction in the number of patients being admitted to our unit and requiring emergency surgical procedures during March and April 2020 was seen, in line with patterns reported internationally.

© 2020 Royal College of Surgeons of Edinburgh (Scottish charity number SC005317) and Royal College of Surgeons in Ireland. Published by Elsevier Ltd. All rights reserved.

## Introduction

Coronavirus disease 2019 (COVID-19) is caused by the novel SARS-Cov-2 virus, first noted in Wuhan, China in December 2019.<sup>1</sup> Since its emergence, its rapid global spread led to it being characterised as a pandemic by the World Health

Organisation on March 11th 2020.<sup>2</sup> The first case of COVID-19 in the Republic of Ireland was reported on 29th February 2020.<sup>3</sup>

In response to this global health crisis, routine elective surgery has been postponed where possible, as is the case in our institution.<sup>4</sup> In addition to this strategy reducing health-care resource utilisation for non-emergency activities,

\* Corresponding author.

E-mail address: [robertmoconnell@rcsi.com](mailto:robertmoconnell@rcsi.com) (R.M. O'Connell).

<https://doi.org/10.1016/j.surge.2020.09.013>

1479-666X/© 2020 Royal College of Surgeons of Edinburgh (Scottish charity number SC005317) and Royal College of Surgeons in Ireland. Published by Elsevier Ltd. All rights reserved.

significantly increased mortality has been shown in patients undergoing surgery during a COVID-19 outbreak.<sup>5,6</sup>

SARS-Cov-2 represents a particular challenge in the operating theatre environment. The virus has been shown to be present in the peritoneal fluid of a patient with known COVID-19 undergoing laparotomy.<sup>7</sup> It has been detected in the blood and faeces of infected patients, while asymptomatic carrier transmission has also been reported.<sup>8,9</sup> Smoke produced by electrocautery devices and during laparoscopic surgery may cause aerosolization of SARS-Cov-2, increasing the risk of transmission to healthcare workers.<sup>10</sup>

While most elective surgery can be temporarily delayed during this healthcare crisis, patients presenting with acute abdominal illness may still require operative management. The Royal Colleges of Surgeons in Ireland and Great Britain recommended a risk reduction strategy for managing these patients, including use of personal protective equipment (PPE), opting for conservative management where possible, and choosing open rather than laparoscopic operations unless the laparoscopic approach may have substantial clinical benefits for the patient.<sup>11</sup>

The aim of our study was to evaluate the impact of the COVID-19 pandemic on the volume of emergency general surgery admissions and operations in our institution.

---

## Methods

### Patients included

All patients referred to the care of the general surgery teams from the emergency department in our institution between March 1st 2020 and April 30th 2020 were retrospectively identified using the electronic handover system used in our department to record activity for each 24-h on call period. Prior to the onset of COVID-19 all patients attending our hospital would be assessed by medical staff within the emergency department and those thought to have emergency surgical pathology would be referred to our on-call service for further evaluation and management. This system changed in mid-March 2020, following the introduction of separate “COVID-19” and “non-COVID-19” emergency departments, whereupon those patients with potential COVID-19 symptoms were referred to a newly constructed department for assessment by emergency medicine physicians, and those shown to be negative for COVID-19 and with emergency surgical issues would be referred to our service. Our hospital is a “Model-3”, or district general, hospital serving a large, mainly rural county with a population of 130,507 in the 2016 census, with a significant proportion of elderly people.<sup>12</sup> All patients admitted during the same time period (March 1st to April 30th) in the preceding three years (2017, 2018, and 2019) were identified using the same system to act as a control. Paediatric patients were defined as those below the age of 17 years on admission.

### Data collected

The electronic discharge summary used in our institution was examined for each patient. The electronic laboratory record

was also examined for those patients who underwent appendicectomy. Data were collected relating to demographics, admission diagnosis, length of stay (LOS), operative or endoscopic procedure performed, admission to the Intensive Care Unit (ICU), in-hospital mortality, and histologic analysis of the appendix where relevant. Admitting diagnosis, including the diagnosis of appendicitis, was determined based on clinical, radiological, laboratory, and histopathological criteria as is the norm in our hospital. We defined the negative appendicectomy rate (NAR) as per the RIFT study – the number of patients with normal appendix histology as a proportion of all patients who had appendicectomy.<sup>13</sup> Non-operative treatment of appendicitis (NOTA), was defined as the management of acute appendicitis with antibiotics alone, rather than operative management, following radiological diagnosis with either computed tomography (CT) or ultrasound of the abdomen and pelvis. Antibiotic choice and length of treatment is at the discretion of the treating surgeon in our institution, but typically intravenous co-amoxiclav 1.2 g TDS is the first line agent in our practice.

### Statistical analysis

Patients were grouped by year of admission, by diagnosis, and by procedure performed for the purpose of statistical analysis. Statistical analysis was performed using Minitab® v18.1 (Minitab LLC., Pennsylvania, USA). One-way analysis of variance (ANOVA) and Student's t-test were used to determine statistical difference. *p* values of <0.05 were considered statistically significant. All continuous variables are presented as mean unless stated.

### Ethical approval

This study received approval from the local hospital ethics committee.

---

## Results

151 patients were admitted to our unit between March 1st and April 30th 2020, compared with 788 over the same time period in 2017–19. This represents a decline in mean daily admissions by 42.8% (2.49 per day v 4.35 per day, *p* < 0.001). Paediatric admissions declined by 52.8% in March–April 2020 versus the control period (0.38 mean admissions per day v 0.78 per day, *p* < 0.001). No significant difference was noted in mean age (50.2 years v 48.0, *p* = 0.302), LOS (4.76 days v 5.22, *p* = 0.38), ICU admission rate (4.6% v 4.6%, *p* = 0.979), or in-hospital mortality (0.66% v 0.64%, *p* = 0.972). In addition, a significant reduction in the number of patients assessed by the surgical team in the emergency department and discharged home was seen (115 patients March–April 2020, mean 187 patients in preceding three years (–45.2%, *p* < 0.001)). Demographic data are summarised in [Table 1](#).

### Admitting diagnosis

24 patients attended with appendicitis during the study period, representing a significant decrease compared to the

**Table 1 – Demographic data.**

	March–April 2020	March–April 2017–19	
Total admissions (n)	151	788	
Total paediatric admissions (n)	23	143	
Admissions/day (+/-SD)	2.49 (+/- 1.5)	4.35 (+/- 2.23)	P < 0.001
Age (years +/-SD)	50.2 (+/- 24.2)	48.0 (+/- 26.7)	P = 0.302
LOS	4.76 (+/- 4.81)	5.22 (+/- 9.83)	P = 0.38
ICU admissions	7 (4.6%)	36 (4.6%)	P = 0.979
In-hospital mortality	1 (0.66%)	5 (0.64%)	P = 0.972

previous three years (35, 45, and 37 respectively,  $p = 0.002$ ), see [Table 2](#). Patients admitted with non-specific right iliac fossa (RIF) pain also declined by 54.2% in comparison with mean number of admissions from the control period (11, 17, 28, and 27,  $p = 0.002$ ). No significant change was noted in the number of patients admitted with acute diverticulitis (8, 15, 14, and 7,  $p = 0.137$ ). A reduction of 69.2% in the number of patients admitted with head injuries was seen in the study period (8, 17, 27, and 34,  $p < 0.001$ ), but no significant change was noted in the number of patients admitted with other trauma (4, 10, 9, and 6,  $p = 0.316$ ). Similarly, a significant decrease was seen in patients attending with acute biliary pathology (-38.8%,  $p < 0.001$ ), bowel obstruction (-21.3%,  $p = 0.023$ ), gastrointestinal bleeding (-21.1%,  $p = 0.026$ ), soft tissue infections (-61.6%,  $p < 0.001$ ), and all other complaints (-22.8%,  $p = 0.007$ ).

### Emergency procedures

Significantly fewer emergency procedures were performed overall in March–April 2020, compared to the same time period in the preceding years (53, 84, 59, and 70,  $p = 0.05$ ), see [Table 3](#). However, there was no significant difference seen in the overall numbers of operative procedures or endoscopic procedures performed. Rates of emergency laparotomies increased by 49% to 7 in March–April 2020 compared to the previous mean ( $p = 0.01$ ). The number of laparoscopic appendicectomies performed declined significantly compared to the control period (17, 29, 36, and 35,  $p = 0.001$ ), but the overall

number of appendicectomies and open appendicectomies performed did not change significantly.

### Management of appendicitis

As seen above, there was a significant decline in the number of patients presenting with acute appendicitis and undergoing appendicectomy in March–April 2020 than in the three previous years, see [Fig. 1](#). No change was seen in the overall NAR (4.5% ( $n = 1$ ), 3.3% ( $n = 1$ ), 0% ( $n = 0$ ), and 0% ( $n = 0$ ) respectively,  $p = 0.393$ ). In March–April 2020 2 patients (8.3%) were managed with NOTA, compared with 5 (14.3%) in March–April 2019, 4 (8.9%) in March–April 2018, and 1 (2.7%) March–April 2017 ( $p = 0.326$ ). No significant difference was seen in LOS for patients undergoing appendicectomy in March–April 2020 and the three previous years (3.91 days v 3.07 days,  $p = 0.064$ ).

### COVID-19 status of admitted patients

Only two of the 151 patients (1.3%) admitted under the care of our acute general surgery service during March–April 2020 were subsequently diagnosed with COVID-19, neither of whom required operative management, and neither of whom subsequently required critical care admission for their respiratory illness.

## Discussion

COVID-19 is a rapidly emerging disease, with a continually evolving understanding in the literature. Our data show a significant decrease of 42.8% in the number of patients requiring admission to our unit. This decline is consistent with national data from the Economic and Social Research Institute, which show a decrease in attendance at Emergency Departments in Ireland by 45.4% during the month of March 2020.<sup>14</sup> Corresponding declines in patient attendances have been reported in emergency departments in the UK and Italy during the COVID-19 outbreak.<sup>15,16</sup> Outside of the field of surgery, the COVID-19 pandemic has led to a reduction of 25–50% in the numbers of people presenting with acute myocardial infarction internationally<sup>17,18</sup>

**Table 2 – Admitting diagnosis, and percentage change in number of patients admitted with the diagnosis, March–April 2020 compared to mean March–April 2019, 2018, and 2017.**

	March–April 2020	March–April 2019	March–April 2018	March–April 2017	ANOVA	% change, 2020 v mean 2017–19
Total Admissions	151	256	292	240	$p < 0.001$	-42.8%
Appendicitis	24	35	45	37	$p = 0.002$	-38.5%
Non-specific RIF pain	11	17	28	27	$p = 0.002$	-54.2%
Acute diverticulitis	8	15	14	7	$p = 0.137$	-33.3%
Biliary Pathology	21	24	52	27	$p < 0.001$	-38.8%
Bowel Obstructions	21	35	20	25	$p = 0.023$	-21.3%
GI Bleeding	5	12	4	3	$p = 0.026$	-21.1%
Soft tissue infection	11	28	25	33	$p < 0.001$	-61.6%
Head injuries	8	17	27	34	$p < 0.001$	-69.2%
Other trauma	4	10	9	6	$p = 0.316$	-52%
Acute Urology	12	32	25	13	$p < 0.001$	-48.6%
Other	26	31	43	27	$p = 0.007$	-22.8%

**Table 3 – Emergency procedures performed by type, and percentage change in number of patients undergoing the procedure, March–April 2020 compared to mean March–April 2019, 2018, and 2017.**

	March–April 2020	March–April 2019	March–April 2018	March–April 2017	ANOVA	% change, 2020 v mean 2017-19
Total emergency procedures	53	84	59	70	p = 0.05	–25.4%
Total operative procedures	40	63	51	57	p = 0.166	–29.8%
Emergency Laparotomy	7	12	1	4	p = 0.01	+40%
Laparoscopic appendicectomy	17	29	36	35	p = 0.001	–49%
Open appendicectomy	5	1	3	1	p = 0.113	+200%
Incision and Drainage	5	6	6	9	p = 0.675	–28.5%
Other	6	15	5	17	p < 0.001	–51.4%
Total emergency endoscopy	13	21	8	13	p = 0.086	–7.1%
OGD	7	11	4	8	p = 0.32	–8.7%
Colonoscopy	6	10	4	5	p = 0.338	–5.3%

We performed significantly less emergency surgical intervention in March and April 2020 than in previous years. International data on emergency surgical volumes during the COVID-19 pandemic are limited, but similar dramatic declines in the number of patients requiring emergency operations have been seen in Italy and the United States.<sup>19,20</sup>

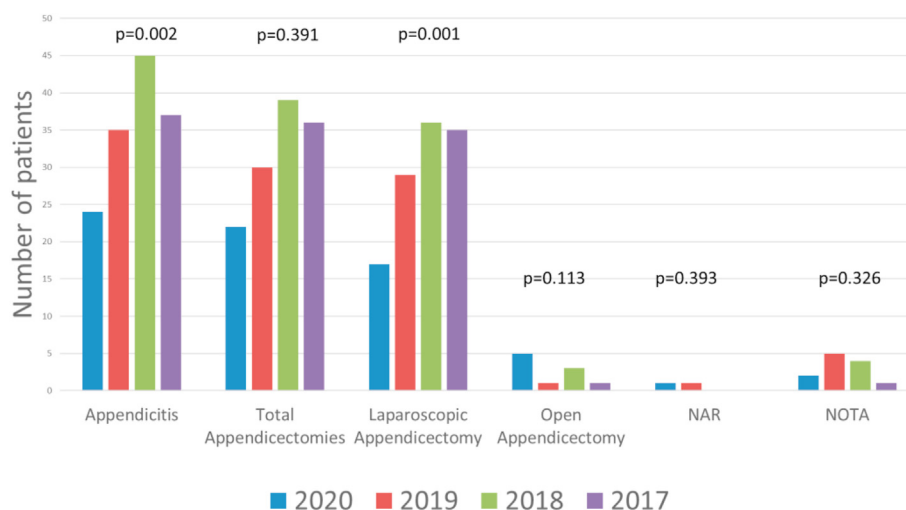
The reasons for the decline in patients presenting with non-COVID illnesses to our institution and internationally are unclear, and likely multifactorial. One proposed hypothesis is that patients are reluctant to attend hospitals for care of non-COVID illnesses because of fear of acquiring COVID-19.<sup>21</sup> This could account for our finding that while there was a reduction in overall admissions during this period, an increased number of emergency laparotomies were performed. While this explanation may be reasonable, our remaining data do not support that we are seeing “fewer, sicker patients”, because our data do not show any significant change in LOS, the proportion of patients admitted to ICU, or the in-hospital mortality compared to March and April in the preceding years.

The COVID-19 crisis has led to an increased use of telemedicine and remote consultation by our institution and internationally.<sup>22</sup> This could allow for reduced attendances and admissions by treating some conditions with either a “watch and wait” strategy, such as those with non-specific RIF

pain, or with oral antibiotics in the community for patients with illnesses that might potentially be suitable for that approach, such as cellulitis, or even appendicitis.<sup>23,24</sup>

Alterations in the public behaviour in response to the COVID-19 outbreak and the resulting public health restrictions may also have influenced the reductions in the numbers of admissions seen in our unit. Falls from a height of less than two metres and road traffic accident are the two biggest sources of major trauma seen in Ireland.<sup>25</sup> Our unit saw a significant decline of 69.2% in the number of patients requiring admission with head injury during the initial phase of the COVID-19 pandemic, and a non-significant decline in other trauma. This may be reflective of reduced volumes of traffic on the roads, reduced construction activity, and reduced injuries related to socialising in bars and night clubs, and similar declines in trauma presentations have been seen in other Irish units.<sup>26</sup>

International data support the hypothesis do suggest that a proportion of patients have been reluctant to access health-care for non-COVID-19 illnesses during the initial phase of the outbreak.<sup>27</sup> This becomes even more important an issue as a so-called “second wave” of COVID-19 becomes more likely once restrictive COVID-19 public health mitigation strategies are eased.<sup>28</sup> Our results show that emergency surgical care



**Fig. 1 – Management of appendicitis by year. NAR = Normal appendicectomy rate. NOTA = Non-operative treatment of appendicitis.**

can be safely provided in the midst of a SARS-CoV-2 viral outbreak, and our patients should be assured of safely accessing care in the event of a second wave of COVID-19 cases. Using our experiences of March–April 2020 as a guidance, our unit has adopted several strategies of risk reduction, while re-commencing routine and non-emergent surgical care, including use of telemedicine outpatient clinics, routine swabbing for COVID-19 in all patients admitted to hospital and all attending for planned surgery or endoscopy, and use of full PPE as per our hospital guidance.

Analysis of the subgroup of patients attending our institution with appendicitis during March and April 2020 shows a significant overall decline in their numbers compared to the same time period in the preceding years. The decision to offer conservative or surgical management of appendicitis in our institution is made during a discussion with the patient, and this is usually informed by the use of either CT or ultrasound diagnostic imaging. Most of our patients elected to be managed operatively for their condition despite the concern about potential SARS-Cov-2 viral transmission, and despite data showing that NOTA may be safe and effective, albeit with a significant short and intermediate risk of recurrence.<sup>29</sup> This is consistent with previous data from our department, which showed a strong preference among patients attending our service for appendectomy rather than conservative management of appendicitis.<sup>30</sup> This reluctance to utilise NOTA in our institution contrasts sharply with a national survey of Irish surgeons, which suggested that most would advise a non-operative approach to acute appendicitis during the COVID-19 crisis.<sup>31</sup> The preferred surgical approach to appendectomy in our department during the COVID-19 pandemic is laparoscopically, wearing full PPE, because of the large volume of evidence demonstrating its superiority in patient outcomes compared to open appendectomy.<sup>32</sup>

## Conclusion

A significant overall reduction in the number of patients being admitted to our unit and requiring emergency surgical procedures during March and April 2020 was seen, in line with patterns reported internationally. The reasons for this are likely multifactorial, but ultimately raise concern about the future potential for excess morbidity and mortality that may be associated with delayed presentation of patients with non-COVID illnesses.

## Sources of financial support

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Statement of authorship

All named authors made substantial contributions to this work, sufficient to meet the guidelines of the International Committee of Medical Journal Editors (ICMJE) of appropriate authorship.

## Declaration of competing interest

None to declare.

## REFERENCES

- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020;**382**(8):727–33.
- Coronavirus disease 2019 (COVID-19) situation report – 51. World Health Organisation; 2020.
- Statement from the national public health emergency team - saturday 29th february. Department of Health; 2020 [press release].
- Yeo D, Yeo C, Kaushal S, Tan G. COVID-19 & the general surgical department - measures to reduce spread of SARS-CoV-2 among surgeons. *Ann Surg* 2020;**272**(1):e3–4.
- Lei S, Jiang F, Su W, Chen C, Chen J, Mei W, et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. *EClinicalMedicine* 2020:100331.
- Collaborative C. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. *Lancet* 2020;**396**(10243):27–38.
- Coccolini F, Tartaglia D, Puglisi A, Giordano C, Pistello M, Lodato M, et al. SARS-CoV-2 is present in peritoneal fluid in COVID-19 patients. *Ann Surg* 2020;**272**(3):e240–2.
- Wang W, Xu Y, Gao R, Lu R, Han K, Wu G, et al. Detection of SARS-CoV-2 in different types of clinical specimens. *J Am Med Assoc* 2020;**323**(18):1843–4.
- Bai Y, Yao L, Wei T, Tian F, Jin DY, Chen L, et al. Presumed asymptomatic carrier transmission of COVID-19. *J Am Med Assoc* 2020;**323**(14):1406–7.
- Zheng MH, Boni L, Fingerhut A. Minimally invasive surgery and the novel coronavirus outbreak: lessons learned in China and Italy. *Ann Surg* 2020;**272**(1):e5–6.
- Updated general surgery guidance on COVID-19. Royal College of Surgeons in Ireland; 2020.
- Office CS. Census 2016 Sapmap area. County Mayo; 2016.
- Bhangu A, Collaborative RSGobotWMMR. Evaluation of appendicitis risk prediction models in adults with suspected appendicitis. *Br J Surg* 2020;**107**(1):73–86.
- B A, W B, K C, L S. COVID-19 and emergency department attendances in Irish public hospitals. Economic and Social Research Institute; 2020.
- A&E Attendances and emergency admissions April 2020 statistical commentary. NHS England; 2020.
- Lazzerini M, Barbi E, Apicella A, Marchetti F, Cardinale F, Trobia G. Delayed access or provision of care in Italy resulting from fear of COVID-19. *Lancet Child Adolesc Health* 2020;**4**(5):e10–1.
- De Filippo O, D'Ascenzo F, Angelini F, Bocchino PP, Conrotto F, Sgalletto A, et al. Reduced rate of hospital admissions for ACS during Covid-19 outbreak in Northern Italy. *N Engl J Med* 2020;**383**(1):88–9.
- Solomon MD, McNulty EJ, Rana JS, Leong TK, Lee C, Sung SH, et al. The Covid-19 pandemic and the incidence of acute myocardial infarction. *N Engl J Med* 2020;**383**(7):691–3.
- Patrity A, Eugeni E, Guerra F. What happened to surgical emergencies in the era of COVID-19 outbreak? Considerations of surgeons working in an Italian COVID-19 red zone. *Updates Surg* 2020;**72**(2):309–10.
- Hemingway JF, Singh N, Starnes BW. Emerging practice patterns in vascular surgery during the COVID-19 pandemic. *J Vasc Surg* 2020;**72**(2):396–402.

21. Long L, Corsar K. The COVID-19 effect: number of patients presenting to the Mid Yorkshire Hospitals OMFS team with dental infections before and during the COVID-19 outbreak. *Br J Oral Maxillofac Surg* 2020;58(6):713–4.
22. Smith WR, Atala AJ, Terlecki RP, Kelly EE, Matthews CA. Implementation guide for rapid integration of an outpatient telemedicine program during the COVID-19 pandemic. *J Am Coll Surg* 2020;231(2):216–222.e2.
23. Sullivan T, de Barra E. Diagnosis and management of cellulitis. *Clin Med* 2018;18(2):160–3.
24. Haijanen J, Sippola S, Grönroos J, Rautio T, Nordström P, Rantanen T, et al. Optimising the antibiotic treatment of uncomplicated acute appendicitis: a protocol for a multicentre randomised clinical trial (APPAC II trial). *BMC Surg* 2018;18(1):117.
25. *Major trauma audit national report 2018*. National Office of Clinical Audit; 2020.
26. Fahy S, Moore J, Kelly M, Flannery O, Kenny P. Analysing the variation in volume and nature of trauma presentations during COVID-19 lockdown in Ireland. *Bone Joint Open* 2020;1(6):261–6.
27. Mauro V, Lorenzo M, Paolo C, Sergio H. Treat all COVID 19-positive patients, but do not forget those negative with chronic diseases. *Intern Emerg Med* 2020;15(5):787–90.
28. Xu S, Li Y. Beware of the second wave of COVID-19. *Lancet* 2020;395(10233):1321–2.
29. Salminen P, Tuominen R, Paaajanen H, Rautio T, Nordström P, Aarnio M, et al. Five-year follow-up of antibiotic therapy for uncomplicated acute appendicitis in the APPAC randomized clinical trial. *J Am Med Assoc* 2018;320(12):1259–65.
30. O'Connell EP, White A, Cromwell P, Carroll E, Khan W, Waldron R, et al. Non-operative treatment of appendicitis: public perception and decision-making. *Ir J Med Sci* 2018;187(4):1029–38.
31. Kelly ME, Murphy E, Bolger JC, Cahill RA. Covid-19 and the treatment of acute appendicitis in Ireland- A new era or short-term pivot? *Colorectal Dis* 2020;22(6):648–9.
32. Jaschinski T, Mosch C, Eikermann M, Neugebauer EAM. Laparoscopic versus open appendectomy in patients with suspected appendicitis: a systematic review of meta-analyses of randomised controlled trials. *BMC Gastroenterol* 2015;15(1):48.