LETTERKENNY UNIVERSITY
HOSPITAL

Emergency General Surgery Report

Improving Outcomes and Saving Lives

Emergency Surgery Outcomes Advancement Project in collaboration with
Altnagelvin Hospital & Raigmore Hospital

This project is supported by the European Union's INTERREG VA Programme, managed by the Special EU Programmes Body (SEUPB).

Donegal Clinical and Research Academy

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Northern Ireland - Ireland - Scotland

eSOAP

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Acknowledgements

The eSOAP project team wish to highlight the significance of this report that reflects work undertaken during the period 2018-2022. The provision of high quality and safe emergency general surgery care is a complex matter. However, the redesign of surgical services is greatly enhanced by access to thorough and pragmatic data such as that available within the eSOAP registry. For Letterkenny University Hospital (LUH), and our collaborating partners in both Northern Ireland and Scotland, this provides a platform whereby we can make a real difference in respect of emergency surgery research, emergency surgery outcomes, adherence to clinical guidelines, and reducing the cost of care delivery.

To actualise this research report would not have been possible without the support and collaboration of our friends and partners across the Centre for Personalised Medicine (CPM). Predominantly this has included emergency surgery clinical expertise at Altnagelvin Hospital and Raigmore Hospital; the Intelligent Systems Research Centre (Ulster University); the Northern Ireland Centre for Stratified Medicine; Letterkenny Institute of Technology; and a range of industry partners. Indeed the CPM brings together fourteen academic healthcare providers and partners who are committed to improving patient experiences and outcomes.

There are a number of other individuals to thank in Letterkenny Institute of Technology (LYIT) and LUH for providing Information Technology expertise that has enabled activation of the eSOAP registry. This includes Dr Michael McCann, Kevin Blake, Matthew O'Hagan, Anthony Campbell, Trevor Carlin, Shaun Reid and Michael Logue. Together they have made a critical contribution to the ongoing work of the eSOAP team. In addition, we have received unwavering support from the management team at Letterkenny University Hospital and, in particular, from Sean Murphy (General Manager), Dr Anne Drake (Director of Nursing), Denise Harkin (Finance Manager) and John Gallagher (Finance). Together with colleagues from the Emergency department, Surgical department, Medical records, Sinead McLaughlin (HIPE), Leonard Molloy (Management Information) and other hospital services in Letterkenny University Hospital, they have provided generous endorsement of our goals and objectives.

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Finally, we would like to express sincere appreciation to all patients, families and carers within emergency surgery services who have consented to support and engage with this research. Your contribution has been invaluable and we are grateful for your sustained collaboration and partnership.

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Introduction

Overview and Executive Summary

Executive Summary

In 2012 Donegal Clinical Research Academy based in Letterkenny collaborated with Western Health and Social Care Trust, University of Ulster and CTRIC in Northern Ireland to consider the bigger picture of patient's safety and a tailored approach to personalised medicine. Working with partners in Raigmore Hospital, Letterkenny Institute of Technology, HSE digital transformation and industry the Emergency Surgery Outcomes Advancement Project (eSOAP) began in late 2018 and finishes March 2022.

The multidisciplinary team, was led by Surgeons in Letterkenny University Hospital, Altnagelvin in Northern Ireland and Raigmore Hospital in Scotland worked with a nursing and admin team (appendix figure x). The funding was obtained by a competitive grant application to the European Union's INTERREG VA Programme, managed by the Special EU Programmes Body (SEUPB).

The projects aim was to create a data collection tool, with data dictionary, clinical pathways and outcome indicators to understand patterns of emergency surgery presentations and identify opportunities to improve processes of care and outcomes.

Achievements of the project;

- Creation of a unique defined data dictionary for EGS
- New EGS digital registry now migrating to MySQL EMERGE data registry
- New Emergency Surgical admission proforma
- New Clinical Pathways for appendicitis, cholecystitis and bowel obstruction
- Key outcome indicators defining optimal process and outcomes
- Data reports for over 6000 EGS presentations in 3 years 2019-2021
- Interregional research, defining new concepts in the care of EGS
- New interregional and global education programs in Emergency Surgery
- Creation of a strategy for improving outcome and saving lives in EGS

Recommendations

- Creation of national policy investing in EGS care
- Establishment of a national-international minimum data set in EGS
- Mandate the need for quarterly reporting of process and outcome data in EGS
- Collaborate National EGS Programs at a European Level
- Define minimum outcome indicators in EGS across Europe
- Identify practice variance for exceptional outcomes with cross implementation
- Establish interdisciplinary oversight committee inclusive of ED, Radiology, ICU, Nursing and Hospital administration
- Involvement of industry and health care providers in national consortium of digital health
- Defining compulsory education requirement and incorporation of EACS course as part of compulsory training
- Legislating accreditation of EGS services with College/Government oversight
- Reporting of patient related outcomes in key EGS conditions

What a patient wants and needs.

Rein De Groot

In December 2016 I was admitted to the Emergency Department at LUH with a
life threatening abdominal infection that had been going for 8 days with a fever. It was hell.

On arriving in the ED (Thursday evening) I was given all the general blood tests and was assessed by the doctor on duty. I was subsequently admitted and was given a drip due to dehydration. I was placed in an isolated room due to suspected infection. I wondered how long I would have to wait to either get better or have a diagnosis. It seemed for ever and when you are a patient you need lot of communication and a clear pathway for you care. We can do this better for other patients.

Overnight as I was genuinely concerned about that I was getting worse. I felt alone.
And even though I was sick for 8 days on Sunday I deteriorated further when the doctor came to review, he ordered an emergency scan as he was genuinely concerned regarding my condition.

A few hours later after the scan emergency surgery was initiated and my Surgeon and the team operated on me. I spent 10 days in ICU after abdominal surgery and had two infections affecting my lung and I nearly died, I was transferred to high dependency and then discharged New Year's Eve.

Post- surgery care was challenging trying to recover from a serious illness and emergency surgery saved my life. Pre surgery care could have been better and taken more seriously which might have brought forward my life saving surgery and reduced further suffering.

I would say as the patient, being listened to, is the utmost of importance when communicating their symptoms and trying to get a diagnosis. The direct care from the nurses is vital in communicating to the doctors when a patient is seriously deteriorating this should always be relayed to the doctor in charge. Early diagnosis and good communication is a key to the patient's journey. This report is amazing in allowing me to express the key to all our care – The patient and their family.

The level of information patients receive (as some patients would rather know little, however I would have liked to have detailed information) is so important and the attempts by Letterkenny Hospital to introduce patient related outcome reporting as a standard in patient care is to be admired.

This report on Emergency Surgery Outcomes is a landmark that surgical care providers should adopt, close to your hearts because some day you may be that emergency patient yourself and what you feel emotionally (as well as in pain) is the key to good outcomes.

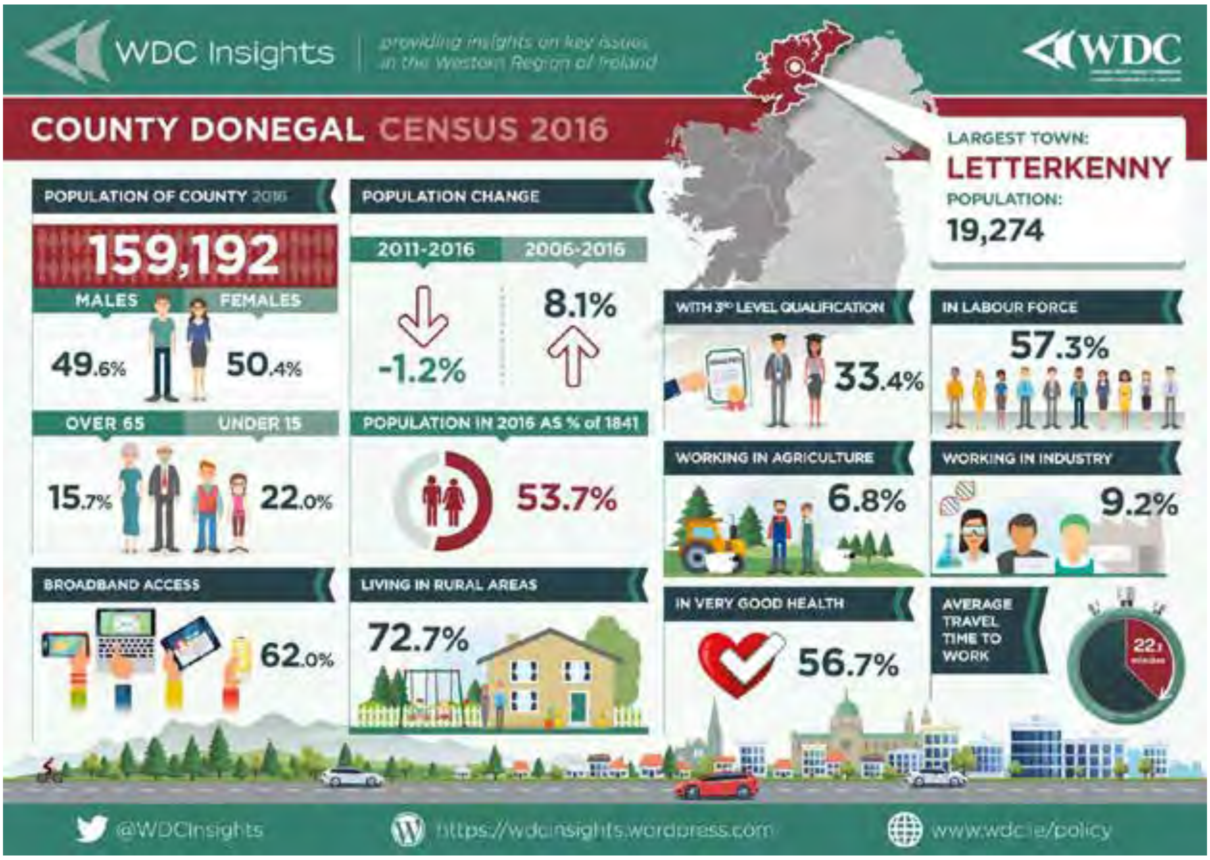
It is an honour for me as a patient to introduce this report, and I am humbled that the last report was introduced by our Noble Laurate Professor Bill Campbell. After all care is for me and other patients and the system needs to get it right

Background

Michael Sugrue

Emergency General Surgery Outcomes Advancement Project
Letterkenny University Hospital (LUH) is a 330 bed model 3 hospital with a population catchment of 159192[7].

Figure 1 Western Development Commission-Donegal [7]



In 2019 attendances at the Emergency Department were 42,723 with an increase of 1,050 (2.5%) on the previous year. Overall, LUH treated 23,411 in-patients during the past year. Furthermore, 21,278 day cases were treated and a total of 64,961 outpatients[8]. There are approximately 1,606 WTEs employed at LUH comprising more than 1,800 staff (excluding agency staff).

Altnagelvin Area Hospital is an acute hospital which offers a range of services, including a 24-hour Accident and Emergency Department and is one of Northern Ireland’s five designated cancer units. It is situated within the Western Health and Social Care Trust with a catchment area consisting of approximately 500,000 residents. It has 472 inpatient beds and 36 day case beds. The General Surgery service provides a full range of services for patients including inpatient facilities, outpatient clinics and theatre facilities. In addition, there are specialist nurses providing specialist nursing care in Stoma Care, Colorectal, Vascular, and Oncoplastic Breast services[9].

Raigmore Hospital, Inverness, is the main Hospital for the NHS Highland Health Board area and has 460 in-patient beds. It also provides certain services to the Western Isles Health Board (Outer

Hebrides) – the total population catchment area covered being 320,000 residents. The Surgical Division provides services across a wide range of specialties including: General Surgery including Upper GI, Colorectal and Vascular, Orthopaedics, ENT, Urology, Ophthalmology, Orthodontics and Oral and Maxillofacial surgery. The Division also manages Obstetrics and Gynaecology, Anaesthetics, a 7 bed Intensive Care Unit, 10 Theatres and Day Surgery Unit[10].

Letterkenny University Hospital, was a lead partner in forming the Centre for Personalised Medicine, Clinical Decision Making, and Patient Safety (CPM) and has worked with Altnagelvin Hospital (Northern Ireland), and Raigmore Hospital (Scotland), Ulster University and Letterkenny Institute of Technology to improve the treatment and care of patients requiring emergency surgery. The Centre for Personalised Medicine is an EU funded project bringing together fourteen academic healthcare providers and partners to develop practical solutions to ensure that patients get the right treatment at the right time. The Centre for Personalised Medicine was awarded €8.6m from the EU's INTERREG VA Programme to carry out this research and the project is being co-ordinated by Ulster University.

Purpose

The CPM focuses on five disease areas, which are: emergency surgery, acute kidney injury, cardiovascular disease, diabetes, and dementia. The Emergency Surgery Outcomes Advancement Project (eSOAP) commenced during late 2018 and is situated within the CPM.

The aim of eSOAP is to improve outcomes for EGS patients; to establish the feasibility of prospective data capture on all EGS admissions; and to assess the outcomes and impact of clinical pathways for patients admitted to EGS services initially in Letterkenny University Hospital, subsequently in Altnagelvin Hospital, and finally in Raigmore Hospital. The project is led by a consultant surgeon within each of these organisations [Mr Michael Sugrue (LUH); Ms Paula Loughlin and Mr Brendan Skelly (Altnagelvin Hospital); Professor Angus Watson (Raigmore Hospital)]. It is a quasi-experimental study designed to collect both retrospective and prospective cohort data to establish an overview of the pattern, presentation, and management of current emergency surgery cases that account for over 10% of hospital admissions[11]. The study also involves the development and application of a live EGS registry, established from the prospective cohort data. Primary project outcomes include in-hospital mortality, in-hospital morbidity, hospital length of stay, intensive care unit length of stay, and unplanned readmissions up to 30-days post discharge.

The registry aims to capture all patients admitted to hospital with an EGS diagnosis, i.e. patients who are admitted directly to the emergency surgery service (via ED or GP) or patients who are referred to the emergency surgical team from another inpatient team (e.g. medicine). Patients will not be included if they are trauma, urology, vascular, cellulitis, neurology or gynaecological admissions.

Our development of the EGS registry will be concentrated upon continuous data collection extending across three calendar years. This allows for systematic data capture and analysis of biomarkers and the variations in care that influence the outcomes associated with EGS. Key Performance Indicators[12] and clinical care pathways will be developed. Over the period of the project these developed pathways will be implemented, evaluating the change in pattern outcome for patients, producing significant research in the field of emergency surgery data collection, registry, key performance indicators, care pathways, and outcomes.

There is a clear requirement to generate prospective outcome and safety data that enable quality measurement within services and benchmarking across hospitals and health systems. These aspirations are impeded by the absence of a national EGS registry. eSOAP seeks to address these deficits by enabling an assessment of patient outcomes in EGS, enhancing the quality and safety of patient care, and providing an effective template for EGS registry development. It will achieve this through the provision of meticulous, valid, risk-adjusted, and concurrent clinical data[9]. The comprehensive information within the eSOAP registry will promote transparency in respect of the functioning of individual surgical teams and services and increase understanding of the complex systems involved in the delivery of EGS care. Emergency surgical registries are important instruments that can positively impact patient outcomes and promote the art and science of outcome analysis, quality improvement, and patient safety[13].

This project is interdisciplinary, combining the computational expertise at the Intelligent Systems Research Centre (Ulster University), extensive knowledge in biology at Northern Ireland Centre for Stratified Medicine, and the emergency surgery clinical expertise at Letterkenny University Hospital, Altnagelvin Hospital and Raigmore Hospital.

Context

It has been reported previously that EGS, and its associated burden, accounts for more than half of the surgical workload across the UK National Health Service (NHS)[6] and half of all surgical mortality within the United States13. This is compounded by an inefficient triage of patients presenting with abdominal pain, wide variability in diagnostic pathology testing rates between clinical teams, and wide variability in outcome rates following emergency surgery[14]. This marked variation in outcomes and the provision of care is exacerbated by the high risk nature of the specialty[15].

The challenges confronting EGS services in the Republic of Ireland, Northern Ireland, and Scotland are coherent with those highlighted previously in England[19]. Essentially these are relative to concerns around training, workforce, and operational issues. These are central to variations in the outcomes that have been identified across EGS[14] and have been amplified by both the Health Service Executive/Royal College of Surgeons in Ireland[17] and the Nuffield Trust/Royal College of Surgeons of England[15]. This situation has been further aggravated by the Covid-19 crisis during 2020/2021.

Within the context of EGS care in Ireland, in 2014 50% of all general surgical activity nationally (Table 1) occurred in Model 3 Hospitals[18]. This is an index of 17 hospitals, including Letterkenny University Hospital, that admit similar groupings of acute medical and surgical patients. Facilities at Model 3 Hospitals include an Acute Medical Assessment Unit (AMAU), a 24-h ED, and Intensive Care Unit. The analysis of consultant manpower within these hospitals indicates a system under pressure[18].

Table 1. Elective and acute inpatient and day case discharges for Model 2, 3 and 4 hospitals

Hospital model (M)	M2	M3	M4
Had surgical procedure			
Inpatients	2,545	12,149	14,274
Day cases	10,666	17,347	11,098
Sub-total **(%)**	**13,211** (19.4%)	**29,506** (43.3%)	**25,371** (37.3%)
No surgical procedure			
Inpatients	1,684	24,506	14,874
Day cases	19,228	42,777	22,885
Sub-total **(%)**	**20,922** (16.6%)	**67,283** (53.4%)	**37,759** (30%)
Grand total **(%)**	**34,133** (12.6%)	**96,789** (49.9%)	**63,130** (32.5%)

(Mealy et al. 2017)

A number of contemporary and pivotal strategic reports relating to EGS care in Ireland[16, 17], the United Kingdom[3, 15, 19], Great Britain and Ireland[20], and the United States[21] provide a contextual backdrop to the ongoing challenges and limitations across the scope of EGS. These reports have emphasised the need for improvements in the delivery of the quality and safety of EGS care whilst outlining possible mechanisms through which this transformation can be achieved. They also refer to the overriding need to enhance the patient experience of EGS care.

Letterkenny University Hospital and Donegal Clinical Research Academy were pleased to host one of the world's first summits on performance in Emergency General Surgery in June of 2016. The Donegal Summit laid a foundation stone in the development of key performance indicators in EGS[12].

Table 2. List of EGS strategic reports

Royal College of Surgeons in Ireland (RCSI). Model of Care for Acute Surgery and the National Policy and Procedure for Safe Surgery
Royal College of Surgeons in Ireland (RCSI). Surgical Services 2020 and Beyond
Royal College of Surgeons of England (RCSE). Emergency Surgery: Standards for unscheduled surgical care. Guidance for providers, commissioners and service planners
Emergency general surgery: challenges and opportunities. Research Report. Nuffield Trust
Royal College of Surgeons of England (RCSE). Emergency surgery policy briefing
The future of emergency surgery – a joint document. Association of Surgeons of Great Britain and Ireland (ASGBI)
Institute of Medicine. IOM report: the future of emergency care in the United States health system
Royal College of Surgeons in Ireland (RCSI). ASAU Patient Experience Report 2019
National Audit of Hospital Mortality Annual Report 2020

Ethics & Consent

There are a number of ethical considerations that required attention within the eSOAP project. Issues included: informed consent as an ongoing process for all concerned; safeguards to ensure no harm comes to the participants; and aspects relating to respect for persons incorporating the right to withdraw and assurance of confidentially and anonymity. Participant information leaflets encompassing written consent were provided to all participants to concentrate these requirements. The project is being conducted in accordance with the Declaration of Helsinki and according to local and regional ethical standards. Ethical approval for this work was obtained from the Research Ethics Committee at Letterkenny University Hospital.

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Global Burden of Emergency Surgery

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Surgical Training Director of the Brazilian College of Surgeons Former President of the World Abdominal Compartment Society

Historically, General Surgery was born out of Emergency Surgery. The first procedures described in the medical literature reflect cases of urgent need for intervention, including infectious and/or traumatic conditions. Appendicitis for example, despite decreasing in Global mortality is still responsible for high mortality rates touching the score of 70,000 deaths per year with more than 300,000 hospital admissions in the United States of America alone. There are more than 11 million documented cases worldwide. Several well-known names have died of appendicitis such as Steve Dillon a British comic book artist, Lord Dunsay an Anglo-Irish writer and dramatist, Robert Neil a Scottish rugby union player and even doctors like Dr Dallas Phemister former president of the American College of Surgeons.

Trauma is another factor that places emergency surgery within a scenario of great responsibility at a global level. This is still the biggest cause of mortality in children and the one that consumes the most years of life in the young adult population in general.
These factors alone have immense relevance, however despite emergency surgery being considered essential in health systems and practiced universally, it continues to be neglected by global health initiatives.

Prolonged hours of work in sub-optimal conditions are examples of neglect, particularly in low- and middle-income countries.

On the other hand, despite political initiatives undervaluing the global responsibility of emergency surgery over the population, isolated actions have been observed over the last few years.

Trends towards specialization in this branch of general surgery are increasingly present and increasingly qualified professionals emerge in different global units in order to offer a better quality of medical-surgical emergency care with lower mortality. The nomenclature Acute Care Surgery appears approximately in the last 20 years for this purpose. The surgeon goes from having a strictly anatomical look to having a more physiological approach at the patient, studying complex cases, critical patients, open abdomen and challenging wounds. It is not a matter of segregating general surgery, but specializing those professionals who like and want to continue treating the population that is in a life-or-death scenario due to an acute condition.

Going back to historical analysis, the global burden of emergency surgery has only increased and will continue to increase. New technologies are appearing and cases that in the past were treated by open surgery now have another alternative. Unlike general or sub-specialty surgery, however, cases of trauma continue to appear, as well as cases of appendicitis, cholecystitis and diverticulitis. Emergency surgery or Acute Care Surgery is the most promising activity with the greatest global responsibility in recent times. It keeps gaining more strength with professional qualification and takes advantage of technology to reduce global mortality.

Lesson from Trauma Care

Bill Schwab
CW Schwab MD, FACS, FRCS(HGlas)
Emeritus Professor of Surgery

Patients with severe injury and emergency surgical diseases require emergent definitive care. Decreasing time to remove infection, obstruction and restore blood flow improves outcomes, decreases morbidity and mortality. In these diverse conditions, rapid diagnosis, initiation of therapeutics, combined with operative management is efficient and cost effective for the patient, hospital and society. The development of trauma systems in the United States has been ongoing for fifty years. Reflections on some of the lessons that advanced trauma systems and their more recent applications to emergency surgical patients are presented.

Modern trauma care in the US civilian sector began in 1966 with a "white paper" by the National Academy of Sciences entitled, "Accidental Death and Disability: The Neglected Disease of Modern Society". This report described the chaotic state of injury care and recommended pivotal changes: emergency departments able to care for the injured, expansion of intensive care, trauma registries and financial support for research plus other recommendations. The American College of Surgeons and the allied American Association for the Surgery of Trauma became the "lead agencies" for elevating care, education, research and promoting policy development. In 2006, these efforts were shown to have a profound effect on improving survival--25% reduction in mortality--and recovery when patients were treated at a trauma center vs a non-trauma hospital.2 In 2007, the Institute of Medicine* recognized the development of trauma systems as a best advancement for the public's health in the later 20th century. Noteworthy were the comprehensive systems approach, effective use of performance improvement, lower mortality and cost, and development of a surgical specialty competent in trauma and critical care.3
*Renamed the National Academy of Medicine.

LEADERSHIP and interdisciplinary performance improvement are two essential factors for system development. Continuous leadership has come from a broad base of surgeons working collaboratively with other key stakeholders: anesthesia, emergency medicine, nursing, radiology, rehabilitation medicine.4 In the late 1990s, Emergency Surgery (ES) was added to the domain of the trauma surgeon as more surgical trainees selected specialty areas and general surgeons were less available at hospitals. ES services or when combined with trauma surgery, Acute Care Surgery services, have rapidly populated all types of hospitals as the advantages of a "trauma" type of response improves patient outcomes and many logistical advantages.5,6 More recent studies have demonstrated that the ES patients are fundamentally different than elective general surgical patients and the burden of ES disease is increasing rapidly in the US.7,8

The second essential for success is a performance improvement program (PIP) that is interdisciplinary and effective. The PIP requires robust accurate patient data, objective analysis and hospital- and system-wide applications combined with actions that support the necessary changes and improvements to optimize care. This ongoing improvement engine is a key to a learning health system and foundational to a highly reliable organization.9 A recent surgical perspective the state of EGS is provided.'0

Lessons learned for effecting change.

LEADERSHIP: Major Professional Organization (MPO) (with partner organizations) accepts the responsibility for leadership, defines and supports a group of national and regional leaders/ experts to develop a strategic agenda with an aim, goals and objectives. Leaders serve as champions for the movement. They work as a unified body to develop the following:

1. **GUIDING DOCUMENT:**

   MPO organizes stakeholder experts to create an optimal resource document (ORD--optimal care of the emergency surgical patient). ORD focuses on standards and guidelines for system, hospital/center, and provider (doctors/nurses, etc.). ORD defines elements and process of an interdisciplinary performance improvement program.4

a. Data and peer-reviewed publications. Used to support recommendations based on improvements in care, decreases in morbidity and mortality, patient satisfaction, cost and operational efficiencies.

b. Periodic publication & DISSEMINATION. ORD updated and published every 3-4 years based on new evidence and studies. ORD is distributed and disseminated widely.

2. **REGISTRY and Performance Improvement:**

   MPO organizes experts to create an applicable registry, with defined glossary of terms and data elements, and requires periodic reporting by hospitals to a national registry maintained by the MPO. Data supports the elements of the national PIP and is made available to approved stakeholders for reporting to the MPO, government and payers.

3. **VERIFICATION PROGRAM:**

   MPO organizes a verification program based on standards in the ORD.

a. Standard 1 and 2 are requirements of hospital for commitment and capacity.

b. MPO conducts hospital verification program leaked to national or providential/state health authority.

c. Verification visits are periodic, conducted by interdisciplinary peer experts and reports reviewed by impartial body of MPO or health department. Verification status of hospitals are public.

4. **WORKFORCE, EDUCATION AND TRAINING:**

   MPO partners with professional organizations and creates a sustainable workforce of interdisciplinary experts/champions/stakeholders/providers.

a. MPO create requirements of competency training.

b. MPO creates certification courses with core, basic and advanced skills sets for providers (ATLS, ATOM, ASSET).

c. MPO works with medical schools and surgical training programs to introduce curricula change.

d. MPO provides educational sessions at national meetings and oversees courses for providers.

5. **RESEARCH:**

   MPO supports ongoing development of a research agenda and publication of data, evidence-based peer review pubs.

6. ADVOCACY:

MPO creates advocacy links to medical, nursing, government officials and payer organizations to promote continuous advancements and policy development.

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Acute Surgical Unit

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PManaging emergency surgical patients within a demanding health care system is a global challenge. To address this issue, there has been considerable resource and system improvement projects within a given health care structure to meet the demand. The Emergency Surgery Outcomes Advancement Project known as eSOAP led by Professor Michael Sugrue in Ireland sets an example of leading the overall understanding of the evolving specialty and aims to improve patient outcomes. Setting up a data registry is a key component to the success of the model of care in Emergency General Surgery. The data elements would seemingly provide a robust standard of Key Performance Indicators (KPIs) leading to not only good patient care but also to provide an accurate outcome measurement and benchmarking qualities for patient care.

According to the eSOAP project, KPIs of common emergency general surgical conditions offer benchmark assessment of performance. The development of emergency surgical Performa, computerized EGS registry and the establishment of a robust coded data dictionary further revolutionised the understanding and care of this cohort of patients. Having robust data and understanding of the patient profile will allow the health service to plan its resources and staffing. In the eSOAP project, the team identified a busy level of activities involved in the hospitals that participated in the study.[2]

On the opposite side of the globe in New Zealand, Auckland City Hospital (ACH) recognises the importance of emergency surgery set-up and formation of an acute surgical system to suit the need of our population. Auckland City Hospital is a tertiary hospital with multiple highly sub-specialised general surgical units. Having a separate stream of acute care surgical service from planned care surgery, it has revolutionised the way acute patients are managed and places this group of patients at the forefront of dedicated surgical care. The patients with acute conditions are no longer having to wait until the sub-specialist finishes their elective work to attend to them. An Acute Surgical Unit (ASU) was set up at ACH in 2009 as a dedicated service to manage emergency general surgical patients. Having the ASU as a consultant led service with a dedicated acute operating room and abiding by the principles of optimal management with streamlined pathways, have all changed the way acute surgical patients are managed to promote optimal outcomes.[1]

As indicated in the eSOAP project, having a proper registry and minimal data set is a powerful tool to manage the resource and system in addition to patient audit and outcome reviews. [2] At Auckland City Hospital in New Zealand, our recent data show there was an increase of up 15% of patient admission volume per annum over the last five years. Additionally, over seventy percent of the overall general surgical discharges are from the ASU while the remainder is from planned care surgery. Whilst two third of our acute patient admissions are managed non-operatively, our theatre demand has increased. Our ASU dedicated operating theatres access increased from standard working hours to after-hour, including evening work, to address the demand as evidence has shown timely access to acute operating theatre contributes to positive patient outcomes.

The Acute Surgical Unit at Auckland City Hospital is led by general surgeons who have a board surgical practice and are supported by multiple sub-specialty Clinicians. From a service and educational perspective, the Unit includes training and non-training Registrars with their positions approved by the Royal Australasian College of Surgeons and the regional vocational surgical training committee. Emergency general surgical practice is an integral part of training. Surgical logbooks, case volume and training experience are part of assessment and form an overall comprehensive acute surgical training for practice and career progression. In addition to medical staff training, ASU is supported by nurse specialists and practitioners. It has been a unique environment to train surgical nurse practitioners in emergency general surgery.

Understanding our Acute patient cohort and their common presentations in the ASU as presented in the eSOAP project allows us to formulate guidelines and care bundles. For example, there is an increase in the number of the elderly admissions to the service from our data. Therefore, involving the geriatric physicians and initiating a dual care system will hopefully enhance elderly patient outcome. As another example, having a well-developed emergency laparotomy pathway and risk-stratification tools allow these critical patients with acute abdomen to receive best care and maximise optimal outcomes. Additionally, over the last few years, we aimed to and have achieved an improvement in the negative appendectomy rate and decreased our decision to OR time for our index cholecystectomy patients as key performance indicators.

Finally, in my view, management of acute patients in emergency general surgery is ever evolving. We are in a much better position of understanding and addressing this issue than a decade ago. Professor Sugrue and his team have led the way in the global promotion of acute patient care and 'data saves lives'. Their work on emergency general surgery is exemplary and comprehensive as the eSOAP project has shown us. The future of emergency general surgery care requires the continued dedication of system reviews, service promotion, patient, and staff education as well as focus on equity and underprivileged access. One of the key components is to allow proper data set and registry to guide the clinicians leading into the next phase of emergency general surgical patient care.

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Acute Surgical Care

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"Data is power"

Everyone knows this slogan, but in the Letterkenny University Hospital thanks to the eSOAP (Emergency Surgery Outcomes Advancement Project) program coordinated by Mr. Michael Sugrue, we have experienced it.

Acute care surgery is defined as the urgent assessment and treatment of serious, emergency conditions. Whether located in an academic or community hospital facility, acute surgical emergencies often represent the most common reason for hospital admission (roughly 10% of the surgical admissions). These conditions include, but are not limited to, acute appendicitis, cholecystitis, diverticulitis, pancreatitis, intestinal obstruction, intestinal ischemia, intra-abdominal sepsis, incarcerated hernias and perforated viscous. The most common delivery model for the care of these patients centred around a surgeon who was required to manage all surgical emergencies for a 12- to 24-hour interval, while concurrently working within the demands of a scheduled clinical practice. Although based on historical background, this system has multiple limitations, including interference with and required time away from a busy "scheduled" elective surgical practice; providing emergency surgery coverage throughout the night, with the high likelihood of still needing to engage in patient care during a busy "post-call" day. To provide acute care surgery is an ongoing challenge.

The Emergency Surgery Outcomes Advancement Project (eSOAP) was designed for data collection and analysis on all surgical emergencies, and to assess the outcomes and impact of clinical pathways for patients requiring urgent surgical admission. The main goal of this unique program was to improve the outcome in the acute surgical care.

I joined the Department of Surgery at Letterkenny University Hospital six years ago, so I was able to witness the development of the eSOAP since 2018. I am proud to have been a member of the team that supported the acute surgery program created and directed by Mr. Sugrue (in collaboration with Altnagelvin and Raigmore Hospitals) with data and clinical experience. Including but not limited to, the following results have been achieved in the past few years: new emergency surgery admission proforma, new clinical pathways for right iliac fossa pain, right upper quadrant pain and small bowel obstruction, data reports for more than 6000 emergency surgery presentations, education program (for students, NCHDs, consultants and nurses) in emergency surgery.

Based on the evidences provided by the program we feel and suggest that the realistic delivery of the safe and effective acute care surgery requires a dedicated hospital-based service (Acute Surgical Assessment Unit) that provides comprehensive care for all general surgical emergencies over a defined period of time.

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Verification of EGS Service

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Emergency general surgery (EGS) accounts for approximately one in ten hospital admissions, yet there is no standardized process for verification or quality improvement of these busy surgical programs[1]. Emergency general surgery is one of the fastest expanding surgical specialties with growth expected to continue through at least 2060. EGS patients present a unique challenge to our systems due to their varied pathophysiology and often severe illness. Mortality following an emergency surgical procedure is approximately 8 times higher than the same procedure performed electively. Establishing systems to verify capabilities, stratify programs and improve care for these patients is crucial as emergency general surgery continues to grow.

Emergency general surgery is a relatively new subspecialty of surgical care. Prior to the inception of acute care surgical services, this type of care was typically rendered by the general surgeon on call. The field began to change in 2003, when the American Association for the Surgery of Trauma (AAST) established EGS as a separate entity from both trauma surgery and surgical critical care[2]. Following this definition shift programs began to change and adapt to meet the needs of their specific population. Small rural centers still largely rely on the traditional "Surgeon-On-Call" model, yet larger referral centers have evolved several methods to ensure coverage and effective care for their EGS patients. Systems have implemented various models including dedicated EGS attending surgeons, off-service trauma surgeons, assigned trauma/surgical critical care fellows and various residents and students. Each system developed a method of care delivery appropriate to their patients, yet no standardized structure was established.

Several studies have identified the similarities between the inception of trauma system verification and the current state of emergency general surgery verification [1 3]. Emergency general surgeons can emulate the proven model of trauma verification to establish a system to verify EGS programs and improve outcomes. These trauma verification programs were created in the US during the 1970's to define standards of care and ensure appropriate resources were available to care for injured patients. Emergency general surgery finds itself in a similar position in 2022. The field continues to grow, yet there is very little oversight to ensure that centers achieve acceptable outcomes. Relatively routine surgical procedures, such as appendectomy and cholecystectomy, have similar outcomes at both large referral centers and rural critical access hospitals. Yet complex cases, such as re-operative exploratory laparotomy, carried a higher risk of mortality at smaller rural centers[3]. Regionalization of EGS systems within a verified network will ensure that higher risk procedures are performed at the appropriate center with adequate resources.

The verification process of an emergency general surgery program should establish three major characteristics of each center: resources available for care, organizational structure, and systems in place for quality improvement. These verifications should be performed by an overseeing organization familiar with the delivery of emergency surgical care and would be best performed in person to fully understand a center and its systems.

Hospital infrastructure must be verified including the availability of designated operating suites, interventional radiology resources, post-operative care units, a surgical intensive care unit and step-down floors for EGS patients. Partner services are also a crucial resource to ensure effective care of EGS patients. These include readily available providers in emergency medicine, interventional radiology, interventional gastroenterology as well as specialized nursing care and respiratory therapists.

The organizational structure of resources available in the surgical department is also critical to ensure an effective EGS service. Surgeon coverage varies from center to center and depends largely on the needs and resources available at each hospital. Coverage styles may shift the level of care available at different timepoints, such as having surgeons in house overnight. Management and reporting structures must be also formally established and verified to ensure surgeon quality and patient outcomes are monitored. Deficient surgeon performance should be identified and addressed promptly. Each verification should also include meetings with hospital administration to assess resources and institutional support to the EGS program. Finally, nurse recruitment, training, and staffing should be discussed with nursing management to ensure high-quality pre and post-operative care.

Similar to the trauma verification system, ongoing quality improvement (QI) is crucial to a high-performing EGS program. Each verification should include a thorough investigation into efforts in place to improve the quality of surgical care at each center. These QI projects can take place through formal methods such as the "Plan-Do-Study-Act" model to identify and address systemic deficiencies. Quality improvement can also be ensured through review of individual cases, including those with unexpected morbidity and mortality. The process by which these cases are identified, data is collected and presented, and how teams follow-up on opportunities for improvement should all be verified.

Establishing a strong verification process will ensure that patients receive safe and appropriate emergency general surgical care. Trauma verification programs standardized the care and established regional trauma systems that improved outcomes for injured patients. Emergency general surgery has the potential see similar improvements in outcomes through this process. Establishing a system of verification for EGS centers will ensure that each program is providing high-quality services and will guide providers to transfer patients to higher levels of care when appropriate. As demand for emergency general surgery grows, verification will ensure that patients achieve the best possible outcomes.

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ESTES and Emergency Surgery

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EMERGENCY GENERAL SURGERY QUALITY IMPROVEMENT: A EUROPEAN PERSPECTIVE

"Improving outcomes and saving lives" should be the motto of every physician and there's no doubt that most of European surgeons daily try to pursue the goal of saving as many lives as possible especially in the surgical acute setting. Unfortunately, or fortunately, we are living in an era of surgical hyper-specialization since, in order to improve quality in specific areas, many hospitals dedicated most of their economic resources to highly specialized surgical units; nowadays young, committed surgeons are therefore attracted by the so-called "organ specific surgery" and take care of emergency surgery cases just because of a contractual obligation with no specific focus on acute care. The lack of a subspecialty in Emergency General Surgery (EGS) did not give any impetus to the development of clinical standards or professional accreditation causing a perfect storm with a provided care that is less than optimal. In the United States Emergency General Surgery accounts for 11% of all hospital admissions yet represents the majority (50%) of all surgical mortality, but in Europe, due to the different systems and absence of a uniformed data collection tool, although results similar to U.S. might be expected, we do not have a baseline, nor a system to evaluate quality improvement.

In 2008 Uranues published the results of a questionnaire sent to experts across 27 European countries on the assessment of attitudes toward acute care surgery and concluded that no unified system of acute care surgery in Europe was yet developed due to different approaches to the surgical critical patient and that, with exception of some dedicated centers, the intra-hospital resources were not dedicated to acute care surgery patients with consequent negative impact on ideal treatment in acute and critical patients with surgical needs. Furthermore, the challenge of EGS is also burdened by the aging society with frailer patients with less physiologic reserves. Emergency surgery should not be considered just a form of elective surgery performed out of hours and adequate care should focus not only on anatomy and pathology, but also and particularly on patient's physiology and rearrangement of impaired physiology should be one of the essential keys of the care of such patients.

Another challenge is represented that not all acute care "surgical" conditions need an operation since many clinical scenarios might be treated through a non-operative approach causing even more difficulties in standardization and individualization of the correct management.

Few years after the report from Uranues the European Society for Trauma and Emergency Surgery in cooperation with European Union of Medical Specialists (U.E.M.S. - Union Européene des Médicine Spècialists) developed a specific curriculum to become Fellow of the European Board of Surgery in Emergency Surgery and some European and overseas surgeons started to be certified as Fellow the European Board of Surgery in Emergency Surgery. The curriculum from UEMS is specifically designed for these surgical and critically ill patients and focuses on different peculiar aspects such as bleeding, inflammation, infection, obstruction, ischemia, compartment syndrome and organ dysfunction, but there are other aspects that an acute care surgeon should consider:

leadership and teamwork ability. These two aspects, that should be indeed part of any surgeon, in stressful situations where time matters and swift decision making is crucial, might make the difference in patient outcome. Nevertheless, such Fellowship is clearly not enough to face the high volume of this population of patients but represented another opportunity to raise the attention on such important issue.

The Emergency Surgery Outcomes Advancement Project (eSOAP) developed by Michael Sugrue and his colleagues from Northern Ireland and Scotland should be considered a milestone in the field of Emergency General Surgery and European Countries might take the chance to improve the outcome of such patients through the installation in their system of eSOAP. This would allow data collection and EGS registry, development of specific bundle of care, definition of key performance indicators, standardization and stratification of specific disease and patients and consequently could create an optimal outcomes improvement through Performance Indicators and creation of Quality Improvement System.

This is a very challenging and ambitious project that should be spread all over European Countries and might be distributed by an International scientific community and stakeholders such as the European Society for Trauma and Emergency Surgery or other societies with specific focus on general and emergency surgery.

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The potential for regional and national use

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It is widely accepted that hospitals who support their staff to engage in clinical research achieve better outcomes for their patients. Indeed the body of evidence to support this assertion continues to grow. It is clear that it is the practice of clinical research; the openness to questioning what we do each day, in a structured and systematic way; that helps us to achieve these better outcomes. Clinical research holds a much greater function than simply adding to the body of knowledge in a particular field through an individual trial.

The availability of good quality, consistent data is an essential precursor for clinical research. This is why eSOAP is so important. The data provided in the inaugural eSOAP report, like all data sets, begged questions. In doing so, it was the starting point for further clinical research and resulted in a number of recommendations to help improve the surgical care provided and outcomes for patients

Good data allows us to engage more effectively with a broad range of stakeholders in the delivery of care, including those working within the hospital and those involved in the broader health service. Good data will also allow us to engage more effectively with patients and service users in the provision of care that meets their needs. This is one of the real benefits of the repository.

It is not enough that our clinicians come to work each day with an inquiring mind and a desire to answer the questions that their clinical work presents to them. At hospital and hospital group levels we must also provide them with the supports that they need to conduct research of a high standard and we must also promote a culture which sees value in research. Our ambition must be to develop a research culture that sees value in all types of clinical research regardless of the scale or methodology applied. The nature of the research, the topics researched and the researchers themselves should be an eclectic mix reflecting the health 'ecosystem' in which we work.

The 10 year strategy for our health services, Sláintecare emphasises the population health approach to the delivery of care. However, in order to meet the needs of the population that we serve we must have a clear understanding of these needs. eSOAP is helping us to develop this clear understanding and to devise and implement clinical strategies to respond effectively to these needs.

This report contains contributions from Ireland and from as far afield as New Zealand. The eSOAP approach is one of partnership via CAWT, but also with industry and with the broader health system. This again reflects an openness to learning and to dissemination of learning that will help ensure better outcomes for patients.

The responsibility of the current generation of clinical professional to contribute to the general body of medical knowledge is well accepted. However, it is often difficult to balance this responsibility with the day to day pressures that come with hospital life.
In addition, it is arguably more difficult to develop and maintain a research supportive environment in smaller hospitals; but it is very important that we do so. In the Saolta Group

alone, of the 228,389 presentations at our EDs and MIU in 2021, 70% were to model 3 and model 2 hospitals. In addition, almost 60% of our inpatient discharges last year were from Model 3 and Model 2 hospitals.

Model 3 and Model 2 hospitals will continue to play a very important role into the future in the delivery of acute care to the communities we serve. Healthcare and in particular, hospital care is constantly evolving. We are seeing a growing emphasis on the delivery of care outside of the hospital setting. Within hospitals we are seeing increasing levels of specialisation particularly of surgical services. Challenges associated with Access to Care have become even more pronounced following 24 months of Covid 19. We do need to continuously look at how surgical care is delivered both on an elective and emergency basis. The work of eSOAP helps to inform this process.

I want to congratulate Mr Sugrue and all of those involved in the compilation of this report. I also want to congratulate and thank all involved in the work of eSOAP. This work is having a real impact on patient care in the North West and indeed much further afield.

IT Working with clinical teams

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After the recent successful application and approval for university designation, Letterkenny Institute of Technology (LYIT) will become the Donegal campus of the newly formed Atlantic Technological University (ATU) and will now take its rightful place in the higher education landscape in an important and strategic part of the country. Our recent collaboration with Letterkenny University Hospital (LUH) on this extensive Interreg funded research project has played a pivotal role in fostering critical partnerships with external stakeholders in the area of clinical research and innovation, driving sustainable growth in academic research development for the institute. This project has provided an opportunity to maximise the impact to the North-West by bringing together the clinical and academic expertise to engage in innovative solution development in the challenging and dynamic area of healthcare data services, helping clinicians, researchers and IT policy makers to develop new treatments and services driven by emerging technologies. This partnership has supported efforts to secure additional funding for critical research infrastructure and academic development as we embark upon this exciting new era for third-level academic provision for the region. The ongoing collaboration with LUH helps achieve critical mass and academic depth to attract, educate, nurture and retain talent in the North-West of Ireland and cross-border thus strengthening and benefiting our region socially, economically and culturally.

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Challenging Policy in EGS

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The Emergency Surgery Outcomes Advancement Project (eSOAP)

Since the publication of the Models of Care for Elective and Acute Surgery by the National Clinical Programme in Surgery in 2010 and 2012 respectively, a greater emphasis has been placed on the surgical journey of those patients admitted to Irish hospitals. An early emphasis in the Models of Care was the separation of elective and emergency patients so that each pathway could be properly adapted to patient need.

For many years emergency general surgery, both nationally and internationally, was considered an 'add on' to a surgeons working day. This approach compromised both groups of patients in that the provision of scheduled care could be disrupted by the unplanned needs of those patients admitted requiring emergency care and those patients admitted as an emergency frequently did not receive care in a timely fashion.

Ample evidence in both this country and abroad demonstrates that emergency general surgery patients are best served in an environment which prioritizes their care along defined pathways with rapid access to senior decision makers, diagnostics and emergency surgery if needed. It is well understood that emergency surgical patients are frequently the most vulnerable and at increased risk of poor outcomes. Evidence from this country and abroad also indicate that high volume surgeons working in multi-disciplinary teams with the appropriate facilities achieve the best outcomes for these compromised patients.

Michael Surgrue and his colleagues are to be congratulated in collaborating with colleagues in Northern Ireland and Scotland in the development of the Emergency Surgery Advancement Project which audits in considerable detail emergency surgery outcomes in their respective communities. The basis of all quality improvement in healthcare rests on such data collection and analysis. The National Emergency Laparotomy Audit (NELA), overseen by the College of Anesthetists in the UK have highlighted what can be achieved in improving outcomes in this regard.

Mr Sugrue's lifelong interest in emergency abdominal surgery also has to be acknowledged in forging an international community of surgeons who share a common interest in improving outcomes for patients undergoing emergency abdominal surgery. Over the years the Emergency Abdominal Surgery Course developed by Mr Surgrue and colleagues has helped educate numerous surgeons in training develop a better understanding of the management of these high risk patients.

Mr Michael Sugrue, Ms Paula Loughlin and Mr Brendan Skelly (Altnagelvin Hospital) and Professor Angus Watson (Raigmore Hospital) and their clinical and research colleagues deserve our praise for further highlighting the need for further work in this challenging area.

EGS and the Emergency Department

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As an Emergency Medicine Consultant working in a busy university teaching hospital environment the emergency surgery patient forms over 10% of our presentations to the department. We know from the research carried out by Mr Sugrue and his colleagues that these patients confer a high degree of morbidity and mortality so it is essential that we aim to provide timely, safe and high quality emergency care to these patients.

Emergency Medicine physicians pride ourselves on delivering evidence based practice and care to our patients. Thus the Emergency Surgery Outcomes Advancement Project (eSOAP) is welcomed and endorsed by our Emergency Department and hospital wide. This crucial piece of research has enhanced the care for patient's presenting with emergency surgical conditions. Several key points from the eSOAP registry have emerged and pertain to improving the patient's outcome and journey from the emergency department.

From an emergency physician perspective our goal is to readily identify and manage patients presenting with an emergency surgical complaint. This database allows us to understand the epidemiology and natural history of such patients and identifies those high risk patients to afford them better care.

Ensuring our patients get the right treatment at the right time is also another key quality indicator in the emergency department.

The inaugural report critically evaluates the utilization of investigations used in assessing patients with emergency surgical presentations. We have welcomed the introduction of a management proforma for those patients presenting with specific emergency surgical conditions. Proformas for right upper quadrant pain, Right iliac fossa pain and suspected bowel obstruction has provided a structured platform for clinicians and enables standardisation of care. These proformas/ decision aids are now integrated into clinical care.

Education forms the basis of medicine and it's important that future generations of clinicians and members of the wider multi-disciplinary team understand emergency surgical presentations and how to manage them appropriately. I am honoured to be a faculty member on this course
We know from the data that emergency general surgery forms over 10% of our workload and these patients confer a high morbidity and mortality. In early identification of these patients, managing them in a timely and appropriate manner and providing standardised care we can improve their outcomes.

We are grateful for research and data gleaned from the eSOAP project and endeavour to champion its use in the Emergency Department to ensure good patient and evidenced based care.

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Physician Associate in EGS

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The role of the physician associate in Ireland is evolving quickly, since the pilot project began at Beaumont Hospital in 2015. As more and more hospitals and other healthcare settings recognise the value of this cadre of medical professionals, the demand increases year on year. Research into the Irish experience with the PA role has revealed continuity of patient care and flexible scope of practice as positive outcomes of the pilot1, however the continued lack of recognition and regulation of the profession by the Department of Health has posed challenges for hiring and expanding the number of posts available across the country.

Lessons learned from America and the UK where PAs are well established, are published extensively in medical, surgical, and health workforce literature. The findings emphasise the high degree of adaptability due to the unique training of PAs as generalists, who are quickly able to function in specialised service delivery areas. A UK study published in 2021 sought to demonstrate whether an ambulatory emergency care (AEC) clinic supported by PAs and consultants would positively impact patient care while also providing workforce stability. The results demonstrated that the practice model enabled fewer emergency admissions and "significantly reduced time-to-reach-treatment decisions"2. These findings also positively impacted bed-flow and delays in patient treatment.

At Our Lady of Lourdes Hospital in Drogheda, the PA role was recently introduced into the Surgical Assessment Unit, where the PA's contributions and role are best described as:
Providing early assessment and triage of patients

Providing post-call coordination of assessment, investigations, and treatment of acute surgical patients

Improving communication within the surgical team, other departments, and with patients. Ireland's health workforce will benefit greatly by increasing the integration and utilization of PAs. Models can be found within the country and beyond, demonstrating the benefits of PA services embedded within emergency general surgery units. We recommend that national recognition and regulation of the PA profession is prioritized to ensure that patients are provided world-class care that is evidence based and cost effective.

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The Power of Data:Improving Outcomes through Analytics

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Knowledge and evidence are foundational for meaningful and effective care delivery transformation within a health organisation. These are derived from the data that is collected throughout an organisation. However, unlocking critical insights about best practice and areas for improvement from collected data is not a straightforward task and requires planning, coordination and engagement from multiple stakeholders. HSE Digital Transformation are committed to uncovering the potential of data and firmly believe in its ability to transform the organisation for the benefit of patients and healthcare providers.

The eSOAP project embodies efforts to put data and evidence at the centre of care delivery reform. The digital registry of over 6,000 patients captures the delivery of care in the hospital with high precision and sets the foundation for building an advanced analytical framework. A key question moving forward is what are the core components for building this framework in order to gain insights that will lead to the improvement of outcomes for EGS patients. I believe that implementing a successful data strategy for eSOAP relies on the development of 4 main areas: interoperability, patient-centric data, strong analytical skills and good governance.

One of the major challenges facing healthcare is the lack of seamless integration between existing electronic systems. Patient data currently exists in silos which severely diminishes its utility by limiting the scope of analytics that can be applied to it. There needs to be an intense focus on ensuring strong interoperability between existing systems. It is critical that the EGS registry developed by eSOAP becomes more integrated with patient management, laboratory, and radiology systems. This will reduce the time and effort taken to manually re-enter patient data into the registry and will allow the registry to scale quicker to include data from other hospitals. We must ensure there is API-led interoperability in which data conforms to international standards. Another key aspect of interoperability is the provision of a universal identifier to link patients across hospitals and care centres. Therefore, it is essential that implementation and broad adoption of the Individual Health Identifier (IHI) is accelerated.

The registry currently records a multitude of data points for each patient as they move through the hospital. However, data acquired in the hospital accounts for only a small percentage of a patient's overall health data and outcomes. To better understand how care is affecting patient outcomes, it is vital that the registry includes follow up data on patients in time periods post discharge. A combination of objective measures in the form physiological measures from wearables devices and subjective measures in the form of patient reported outcomes measures (PROMs) will give a more accurate depiction of the patient's quality of life. These additional sources of data will give a more complete picture of the patient's health and will be of high benefit to machine learning and patient clustering algorithms.

The eSOAP team have done a tremendous job at aggregating data onto a common platform. However, this effort will have little value unless sufficient insight and action can be derived from the aggregated data. It is important that the HSE invest in establishing a dedicated, in-house team of data scientists that can be deployed across the organisation to work on various data projects. This team, typically with backgrounds in research; engineering or mathematics, will apply expertise in advanced analytical problem solving to generate deep insights about the generated data. In addition, it is important for such a team to work in close collaboration with surgeons and healthcare practitioners to clearly understand the problem space and operational questions that need to be answered.

Finally, it is important that good governance processes are put in place for the registry. Accuracy, completeness and security are a top priority and having well planned data governance will ensure that high standards are met for each of these aspects. This will result in a high level of confidence that the data existing in the registry is an accurate depiction of the reality of care. Routine validation of the registry must be conducted, the results of which should be published with surgical teams to promote clear note taking and quality data input.

Ensuring that each of these areas are well covered will set the stage for the eSOAP EGS registry to have a profound impact on patients lives nationally and internationally. It will allow for advanced technology like artificial intelligence to take healthcare from descriptive and reactive to predictive and proactive. It will create an evidence-led culture in emergency surgery leading to a reduction in the variation of care and the facilitation of best-practice standards.

Industry Partnership, improving care

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On behalf of the team at TCS, I wanted to congratulate Mr Michael Sugrue, Ms Paula Loughlin, Mr Brendan Skelly and Professor Angus Watson and their clinical and research colleagues in highlighting the potential for clinical registries within this report. eSOAP has clearly identified the problems to be solved and the requirement for a data registry that would allow for reliable, timely and accurate performance measurements and outcome reporting.

Delivering high quality and safe Emergency General Surgical Care is critical and a matter of life and death, representing 10% of hospital admissions in Ireland. This registry offers an essential record of each patient's journey from admission, their modes of presentation, observations and acute general surgery interventions.

Like many environments, there was deficient information for clinical decision-making in EGS settings, especially at time of essential need. This meant that postoperative morbidity and mortality were higher due to high risk of intraoperative & perioperative complexities.

eSOAP has shown the need for standardised, patient-centred, multidisciplinary pathways of care. It also highlighted how best to channel the wide variety of indications, patient profiles, clinical presentations and course, therapeutic options and patient outcomes.

At TCS, our goal is to support the eSOAP team at Letterkenny and internationally in further developing the registry that is secure, scalable and robust with built-in intelligence, indicators and benchmarks. We are determined to ensure that this clinical registry and the data captured is utilised to its full potential across hospitals, nationally and internationally.

By leveraging data, and by making this available with relevant insights at the right time, we can see clearly how we can deliver better clinical outcomes whilst lowering costs and reducing complexity in an area that has one of the highest mortalities in medicine.

We look forward to supporting the team in developing the registry further to allow for EGS severity assessment for risk-adjusted outcomes. Using analytics and predictive analytics, we'll explore how the registry can standardise EGS patient care, using evidence-based guidelines, trending, connected systems and smart data systems.

Ethical and Data Privacy Concerns

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The opening lines from 'Ethics and data protection' (EU Commission, 5th July 2021) read as follows:

"Data protection is both a central issue for research ethics in Europe and a fundamental human right. It is intimately linked to autonomy and human dignity, and the principle that everyone should be valued and respected."

The Emergency Surgery Outcomes Advancement Project (eSOAP) commenced in 2018. Project initiation was followed some months later by the introduction of the European Union (EU) General Data Protection Regulation (GDPR) on 25th May 2018, which was given effect within Ireland by the Data Protection Act (2018). This was followed, on 8th August 2018, by the Health Research Regulations which established additional regulatory requirements for health research governance, processes and procedures.

This provides some relevant background to the turbulent health research context within which the eSOAP project was introduced from the outset. Registry-based research into personal health data offers significant potential for improvements in treatment and care. However, it is also important to recognise that participants may have a strong and legitimate interest in deciding whether or not their data should be collected and used for registry-based research. In generating an effective template for registry development the eSOAP project team were presented with significant challenges in seeking to affect a proper balance between the protection of personal health information and the use and sharing of such information in order to improve emergency surgical care.

To overcome these challenges and address ethical and data privacy concerns the eSOAP project was predicated upon a robust ethical framework that incorporated the development of a research protocol that was reviewed, approved, and monitored via the Research Ethics Committee (Letterkenny University Hospital). In addition, a risk based approach to data processing was underpinned by Data Protection Impact Assessments that were undertaken in consultation with the regional Data Protection Office. Finally, appropriate transparency arrangements were implemented which included development of an emergency surgery stakeholder forum with patient and public involvement, an explicit patient consent process, and display of patient and public information leaflets and posters within the hospital setting

This approach enabled improved health system integration whilst balancing the need to share information in the health sector with protecting the health information privacy of individuals. Fundamentally, it addressed two key principles outlined by the European Commission:

providing research subjects with detailed information about what will happen to their personal data requiring the organisations processing the data to ensure the data are properly protected, minimised, and destroyed when no longer needed

It is a fundamental belief of the eSOAP research team that each patient should feel confident that their personal data and information will be used and protected appropriately.

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Emergency General Surgery Registry

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In order to perform high-quality and patient centred evaluation of implantable devices and surgical procedures, well-designed surgical registries are essential (1–3). The value of registries for patient benefit has been made clear by failures to monitor surgical procedures and devices, such as the 'Poly Implant Prothese breast implant scandal' that led to significant patient harm (4). More recently the Cumberlege report that detailed the failings of the introduction and evaluation of vaginal mesh in the United Kingdom (UK) (5). Due to the utility of registries in device and procedure monitoring, they are becoming increasingly incorporated in surgical specialties in Great Britain & Ireland as well as internationally.

Of note are registries such as the National Joint Registry in the UK, which has been used to demonstrate higher than expected revision rates for metal-on-metal hip implants (6). Due to their success the use case for registries has expanded, and there is a clear benefit to monitoring of all surgical procedures for audit and research purposes with prominent examples in the UK including the National Emergency Laparotomy Audit, the National Hip Fracture Database, and the National Vascular Registry; some of these even being utilised in randomised control trials.

Whilst registries are effective at capturing specific outcomes, they are sometimes limited in terms of their outcome measures, follow-up and often do not capture all procedures performed by their respective specialties. Covering the entire diagnostic pathway from lab results to surgery and immediate to short term outcomes are important to understanding immediate management of surgical conditions. This will be particularly helpful in understanding the pathophysiology of general surgical disease and in this sense the eSOAP project is ahead of the curve. It will be exciting to see further focus on core outcome sets rather than emphasis on blunt outcomes such as 30-day mortality alone in the future. Of great importance for future registries is ensuring the inclusion of patient relevant outcomes in the form of validated patient reported outcome measures.

A current issue our research team has identified with the development of independent registries is that they often do not link with other data sets and suffer from sporadic funding and data entry alike (7,8). It's essential that the EGS registry learns from other groups and ensures interoperability with other platforms for ease in research use in the wider scale. The registry space is developing rapidly in healthcare, and more and more registries are utilising automated systems for data collection at the point of care. Going forwards it will be exciting to see the impacts of a fully automated and fully interoperable registry that collects relevant data from secondary care and primary care electronic patient records and national statistics. The impacts on case ascertainment and clinician burden would be phenomenal, especially in the context of non-mandatory registries. Until then further use of manual entry registries in key areas for improvement of patient safety are essential to improving patient care and promoting the health and wellbeing of our populations.

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Digital Health Transformation for the future

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Many people recognize that health systems are currently on an unsustainable path with growing demands accompanied by inflating budgets and predicted shortages of clinical staff. However fortunately we are now at a very unusual time in human history, whereby multiple disruptive technologies are all showing up at the same time – cloud computing, internet of things, mobile and social computing, artificial intelligence and others. These exponential technologies if harnessed correctly can provide many of the solutions to avoid a future health system meltdown and provide better and more affordable/accessible health for everyone.

Healthcare is fundamentally an information business and yet the healthcare industry is one of the lowest spending on digital and IT solutions. This needs to be addressed and as 'necessity is the mother of invention' this deficit and the technology debt that exists in healthcare will surely be addressed. According to the OECD Healthcare is a decade behind other industries in digitalising. But we are catching up fast. However there is a very complex digital transition to be managed, one where patients increasingly become involved in their healthcare and real-time data and communications allows high precision and high frequency feedback loops to be enabled to help restore, preserve and improve health.

To enable this complex multi-stakeholder change one needs a new paradigm and methodology. In Ireland we are using 'Open Innovation 2.0' (OI2) a new bleeding edge digital innovation approach which can help systematically enable exponential change in our healthcare system. By involving all four cohorts of the quadruple helix (Government, Industry, Academia and Citizens/Patients we will drive a structural improvement in our healthcare system through digital technologies. Patient centricity and involvement as an innovator is key. While the OI2 methodology is sophisticated, at its highest level it involves generating high trust relationships and extensive networking in an ecosystem all working towards a shared vision. Our vision in Ireland is to Leap Frog through technology.

We will leap frog from a health system that is primarily paper, presence, clinician and acute centred to one which is patient, home/community, cloud and digital based. Our vision is to move from being a European Digital Health Laggard to a European Digital Health Leader by 2025. To drive this strategy we have developed a Digital Innovation Strategy **'Stay Left, Shift Left' (SLSL)** which aligns very closely with the Irish government health reform strategy 'Sláintecare'

Stay left is about keeping well people well or if a citizen happens to have a chronic condition or needs rehabilitation, this can be done and be managed best of all from home.

Shift Left is about moving patients as quickly as possible from an Acute to a Community to a Home setting.

In pursuing SLSL, we seek to find digital interventions which deliver parallel improvements in the quadruple aim,

Improved care and outcomes.
Reduced cost or better value.
Improved clinician and patient experience.
Improved quality of life for citizens, patients and staff.

By orchestrating the Digital Health Ecosystem through a shared vision of Stay Left, Shift Left we will achieve multiplicative outcomes and accelerate progress towards healthcare industry leadership.

Incremental Innovation is not enough but as we deploy digital technologies towards SLSL and the quadruple aim we are increasingly finding solutions which deliver 10X benefits e.g. 10 faster, 10X cheaper, 10 Better, 10X volume. For example by treating patients at home using a 'hospital at home' approach we can do this 10X more cheaply than admitting patients to an acute hospital while delivering equivalent or often better outcomes. Also by discovering and treating chronic diseases earlier we can reduce lifetime costs for patients by a potential factor of 10X.

In Ireland as part of our OI2 approach we have deployed more than 50 digital health living labs where new digital health solutions are tested, iterated and implemented with clinicians and patients alike and we are starting to see a pattern where the cumulative benefits delivered are approaching 10x in many of the solutions. The combination of a non-Linear approach (O12) and exponential technologies are suggesting the emergence of a potential new power law – a Moore's law for healthcare improvement as I have previously written about. Healthcare is a complex adaptive system and the behaviour of such a system powered by digital technologies is likely that the system performs more substantively that the sum of its individual parts. The multiplicative effect of OI2 and Digital technologies leads to an instantiation of Kurzweil's law of accelerating returns. This brings great hope for the future in that we will not only be able to fix healthcare but to extend life, improve quality of life and detect and fix healthcare problems before they become issues.

This eSoap project lead by the fearless Dr Michael Sugrue is an example of data driven health innovation at work and the insights provided herein are life changing and practice changing. It is such a privilege to work with Michael and we will fully strive to bring this living lab into a broad adoption and then exploitation phase.

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Integration of EGS with EMR

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Electronic Medical Records (EMR) are the digital version of papercharts. By definition, an EMR is a collection of medical information about a person that is stored on a computer. EMR contain the medical and treatment history of the patient in one practice, including information about a patient's health, such as diagnoses, medicines, tests, allergies, immunizations, and treatment plans. Clinical notes were often messy and very brief and EMR meant a fantastic tool to improve this. EMR have several advantages over paper records like track data over time, easily identify which patients are due for checkup, see how patients are doing on certain parameters or monitor and improve overall quality of care.

EMR greatly improve hospital and clinic efficiency and provide more timely service for patients. Electronic medical records can be seen by all healthcare providers who are taking care of the patient and give them instant access to other clinicians' evaluations, as well as all diagnostic tests and can be used by them to help make recommendations about the patient's care. EMR systems have the potential to improve quality of health care, streamline workflow and increase efficiency in the healthcare system. No doubt that EMR accelerates the improvement of patient care provision. EMR are nowadays almost worldwide implemented and a must in health care facilities in the third world.

From an academic point of view, the EMR is an excellent tool for big data research through the huge amount of clinical information that is stored in the database. EHR data can generate clinically plausible mortality predictive models with excellent discrimination, providing opportunities to aid real-time decision support (1).

However, some problems with EMR have also been identified, such as the cost of implementing and maintaining EMR systems, and the skills and training needed for using them and extract its full potential. In a retrospective study conducted in Sydney comparing pre and post implementation of EMR system including all medical and nursing information, a reduction in performance of Emergency Department KPI's was observed although the study started 3 months after the implementation to avoid confounding learning effect. Increases in waiting time, even for discharged patients and treatment time was observed in all triage categories (2). A clinical information system must be fit for purpose for any gain to be made.

On the other hand, although locally developed systems, designed around local procedures and conditions, even giving specific computer-assisted decision support that implemented from the ground up have shown benefit, the information in EMR doesn't travel easily out of the facility informatic systems, making it difficult to deliver the information to patients (needs to be printed) or members of the care team for investigation purposes.

Activity database and it's reports are paramount for progress in Emergency General Surgery (EGS), and electronic medical records are the cornerstone for an easy, friendly and exportable database. With this premise, the Emergency Surgery Outcomes Advancement Project (eSOAP) began in late 2018. Supported by the European Union's INTERREG VA Programme and lead by Dr.

Michael Sugrue in Letterkenny University Hospital, and with collaboration of consultant surgeons from Altnagelvin and Raigmore Hospitals, the aim of eSOAP was to improve outcomes in EGS patients, to establish the feasibility of prospective data capture on all EGS admissions and to assess the outcomes and impact of clinical pathways for patients admitted to EGS services. It was a quasi-experimental study designed to collect both retrospective and prospective cohort data to establish an overview of the pattern, presentation, and management of current emergency surgery cases that account for over 10% of hospital admissions. The study also involved the development and application of a live EGS registry, established from the prospective cohort data.

The eSOAP project has evaluated the pattern and presentation of emergency general surgery patients identifying over 3000 admissions in 2019. Primary project outcomes include in-hospital mortality, in-hospital morbidity, hospital length of stay, intensive care unit length of stay, and unplanned readmissions up to 30-days post discharge. The result was published in the Letterkenny University Hospital Emergency General Surgery Inaugural Report 2019, demonstrating successful collaboration in EGS by surgeons and healthcare providers across three health jurisdictions, establishment of a robust coded data dictionary, the development of a computerized EGS registry (REDCap and GDPR compliant), the development of a new EGS proforma to help standarise documentation, creating an understanding of the unique epidemiology of EGS presentations. It also showed a critical evaluation of investigations used in care and development of new pathways in management of EGS patients, identified areas of excellence and improvement, and helped the development of a new electronic complication reporting system that resulted in the identification of new strategies to reduce complications in EGS. eSOAP project also enhance educational activities like Emergency Abdominal Surgery Course. EASC program, with its three versions for students (sEASC), nurses (nEASC) and consultants (aEASC) is recognized throughout the world as a leading teaching course.

eSOAP is the paradigm of integration of EMR in EGS. Work to date has highlighted the need to expand patient and public involvement to develop more comprehensive KPI's for EGS, but also to transform outcomes in EGS worldwide through benchmarking. The next step is the EMERGE. This is an international project, led by Letterkenny University Hospital and involving institutions from Ireland, Portugal, Italy and Spain within the European Society for Trauma and Emergency Surgery (ESTES) that aims, through innovation, to create one of medicine's largest cohort of patients, transforming EGS care to make it safer and with better value health care outcomes.

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The Challenges of Data Collection

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Science is as good as the data it is based upon. Medical science has recognized this long ago. To answer meaningful clinical questions, one must look for the best available evidence. Good quality studies formulate a properly designed research question, perform power calculation of size of the sample and properly randomize subjects, considering possible confounding factors. This research method, based on the experimental method, forms the basis of current clinical practice. However, this may not answer many meaningful questions. Randomized controlled trials (RCT's) study highly selected populations, with stringent inclusion and exclusion criteria. Furthermore, after the completion of the RCT, there is rarely a long-term follow up. Finally, in some time-sensitive situations, such as surgical emergencies, designing and implementing an RCT may be particularly difficult, when compared with elective surgery.

In the particular case of general emergency surgery, high level evidence is crucially needed. The global burden of emergency general surgery is colossal, accounting for 3 million admissions (11% of all hospital admissions) each year in the United States, with a disproportionately high mortality rate when compared with elective general surgery (1). Moreover, there are huge discrepancies in the quality of surgical care (2). There is pressing need to improve outcomes and RCT's may simply not be able to provide all the answers.

A change from the current evidence-based paradigm is required, with a focus on the observational method. High quality data is becoming increasingly available from clinical registries (3). Advances in health information technology, have allowed safe, reliable, and up-to-date accrual of data and clinical registries may prove closer to the "real-life" than RCT's. Registries collect data from a given population (for instance patients admitted in the emergency room with a clinical presentation, or a specific disease, or exposed to a certain therapy) in a continuous and usually cost-effective way. Key outcome indicators can be easily obtained with this method and bolster continuous improvement programs. This is particularly relevant in benchmarking results between institutions and in supporting health policy decision-making. The process of clinical decision-making is also evolving and there has been recent research into machine learning as a decision aid in emergency surgery (4). Interestingly, as early as 1972, computer systems had already proven more accurate than standard clinical judgement in diagnosing acute abdominal pain (5). It is clear that only the big data that clinical registries provide will be able to fuel the development of artificial neural networks for emergency surgery.

However, reliable clinical registries are challenging to implement. First, patient recruitment should be unbiased and ideally should not be obtained by sampling. Missing and or unreliable data will compound analysis of results and can introduce significant bias. Given the increasing role of information technologies in the clinical setting, one could easily assume that gathering clinical data would become increasingly easier. However, this is not necessarily true. Different hospitals may use different software platforms, hampering the implementation of cross-institutional registries. Furthermore, although clinical data are universally collected, the variables that are recorded, and the way in which they are documented, may vary. Moreover, many clinical registries rely on voluntary integration of clinical data, which may raise compliance issues. Reliability of data will also depend on the level of engagement of the clinical provider. This may be particularly relevant in emergency surgery, in which late hours and weekend work may inadvertently reduce the compliance with registry keeping, or indeed the accuracy of the clinical documents.

Several solutions may solve these difficulties. One is relying on full-time data collectors and managers. These can, at a cost, more reliably gather data, organize databases, ensure compliance and minimize the ratio of missing variables. These must be trained professionals, with a knowledgeable background on the topic and ideally some degree of clinical experience. Nurses are an obvious choice, and many registries have nursing staff with time devoted to data collection. There is an evident drawback, which is the cost. However, this can be minimized in situations where third-party payers are willing to invest in accurate and reliable clinical data collection.

Another solution to improve reliability is to build user-friendly interfaces between clinical software and registry software, thus avoiding duplication of work. In the current information technology (IT) world, this is likely easy to achieve. It requires that registry coordinators and clinical researchers work closely with IT systems experts in developing user-friendly platforms, ideally integrated within the daily clinical software.

The pioneering work by the Donegal Clinical and Research Academy (DCRA) has been admirable. By championing the development of clinical research and education in the field, true progress can be expected in the management of life-threatening conditions, improving clinical pathways and decreasing morbidity and mortality. Working closely with other societies, such as the European Society of Trauma and Emergency Surgery (ESTES), the World Society of Emergency Surgery (WSES) and the Lusitanian Association for Trauma and Emergency Surgery (ALTEC-LATES), the DRCA has led the way in improving care and safety of the acutely ill surgical patient. A particularly exciting venture in this field is the Emergency Surgery Outcomes Advancement Project – eSOAP.

In the current report, several key outcome indicators allow an accurate and thorough analysis, enabling benchmarking across distinct institutions. Good quality clinical registries are thus not only welcome but highly needed. It is up to surgical leaders across Europe and all over the World to promote them. Only then can we transform data into interpretable results. A global coalition of emergency surgeons is vital to achieve this goal.

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The Digital Age in Surgery

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Since 2020, healthcare has experienced systemic pressures and disruptions unlike any we knew. Finding new ways to meet the urgent needs of patients created an acceleration of change to processes to adjust to this new normal.

Digital technologies have entered the surgery environment during this period opening a new world of high-powered computing, visualisation, machine learning (ML) and artificial intelligence (AI) to create an ecosystem of next-gen digital tools to augment every stage of surgery. These technologies are being integrated into open, laparoscopic, and robotic assisted surgery platforms, and bring new solutions for surgical video and data management, and clinician decision support.

Hospital information used to be – and still often are - collected with pens, on notepads, stored on hard drives and USB sticks. Operations in emergency room, surgical suite, and the ambulatory areas were all documented on paper, and completely separated in siloes. Leveraging digital technology, every piece of data is collected in IT systems: surgical video, clinical information, diagnostic imaging, etc. Whilst various of these IT systems have been in place for some time, many were not designed around the physician – and they have not offered the easy, connected digital experiences we are now used to in our homes.

As an example, from spending lots of time with surgeons in the operating room, we discovered some real pain points for them particularly around the use of surgical video. We know surgical video is being recorded: there is a lot of evidence on the benefits of using videos for training and quality improvement. However, just being able to access the video of the operation just performed is often times a laborious process – meaning the benefits are not fully realised. This should not be the case in 2022.

(Green, et al., 2019) recommended that surgical training programs incorporate schematics and imaging into video, supplement video with other education tools, and utilize audio in video. For video review, they also recommended that residents review video preoperatively and postoperatively for learning and that attendings review video postoperatively for assessment. Adoption of digital technologies has often been slower in healthcare – and surgery - than other sectors. Cyber security, cloud data storage, funding, and time to adopt are important considerations when digitising clinical and patient information. It requires all involved to create an ecosystem that generates easier adoption and builds trust, so real value can be gained from surgical data. This is particularly important as more ML and AI become embedded in digital surgery solutions.

Engineers are solving for much easier digital tools to support surgeons in their everyday work; and they are also solving for how to make the outputs increasingly intelligent. Medtronic developed Touch Surgery™ Enterprise to resolve these needs. There is now published research identifying the potential for automated surgical video analytics. (Khan, et al., 2021) found that ML-based surgical workflow analysis has numerous opportunities to support improvements across education, operative efficiency, and patient outcomes.

Working together, we can find new ways to collaborate and solve a 'new normal' need. When we have quality data, structured and secure, that is easily accessible at surgeons' fingertips, without the clunky IT or paper-based experiences of old, the opportunities to assist individual learning, improve the sharing of knowledge and improve patient care will be more streamlined, smarter and available at scale.

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SECTION 2

Registry Results

General Introduction to Data Reporting and Results

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This section and subsequent sub-sections are the result of data entry and analysis performed by the eSOAP team at Letterkenny University over a 3 year period. We would have wished to have data also from our partners in Altnagelvin and Raigmore Hospitals but due to resource/funding constraints this was not possible. Data collection was undertaken in an ongoing fashion, challenged by Covid 19 which unfortunately, forced removal of our data collectors Louise and Carol Ann back to their clinical duties during staff shortages.

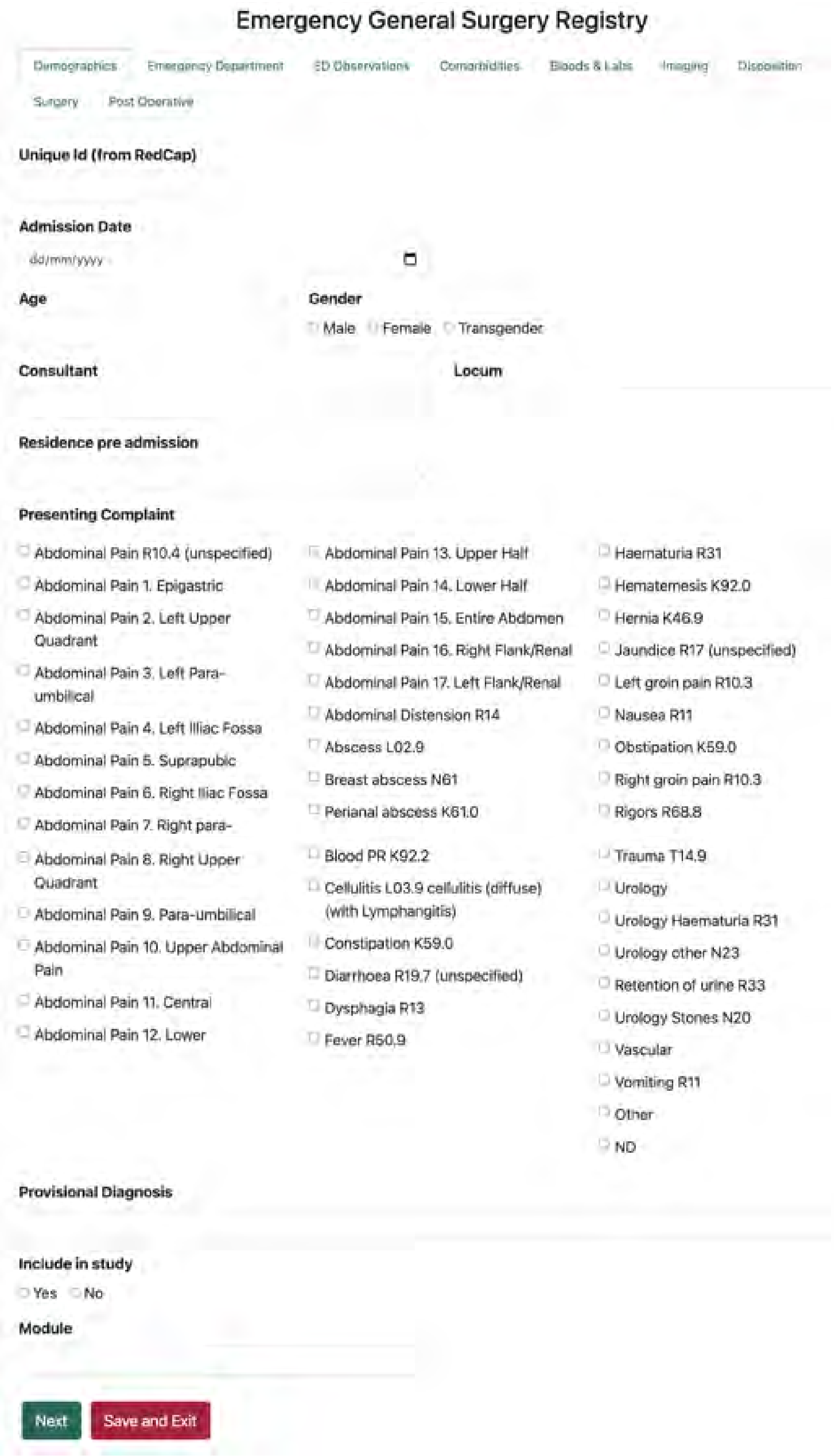
The following chapters will provide an overview of the hospital's data obtained from the EGS minimum data set, screen shots of which are shown below. The collecting data items included the patients' presentation, method of arrival to hospital and triage data, patient demographics, their vital signs, and reasons for presentation.
As part of the minimum dataset, when a patient presented with abdominal pain, the location of their abdominal pain is reported.

The reporting of results from the REDcap registry follows the flow of patient care, and after Emergency Department registration and triage, laboratory and imaging results are displayed. The type and timing of imaging is reported. Patient's outcomes are reported in terms of their disposition within the hospital and need for surgery.

The results shown in pages 56 to 70 refer to overall general patient data whereas subsequent results relate to different focused modules. Due to resource constraints, more detailed data collection was confined to a small select group of modules;

Emergency General Surgery Registry

The format of the registry at the user interface is shown in the next pages



Emergency General Surgery Registry

Unique Id (from RedCap)

Admission Date

dd/mm/yyyy

Age

Gender

○ Male ○ Female ○ Transgender

Consultant

Locum

Residence pre admission

Presenting Complaint

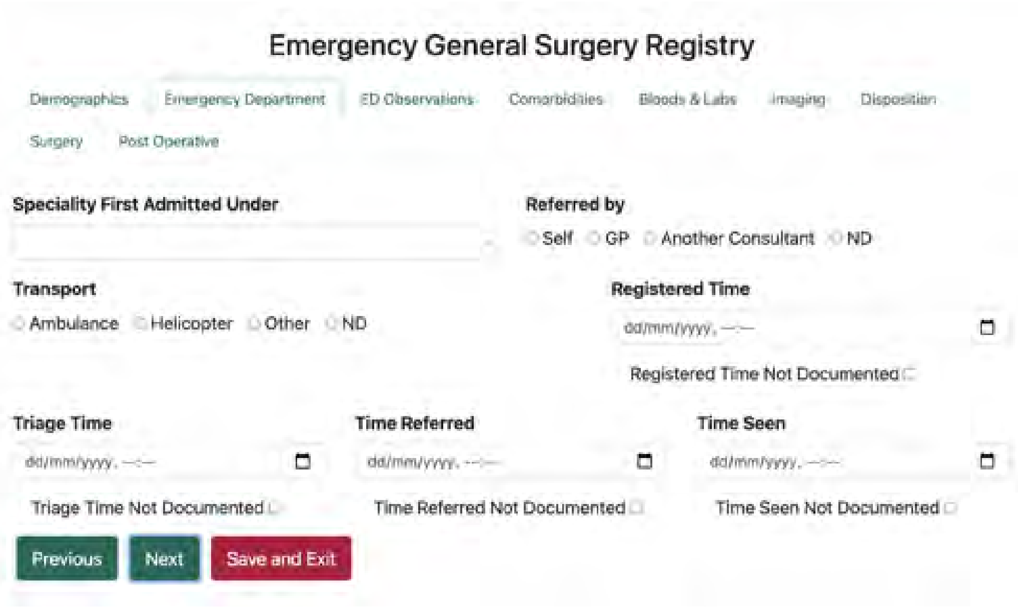
- ☐ Abdominal Pain R10.4 (unspecified)
- ☐ Abdominal Pain 1. Epigastric
- ☐ Abdominal Pain 2. Left Upper Quadrant
- ☐ Abdominal Pain 3. Left Para-umbilical
- ☐ Abdominal Pain 4. Left Illiac Fossa
- ☐ Abdominal Pain 5. Suprapubic
- ☐ Abdominal Pain 6. Right Iliac Fossa
- ☐ Abdominal Pain 7. Right para-
- ☐ Abdominal Pain 8. Right Upper Quadrant
- ☐ Abdominal Pain 9. Para-umbilical
- ☐ Abdominal Pain 10. Upper Abdominal Pain
- ☐ Abdominal Pain 11. Central
- ☐ Abdominal Pain 12. Lower
- ☐ Abdominal Pain 13. Upper Half
- ☐ Abdominal Pain 14. Lower Half
- ☐ Abdominal Pain 15. Entire Abdomen
- ☐ Abdominal Pain 16. Right Flank/Renal
- ☐ Abdominal Pain 17. Left Flank/Renal
- ☐ Abdominal Distension R14
- ☐ Abscess L02.9
- ☐ Breast abscess N61
- ☐ Perianal abscess K61.0
- ☐ Blood PR K92.2
- ☐ Cellulitis L03.9 cellulitis (diffuse) (with Lymphangitis)
- ☐ Constipation K59.0
- ☐ Diarrhoea R19.7 (unspecified)
- ☐ Dysphagia R13
- ☐ Fever R50.9
- ☐ Haematuria R31
- ☐ Hematemesis K92.0
- ☐ Hernia K46.9
- ☐ Jaundice R17 (unspecified)
- ☐ Left groin pain R10.3
- ☐ Nausea R11
- ☐ Obstipation K59.0
- ☐ Right groin pain R10.3
- ☐ Rigors R68.8
- ☐ Trauma T14.9
- ☐ Urology
- ☐ Urology Haematuria R31
- ☐ Urology other N23
- ☐ Retention of urine R33
- ☐ Urology Stones N20
- ☐ Vascular
- ☐ Vomiting R11
- ☐ Other
- ☐ ND

Provisional Diagnosis

Include in study

○ Yes ○ No

Module



Emergency General Surgery Registry

Speciality First Admitted Under

Referred by
○ Self ○ GP ○ Another Consultant ○ ND

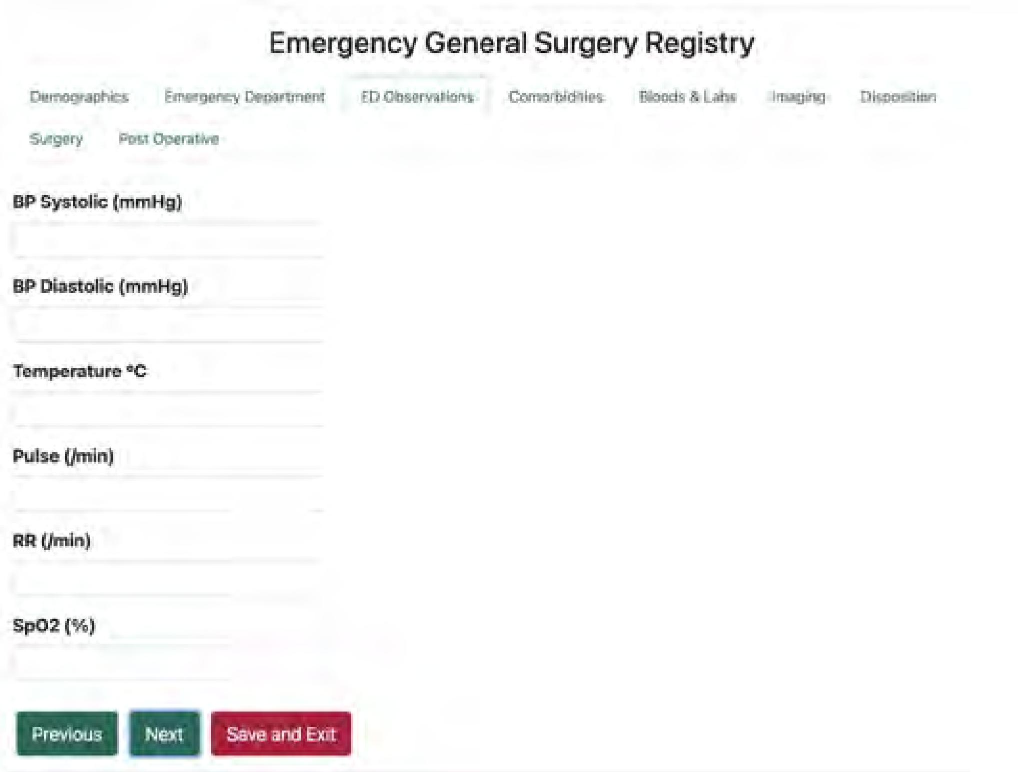
Transport
○ Ambulance ○ Helicopter ○ Other ○ ND

Registered Time
dd/mm/yyyy, --:--
Registered Time Not Documented ☐

Triage Time
dd/mm/yyyy, --:--
Triage Time Not Documented ☐

Time Referred
dd/mm/yyyy, --:--
Time Referred Not Documented ☐

Time Seen
dd/mm/yyyy, --:--
Time Seen Not Documented ☐



Emergency General Surgery Registry

BP Systolic (mmHg)

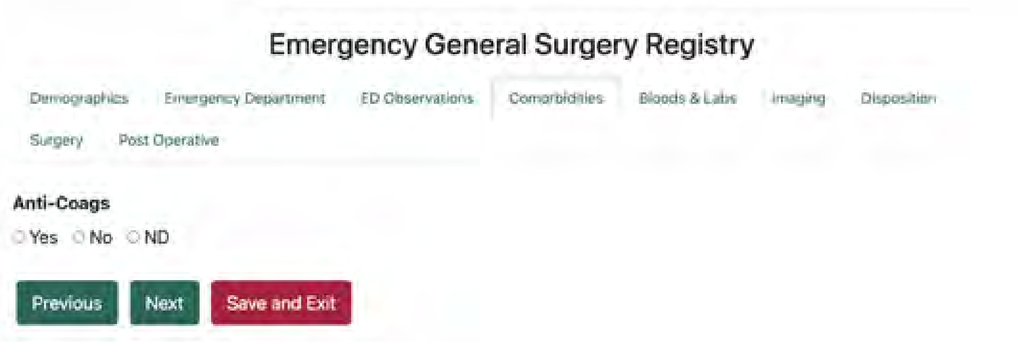
BP Diastolic (mmHg)

Temperature °C

Pulse (/min)

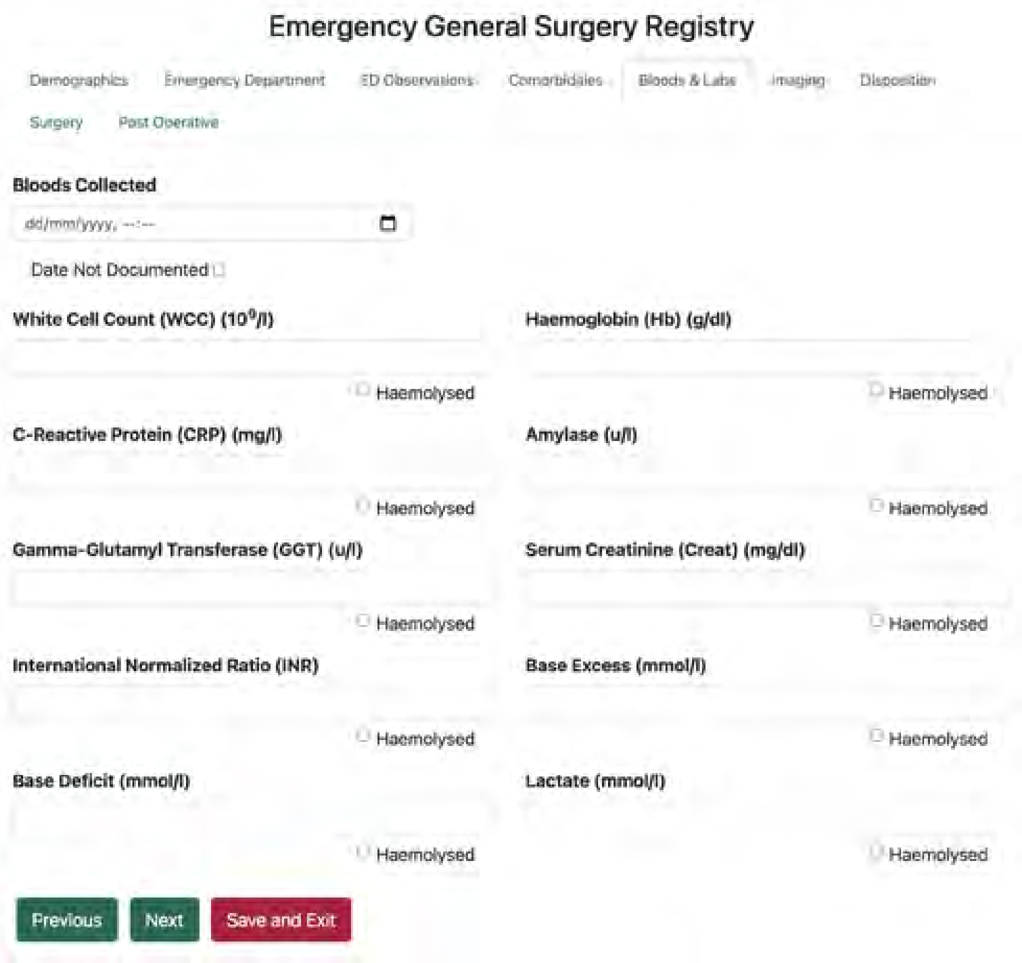
RR (/min)

SpO2 (%)



Emergency General Surgery Registry

Anti-Coags
○ Yes ○ No ○ ND



Emergency General Surgery Registry

Bloods Collected

dd/mm/yyyy, --:--

Date Not Documented ☐

White Cell Count (WCC) (10^9/l) ☐ Haemolysed

Haemoglobin (Hb) (g/dl) ☐ Haemolysed

C-Reactive Protein (CRP) (mg/l) ☐ Haemolysed

Amylase (u/l) ☐ Haemolysed

Gamma-Glutamyl Transferase (GGT) (u/l) ☐ Haemolysed

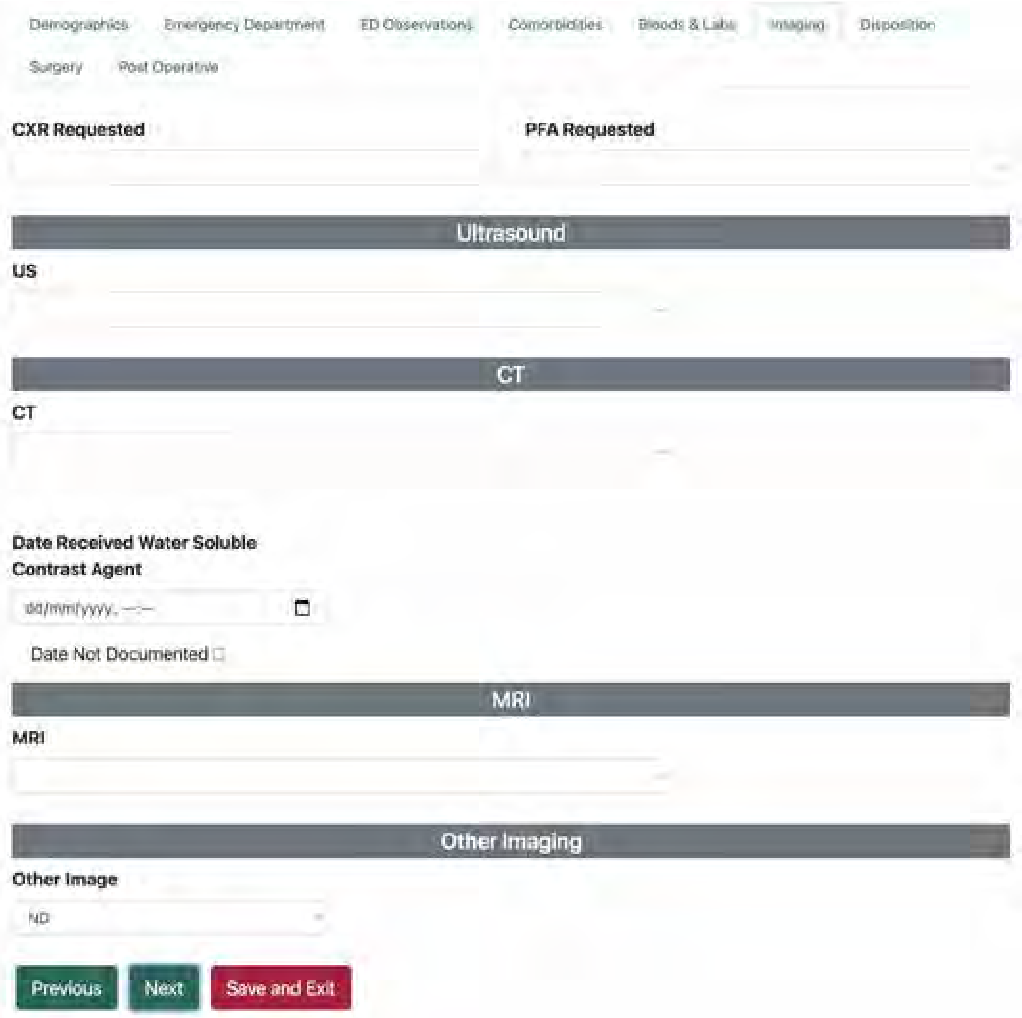
Serum Creatinine (Creat) (mg/dl) ☐ Haemolysed

International Normalized Ratio (INR) ☐ Haemolysed

Base Excess (mmol/l) ☐ Haemolysed

Base Deficit (mmol/l) ☐ Haemolysed

Lactate (mmol/l) ☐ Haemolysed



CXR Requested

PFA Requested

US

CT

Date Received Water Soluble Contrast Agent

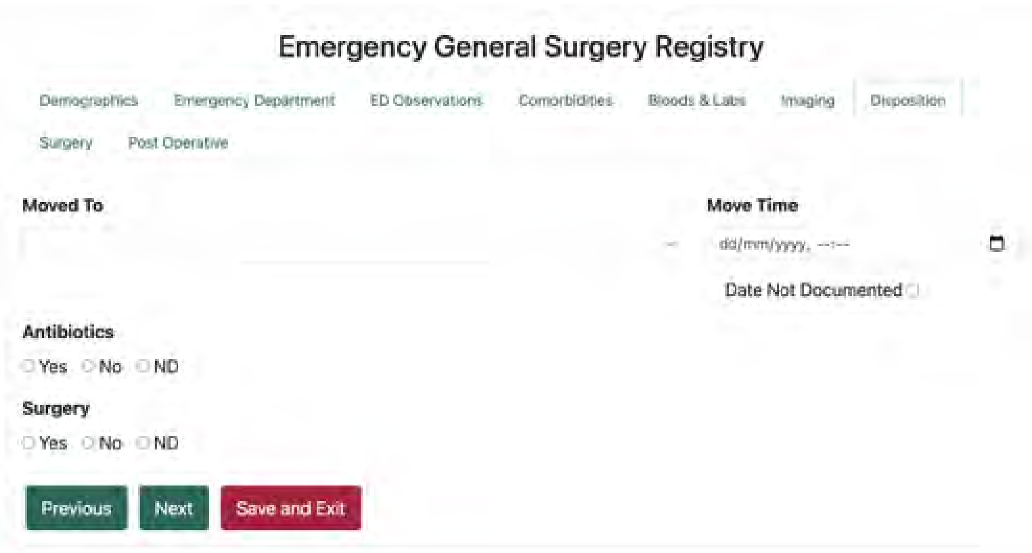
dd/mm/yyyy, --:--

Date Not Documented ☐

MRI

Other Image

ND



Emergency General Surgery Registry

Moved To

Move Time

dd/mm/yyyy, --:--

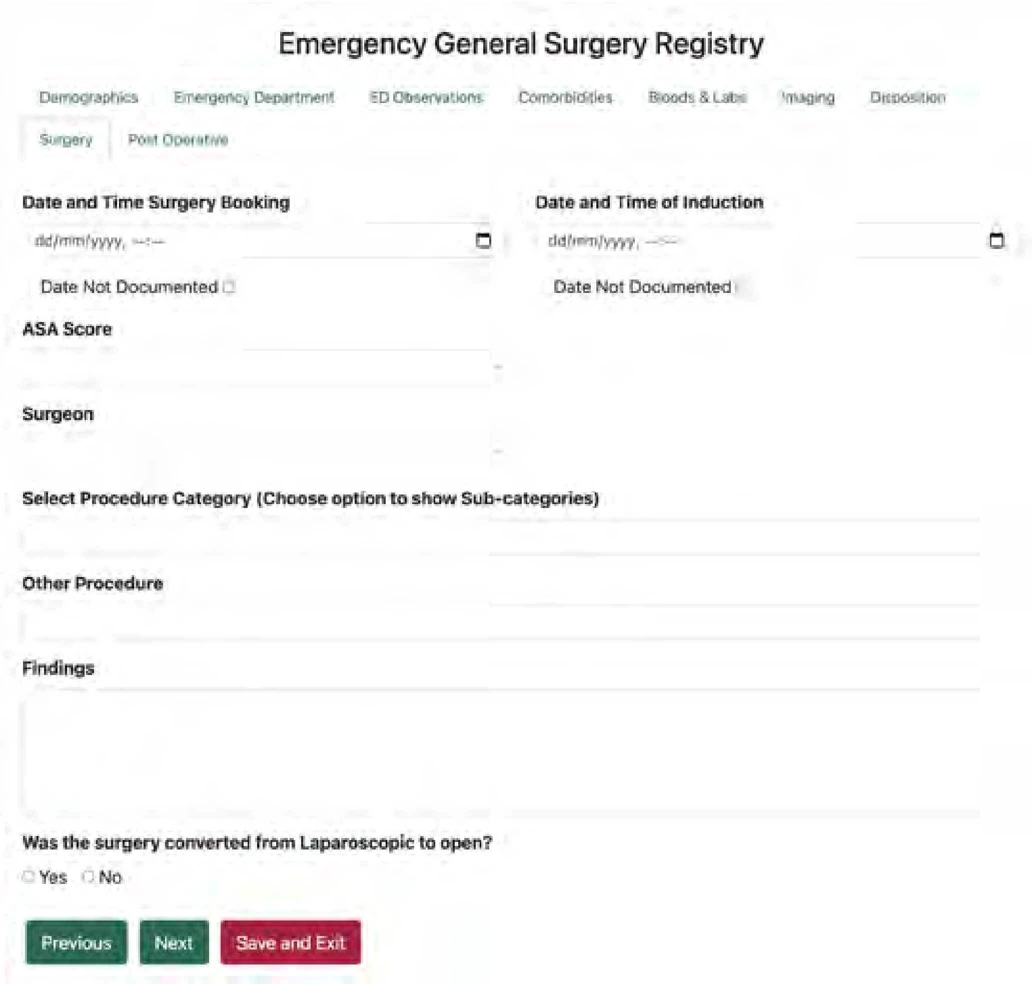
Date Not Documented ☐

Antibiotics

○ Yes ○ No ○ ND

Surgery

○ Yes ○ No ○ ND



Emergency General Surgery Registry

Date and Time Surgery Booking

dd/mm/yyyy, --:--

Date Not Documented ☐

Date and Time of Induction

dd/mm/yyyy, --:--

Date Not Documented ☐

ASA Score

Surgeon

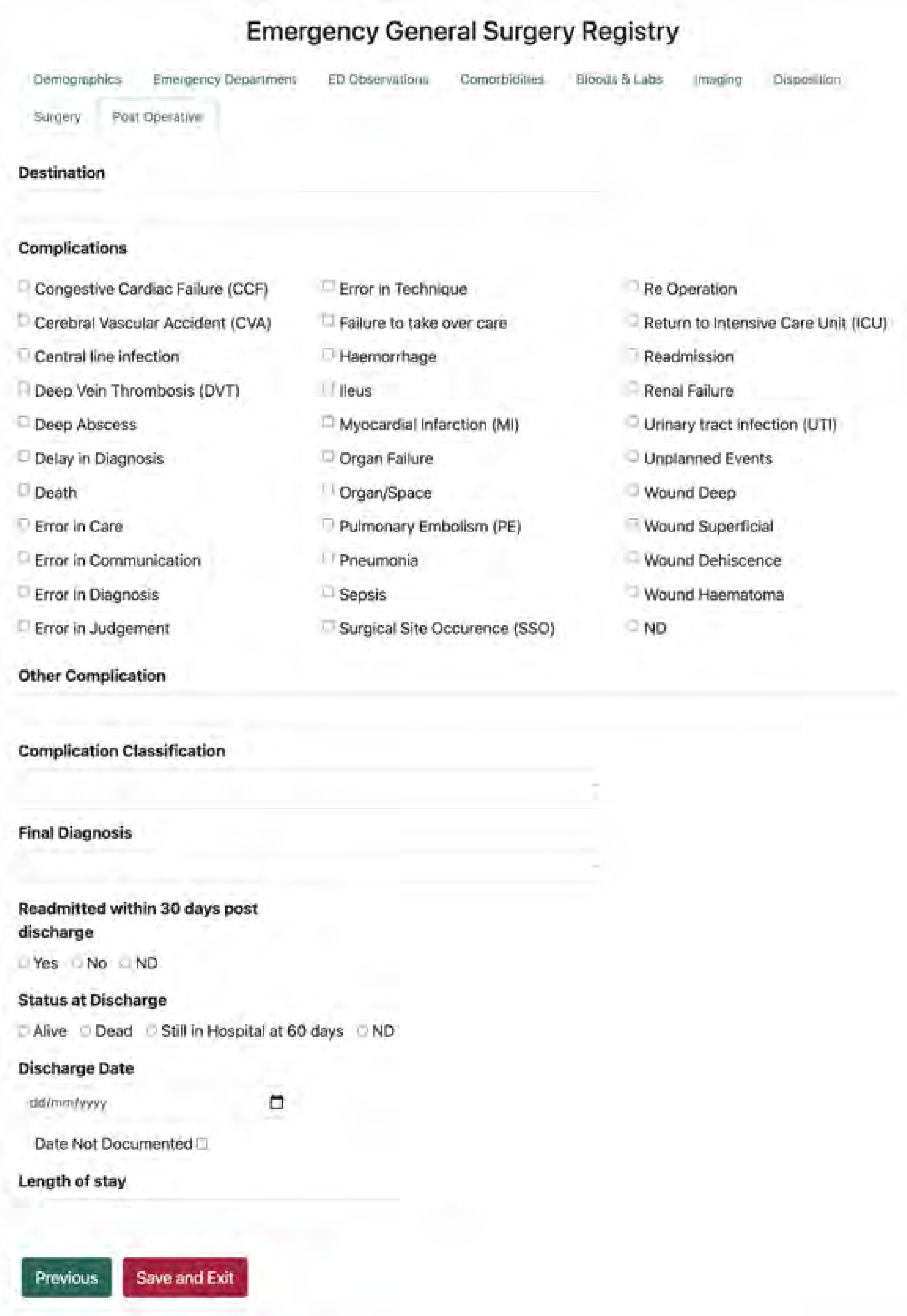
Select Procedure Category (Choose option to show Sub-categories)

Other Procedure

Findings

Was the surgery converted from Laparoscopic to open?

○ Yes ○ No



Emergency General Surgery Registry

Destination

Complications

☐ Congestive Cardiac Failure (CCF)
☐ Cerebral Vascular Accident (CVA)
☐ Central line infection
☐ Deep Vein Thrombosis (DVT)
☐ Deep Abscess
☐ Delay in Diagnosis
☐ Death
☐ Error in Care
☐ Error in Communication
☐ Error in Diagnosis
☐ Error in Judgement
☐ Error in Technique
☐ Failure to take over care
☐ Haemorrhage
☐ Ileus
☐ Myocardial Infarction (MI)
☐ Organ Failure
☐ Organ/Space
☐ Pulmonary Embolism (PE)
☐ Pneumonia
☐ Sepsis
☐ Surgical Site Occurence (SSO)
☐ Re Operation
☐ Return to Intensive Care Unit (ICU)
☐ Readmission
☐ Renal Failure
☐ Urinary tract infection (UTI)
☐ Unplanned Events
☐ Wound Deep
☐ Wound Superficial
☐ Wound Dehiscence
☐ Wound Haematoma
☐ ND

Other Complication

Complication Classification

Final Diagnosis

Readmitted within 30 days post discharge

○ Yes ○ No ○ ND

Status at Discharge

○ Alive ○ Dead ○ Still in Hospital at 60 days ○ ND

Discharge Date

dd/mm/yyyy

Date Not Documented ☐

Length of stay

Emergency Surgery Data Analysis and Reporting 2019-2021

This section of the report will share the results of EGS patient analysis over three years. At the outset we will provide some national data to add context.

Overall Presentations

The following (modified) figures and tables are sampled from the Healthcare Pricing Office 2020 Annual Report. They give an overview of the National picture of patient discharges for the Republic of Ireland for the year 2020.

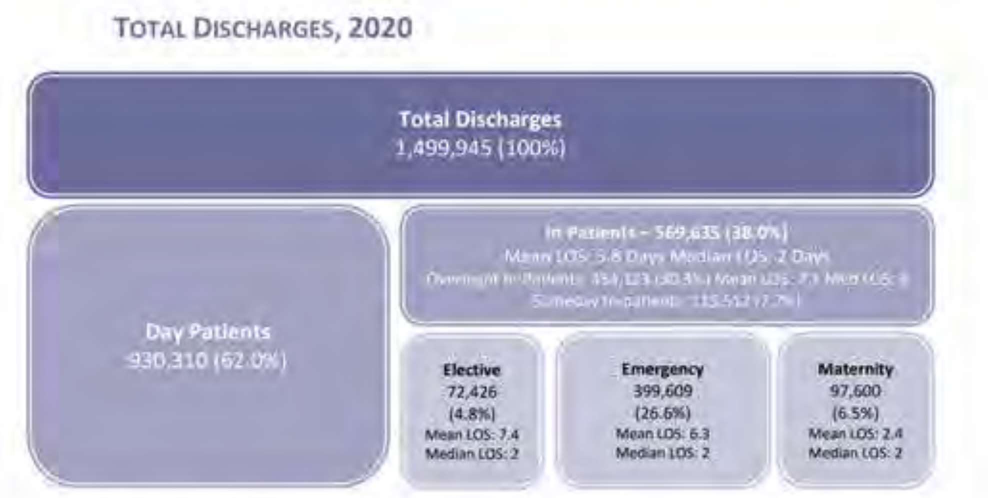


FIGURE 1.1 Total Discharges by Patient Type and Admission Type (N), 2016–2020

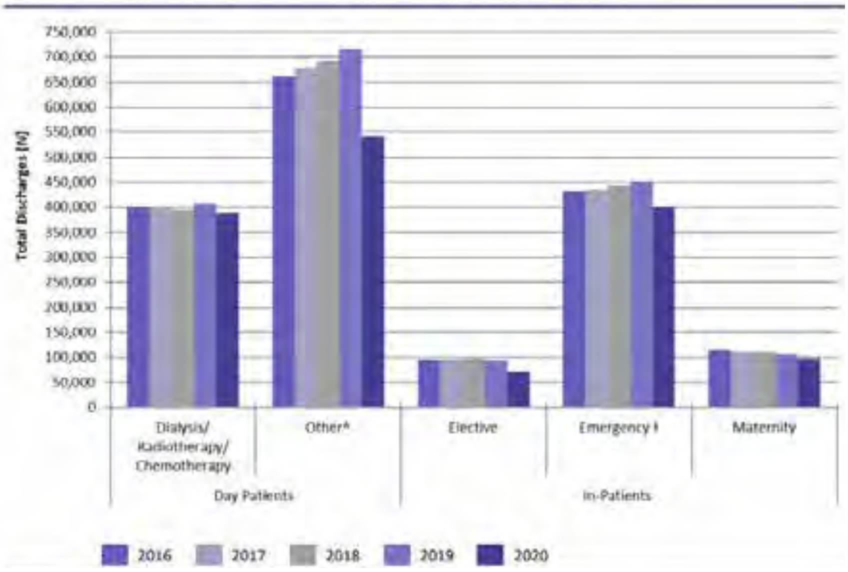
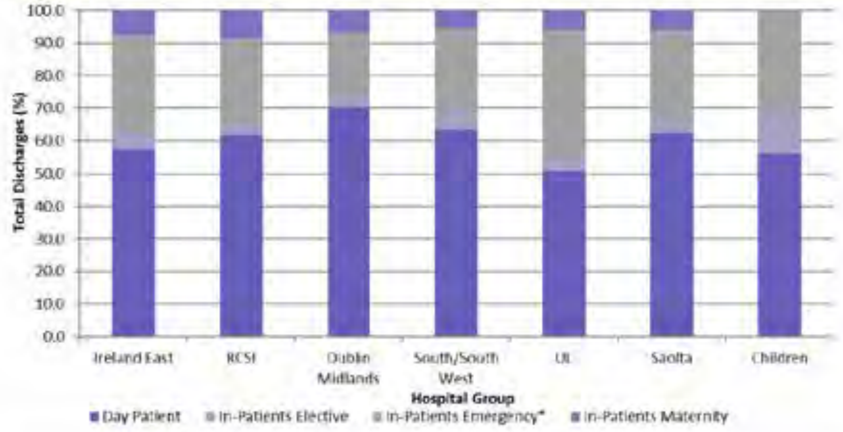


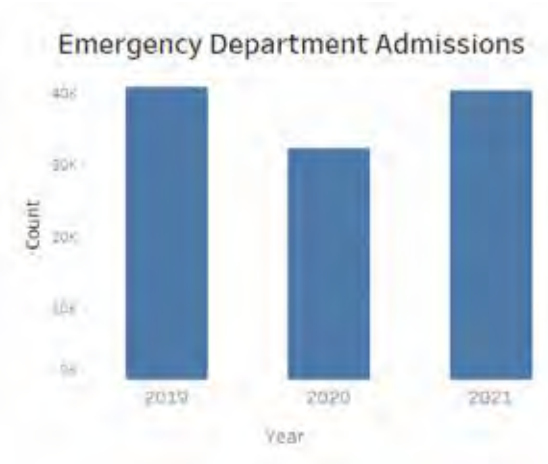
TABLE 1.1 Acute Public Hospital Discharges in HIPE (N, %), 2016-2020

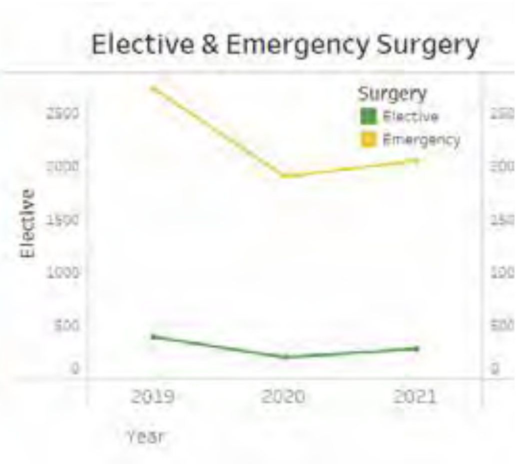
		2016	2017	2018	2019	2020	% Change 2016–2020	% Change 2019–2020
		N (%)	N (%)	N (%)	N (%)	N (%)		
Total Discharges		**1,704,452**	**1,718,523**	**1,737,212**	**1,771,022**	**1,499,945**	**12.0**	**15.3**
		100	**100**	**100**	**100**	**100**		
Discharge Rate[a]		**359.6**	**358.6**	**357.7**	**359.9**	**301.4**	**-16.2**	**-16.3**
Sex								
Males		788,702	800,443	817,851	837,916	714,171	-9.4	-14.8
		46.3	46.6	47.1	47.3	47.6		
Females		915,750	918,080	919,361	933,106	785,774	-14.2	-15.8
		53.7	53.4	52.9	52.7	52.4		
Hospital Group								
Ireland East		325,110	329,543	338,603	354,669	292,944	-9.9	-17.4
		19.1	19.2	19.5	20.0	19.5		
RCSI		254,227	258,768	258,954	263,641	230,758	-9.2	-12.5
		14.9	15.1	14.9	14.9	15.4		
Dublin Midlands[c]		318,725	319,373	325,230	333,923	286,770	-10.0	-14.1
		18.7	18.6	18.7	18.9	19.1		
South/South West		329,632	331,619	329,610	325,579	283,315	-14.1	-13.0
		19.3	19.3	19.0	18.4	18.9		
UL		106,749	111,771	113,077	114,679	100,268	-6.1	-12.6
		6.3	6.5	6.5	6.5	6.7		
Saolta		310,448	309,209	312,651	320,246	259,591	-16.4	-18.9
		18.2	18.0	18.0	18.1	17.3		
Children's		54,234	53,211	53,795	52,404	42,150	-22.3	-19.6
		3.2	3.1	3.1	3.0	2.8		
No group		5,327	5,029	5,292	5,881	4,149	-22.1	-29.5
		0.3	0.3	0.3	0.3	0.3		
In-Patients		**643,850**	**641,509**	**650,900**	**650,347**	**569,635**	**-11.5**	**-12.4**
		100	**100**	**100**	**100**	**100**		
Elective		95,870	96,100	96,893	94,256	72,426	-24.5	-23.2
		14.9	15.0	14.9	14.5	12.7		
Emergency[d]		432,490	434,214	443,313	448,313	399,609	-7.6	-10.9
		67.2	67.7	68.1	68.9	70.2		
Maternity		115,490	111,195	110,694	107,778	97,600	-15.5	-9.4
		17.9	17.3	17.0	16.6	17.1		
In-Patient Length of Stay								
In-Patients	**Mean**	**5.7**	**5.7**	**5.7**	**5.7**	**5.8**	**1.8**	**1.8**
	Median	**2**	**2**	**2**	**2**	**2**		
Elective	Mean	6.9	6.7	6.8	6.9	7.4	7.2	7.2
	Median	2	2	2	2	2		
Emergency[d]	Mean	6.2	6.3	6.2	6.3	6.3	1.6	0.0
	Median	2	2	2	2	2		
Maternity	Mean	2.7	2.7	2.6	2.6	2.4	-11.1	-7.7
	Median	2	2	2	2	2		
Overnight In-Patients	**Mean**	**6.8**	**6.9**	**7.0**	**7.1**	**7.1**	**4.4**	**0.0**
	Median	**3**	**3**	**3**	**3**	**3**		

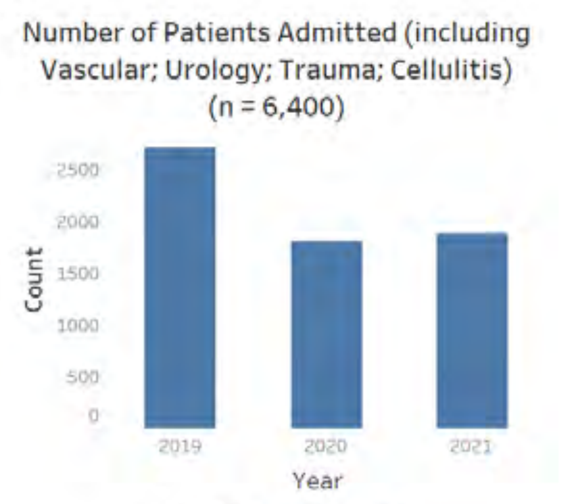
FIGURE 2.9 Total Discharges: Hospital Group by Admission Type (%)

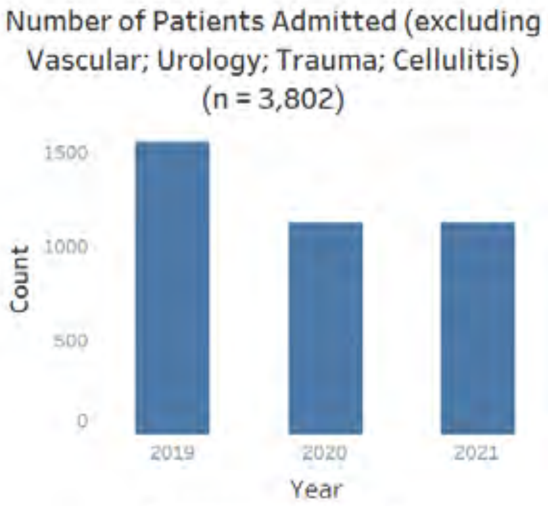


Letterkenny University Hospital Overview 2019-2022

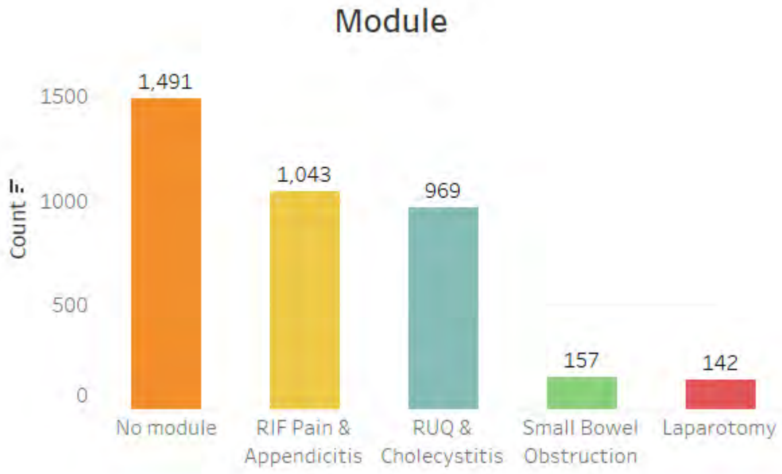







Number of Patients Admitted (excluding Vascular; Urology; Trauma; Cellulitis) (n = 3,802)
Count
1500
1000
500
0
2019
2020
2021
Year


Registered ED time
Count
2000
1500
1000
500
0
00:00 - 07:59
08:00 - 17:59
18:00 - 23:59
Hour Registered


Module
Count
1500
1000
500
0
1,491
1,043
969
157
142
No module
RIF Pain & Appendicitis
RUQ & Cholecystitis
Small Bowel Obstruction
Laparotomy

Editorial Comment

Emergency General Surgery (EGS) admissions account for over half of all surgical admissions, with 3802 EGS admissions from a pool of 6400 surgical admissions over the period 2019-2021. This large volume of patients reduced somewhat during Covid peaks. 60% presenting during normal working hours and a further 40% (1500) presented between the hours of 1800 and 0800. The majority of the patients presented either with RIF or RUQ pain. These two conditions should ideally be the target for optimization of care, given their dominance in EGS care. The data identifies that more admissions occur earlier in the week and this should be linked to hospital staffing.

The bimodal distribution of pain with a dominant peak in those 60-90 should alert us to increasing need for geriatric and age care involvement with associated robust discharge planning.

As 20% of patients arrived by ambulance we need to look at ambulance turnaround times and facilities to deal with timely ED response. The median time from registration to surgical review is over 3 hours and this could be shortened by the introduction of an Acute Surgical Unit.

Patients presenting with physiological instability, while in the minority, are a source of excess mortality and adverse outcomes. The eSOAP digital arm could be expanded to incorporate digital observation and early warning systems. As Dr Schwab says in his introduction, EGS Care can learn from Trauma and introducing EGS Teams for those unstable peritonitic patients could reduce lives lost. Dr Tolenon has shown how effective an organised response can lead to very significant reduction in mortality in high risk groups such a mesenteric ischaemia. The overall laboratory data indicates large numbers of patients with sepsis and raised inflammatory markers, and associated kidney injury.

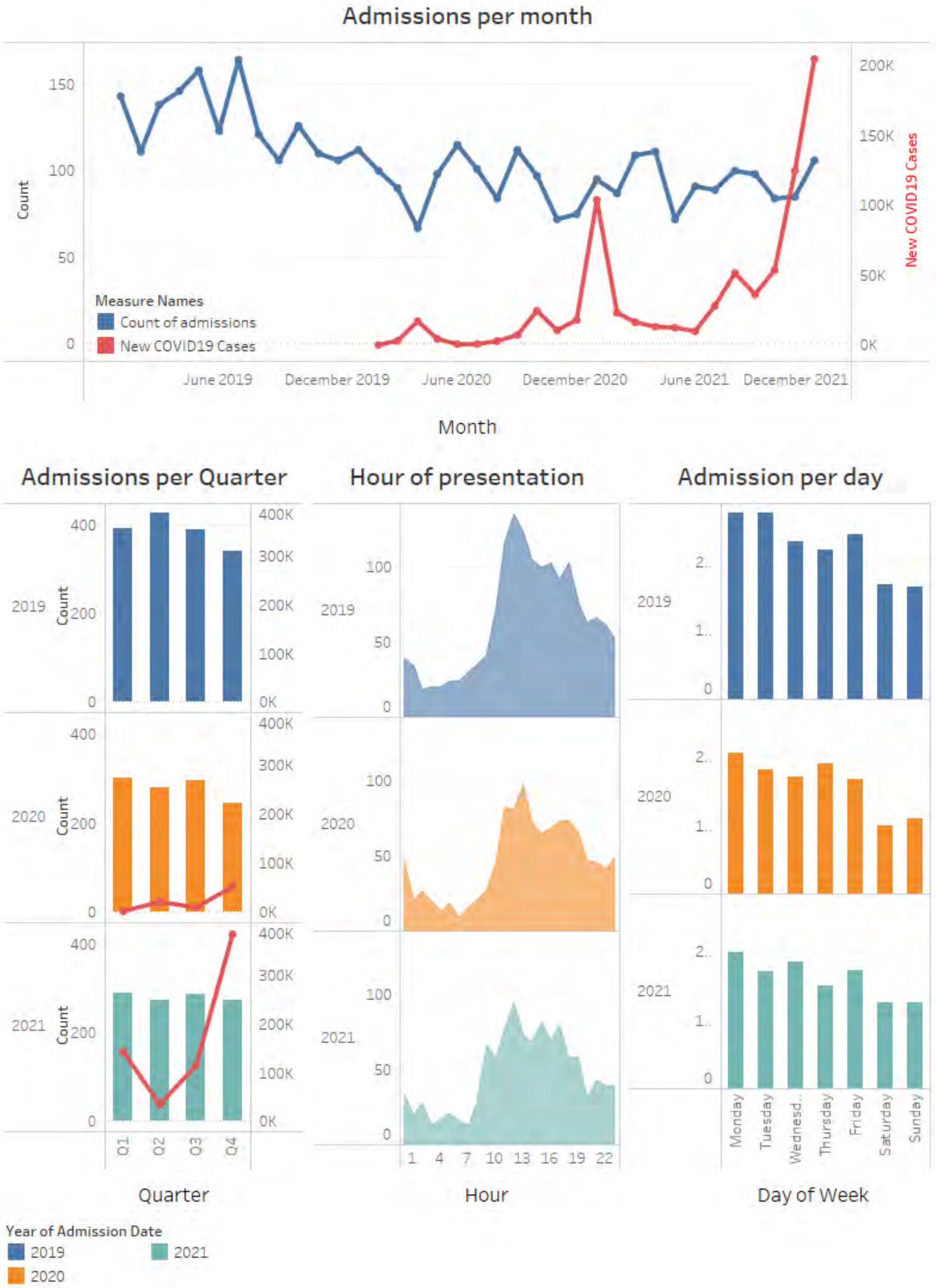
eSOAP would like to continue working with the HSE Digital Transformation unit and create smart agile reporting systems to ensure prompt action when abnormal results are found. This could be enhanced by public private partnerships, with companies like TCS and Medtronic. The eSOAP project has led to the instillation of digital archiving systems as a first step to decision tree analysis, machine learning and AI in EGS. Working with the World Society of Emergency Surgery and the European Society of Trauma and Emergency Surgery there is increasing research in this area to improve the process of care.

CT scanning times peaked in the mid-morning and it is encouraging to see that many scans were completed within 4 hours of admission. Abdominal ultrasound on the other hand was generally performed the next day, which may be due to a combination of the clinical condition, time of actual request and resources within ultrasound. It would appear that there is an ideal opportunity to reduce this by having point of care ultrasound performed in the Emergency Department by accredited staff.

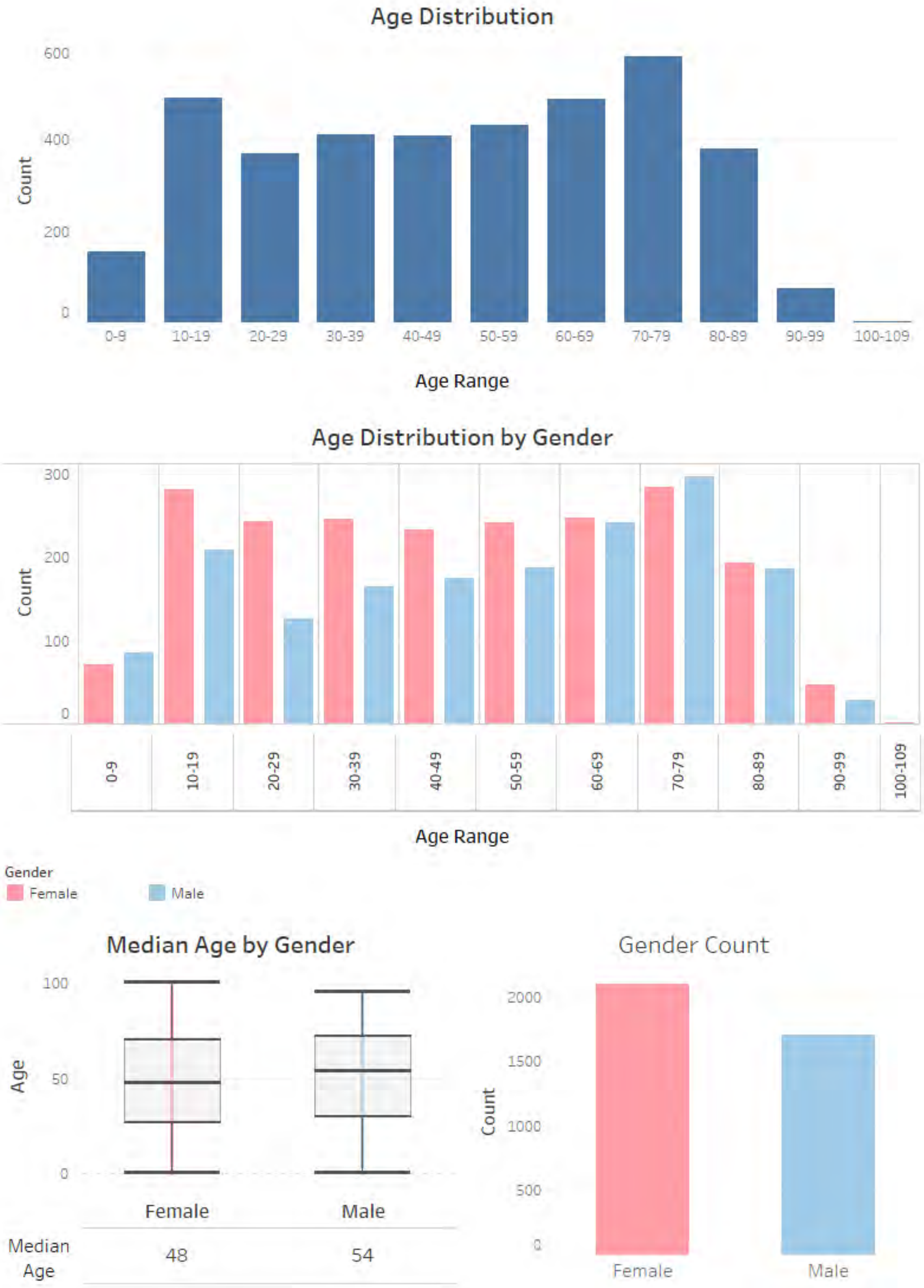
Almost 500 MRI scans were undertaken in EGS patients. The inability to undertake MRI scanning at weekends has a knock-on effect, delaying patient discharge.

Almost 30% of EGS patients underwent surgery, the majority within the first 24 hours. The hours from booking to time of surgery is variable with a wide distribution, which probably reflects the variable conditions of the patients, but it lends itself to further interrogation. The question is posed and needs to be answered and this would require a linked digital OR management system. The integration of the eSOAP registry with other hospital systems is vital to future streamlined care.

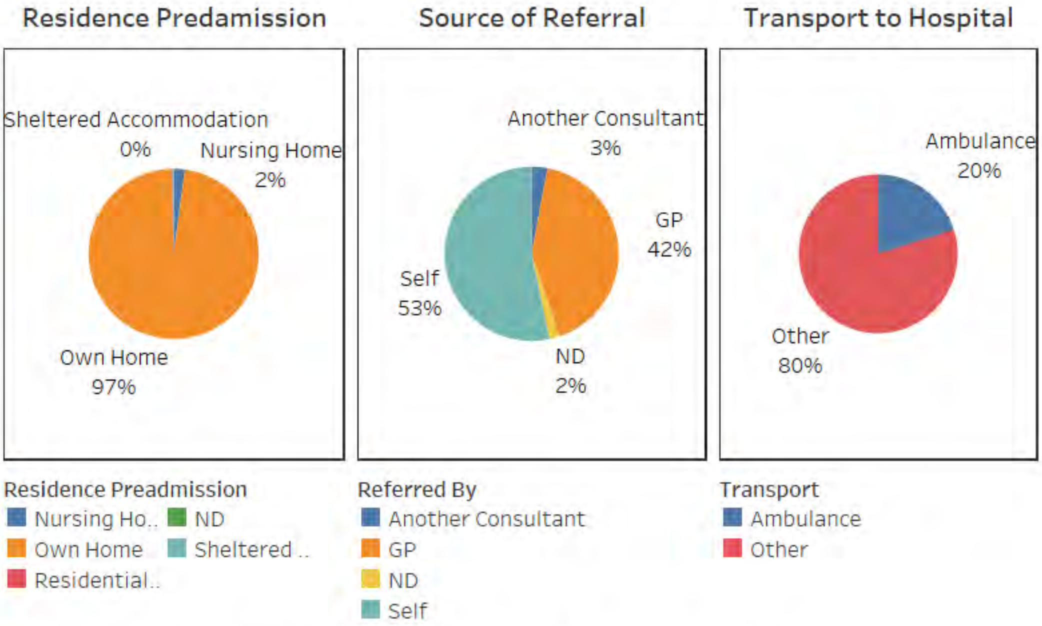
EGS Admissions 2019, 2020, 2021
(n=3,802)



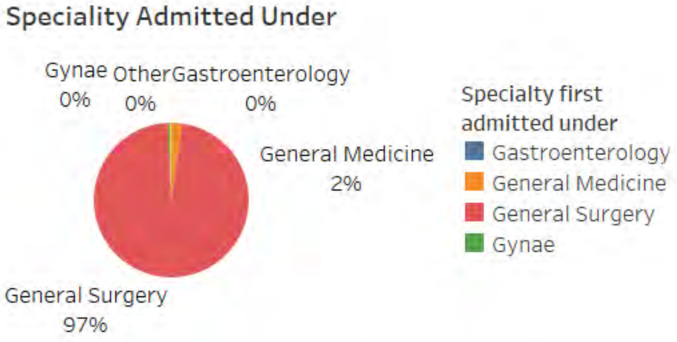
Age Distribution of EGS Admissions 2019, 2020, 2021 (n=3,795)

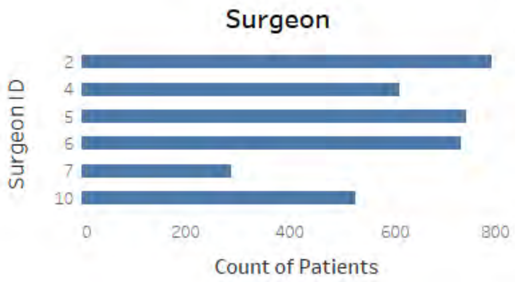


Patient Journey in 2019, 2020, 2021
(n=3,797)



Specialty & Surgeon 2019, 2020, 2021
(n=3,797)

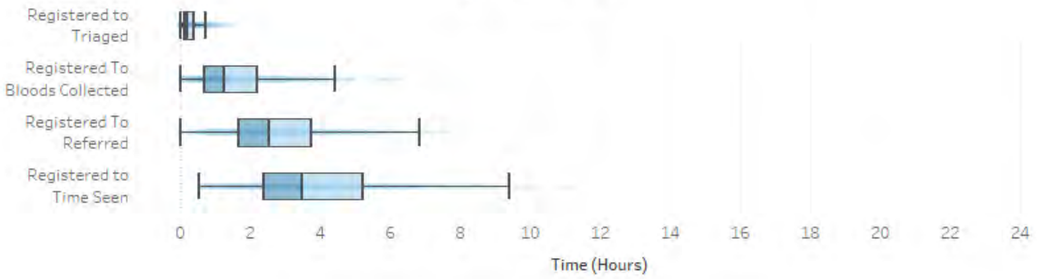




Surgeon by year

Consultant Surgeon	2019	2020	2021	Grand Total
2	382	198	204	784
4	250	210	147	607
5	285	235	214	734
6	317	210	198	725
7	288			288
10	8	267	249	524

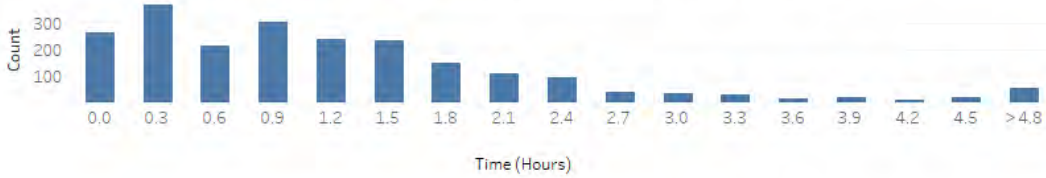
Emergency Department Times 2019, 2020, 2021 (n=3,158)



Registered to Triage (Median = 0.18 hrs)

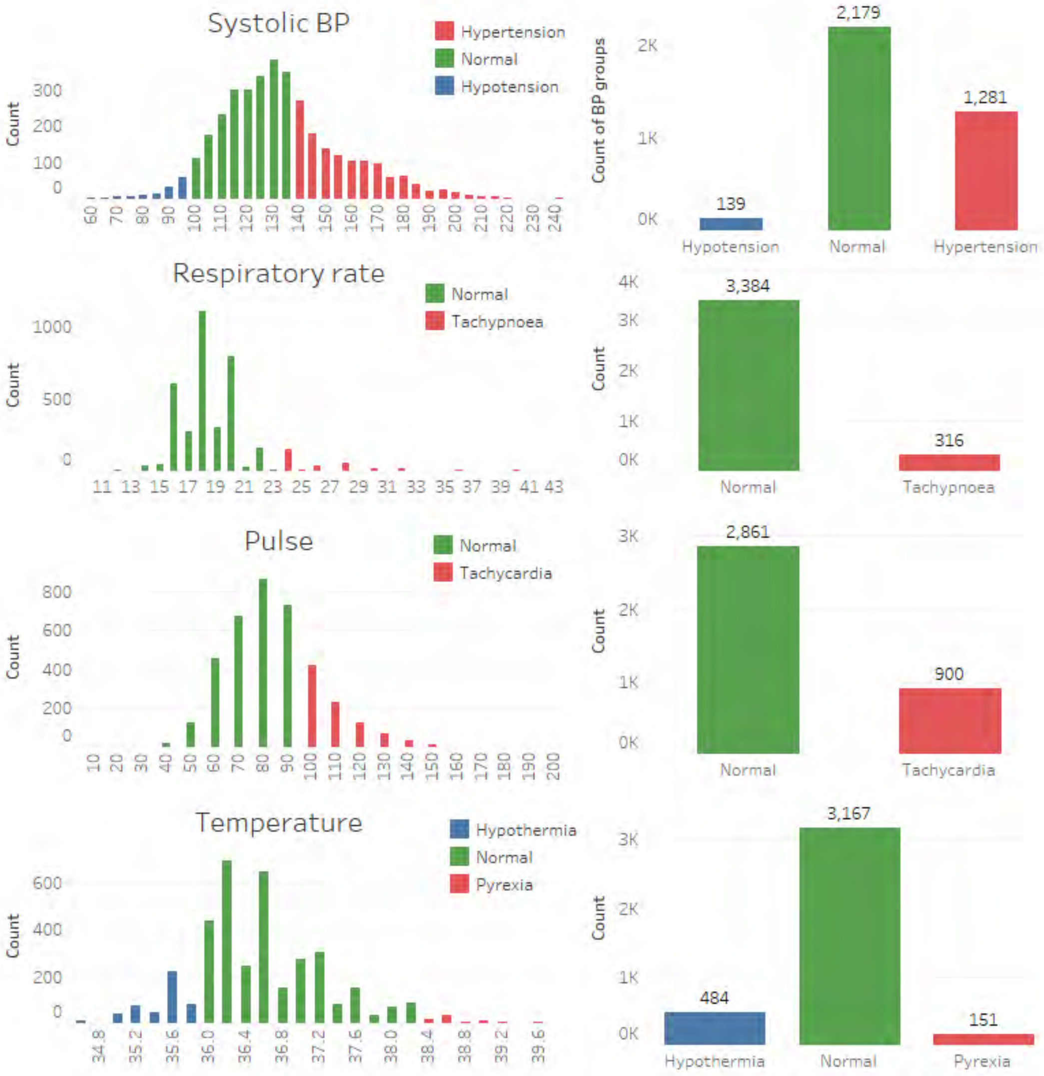
Triage to Bloods Collected (Median = 0.93 hrs)

Bloods Collected to Time Referred (Median = 1.17 hrs)

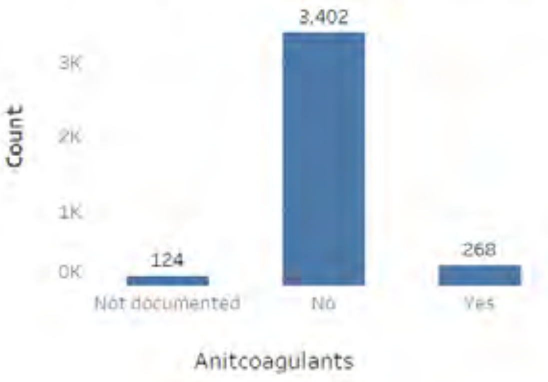


Time Referred to Time Seen (Median = 0.80 hrs)

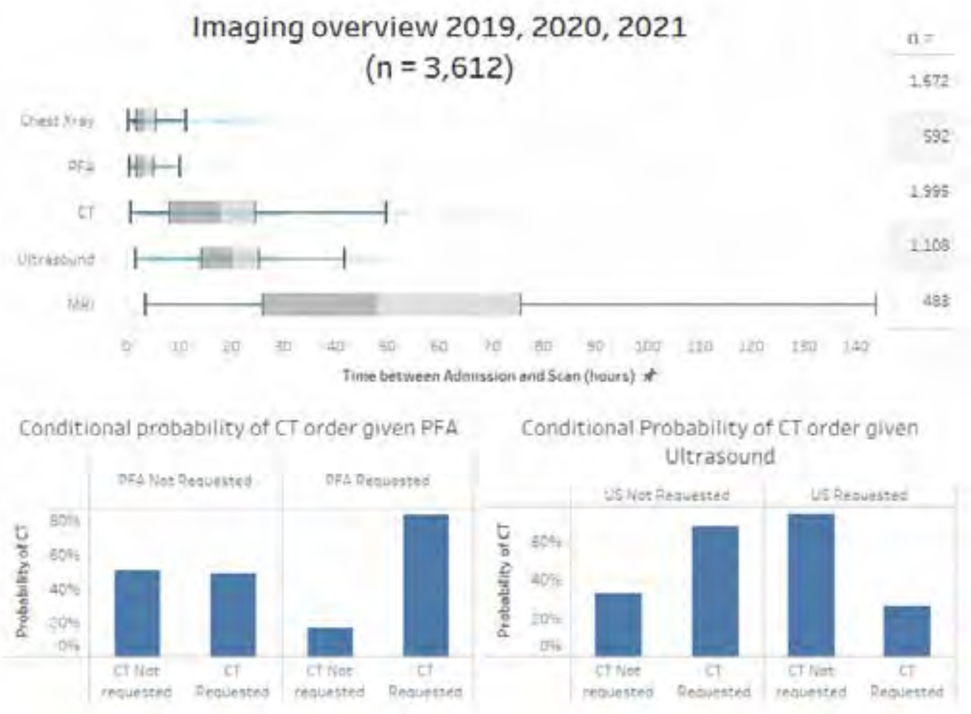
Vital Signs 2019, 2020, 2021
(n=3,734)

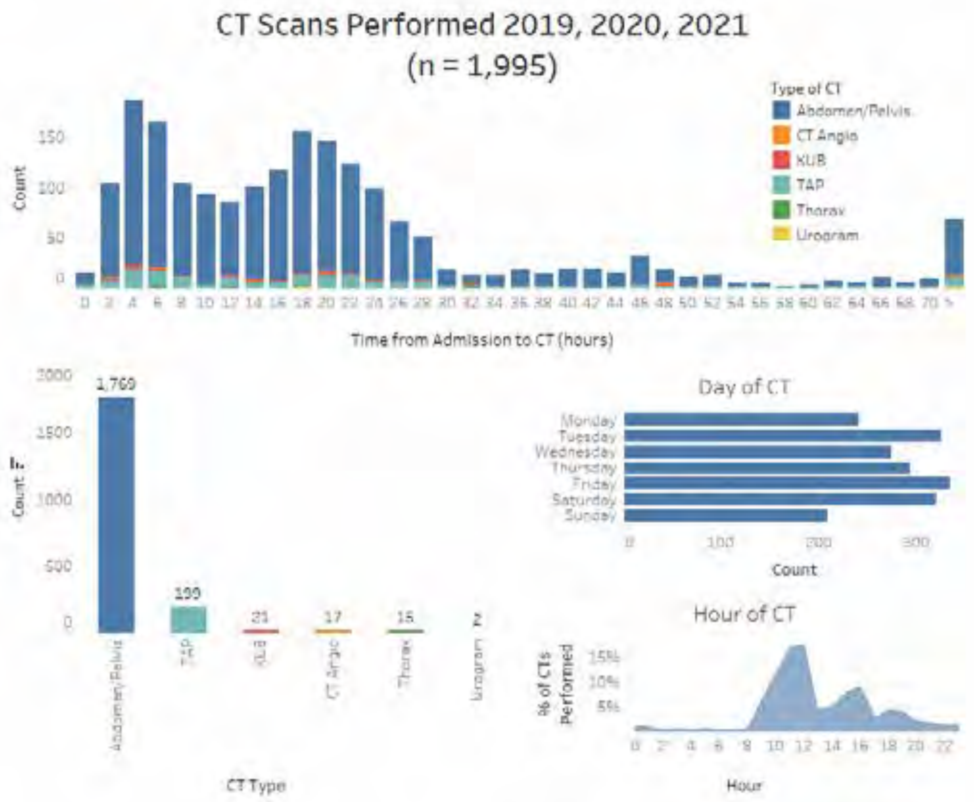


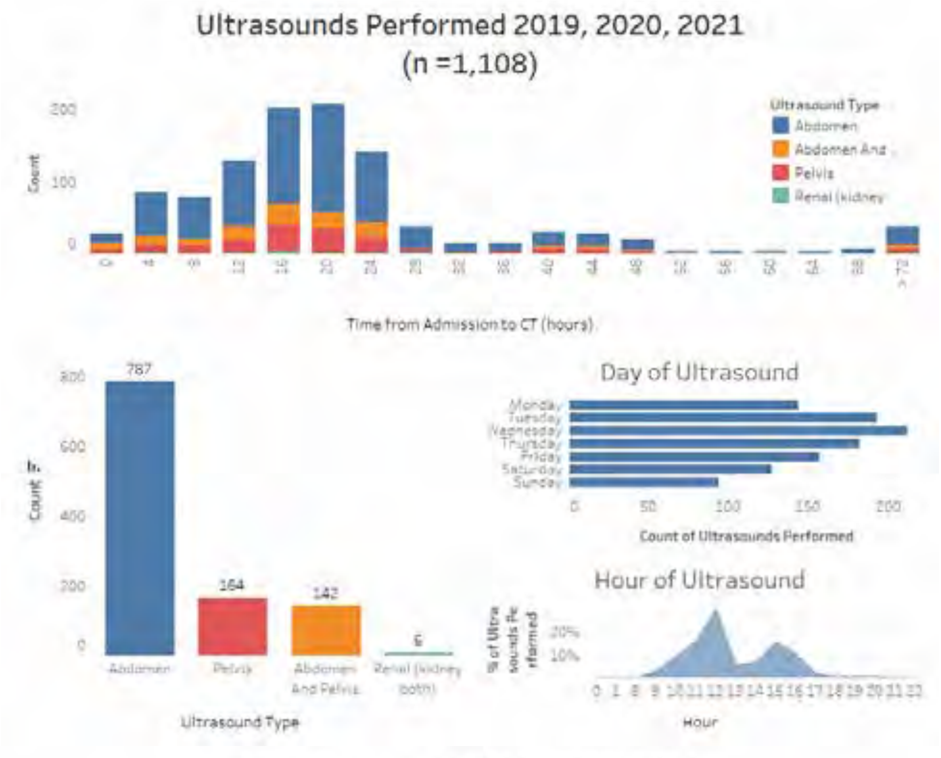
Use of Anticoagulants 2019, 2020, 2021

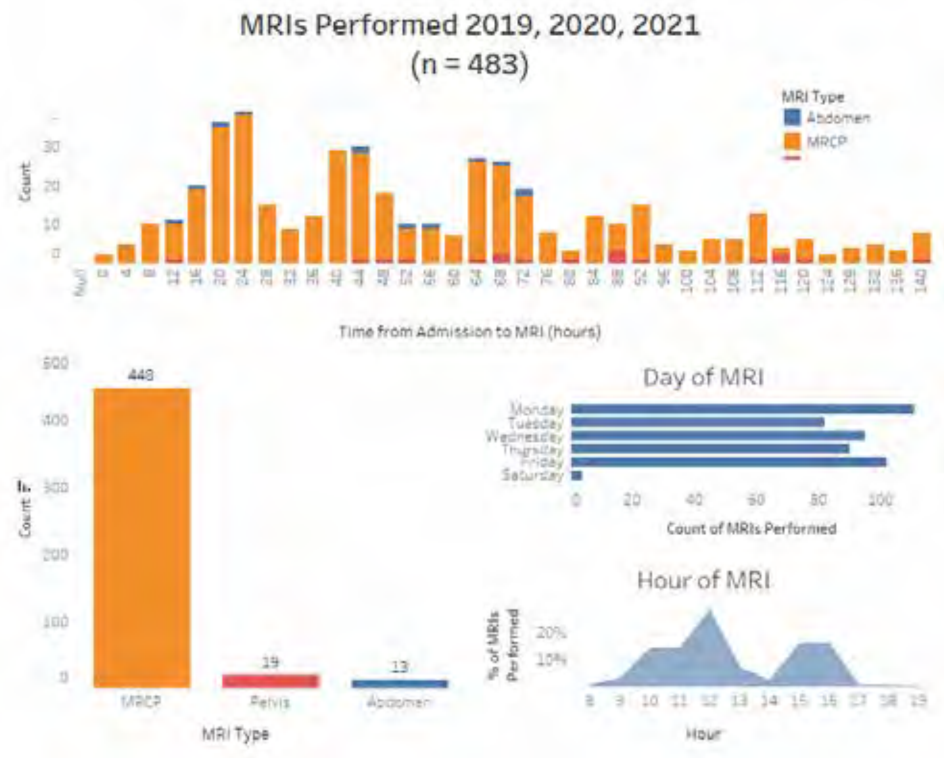


Lab Results 2019, 2020, 2021 (n=3,655)

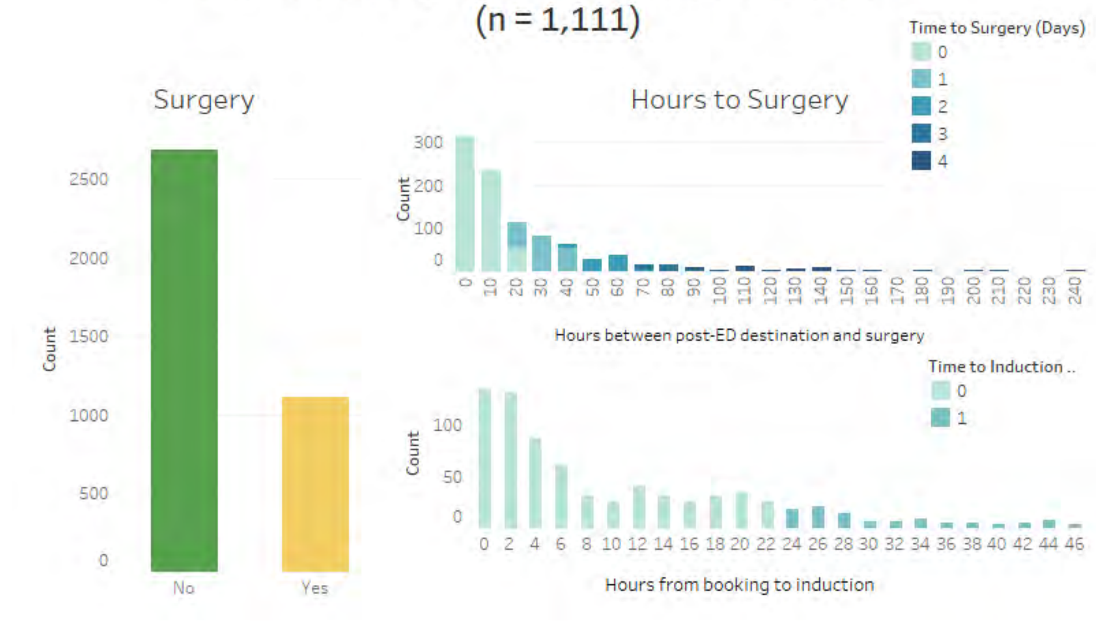

Imaging overview 2019, 2020, 2021
(n = 3,612)
n =
Chest Xray
PFA
CT
Ultrasound
MRI
1,672
592
1,995
1,108
483
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Time between Admission and Scan (hours)
Conditional probability of CT order given PFA
PFA Not Requested
PFA Requested
Probability of CT
80%
60%
40%
20%
0%
CT Not requested
CT Requested
CT Not requested
CT Requested
Conditional Probability of CT order given Ultrasound
US Not Requested
US Requested
Probability of CT
60%
40%
20%
0%
CT Not requested
CT Requested
CT Not requested
CT Requested

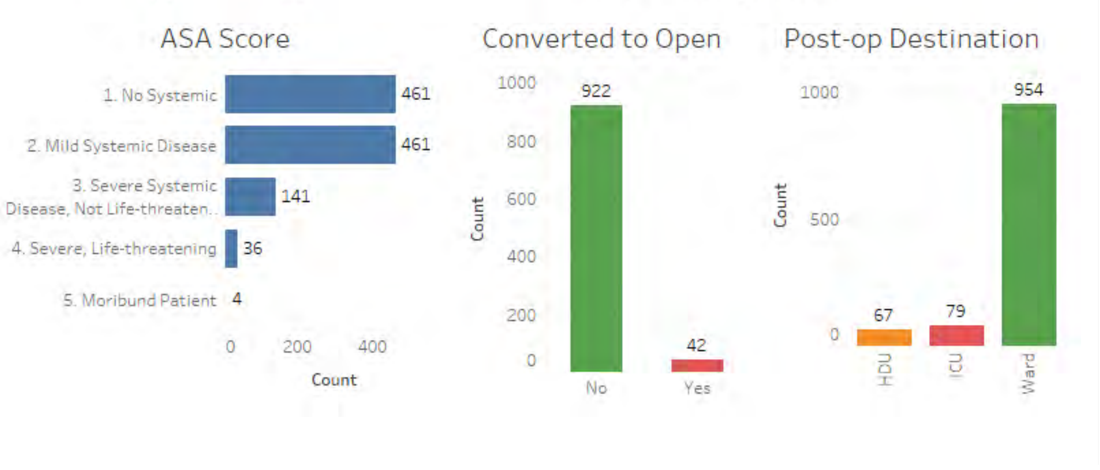

CT Scans Performed 2019, 2020, 2021
(n = 1,995)
Type of CT
Abdomen/Pelvis
CT Angio
KUB
TAP
Thorax
Urogram
Count
150
100
50
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 >
Time from Admission to CT (hours)
Count
2000
1500
1000
500
0
1,769
199
21
17
15
2
Abdomen/Pelvis
TAP
KUB
CT Angio
Thorax
Urogram
CT Type
Day of CT
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
100
200
300
Count
Hour of CT
% of CTs Performed
15%
10%
5%
0 2 4 6 8 10 12 14 16 18 20 22
Hour

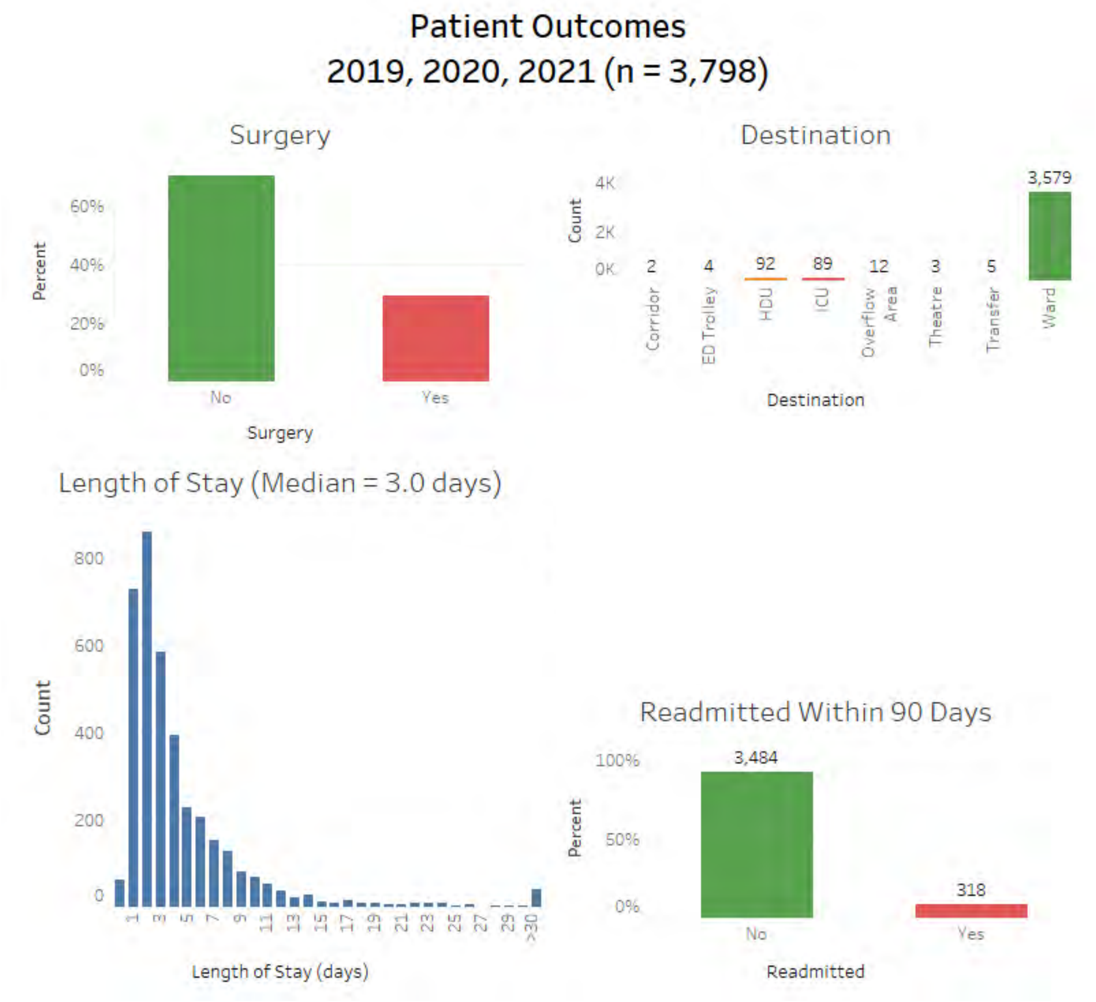

Ultrasounds Performed 2019, 2020, 2021
(n =1,108)
Count
200
100
0
Time from Admission to CT (hours)
Ultrasound Type
Abdomen
Abdomen And ..
Pelvis
Renal (kidney
Count
800
600
400
200
0
787
164
142
6
Abdomen
Pelvis
Abdomen And Pelvis
Renal (kidney both)
Ultrasound Type
Day of Ultrasound
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
50
100
150
200
Count of Ultrasounds Performed
Hour of Ultrasound
% of Ultrasounds Performed
20%
10%
Hour


MRIs Performed 2019, 2020, 2021
(n = 483)
Count
30
20
10
0
Time from Admission to MRI (hours)
MRI Type
Abdomen
MRCP
Count
500
400
300
200
100
0
448
19
13
MRCP
Pelvis
Abdomen
MRI Type
Day of MRI
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
0
20
40
60
80
100
Count of MRIs Performed
Hour of MRI
% of MRIs Performed
20%
10%
8
9
10
11
12
13
14
15
16
17
18
19
Hour

Patient undergoing surgery 2019, 2020, 2021
(n = 1,111)





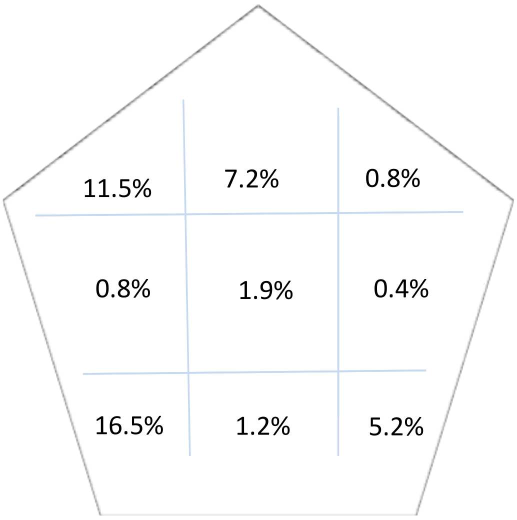


Patient Outcomes
2019, 2020, 2021 (n = 3,798)

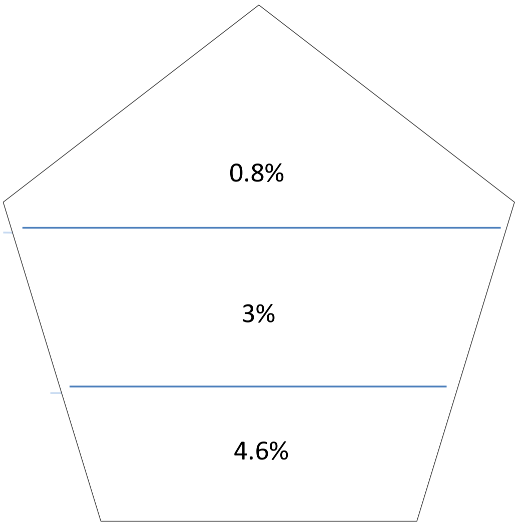
Location of abdominal pain at presentation

These series of figures represent the 17 locations of abdominal pain recorded by the admitting surgical teams.
(n= 6400)

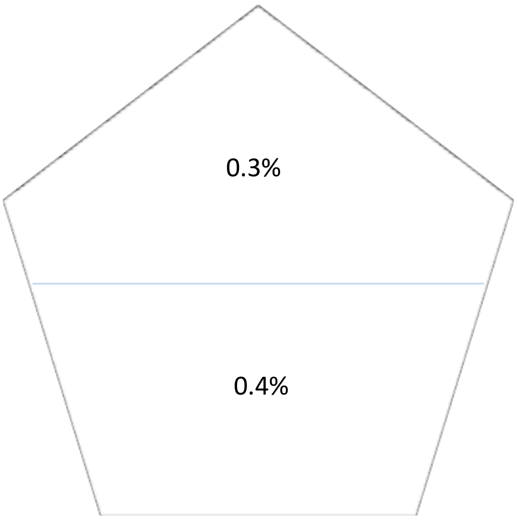
1. Epigastric = 464
2. Left Upper Quadrant = 54
3. Left Para-umbilical = 30
4. Left Iliac Fossa = 333
5. Suprapubic = 74
6. Right Iliac Fossa = 1059
7. Right Para-umbilical = 55
8. Right Upper Quadrant = 742
9. Para-umbilical = 126



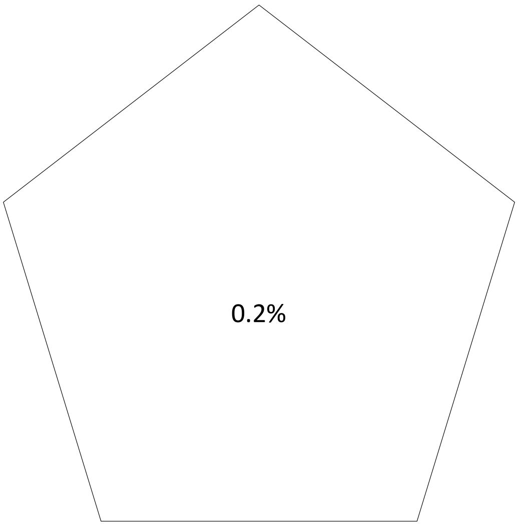
10. Upper abdominal pain = 53
11. Central = 195
12. Lower = 298



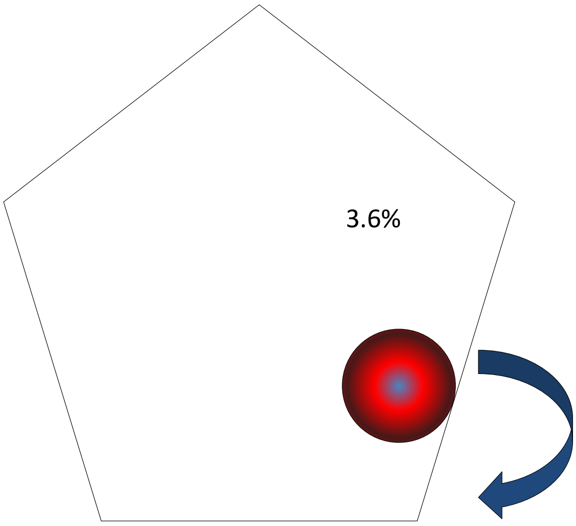
13. Upper Half = 23
14. Lower Half = 27



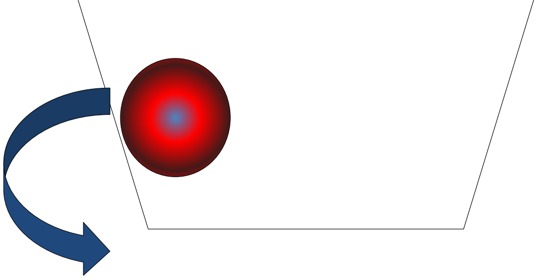
15. Entire Abdomen = 11



16. Right Flank/Renal = 276



17. Left Flank/Renal = 236



Right Upper Quadrant Pain & Cholecystitis Module

Editorial Comment

Surgeons and the health care teams can pride themselves on management of elective patients with biliary colic and cholecystitis, in part due to the smooth and safe transformation from open to laparoscopic surgery. In addition there had been a reduction in variability in elective practice and a more streamlined approach to surgical techniques and safety.

During the eSOAP program the team have made significant contribution to the operative classification of surgical findings and a new operating template developed has been endorsed by the World Society of Emergency Surgery (WSES) and now translated into Mandarin, Arabic and Japanese.

The challenge remains in some health care sectors to deliver timely surgery to patients presenting with cholecystitis. The registry has identified almost a thousand patients with right upper quadrant pain (RUQ) in 3 years admitted to Letterkenny University Hospital. Only 60% of those present in normal working hours from 08.00am to 18.00, with two peaks at 11.00 and 17.00. Tuesday being the most common day for presentation with a distinct COVID related effect with reduction in admissions in late 2020. Only 35% of patients with cholecystitis underwent same admission surgery

Right upper quadrant pain has a bimodal gender presentation affecting older males and younger females with a median age of 52 years in females and 69 in males. 22% of patients are transported by Ambulance to hospital. The workload experienced by surgeons in RUQ patient approaches 50 cases per year. The patients may present with a septic profile and 110/332 had rigors on presentation. Inflammatory markers were significantly elevated; in 20% of these patients with markedly elevated White Cell Count, CRP and associated abnormal liver function tests. Anaemia occurred in 24% with renal impairment in 15%.

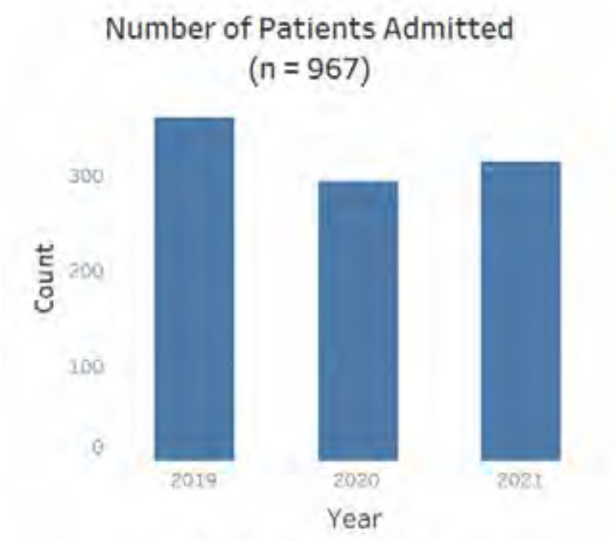
Imaging was undertaken in over 50% of patients with ultrasound undertaken as the main imaging modality at a median time of almost 24 hours post admissions. MRI scans are performed in 331 patients at a median time of 48 hours and CT scans in 340 patients at a median time of 24 hours. The dominant day for performing CT was Saturday. Of those right upper quadrant pain patients a final diagnosis of cholecystitis was documented in 30%, 326 patients undergoing a formal diagnosis of cholecystitis with surgery performed in 35% of these. Of those who did not have surgery 43 were readmitted within 90 days. The median length of stay was 3 days.

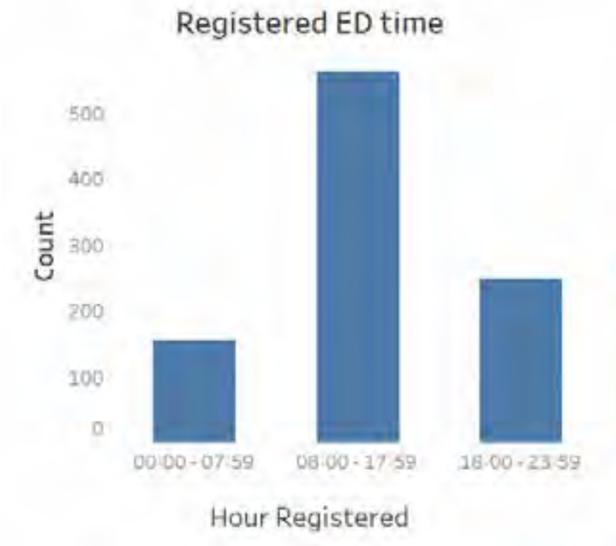
The registry has identified that the management of right upper quadrant pain is an essential part of clinical care in a busy hospital. There is a need for prompt ultrasound with the use of point of care ultrasound and weekend ultrasound and greater utilization of index admission surgery.

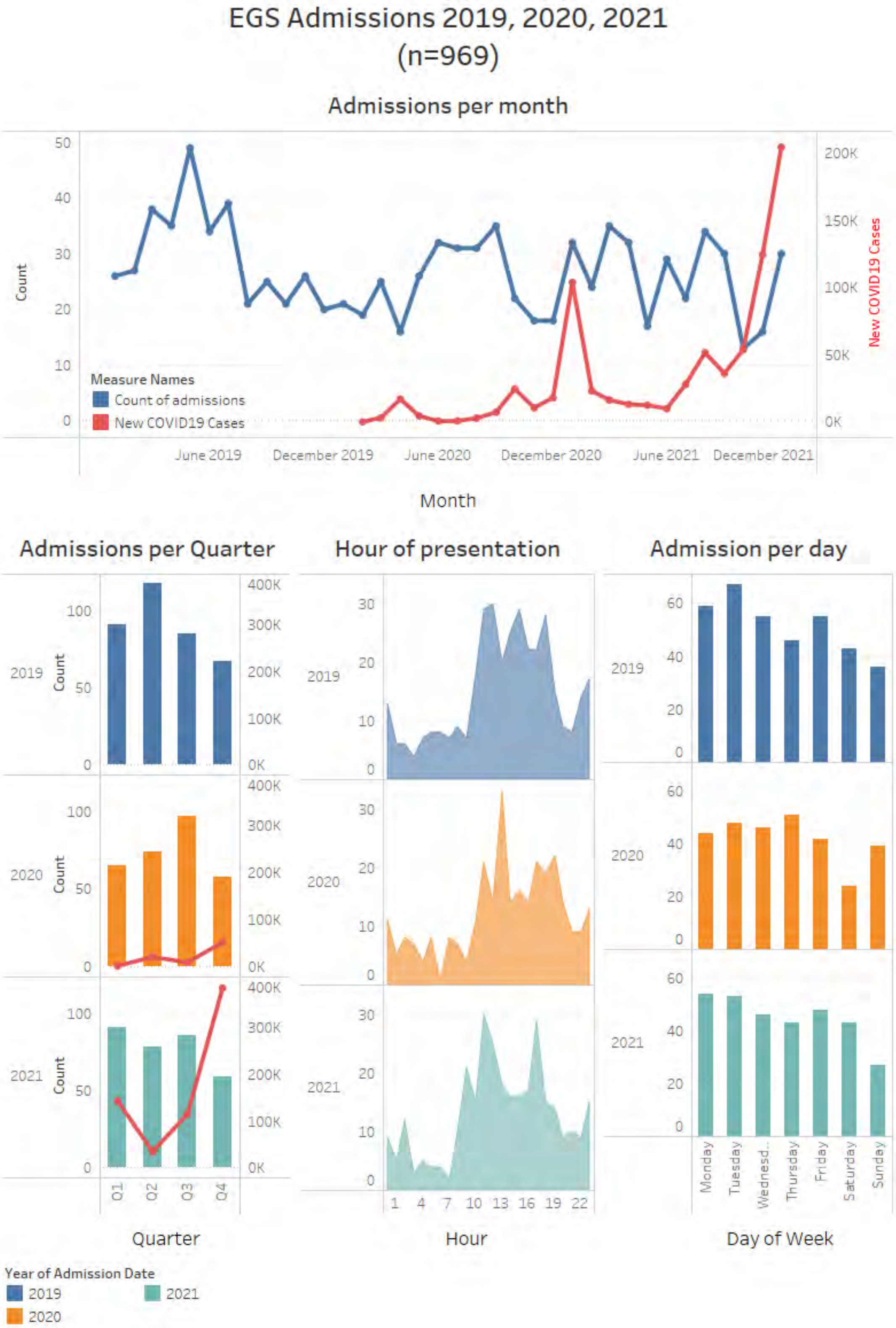
Recommendations

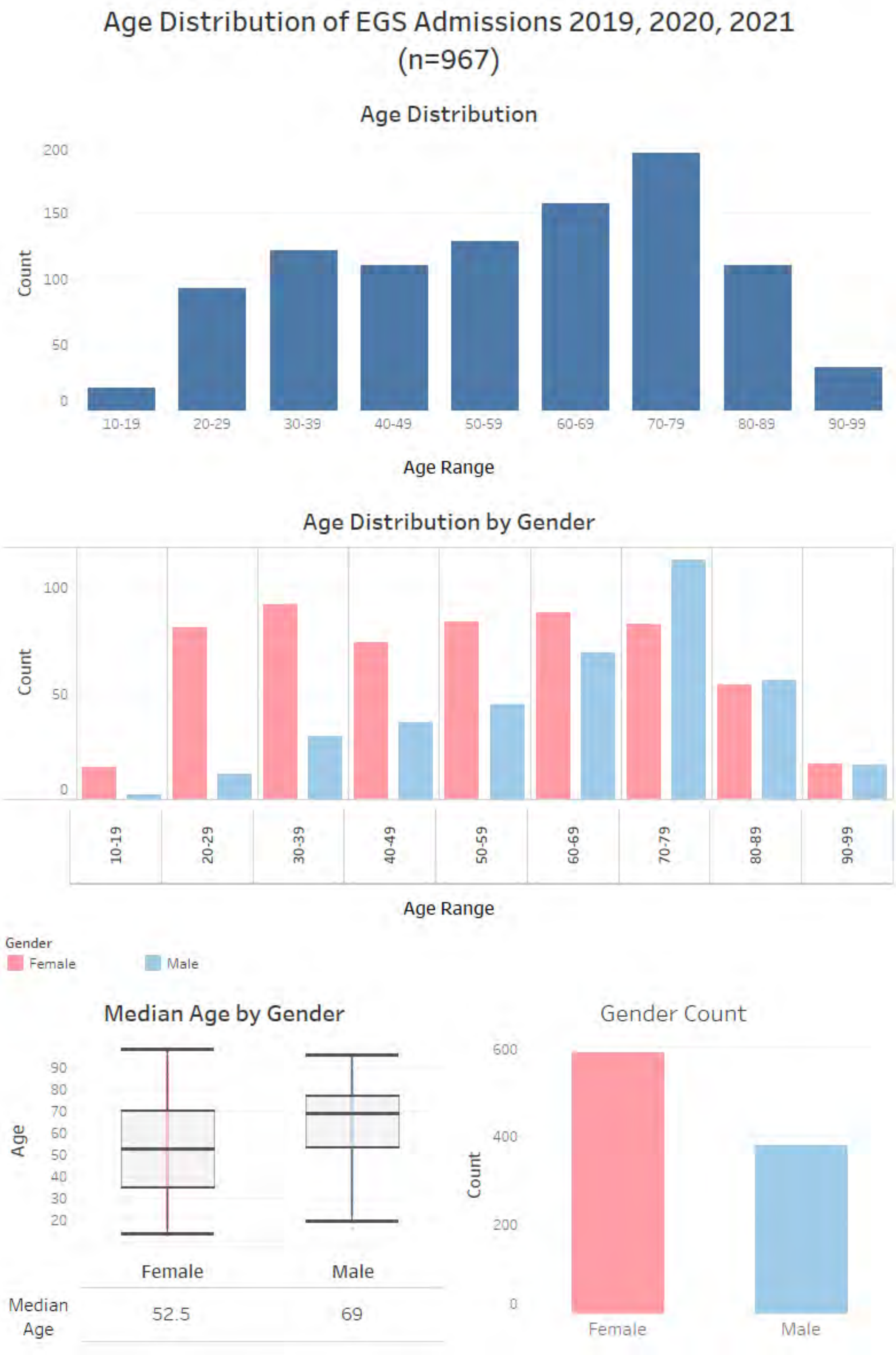
- The large volume of right upper quadrant pain admissions require clear decision pathways to streamline care
- Point of Care US should be introduced to the Emergency Department to facilitate earlier diagnosis
- Access to MRI in patients with suspected bile duct pathology needs to be more available
- Evaluation of the reason for the low index surgery rates needs to be undertaken
- Access to emergency surgery list needs to be enhanced
- Digitally archived of operative procedure may enhance safety and reduce bile leaks
- Patient related outcome measures should be monitored.

Overall RUQ

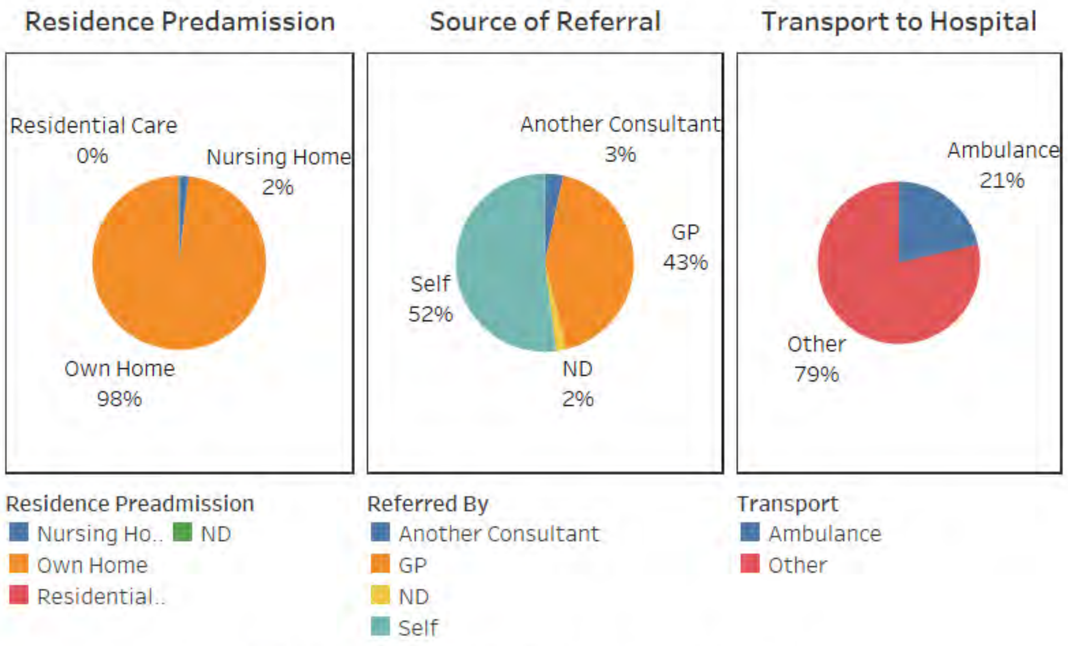




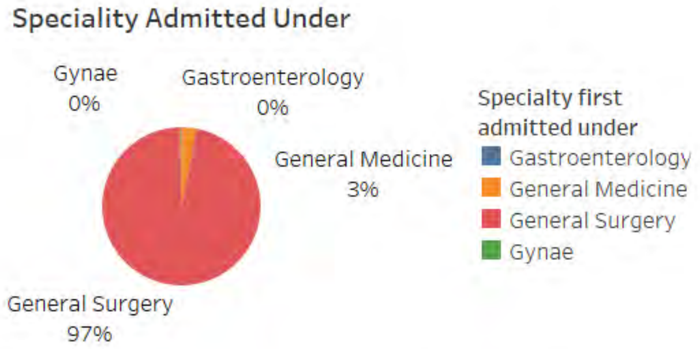

EGS Admissions 2019, 2020, 2021
(n=969)
Admissions per month
Count
50
40
30
20
10
0
200K
150K
100K
50K
0K
New COVID19 Cases
Measure Names
🟦 Count of admissions
🟥 New COVID19 Cases
June 2019
December 2019
June 2020
December 2020
June 2021
December 2021
Month
Admissions per Quarter
Hour of presentation
Admission per day
2019
2020
2021
Count
100
50
0
400K
300K
200K
100K
0K
Q1
Q2
Q3
Q4
Quarter
30
20
10
0
1
4
7
10
13
16
19
22
Hour
60
40
20
0
Monday
Tuesday
Wednesd...
Thursday
Friday
Saturday
Sunday
Day of Week
Year of Admission Date
🟦 2019
🟩 2021
🟧 2020

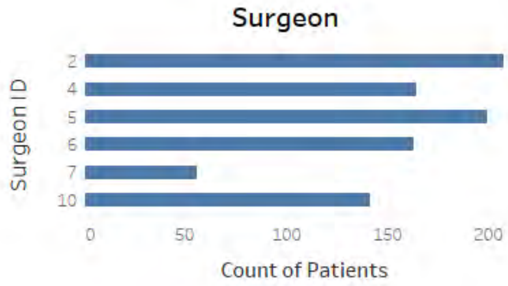

Age Distribution of EGS Admissions 2019, 2020, 2021
(n=967)
Age Distribution
Count
200
150
100
50
0
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
90-99
Age Range
Age Distribution by Gender
Count
100
50
0
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
90-99
Age Range
Gender
Female
Male
Median Age by Gender
Age
90
80
70
60
50
40
30
20
Female
Male
Median Age
52.5
69
Gender Count
Count
600
400
200
0
Female
Male

Patient Journey in 2019, 2020, 2021
(n=969)



Specialty & Surgeon 2019, 2020, 2021
(n=969)



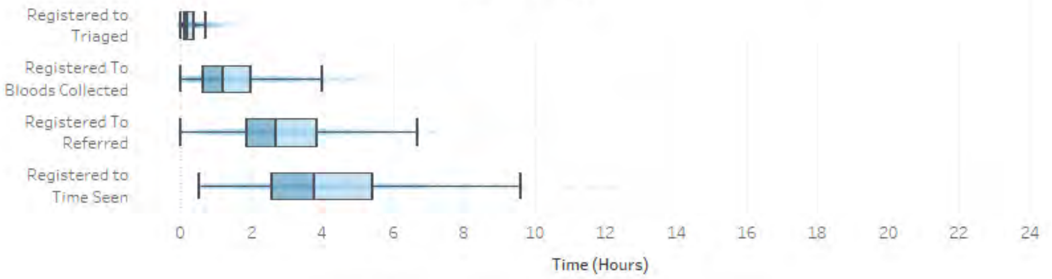


Surgeon by year

Consultant Surgeon	2019	2020	2021	Grand Total
2	95	54	58	207
4	65	59	40	164
5	82	60	57	199
6	59	58	46	163
7	56			56
10	3	63	75	141

*Due to rounding, 0% represents specialties with less than 1% of patients admitted

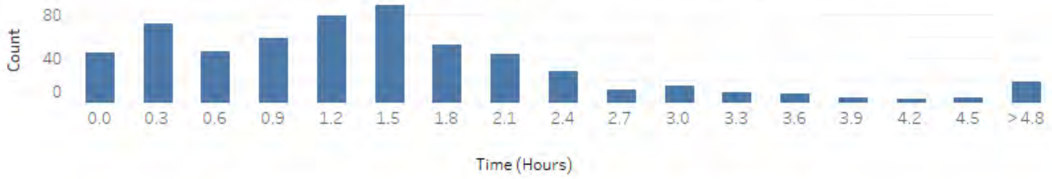
Emergency Department Times 2019, 2020, 2021 (n=799)



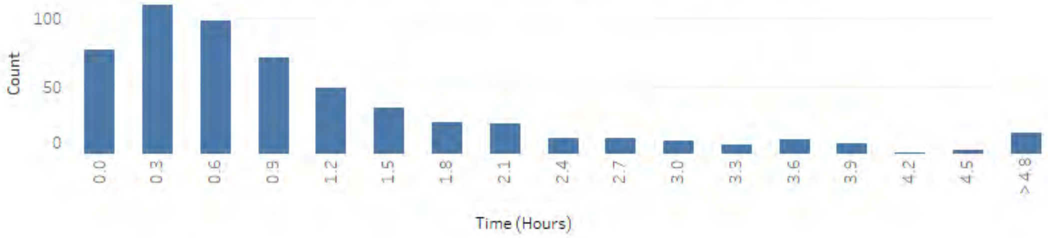
Registered to Triage (Median = 0.18 hrs)

Triage to Bloods Collected (Median = 0.90 hrs)

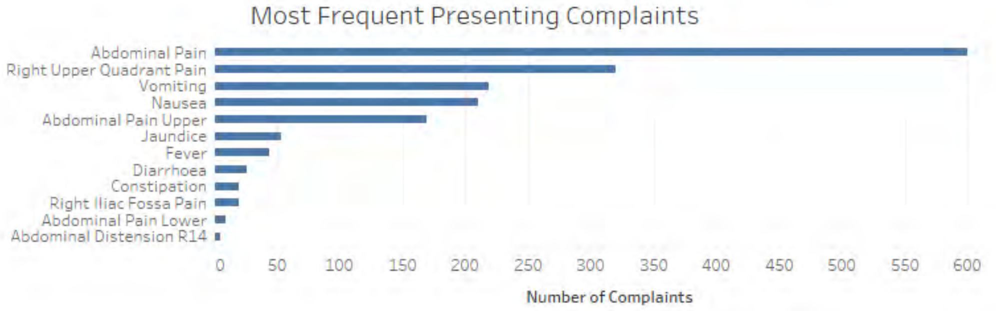
Bloods Collected to Time Referred (Median = 1.48 hrs)

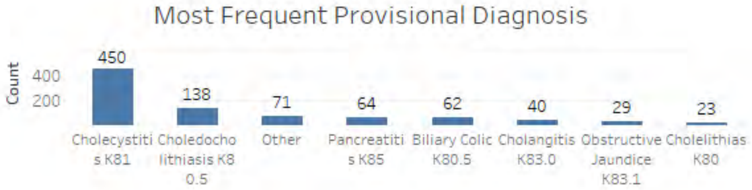


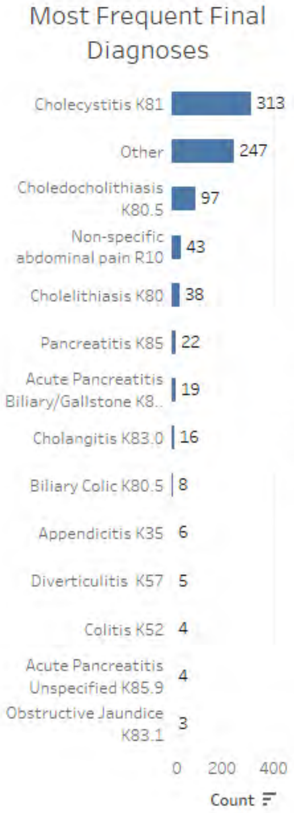
Time Referred to Time Seen (Median = 0.86 hrs)



Presenting Complaints & Diagnoses 2019, 2020, 2021 (n=967)



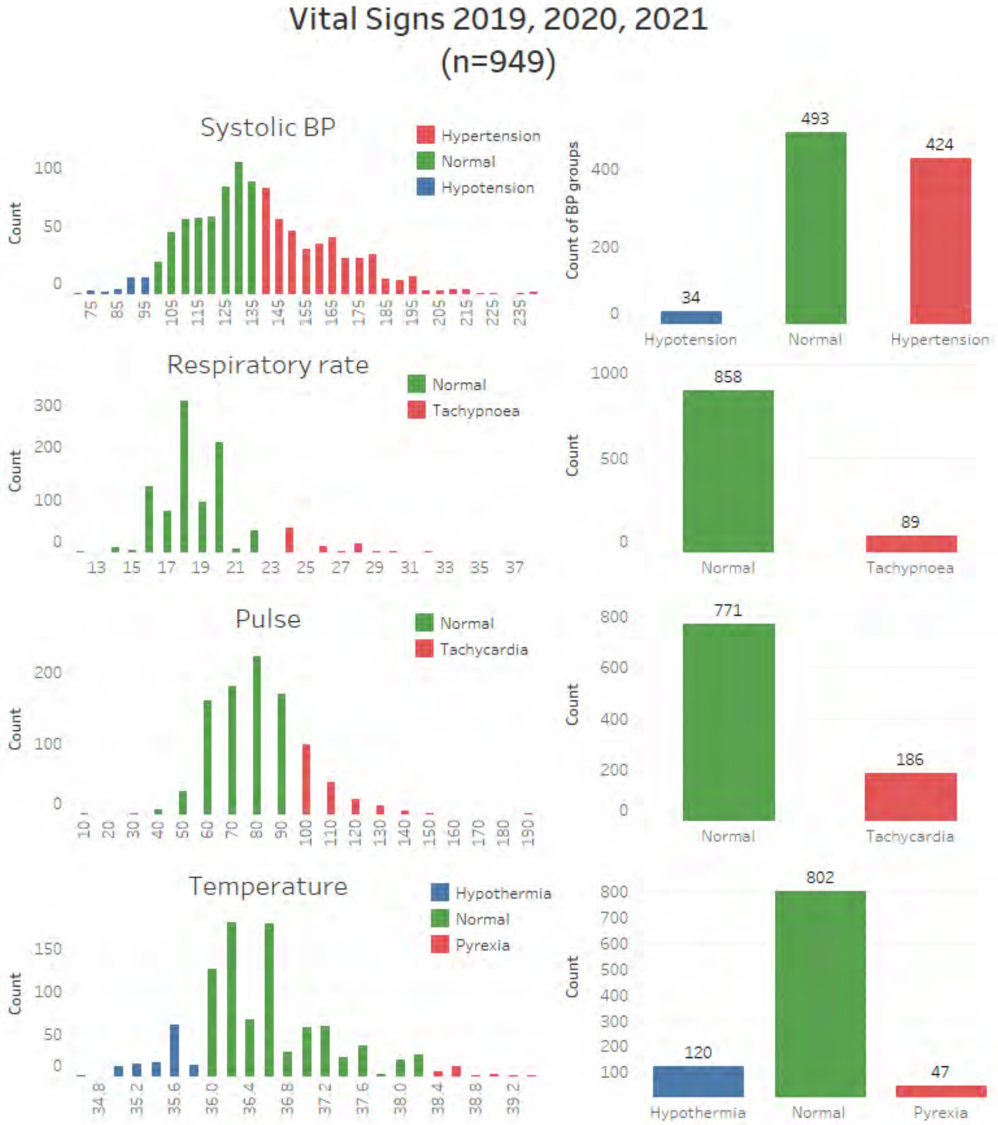


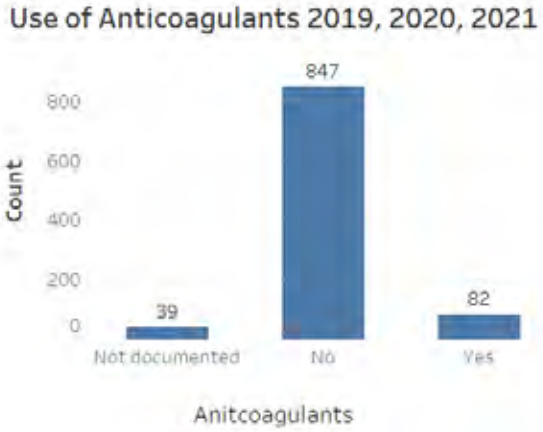


Provisional Diagnosis

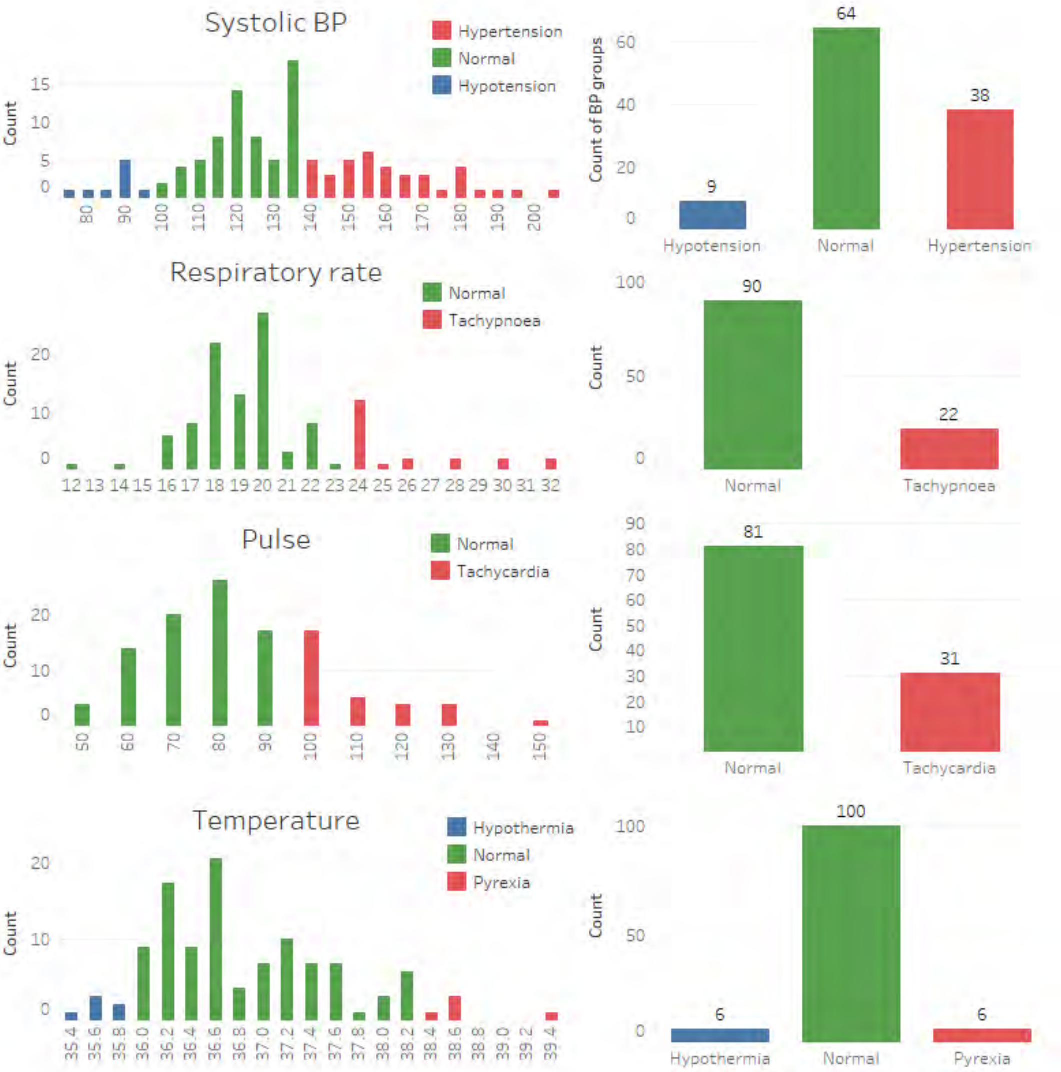
Final Diagnosis	Chole-cystitis	Choledoch-olithiasis	Other	Biliary Colic	Pancreatitis	Cholangitis	Obstructive Jaundice	Cholelithias
Cholecystitis K81	237	18	17	22	9	7	4	6
Other	83	60	59	13	9	15	13	4
Choledocholithiasis K80.5	22	48	11	1	3	9	7	4
Non-specific abdominal pain R10	30	3	0	4	3	0	0	4
Cholelithiasis K80	17	14	2	3	1	1	1	2
Pancreatitis K85	2	1	0	0	18	2	0	0
Acute Pancreatitis Biliary/Gallstone K85.1	2	1	0	0	15	0	0	0
Cholangitis K83.0	5	2	1	2	1	6	0	2
Biliary Colic K80.5	5	0	0	2	1	0	0	0
Appendicitis K35	5	0	1	1	0	0	0	0
Diverticulitis K57	4	0	0	1	1	0	0	0
Colitis K52	3	0	0	0	1	0	0	0
Acute Pancreatitis Unspecified K85.9	0	0	0	0	4	0	0	0
Obstructive Jaundice K83.1	0	0	0	0	0	0	3	0

*Values in confusion table do not sum to adjacent histograms as they only show the most frequent provisional and final diagnoses


Vital Signs 2019, 2020, 2021
(n=949)
Systolic BP
Hypertension
Normal
Hypotension
Count
100
50
0
75 85 95 105 115 125 135 145 155 165 175 185 195 205 215 225 235
Count of BP groups
400
200
0
34
493
424
Hypotension
Normal
Hypertension
Respiratory rate
Normal
Tachypnoea
Count
300
200
100
0
13 15 17 19 21 23 25 27 29 31 33 35 37
1000
500
0
858
89
Normal
Tachypnoea
Pulse
Normal
Tachycardia
200
100
0
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190
800
600
400
200
0
771
186
Normal
Tachycardia
Temperature
Hypothermia
Normal
Pyrexia
150
100
50
0
34.8 35.2 35.6 36.0 36.4 36.8 37.2 37.6 38.0 38.4 38.8 39.2
800
700
600
500
400
300
200
100
120
802
47
Hypothermia
Normal
Pyrexia

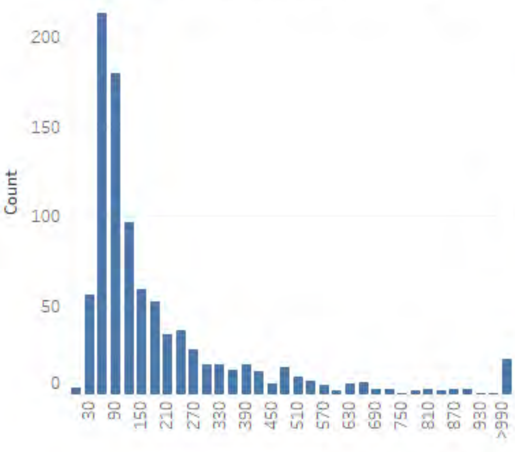

Use of Anticoagulants 2019, 2020, 2021
Count
800
600
400
200
0
39
847
82
Not documented
No
Yes
Anitcoagulants

Patients with Rigors: Vital Signs 2019, 2020, 2021 (n=112)

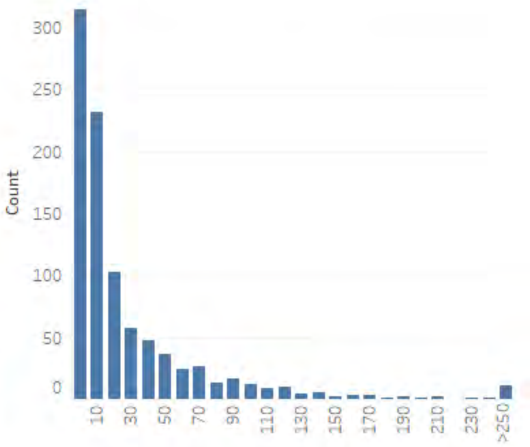


Lab Results 2019, 2020, 2021 (n=941)

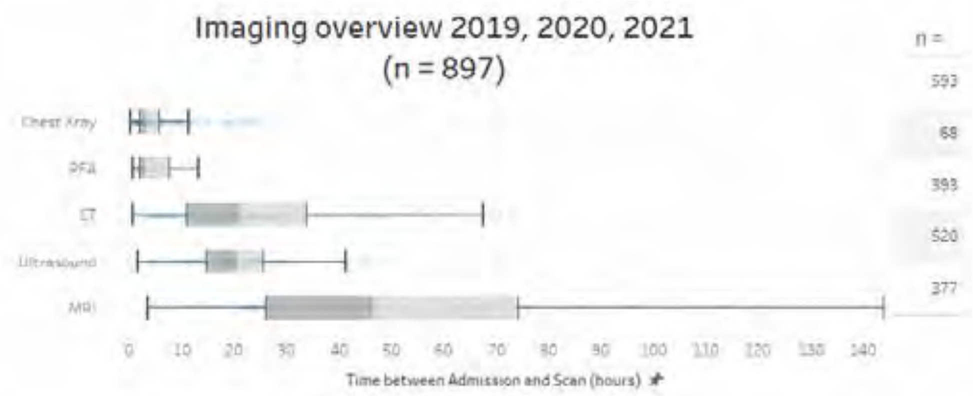
Alkaline Phosphatase (n = 934)



Bilirubin (n = 937)

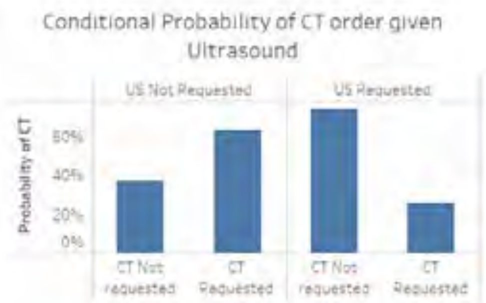


Lab Results 2019, 2020, 2021 (n=941)

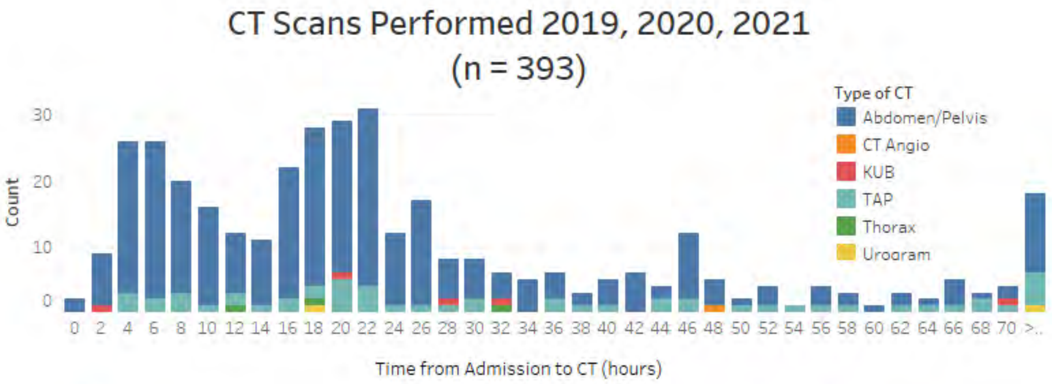


Imaging overview 2019, 2020, 2021
(n = 897)

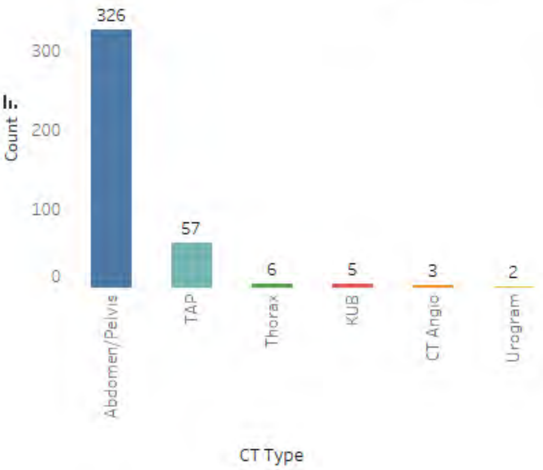
Conditional probability of CT order given PFA

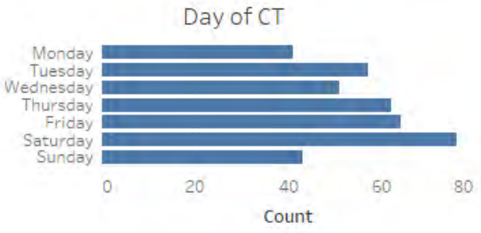


Conditional Probability of CT order given Ultrasound

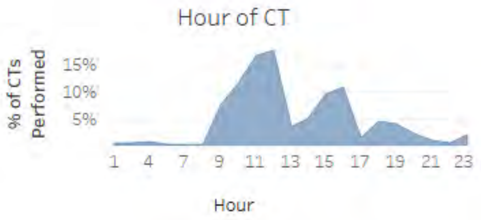


CT Scans Performed 2019, 2020, 2021
(n = 393)

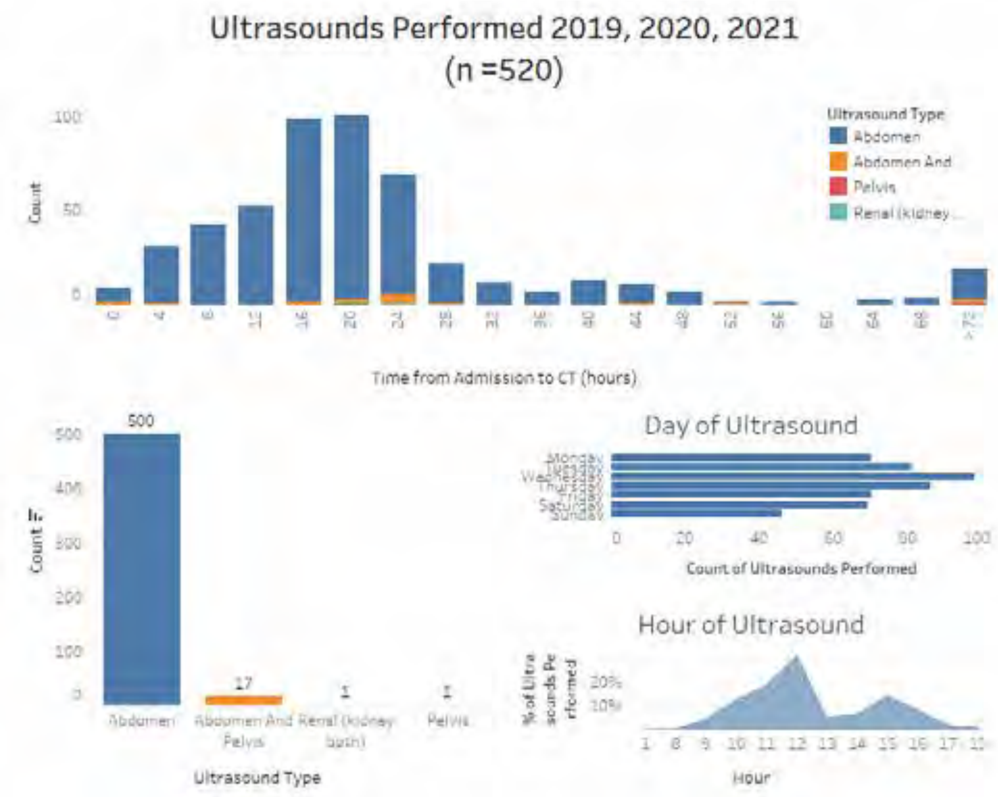


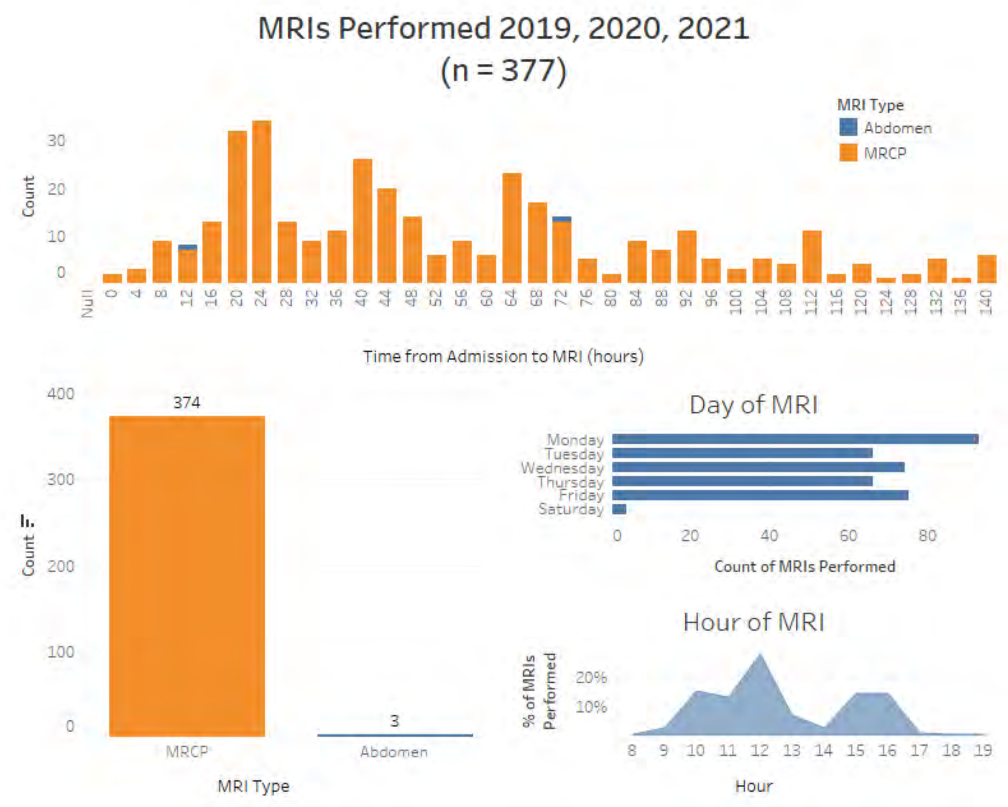


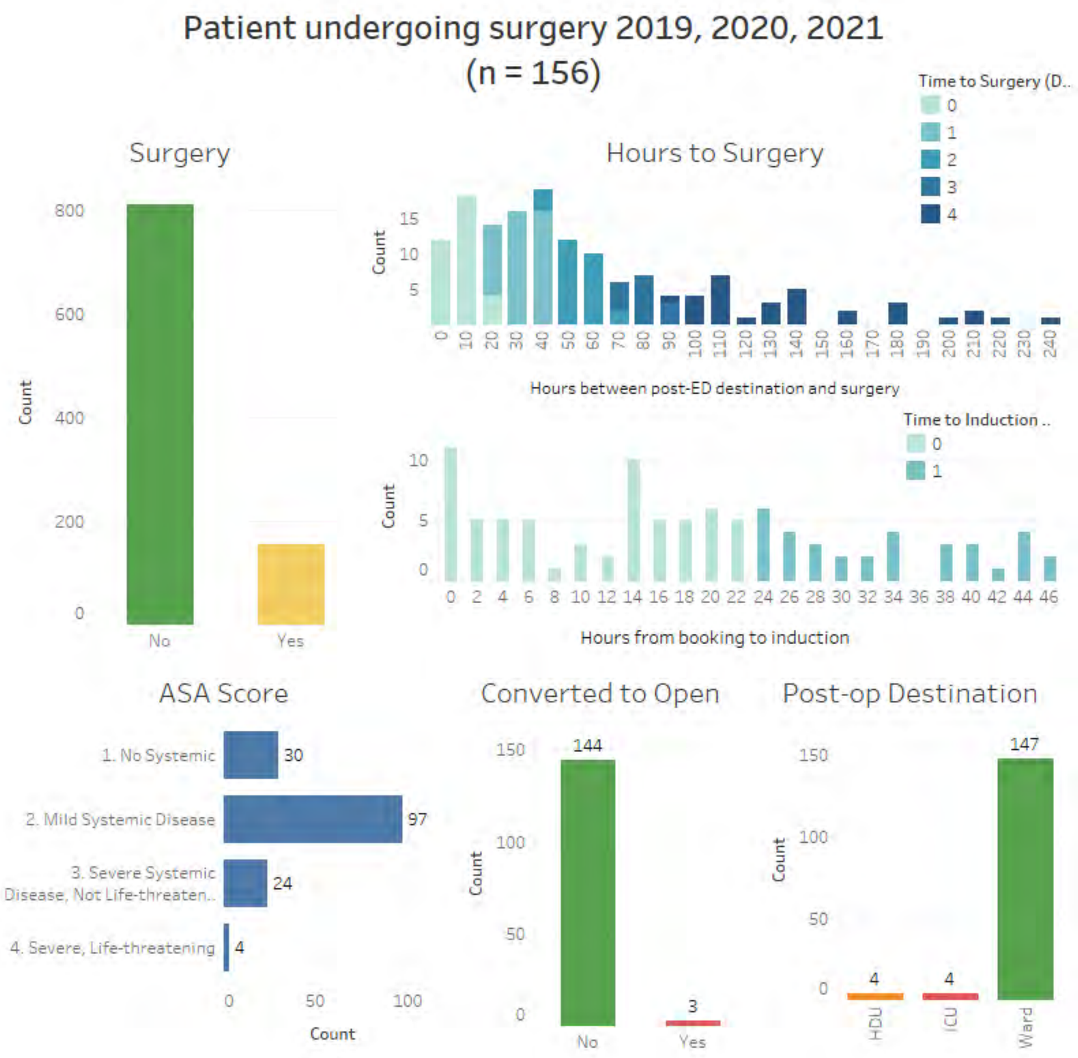
Day of CT

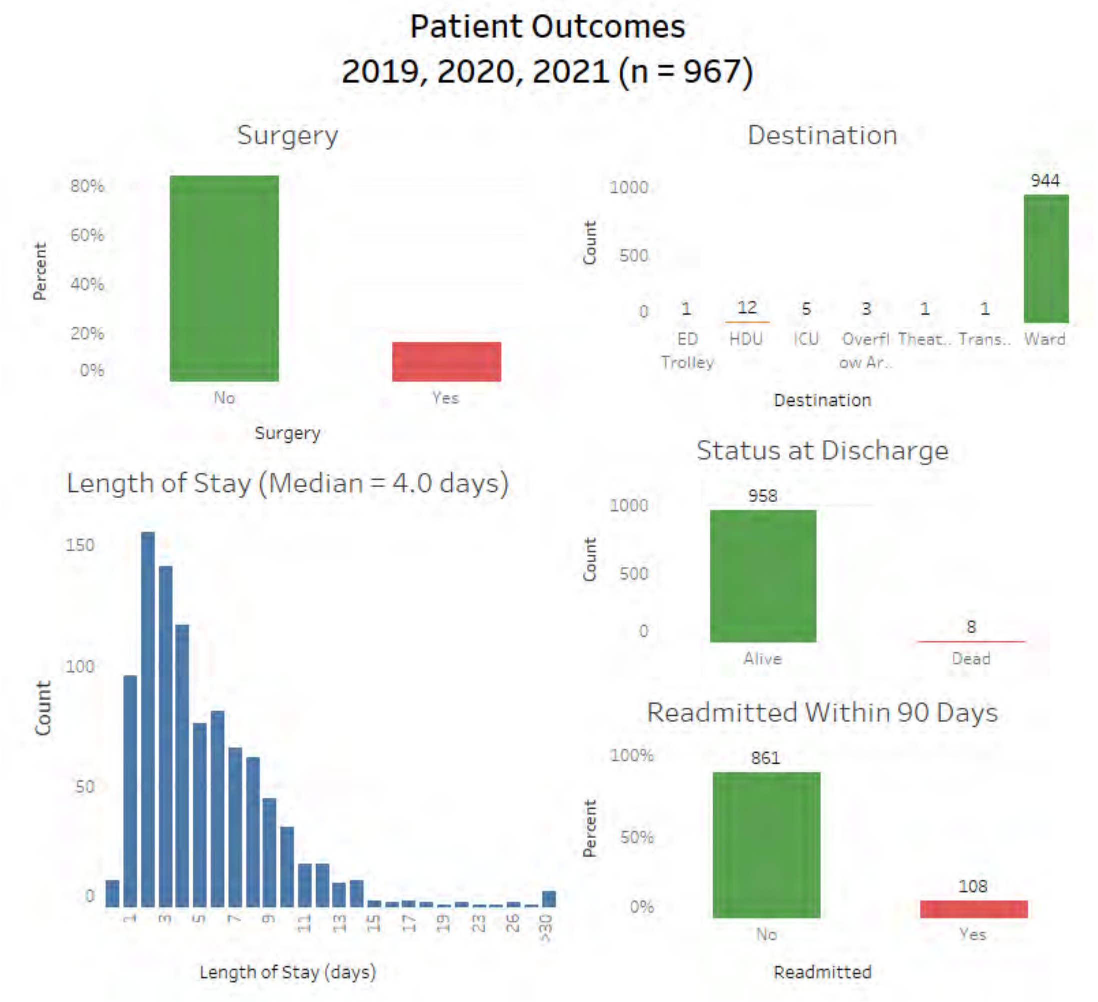


Hour of CT

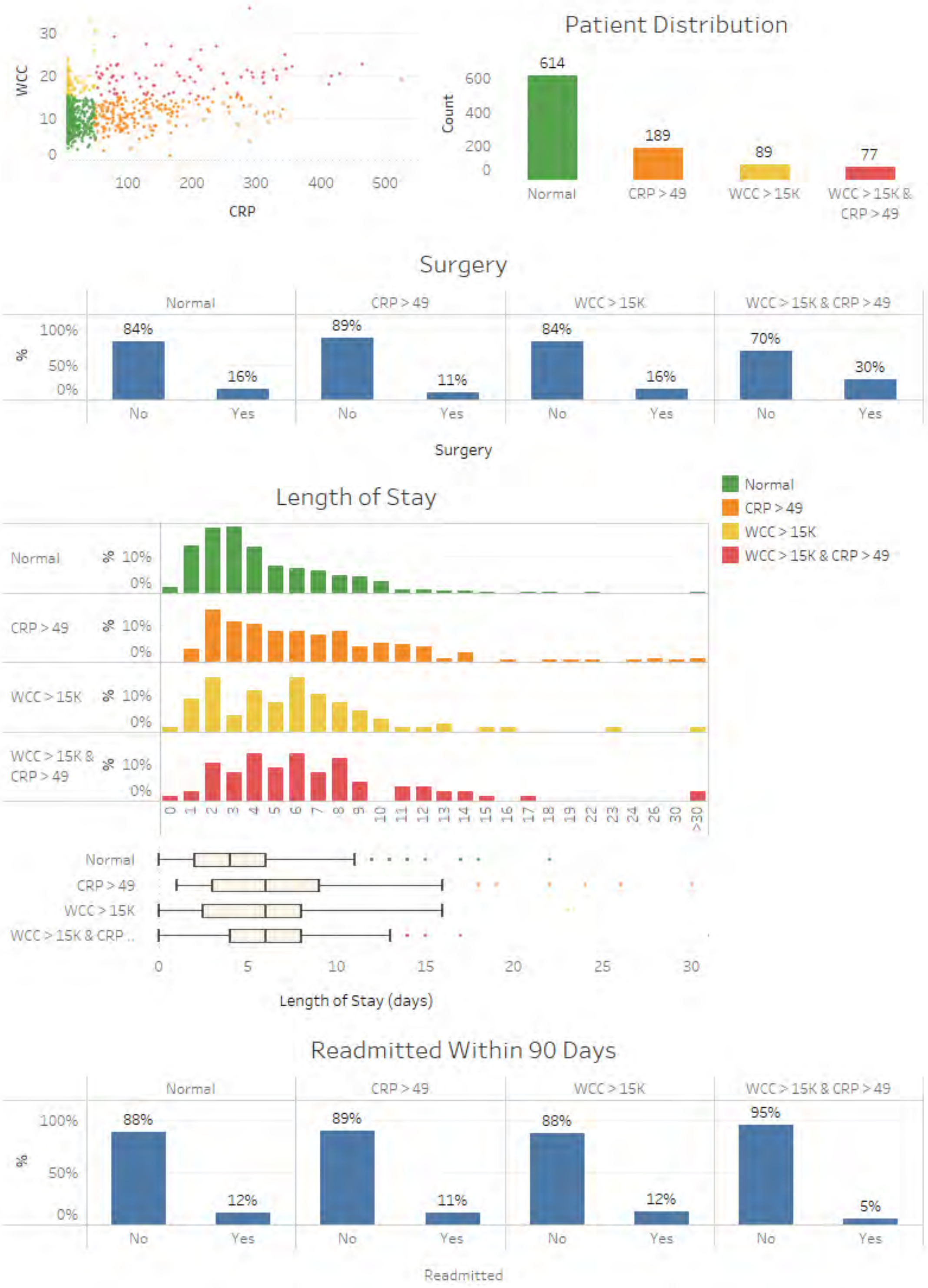

Ultrasounds Performed 2019, 2020, 2021
(n =520)
Ultrasound Type
Abdomen
Abdomen And
Pelvis
Renal (kidney...
Count
100
50
0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
>72
Time from Admission to CT (hours)
500
17
1
1
500
400
300
200
100
0
Count
Abdomen
Abdomen And Pelvis
Renal (kidney both)
Pelvis
Ultrasound Type
Day of Ultrasound
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
20
40
60
80
100
Count of Ultrasounds Performed
Hour of Ultrasound
% of Ultrasounds Performed
20%
10%
7
8
9
10
11
12
13
14
15
16
17
18
Hour


MRIs Performed 2019, 2020, 2021
(n = 377)
MRI Type
Abdomen
MRCP
Count
30
20
10
0
Null
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
84
88
92
96
100
104
108
112
116
120
124
128
132
136
140
Time from Admission to MRI (hours)
400
300
200
100
0
Count
374
3
MRCP
Abdomen
MRI Type
Day of MRI
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
0
20
40
60
80
Count of MRIs Performed
Hour of MRI
% of MRIs Performed
20%
10%
8
9
10
11
12
13
14
15
16
17
18
19
Hour

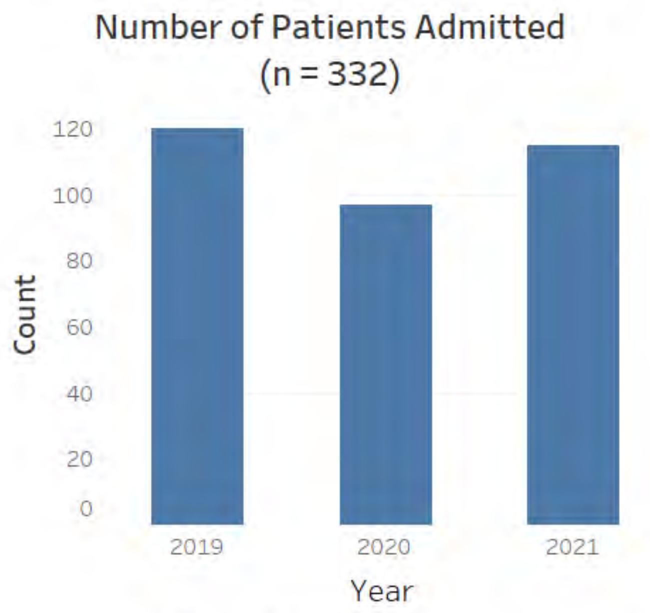

Patient undergoing surgery 2019, 2020, 2021
(n = 156)

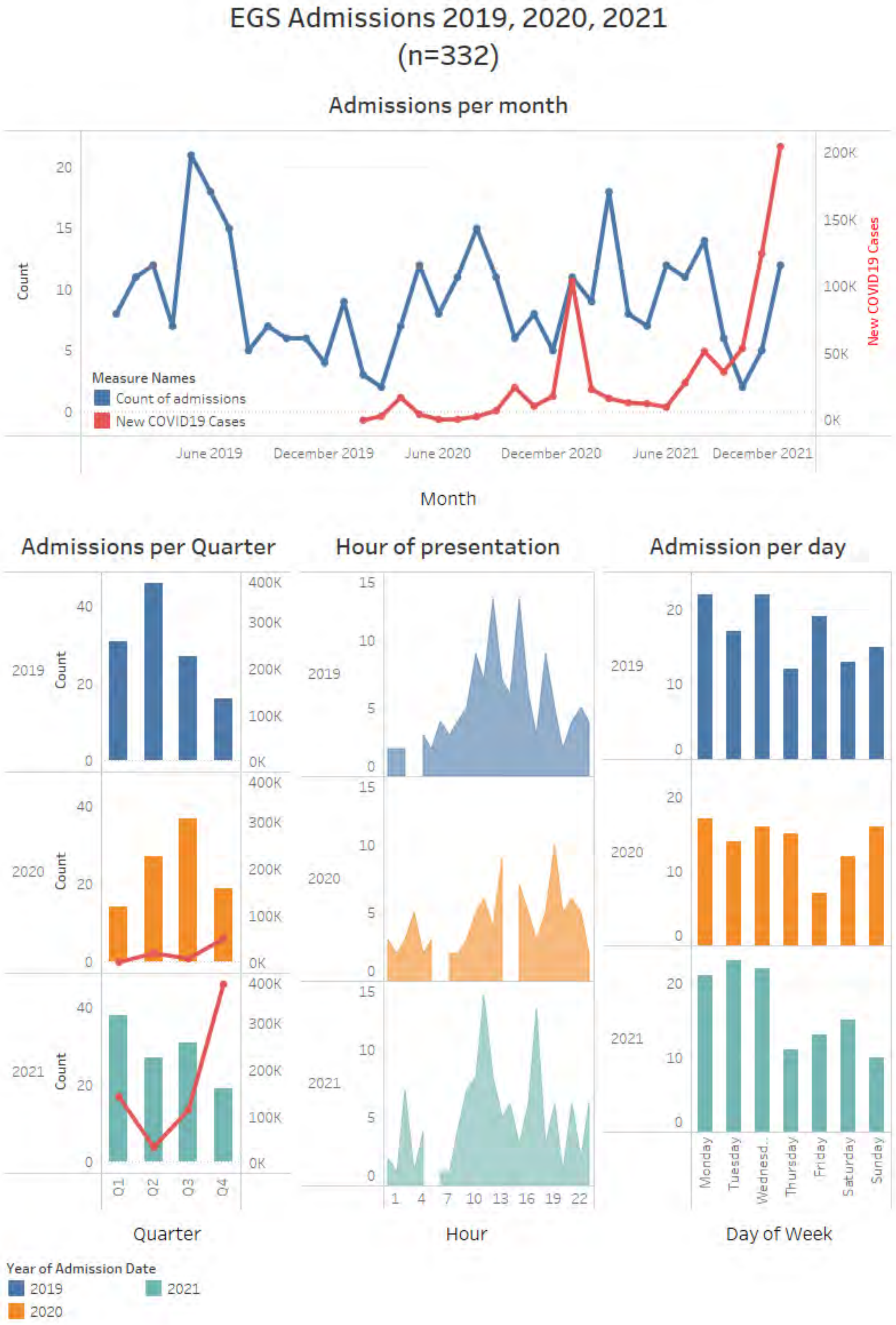

Patient Outcomes
2019, 2020, 2021 (n = 967)
Surgery
Percent
80%
60%
40%
20%
0%
No
Yes
Surgery
Destination
Count
1000
500
0
1
12
5
3
1
1
944
ED Trolley
HDU
ICU
Overfl ow Ar..
Theat..
Trans..
Ward
Destination
Length of Stay (Median = 4.0 days)
Count
150
100
50
0
1
3
5
7
9
11
13
15
17
19
23
26
>30
Length of Stay (days)
Status at Discharge
Count
1000
500
0
958
8
Alive
Dead
Readmitted Within 90 Days
Percent
100%
50%
0%
861
108
No
Yes
Readmitted

Patient Outcomes by Lab Results
2019, 2020, 2021 (n = 967)

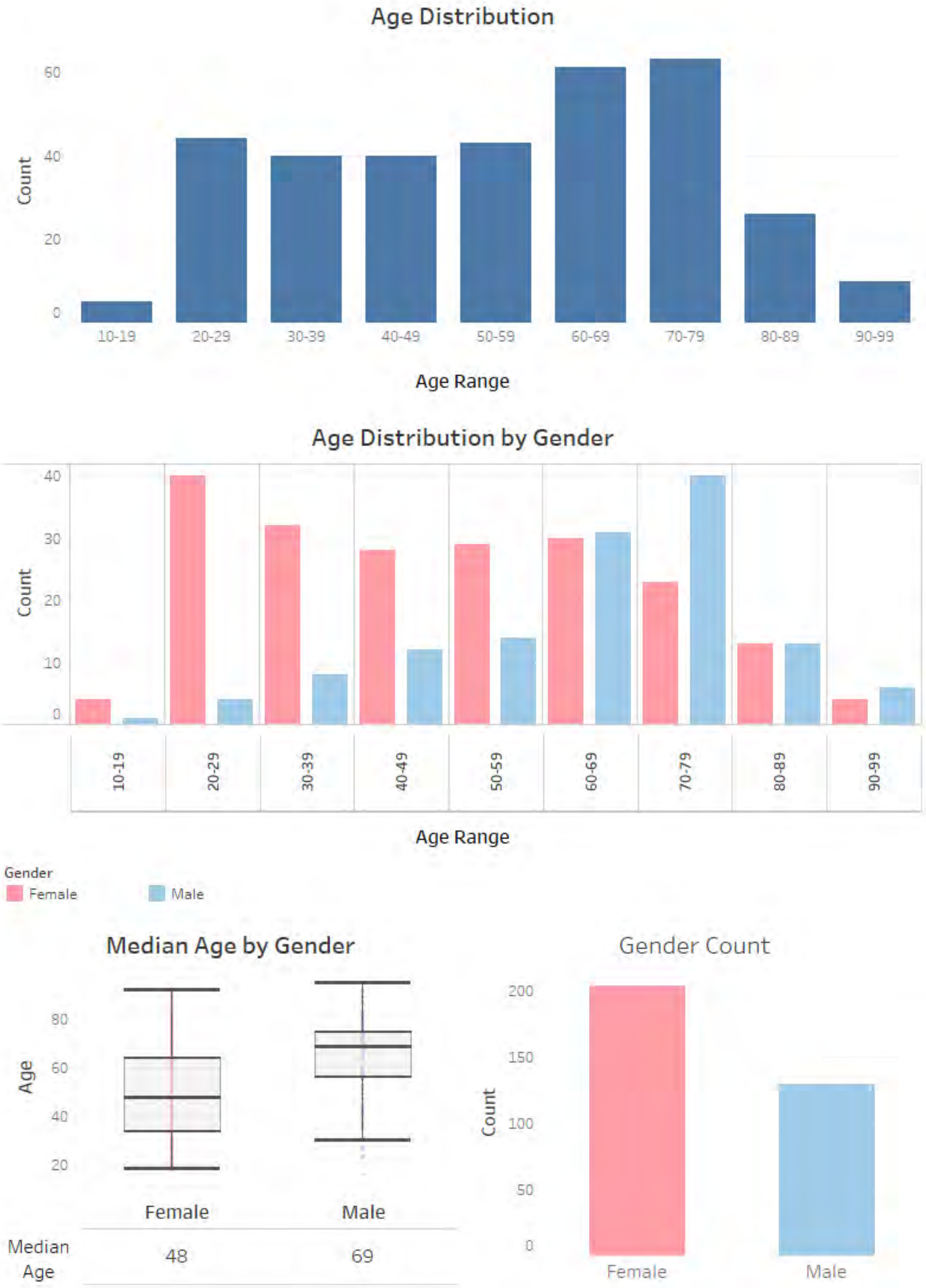


Final Diagnosis: Cholecystitis

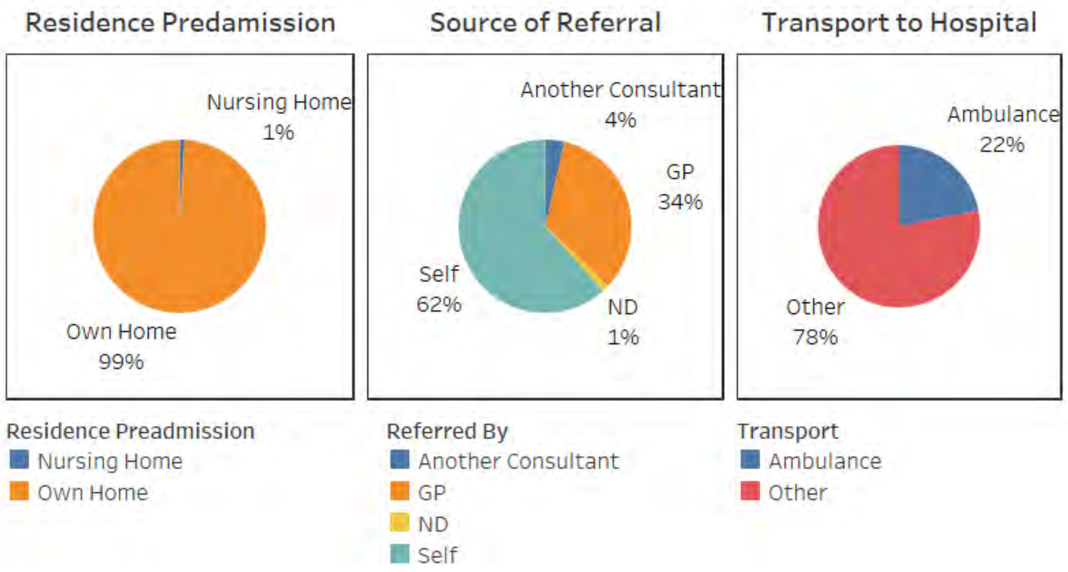



EGS Admissions 2019, 2020, 2021
(n=332)
Admissions per month
Count
20
15
10
5
0
200K
150K
100K
50K
0K
New COVID19 Cases
Measure Names
🟦 Count of admissions
🟥 New COVID19 Cases
June 2019
December 2019
June 2020
December 2020
June 2021
December 2021
Month
Admissions per Quarter
2019
2020
2021
Count
40
20
0
400K
300K
200K
100K
0K
Q1
Q2
Q3
Q4
Quarter
Hour of presentation
15
10
5
0
1
4
7
10
13
16
19
22
Hour
Admission per day
Monday
Tuesday
Wednesd..
Thursday
Friday
Saturday
Sunday
Day of Week
Year of Admission Date
🟦 2019
🟧 2020
🟩 2021

Age Distribution of EGS Admissions 2019, 2020, 2021 (n=332)

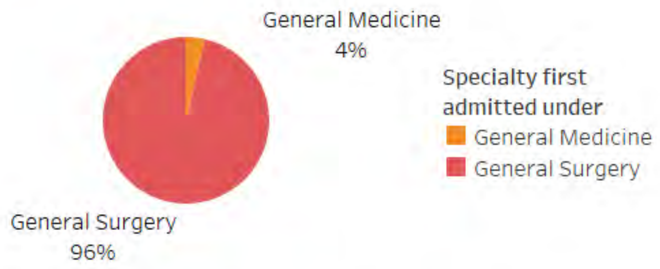


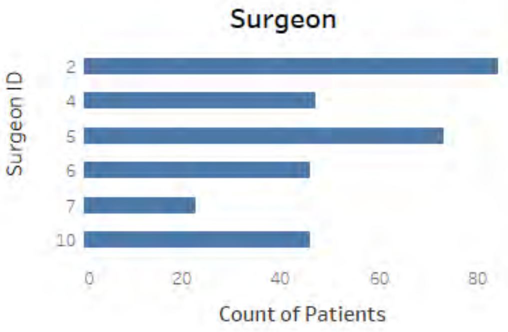
Patient Journey in 2019, 2020, 2021
(n=332)



Specialty & Surgeon 2019, 2020, 2021
(n=332)

Speciality Admitted Under

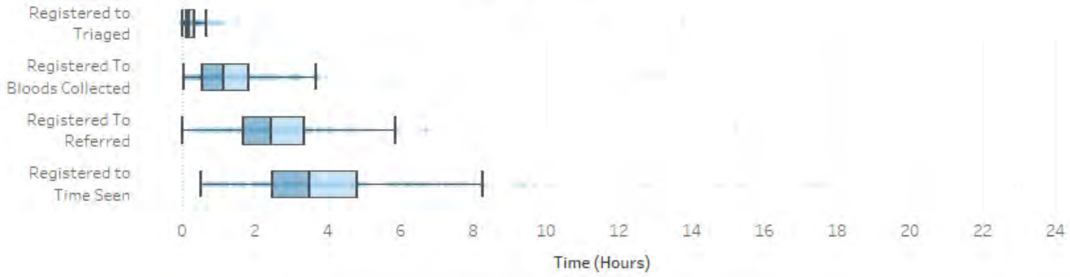




Surgeon by year

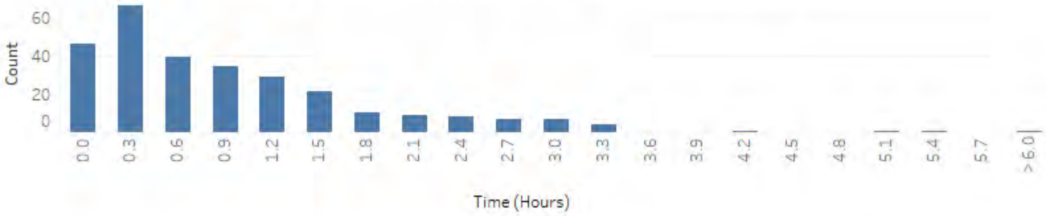
Consultant Surgeon	2019	2020	2021	Grand Total
2	36	19	29	84
4	12	26	9	47
5	29	18	26	73
6	18	14	14	46
7	23			23
10	1	20	25	46

Emergency Department Times 2019, 2020, 2021
(n=278)

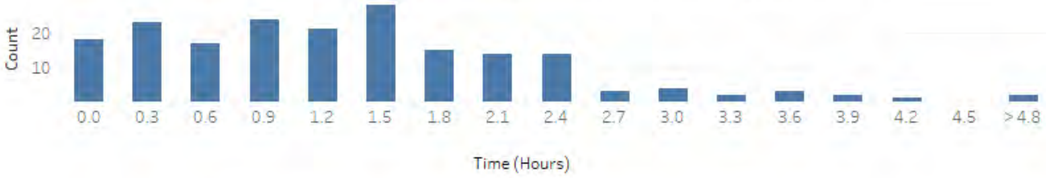


Registered to Triage (Median = 0.17 hrs)

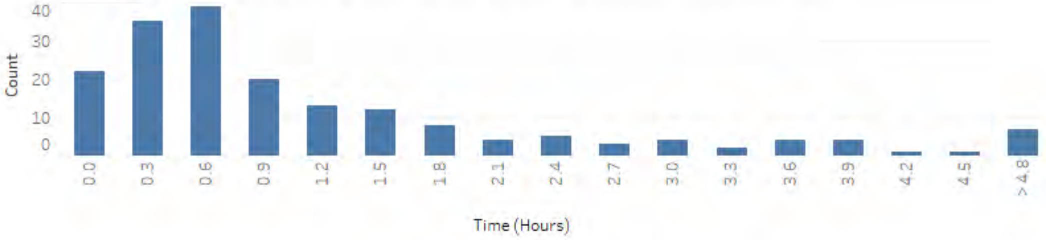
Triage to Bloods Collected (Median = 0.83 hrs)

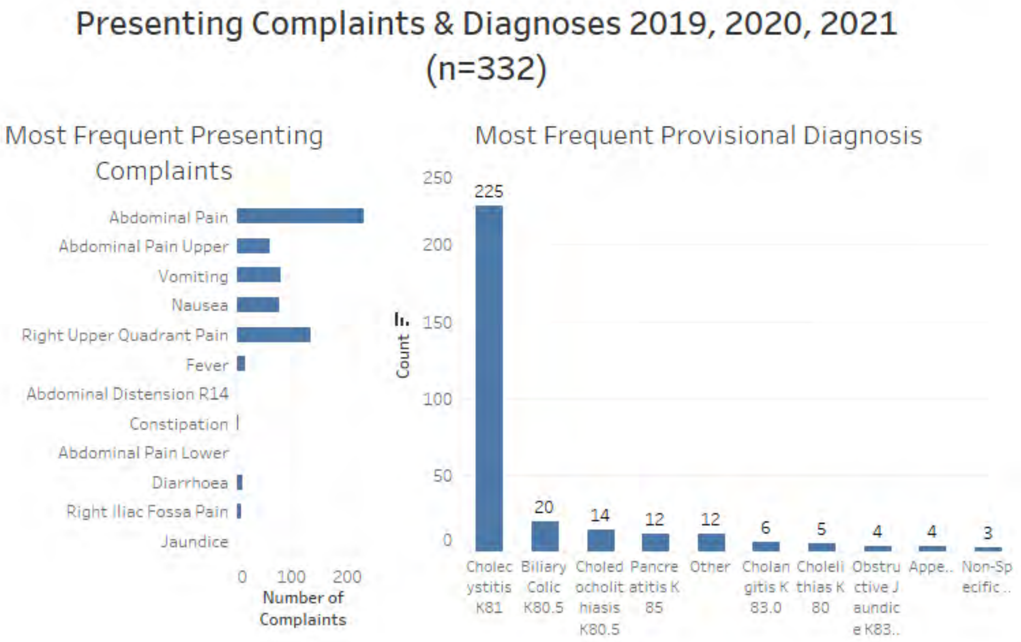


Bloods Collected to Time Referred (Median = 1.33 hrs)



Time Referred to Time Seen (Median = 0.85 hrs)

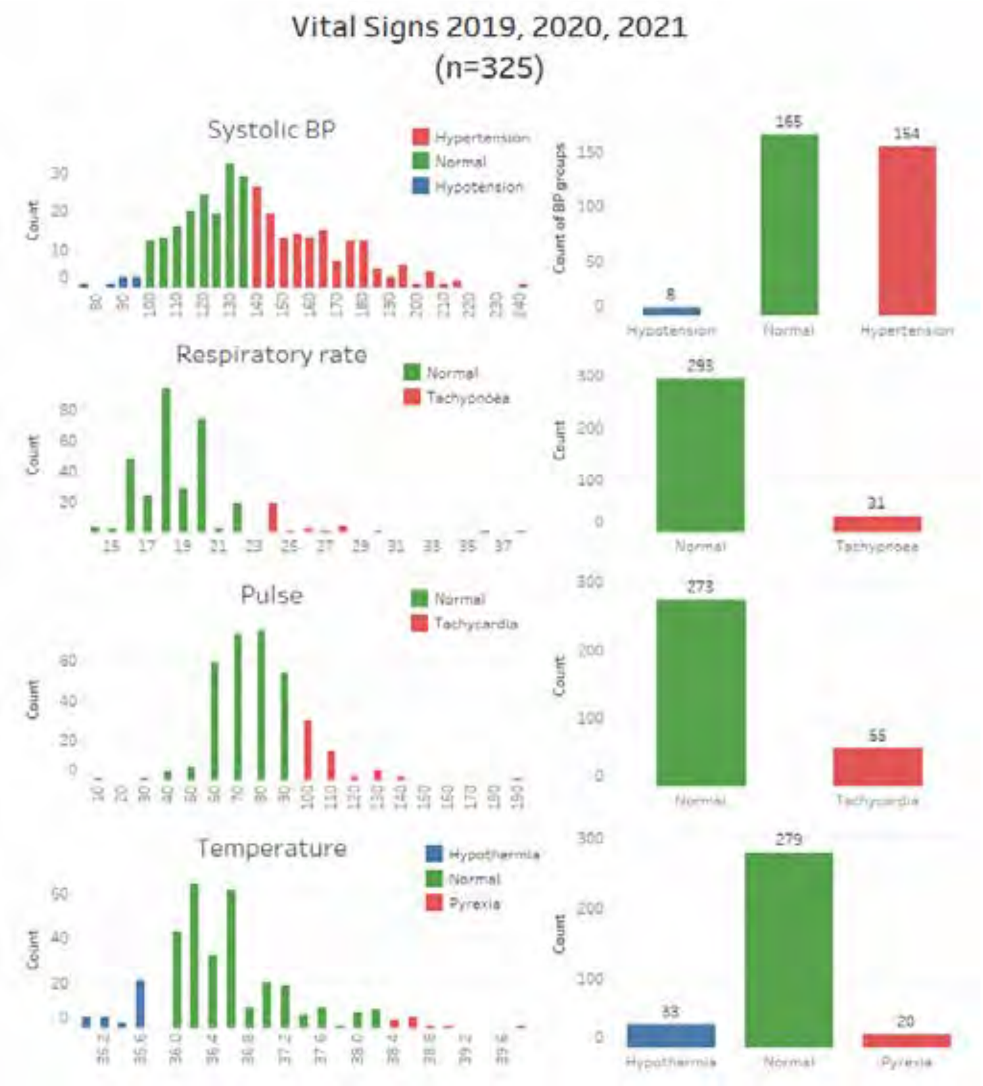


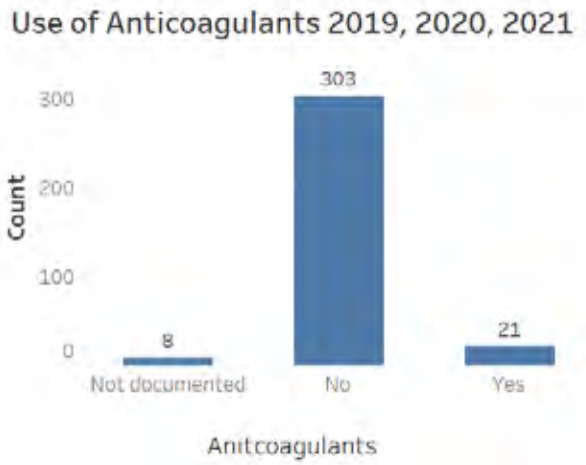


Presenting Complaints & Diagnoses 2019, 2020, 2021 (n=332)

Most Frequent Presenting Complaints

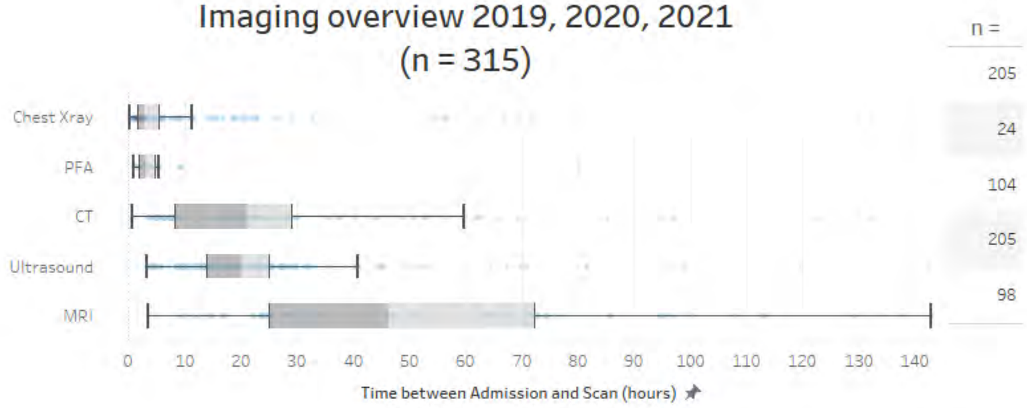
Most Frequent Provisional Diagnosis


Vital Signs 2019, 2020, 2021
(n=325)
Systolic BP
Hypertension
Normal
Hypotension
Count
Count of BP groups
8
165
154
Hypotension
Normal
Hypertension
Respiratory rate
Normal
Tachypnoea
293
31
Pulse
Normal
Tachycardia
273
55
Temperature
Hypothermia
Normal
Pyrexia
33
279
20

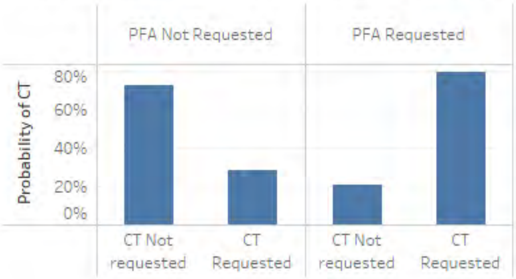

Use of Anticoagulants 2019, 2020, 2021
Count
300
200
100
0
8
303
21
Not documented
No
Yes
Anitcoagulants

Lab Results 2019, 2020, 2021 (n=326)

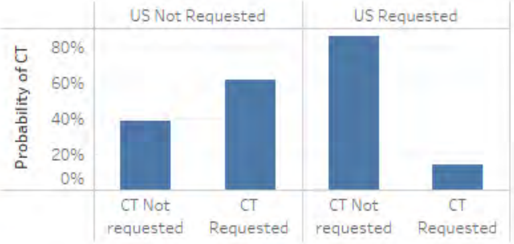
Imaging overview 2019, 2020, 2021
(n = 315)



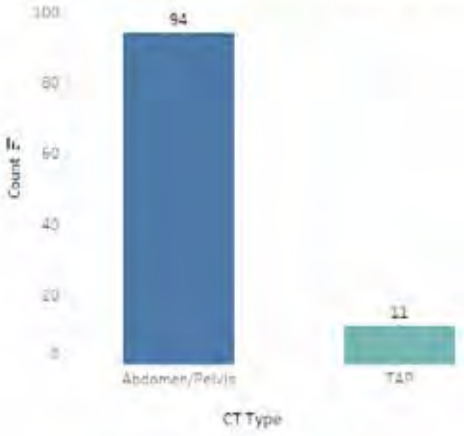
Conditional probability of CT order given PFA



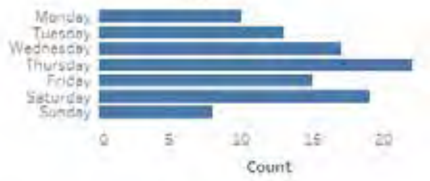
Conditional Probability of CT order given Ultrasound



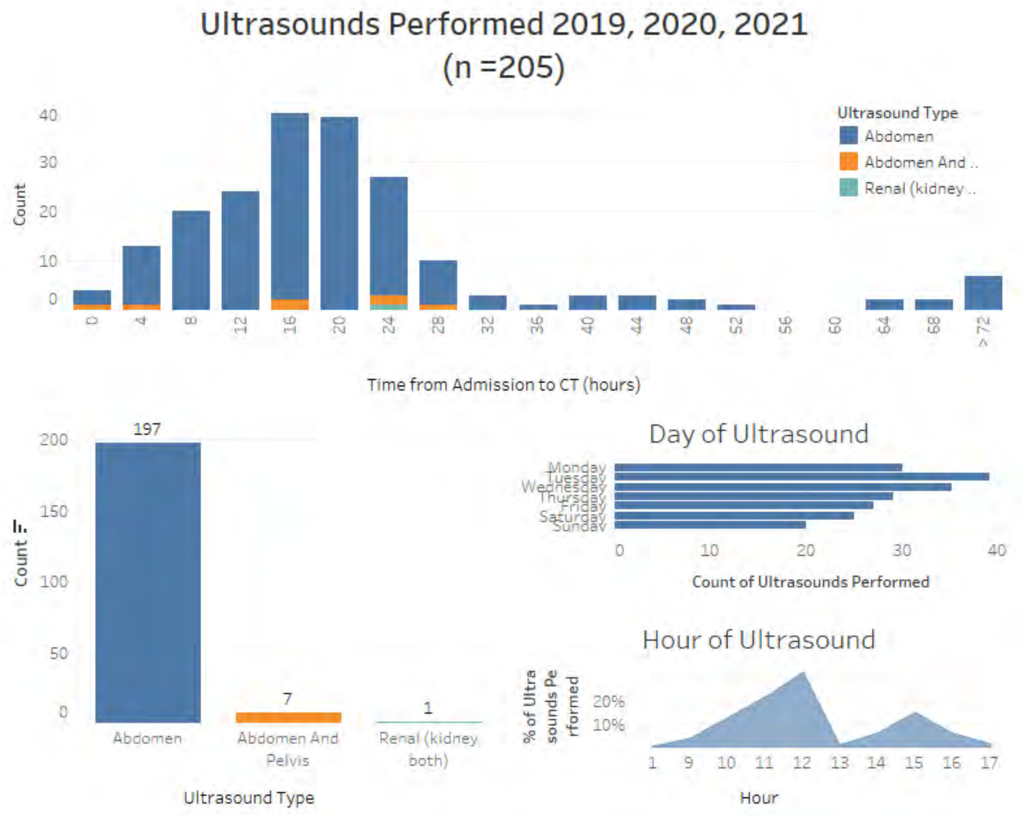
CT Scans Performed 2019, 2020, 2021
(n = 104)



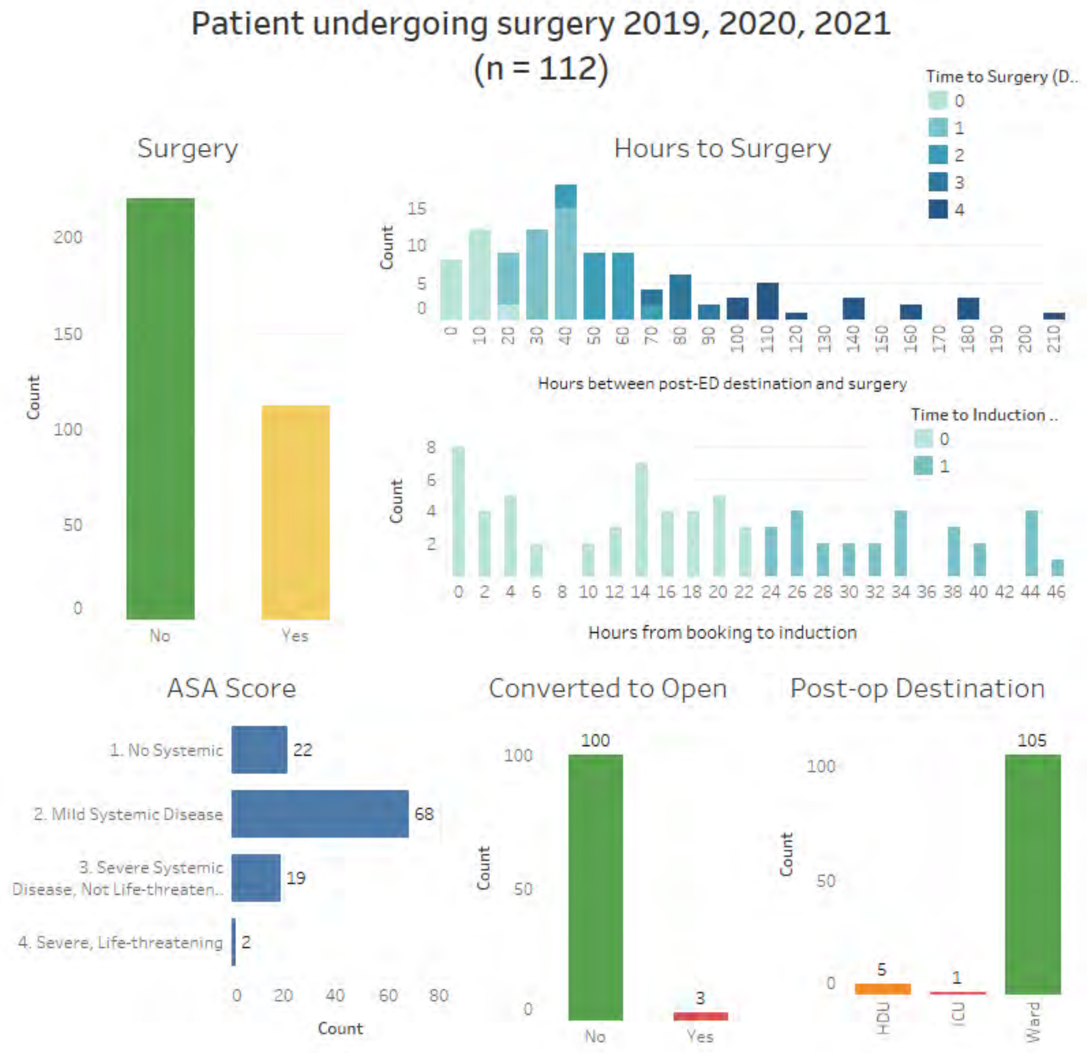
Day of CT



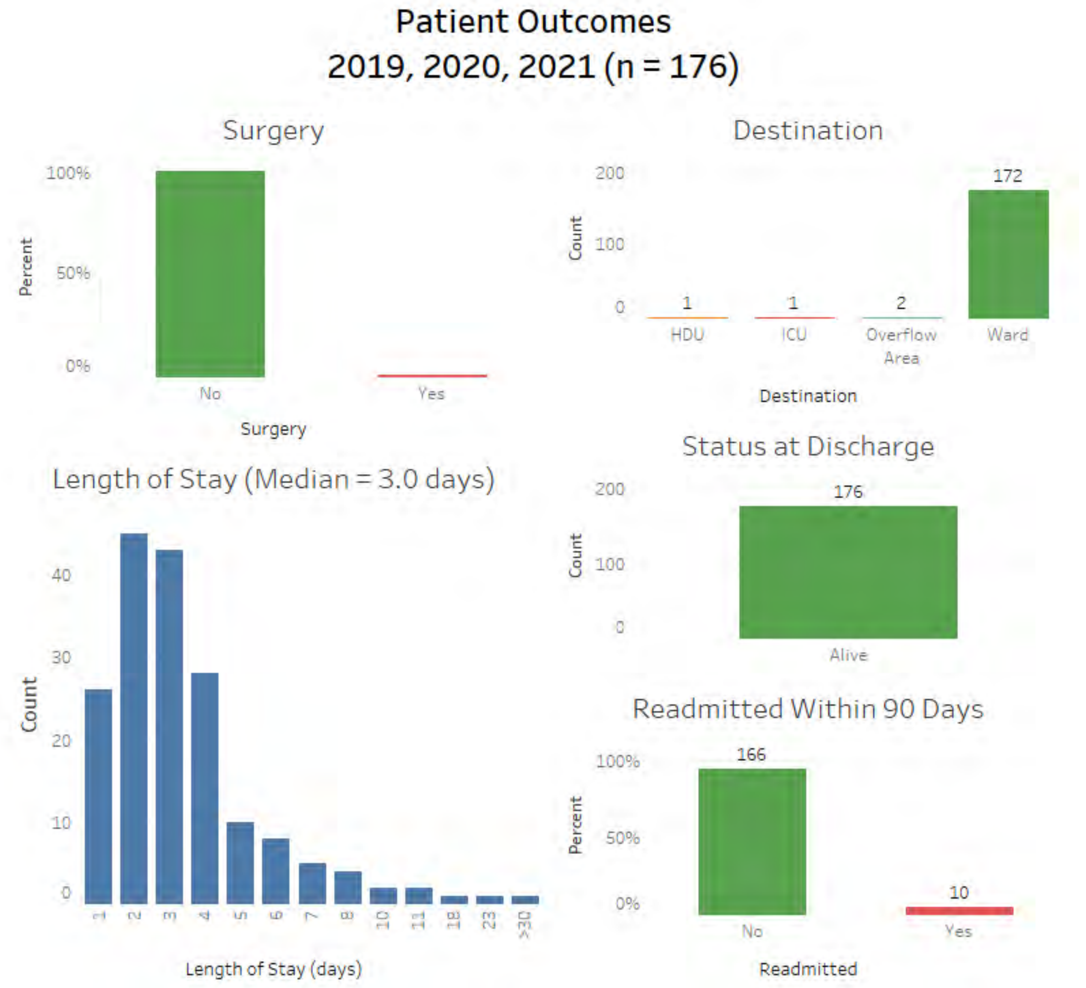
Hour of CT


Ultrasounds Performed 2019, 2020, 2021
(n =205)
Count
40
30
20
10
0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
> 72
Time from Admission to CT (hours)
Ultrasound Type
Abdomen
Abdomen And ..
Renal (kidney ..
Count
200
150
100
50
0
197
7
1
Abdomen
Abdomen And Pelvis
Renal (kidney both)
Ultrasound Type
Day of Ultrasound
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
10
20
30
40
Count of Ultrasounds Performed
Hour of Ultrasound
% of Ultra sounds Pe rformed
20%
10%
1
9
10
11
12
13
14
15
16
17
Hour

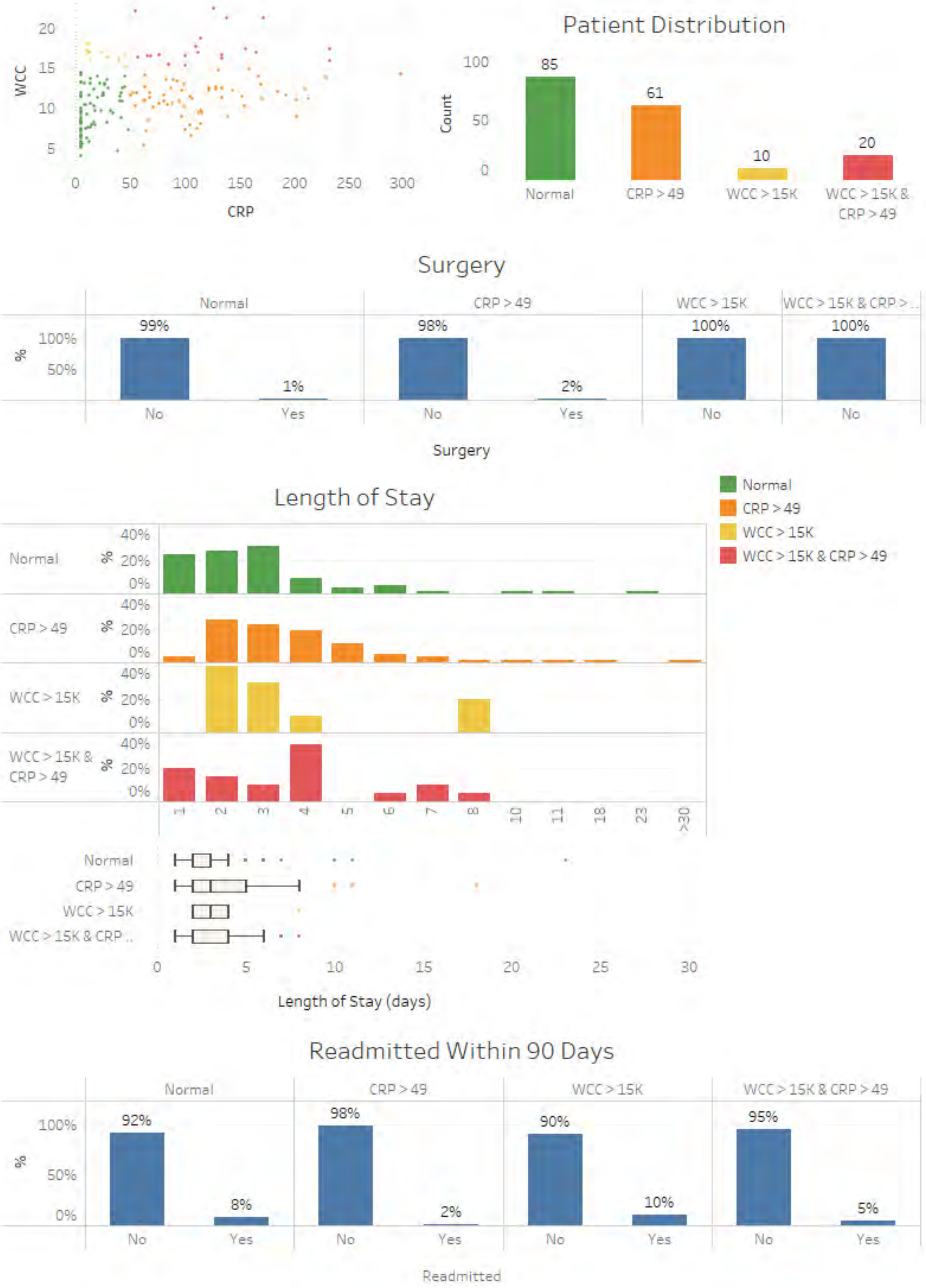

MRIs Performed 2019, 2020, 2021
(n = 98)
MRI Type
Abdomen
MRCP
Count
10
5
0
0
8
12
16
20
24
28
32
36
40
44
48
52
56
64
68
72
76
84
92
96
100
104
112
128
132
136
140
Time from Admission to MRI (hours)
Count
100
80
60
40
20
0
97
1
MRCP
Abdomen
MRI Type
Day of MRI
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
0
5
10
15
20
25
Count of MRIs Performed
Hour of MRI
% of MRIs Performed
20%
10%
8
9
10
11
12
13
14
15
16
17
Hour



Patient undergoing surgery 2019, 2020, 2021 (n = 112)

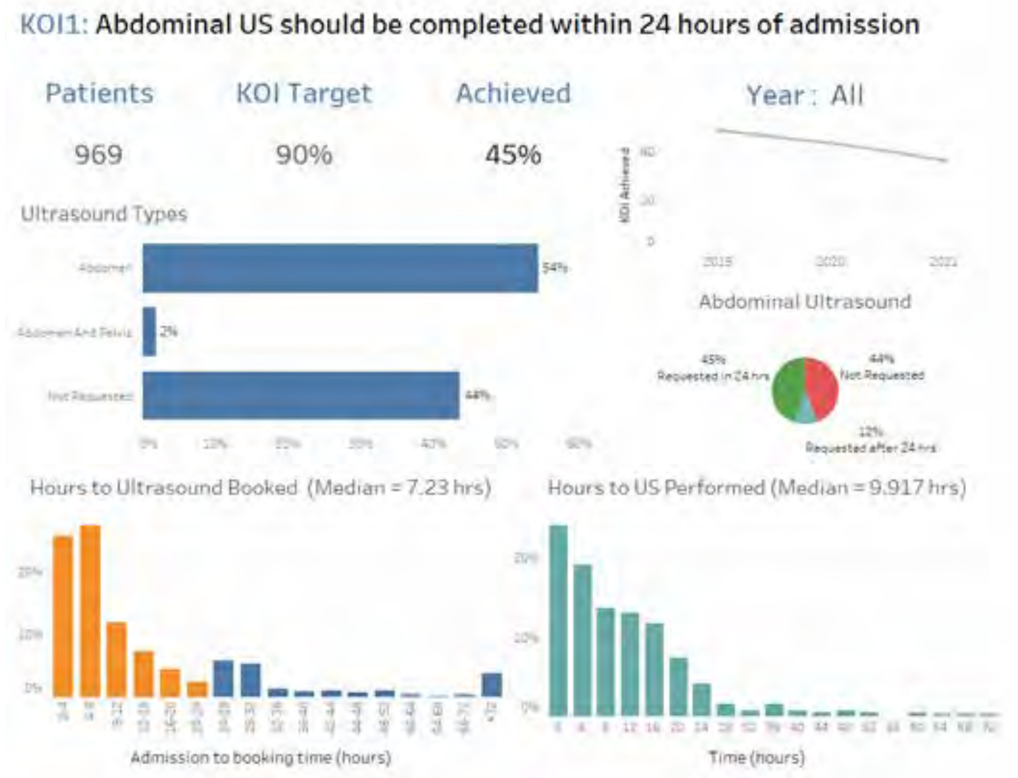

Patient Outcomes
2019, 2020, 2021 (n = 176)
Surgery
Percent
100%
50%
0%
No
Yes
Surgery
Destination
Count
200
100
0
1
1
2
172
HDU
ICU
Overflow Area
Ward
Destination
Length of Stay (Median = 3.0 days)
Count
40
30
20
10
0
1
2
3
4
5
6
7
8
10
11
18
23
>30
Length of Stay (days)
Status at Discharge
Count
200
100
0
176
Alive
Readmitted Within 90 Days
Percent
100%
50%
0%
166
10
No
Yes
Readmitted

Patient Outcomes by Lab Results 2019, 2020, 2021 (n = 176)



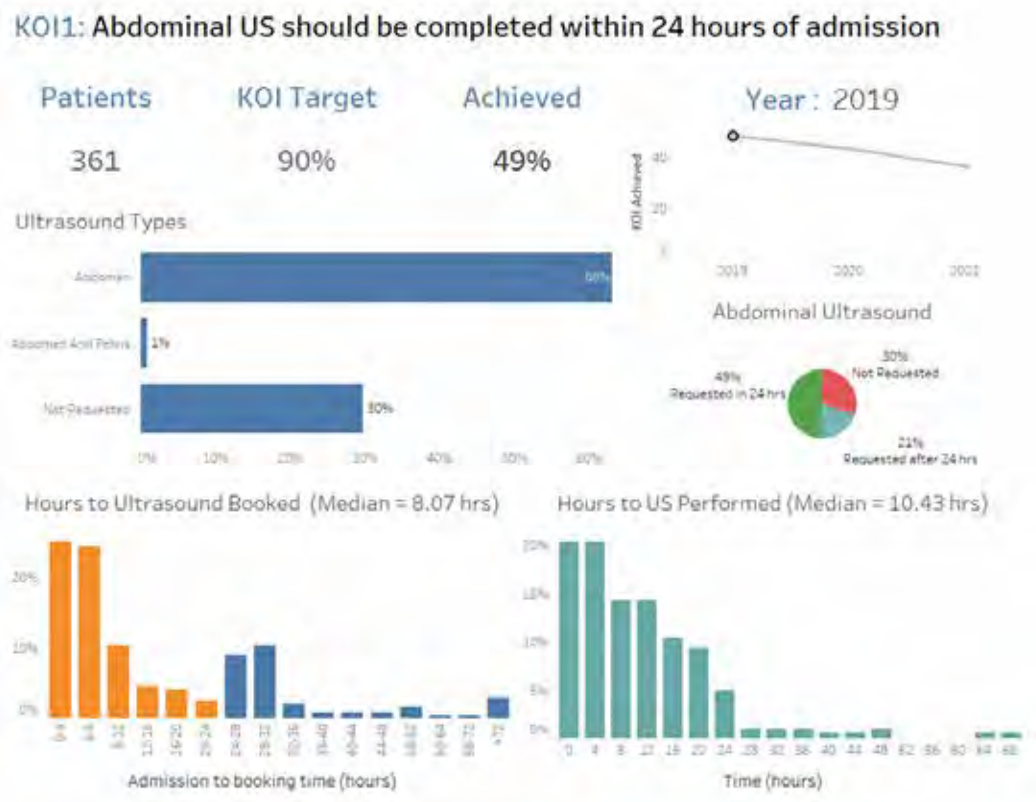
RUQ Key Outcome Indicators

KEY OUTCOME INDICATOR		Target
Care Process		
1	Abdominal US should be completed within 24 hours of admission	90%
Surgical Outcomes		
2	Patients admitted with acute cholecystitis should undergo surgery within 6 days of symptom onset and within 3 days of admission	60%
3	Incidence of 90-day readmission with recurrent cholecystitis	<10%
Adverse Events		
4	Incidence rate of bile leaks	<2%
Care Process		
5	Incidence of 30 day readmission post cholecystectomy	< 10%



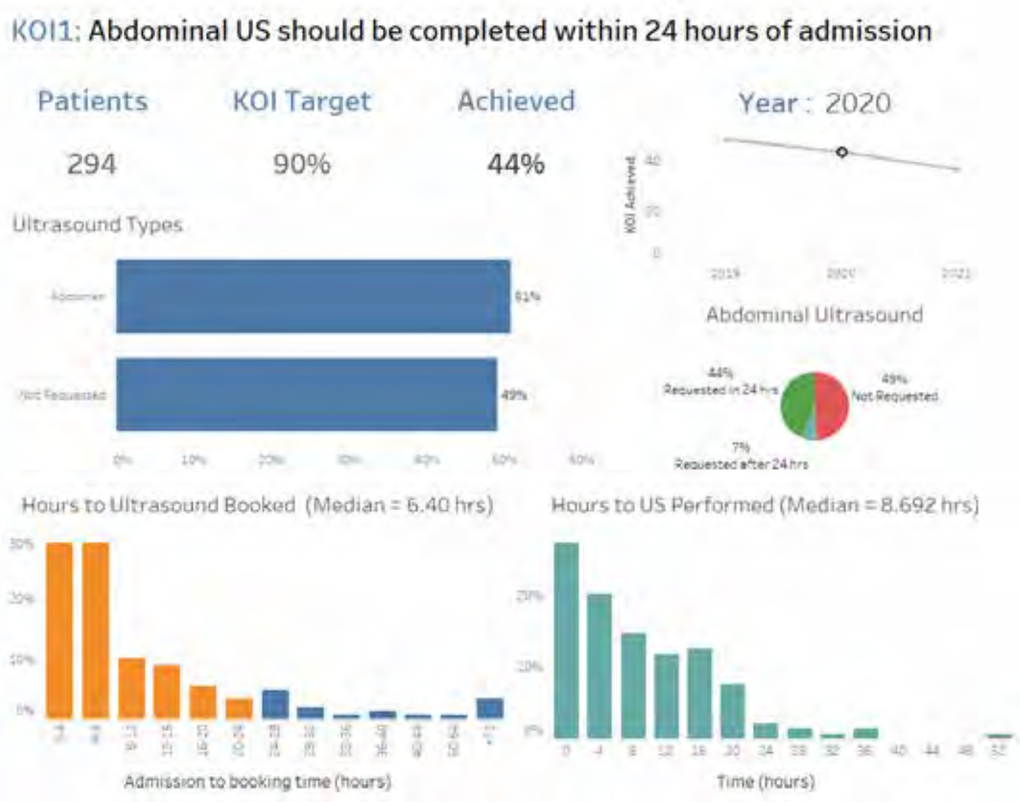
KOI1: Abdominal US should be completed within 24 hours of admission

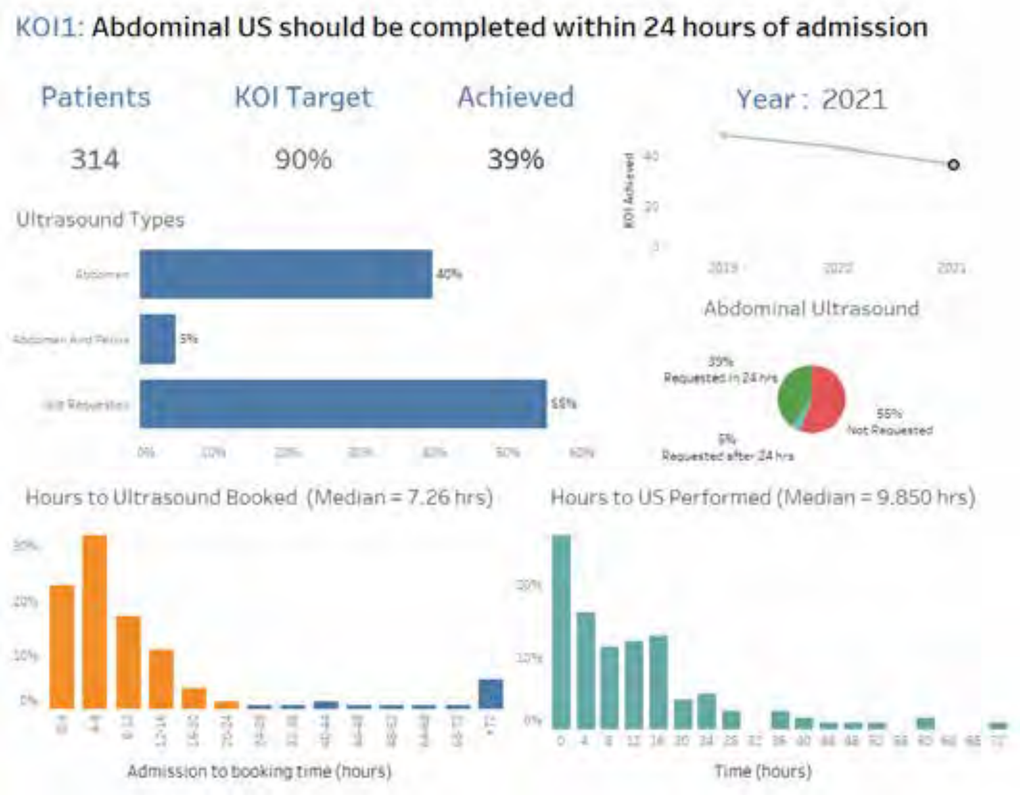
Patients	KOI Target	Achieved	Year : All
969	90%	45%	



KOI1: Abdominal US should be completed within 24 hours of admission

Patients	KOI Target	Achieved	Year : 2019
361	90%	49%	

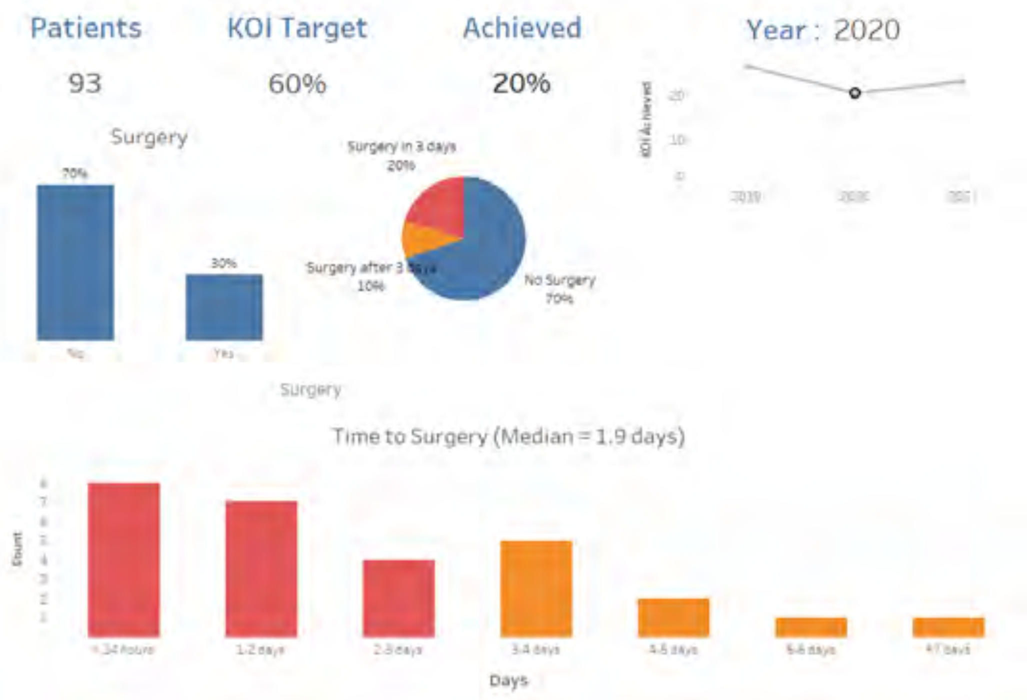

KOI1: Abdominal US should be completed within 24 hours of admission
Patients
294
KOI Target
90%
Achieved
44%
Year : 2020
KOI Achieved
40
20
0
2019
2020
2021
Ultrasound Types
Abdomen
51%
Not Requested
49%
0%
10%
20%
30%
40%
50%
60%
Abdominal Ultrasound
44%
Requested in 24 hrs
49%
Not Requested
7%
Requested after 24 hrs
Hours to Ultrasound Booked (Median = 6.40 hrs)
30%
20%
10%
0%
Admission to booking time (hours)
Hours to US Performed (Median = 8.692 hrs)
20%
10%
0%
0
4
8
12
16
20
24
28
32
36
40
44
48
52
Time (hours)


KOI1: Abdominal US should be completed within 24 hours of admission
Patients
314
KOI Target
90%
Achieved
39%
Year : 2021
KOI Achieved
40
20
0
2019
2020
2021
Ultrasound Types
Abdomen
40%
Abdomen And Pelvis
5%
Not Requested
55%
0%
10%
20%
30%
40%
50%
60%
Abdominal Ultrasound
39%
Requested in 24 hrs
55%
Not Requested
5%
Requested after 24 hrs
Hours to Ultrasound Booked (Median = 7.26 hrs)
30%
20%
10%
0%
Admission to booking time (hours)
Hours to US Performed (Median = 9.850 hrs)
20%
10%
0%
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
Time (hours)

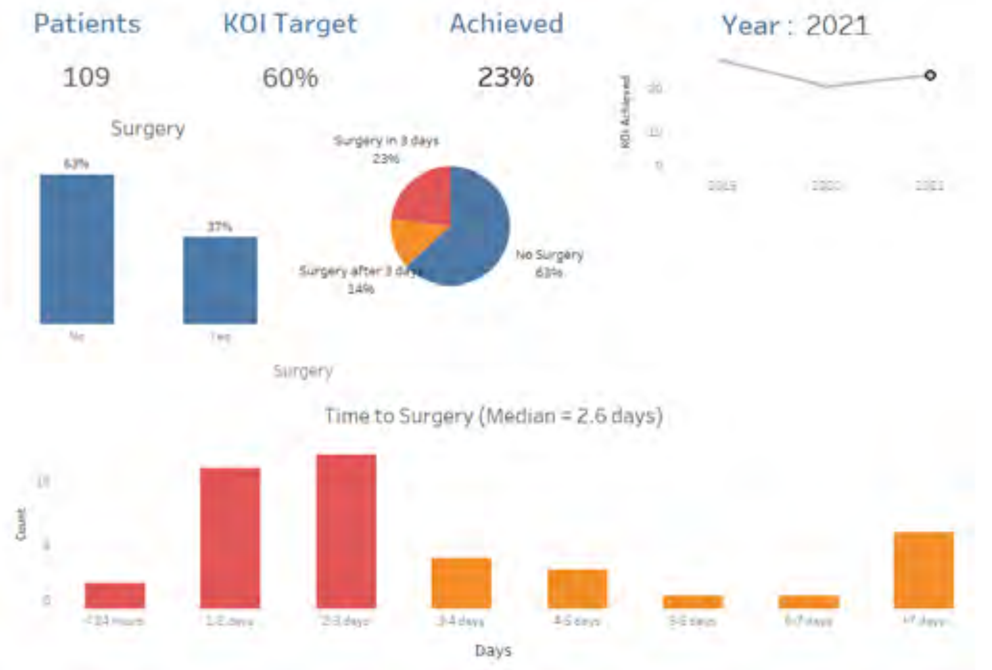
KOI2: Patients admitted with acute cholecystitis should undergo surgery within 6 days of symptom onset and within 3 days of admission

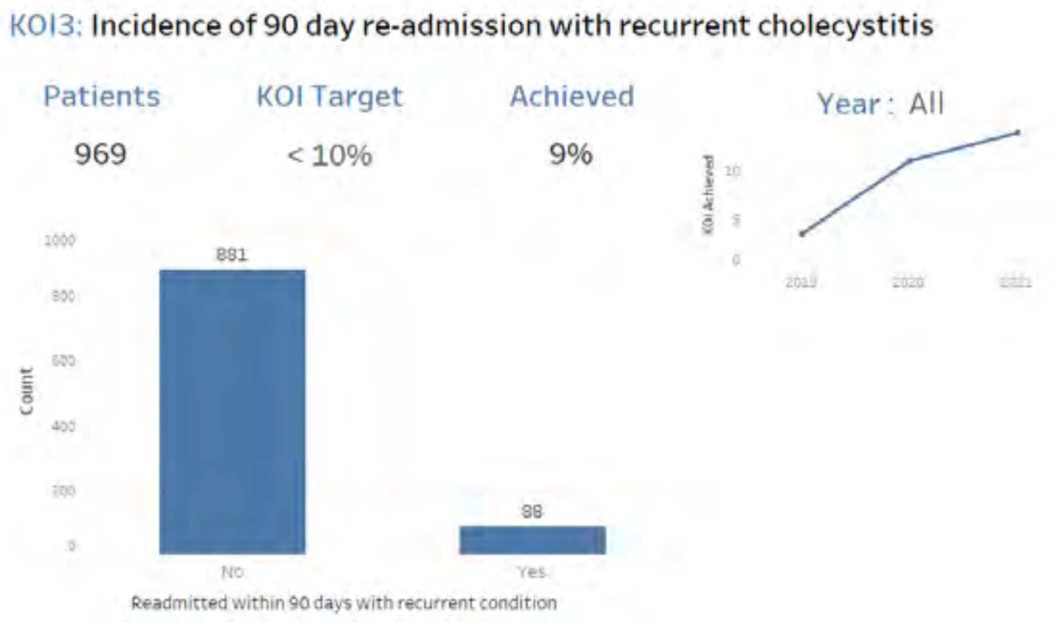
KOI2: Patients admitted with acute cholecystitis should undergo surgery within 6 days of symptom onset and within 3 days of admission

KOI2: Patients admitted with acute cholecystitis should undergo surgery within 6 days of symptom onset and within 3 days of admission



KOI2: Patients admitted with acute cholecystitis should undergo surgery within 6 days of symptom onset and within 3 days of admission

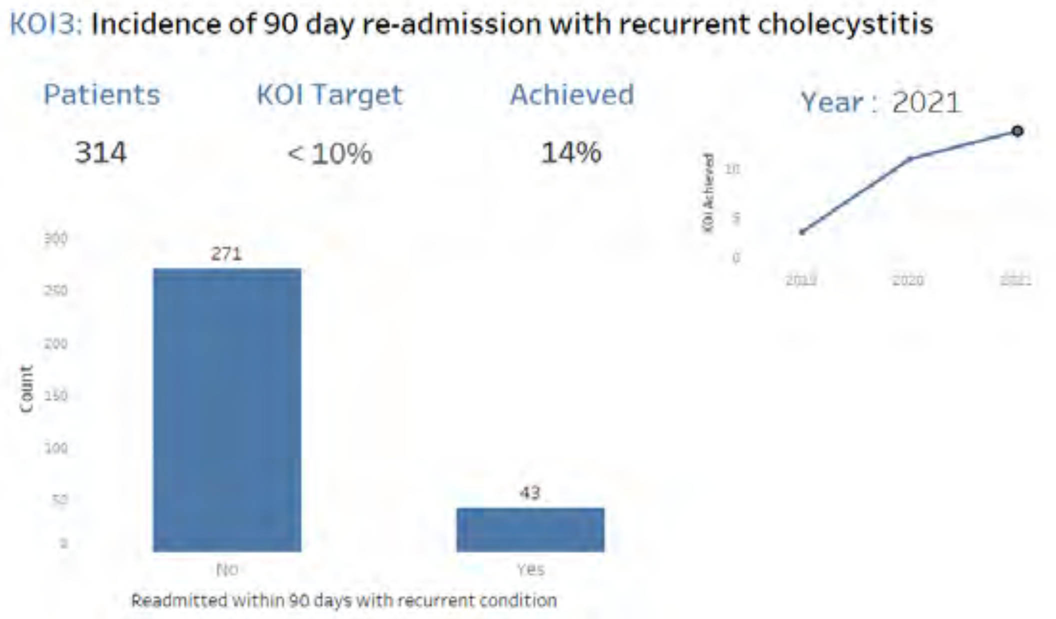




KOI3: Incidence of 90 day re-admission with recurrent cholecystitis

Patients	KOI Target	Achieved
969	< 10%	9%

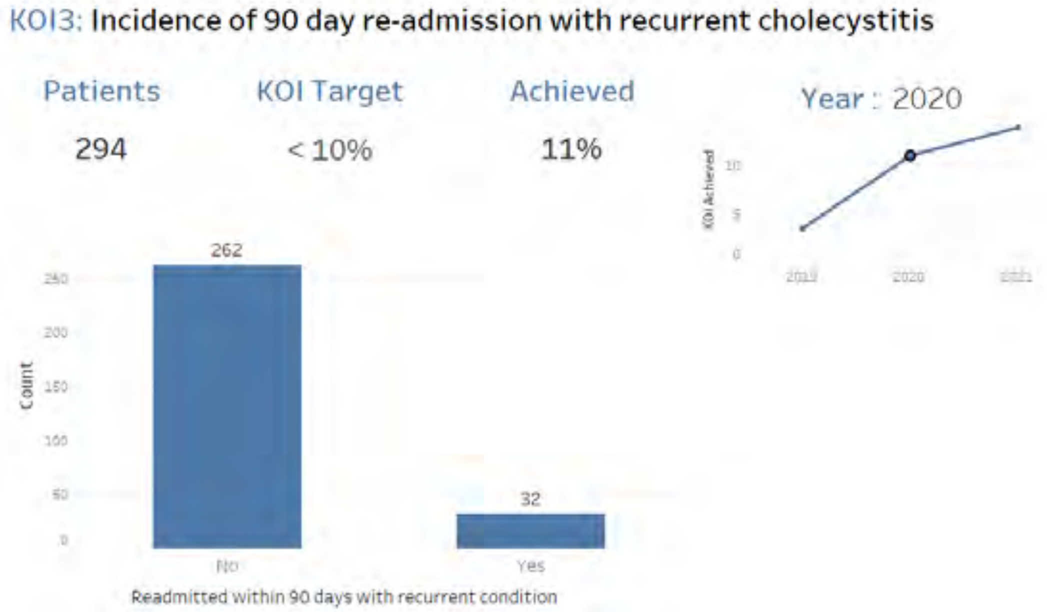
Year : All



KOI3: Incidence of 90 day re-admission with recurrent cholecystitis

Patients	KOI Target	Achieved
314	< 10%	14%

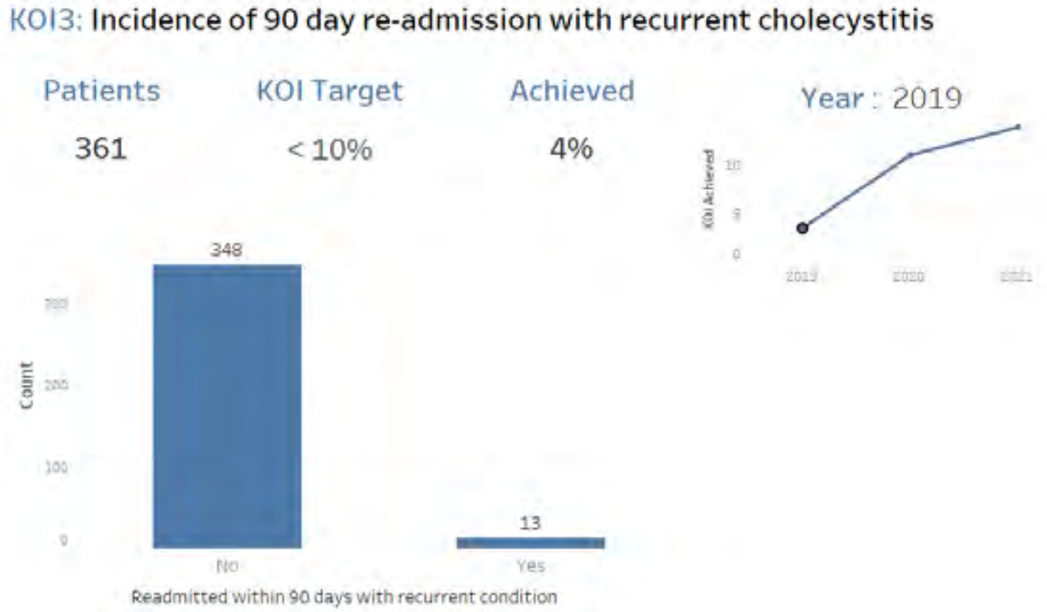
Year : 2021



KOI3: Incidence of 90 day re-admission with recurrent cholecystitis

Patients	KOI Target	Achieved
294	< 10%	11%

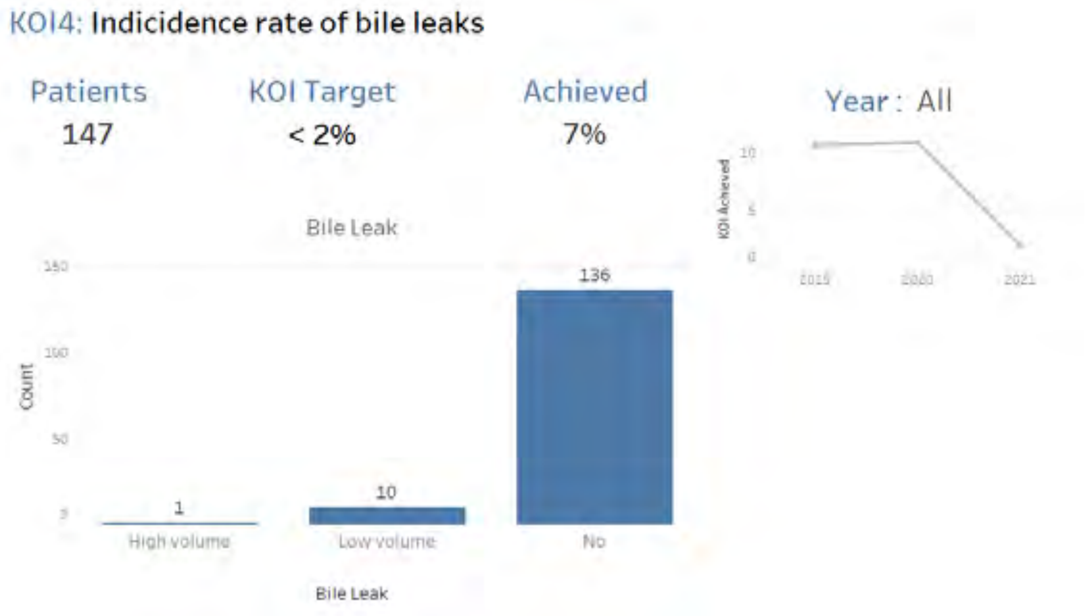
Year : 2020



KOI3: Incidence of 90 day re-admission with recurrent cholecystitis

Patients	KOI Target	Achieved
361	< 10%	4%

Year : 2019



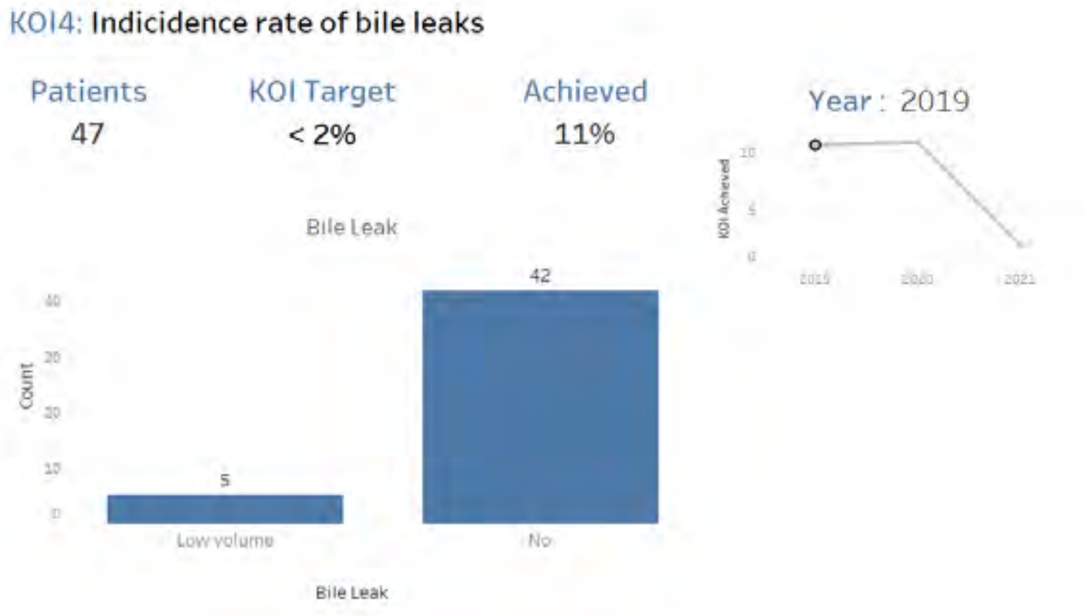
KOI4: Indicidence rate of bile leaks

Patients 147

KOI Target < 2%

Achieved 7%

Year : All



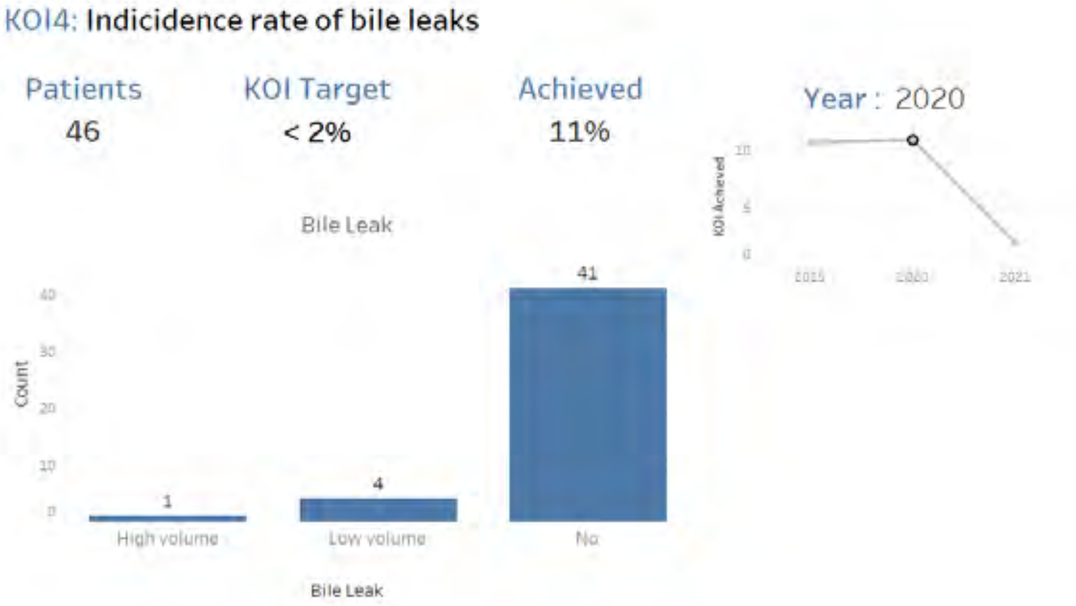
KOI4: Indicidence rate of bile leaks

Patients 47

KOI Target < 2%

Achieved 11%

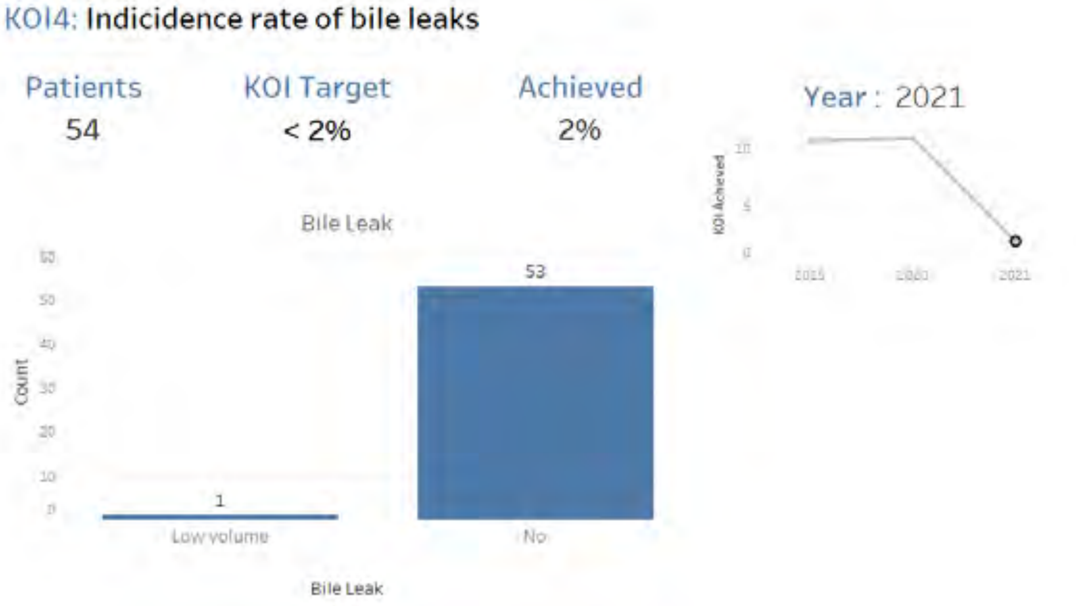
Year : 2019



KOI4: Indicidence rate of bile leaks

Patients	KOI Target	Achieved
46	< 2%	11%

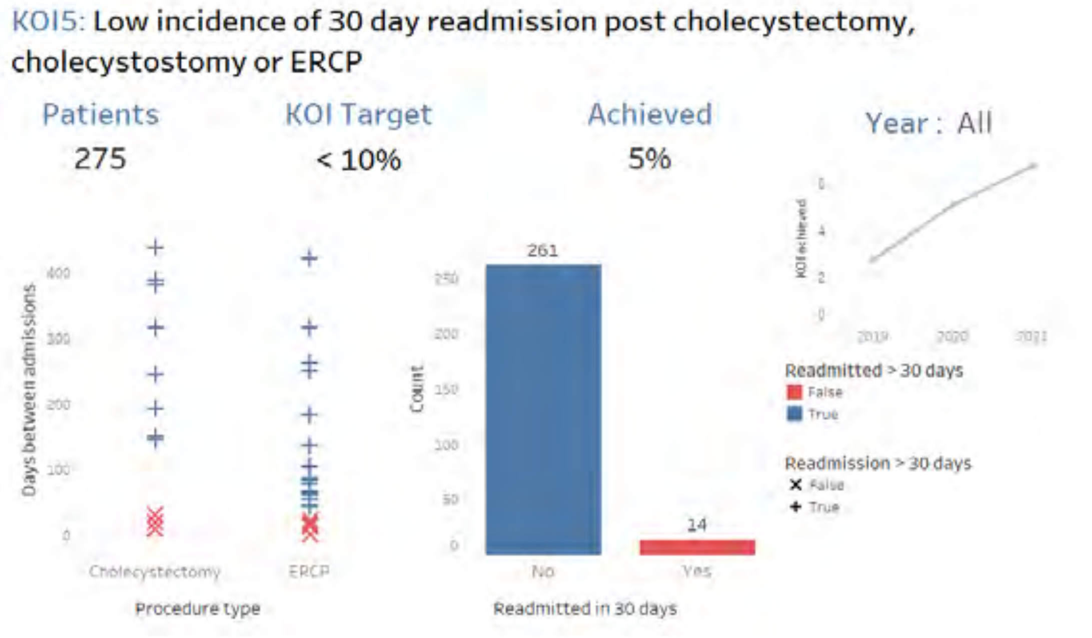
Year : 2020



KOI4: Indicidence rate of bile leaks

Patients	KOI Target	Achieved
54	< 2%	2%

Year : 2021



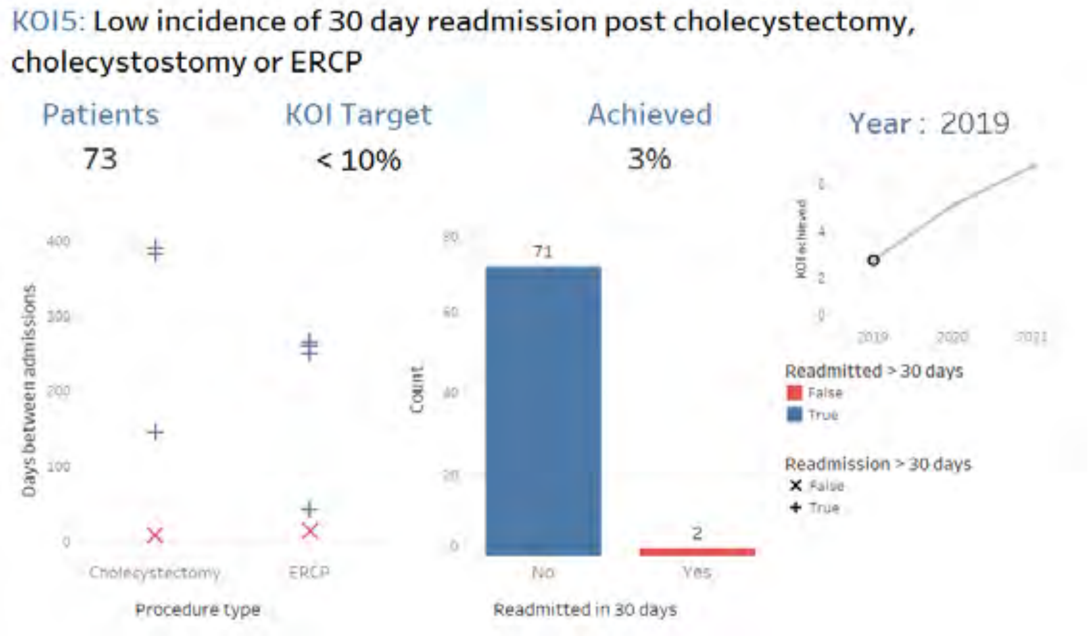
KOI5: Low incidence of 30 day readmission post cholecystectomy, cholecystostomy or ERCP

Patients 275

KOI Target < 10%

Achieved 5%

Year : All



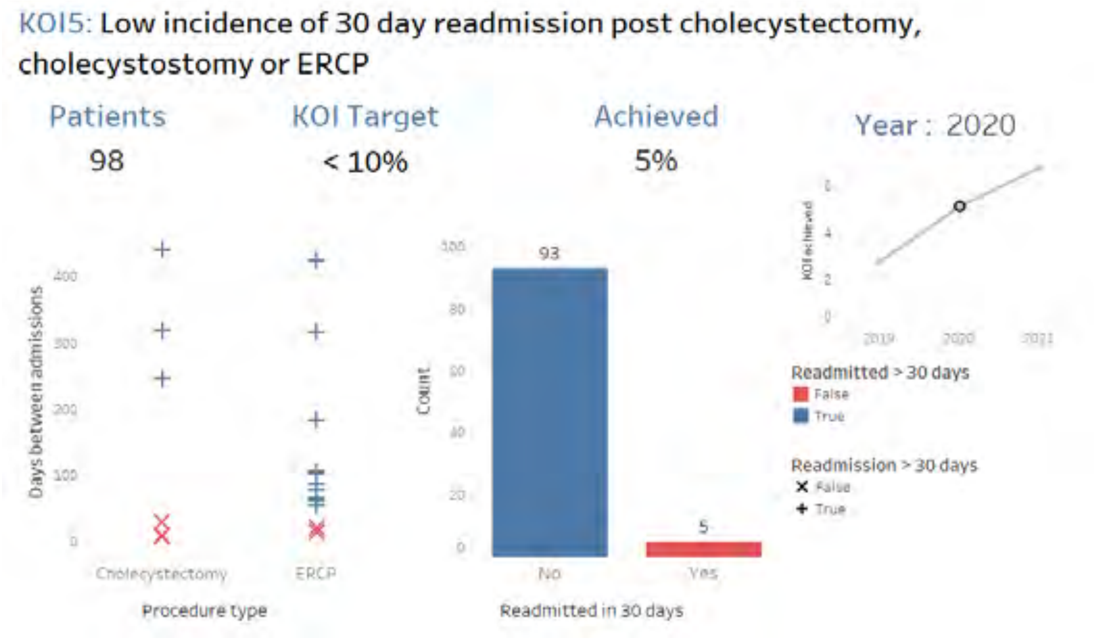
KOI5: Low incidence of 30 day readmission post cholecystectomy, cholecystostomy or ERCP

Patients 73

KOI Target < 10%

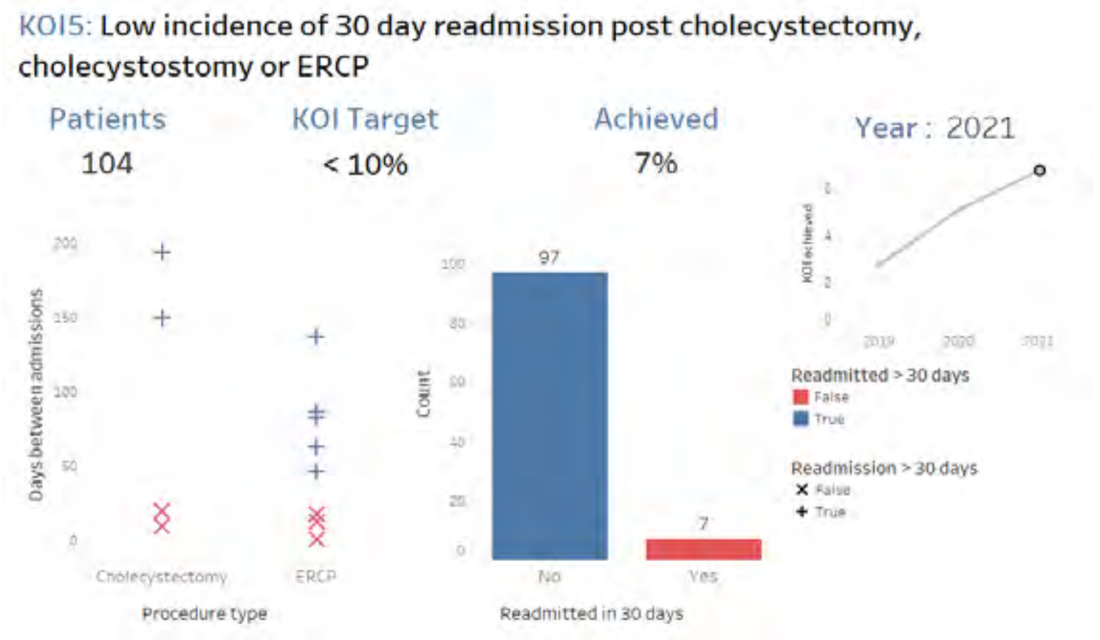
Achieved 3%

Year : 2019



KOI5: Low incidence of 30 day readmission post cholecystectomy, cholecystostomy or ERCP

Patients	KOI Target	Achieved	Year : 2020
98	< 10%	5%	



KOI5: Low incidence of 30 day readmission post cholecystectomy, cholecystostomy or ERCP

Patients	KOI Target	Achieved	Year : 2021
104	< 10%	7%	

Acute Gallbladders Improving outcome

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Acute complications of biliary calculi (such as complicated cholecystitis, choledocholithiasis with or with-out cholangitis, and biliary pancreatitis), are highly morbid, and commonly require urgent hospital admission for surgical care. The complications of biliary calculi can be complex to manage. Despite frequent presentation to the Emergency General Surgeon, significant variability exists in the optimal timing of diagnostic investigations, and the choice and timing of surgical, endoscopic, or percutaneous interventional radiologic therapeutic techniques utilized to treat these conditions at individual surgeon and unit levels.[1]

Attempts to address heterogeneity in practice patterns have been made through consensus guidelines, such as the Tokyo Practical Guidelines for the Management of Acute Cholangitis and Cholecystitis (also known as "TG18", or "the Tokyo Guidelines", most recently updated in 2018), [2] and the 2020 World Society of Emergency Surgery "WSES Guidelines for the treatment of acute calculous cholecystitis".[3] However, successful 'paper to practice' translation of promising initiatives from published research into clinical practice has been estimated to take, on average, seven years. Heterogeneity in practice and divergence from 'best practice' guidance may be reflective of guideline awareness, differences in models of acute surgical care delivery, or simply individual surgeon preference and the exigencies of real-world limitations on practice. A new challenge for evidence-based Emergency General Surgery will be leveraging large robust registry datasets, used together with implementation science techniques, to create engaging evidence-based clinical guidance and decision-support for surgeons at the bedside or in the operating room.

The best available epidemiologic outcomes data, to which the TG18 and WSES guidelines are mapped, advocate for prompt clinical and radiologic diagnosis of acute cholecystitis, biliary pancreatitis or cholangitic choledocholithiasis and the early evaluation of surgical risk, with the simultaneous commencement of appropriate resuscitation and antimicrobial administration. To guide appropriate anti-microbial management based on local antimicrobial susceptibility data, blood and/or bile cultures are strongly recommended in TG18 and WSES. Where local surgical expertise or appropriate perioperative care are not available, WSES and TG18 urge outbound transfer of these patients to a higher level-of-care. Recent data suggest good adherence to commencement of appropriate antimicrobial cover at diagnosis (as promoted by the SCCM/ESICM Surviving Sepsis Guidelines), and prompt termination post-operatively (informed by studies such as the STOP-IT Trial). Antibiotic agent choice, however, appears largely empiric and reflexive, as fewer than half of surveyed surgeons report taking blood or bile cultures in patients with acute cholecystitis. Where correlative culture and sensitivity data are not accumulated, local microbiograms and the antibiotic guidelines that are derived from them may not accurately reflect contemporary agent sensitivity or resistance patterns in the local microbiologic ecosystem. Overwhelmingly, observational data suggests that index admission laparoscopic cholecystectomy and/or biliary drainage where patient factors allowed, performed within 7 days of hospital admission and within 10 days of onset of symptoms, is superior to either intermediate cholecystectomy performed between 7 days of hospital admission and 6 weeks or delayed laparoscopic cholecystectomy performed between 6 weeks and 3 months of the initial hospital admission for acute cholecystitis. Both TG18 and WSES advise reserving delayed cholecystectomy or expectant management for patients in which delayed presentation, negative physiologic factors or co-morbidity favoured non-operative management. However, a recent prospective observational cohort study of 338 patients treated simultaneously in 25 hospitals across 9 countries treated for complicated acute calculous biliary diseases, demonstrated that only half of patients underwent index admission laparoscopic cholecystectomy, depending on whether a predominantly elective-centric General Surgeon 'on-call' or a dedicated Emergency General Surgery service was involved in the patient's care. [1]

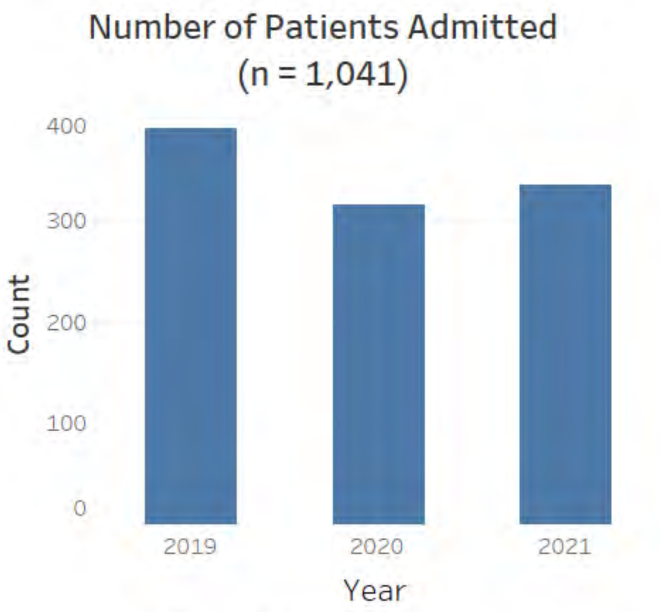
In patients with obstructive cholangiopathy from gallstone disease – be it uncomplicated choledocholithiasis, acute cholangitis or biliary pancreatitis – require thoughtful, prompt and coordinated care in order to minimize disease recidivism and the morbidity associated with complications. The bile ducts must be cleared of stones and debris (principally through ERCP, which is best tolerated in the widest cohort of patients) before prompt attention is given to surgical treatment of the gallstone reservoir, the gallbladder. Retrospective observational data of non-randomized 'usual care' in 2 European institutions (Orebro, Sweden and Tallaght, Dublin, Ireland) with entirely different historical practice patterns highlights the potential patient and health system benefits of same admission ERCP and cholecystectomy over delayed surgery in minimizing readmission without accruing excess complication-related morbidity. While the practice of 'simultaneous' rendezvous ERCP and laparoscopic cholecystectomy remains a rarity, many institutions have embraced a model of ERCP with 'next-day' cholecystectomy, or even ERCP in the endoscopy suite with transportation to the OR during the same anaesthesia event, for subsequent cholecystectomy. The community seroprevalence of SARS-CoV-2 (COVID-19) is alarmingly-high at present. Given the patient-level association between COVID-19 PCR positivity and a four-fold increase in post-operative mortality in the COVIDSurg trial, simultaneous laparoscopic cholecystectomy and ERCP -- which shortens hospital stay, and prevents multiple admissions and aerosol-generating anaesthesia events -- seems intuitively preferable in the COVID-negative patient at index admission. EGS surgeons should work with their endoscopists, anaesthesiologists and OR staff to determine the optimal patient-level work-flow for their unique set of location-dependant circumstances.

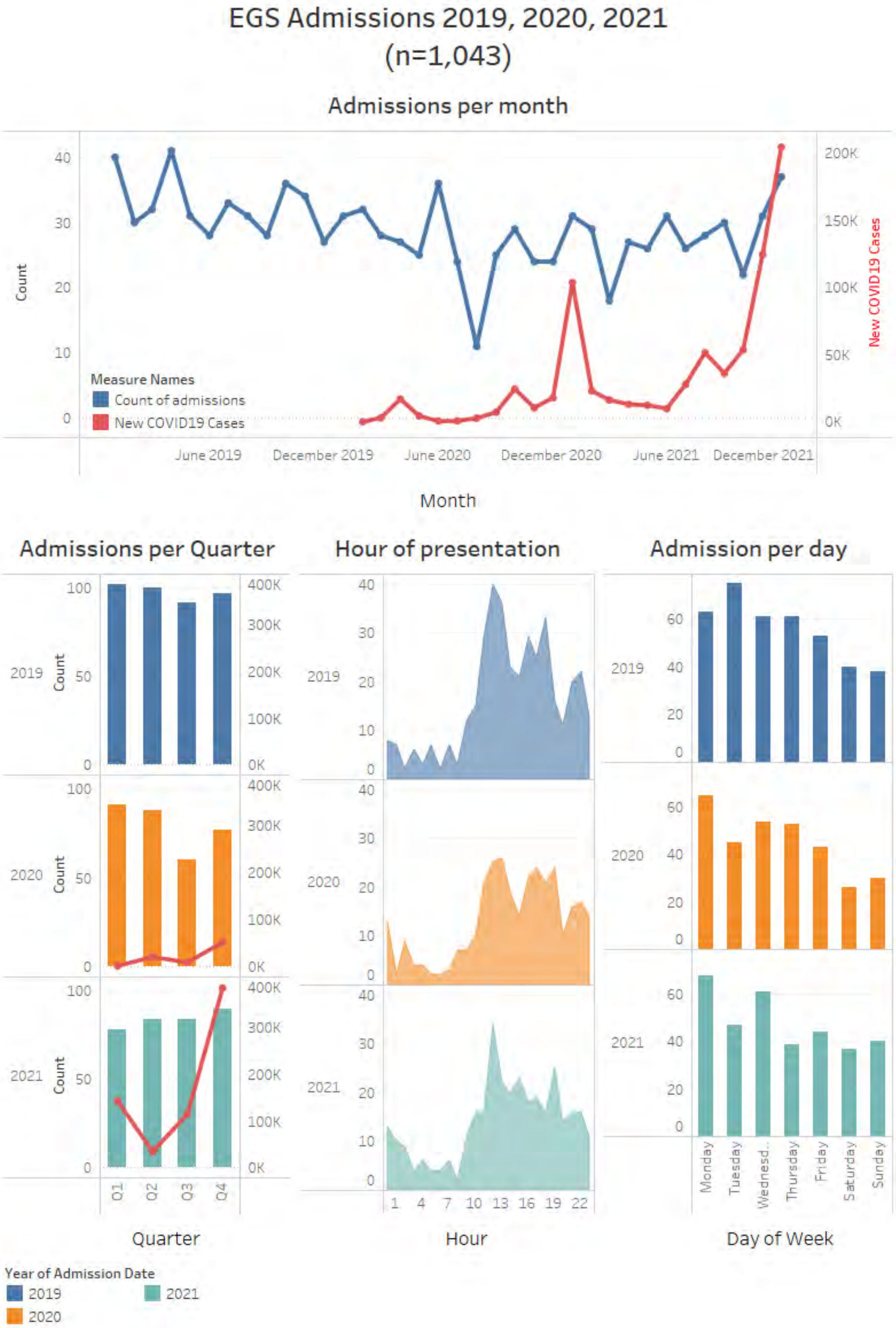
Selected Bibliography:

1. Bass GA, Gillis A, Cao Y, Mohseni S, et al. Patterns of prevalence and contemporary clinical management strategies in complicated acute biliary calculous disease: an ESTES "snapshot audit" of practice. European J Trauma Emerg Surg. 2020;1–13.
2. Mayumi T, Okamoto K, Takada T, Strasberg SM, Solomkin JS, Schlossberg D, et al. Tokyo Guidelines 2018: management bundles for acute cholangitis and cholecystitis. J Hepato-bil-pan Sci. 2018;25:96–100.
3. Pisano M, Allievi N, Gurusamy K, Borzellino G, Cimbanassi S, Boerna D, et al. 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculus cholecystitis. World J Emerg Surg. 2020;15:61.

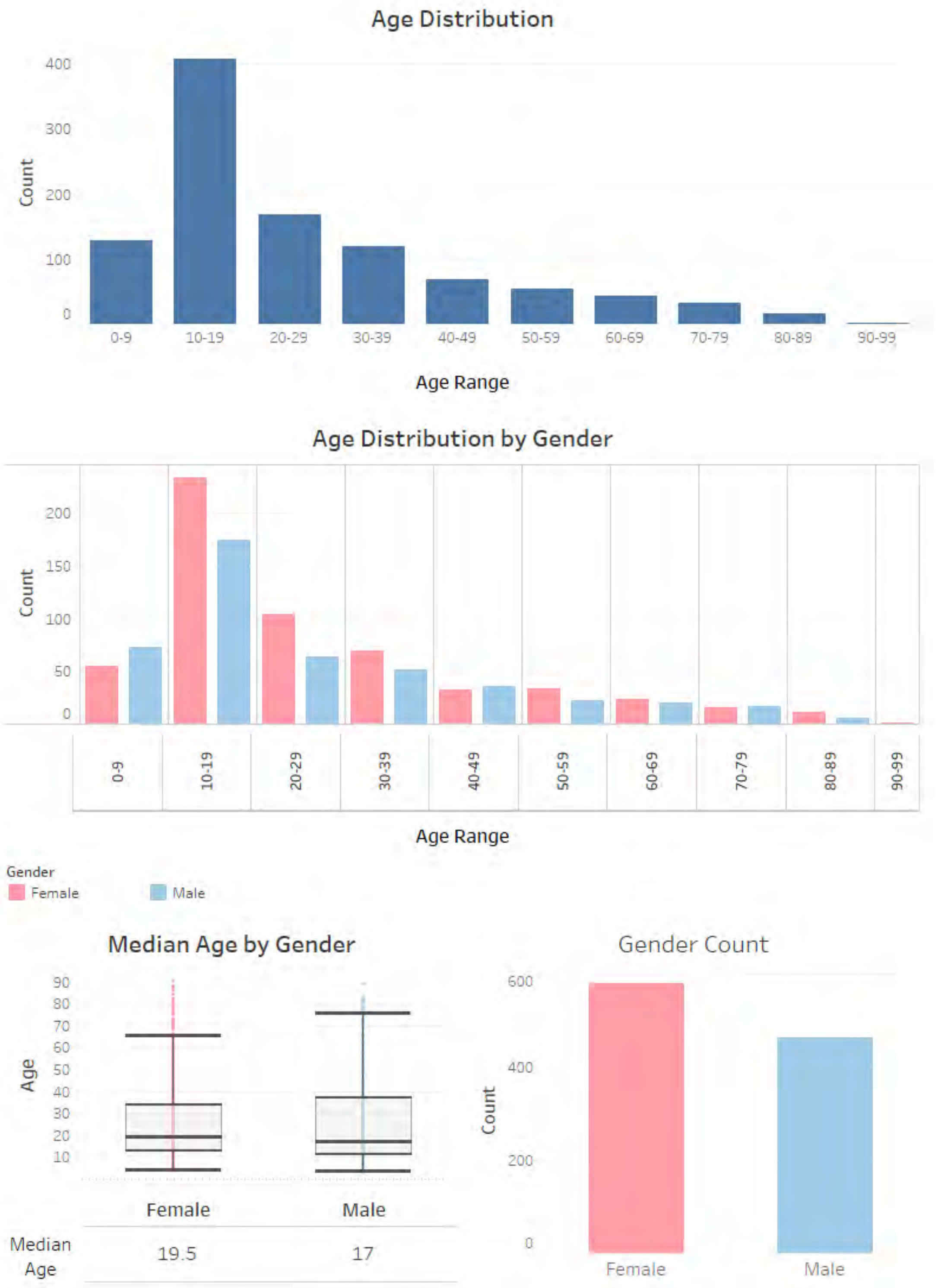
Right Iliac Fossa Pain and Appendicitis Module

Overall RIF



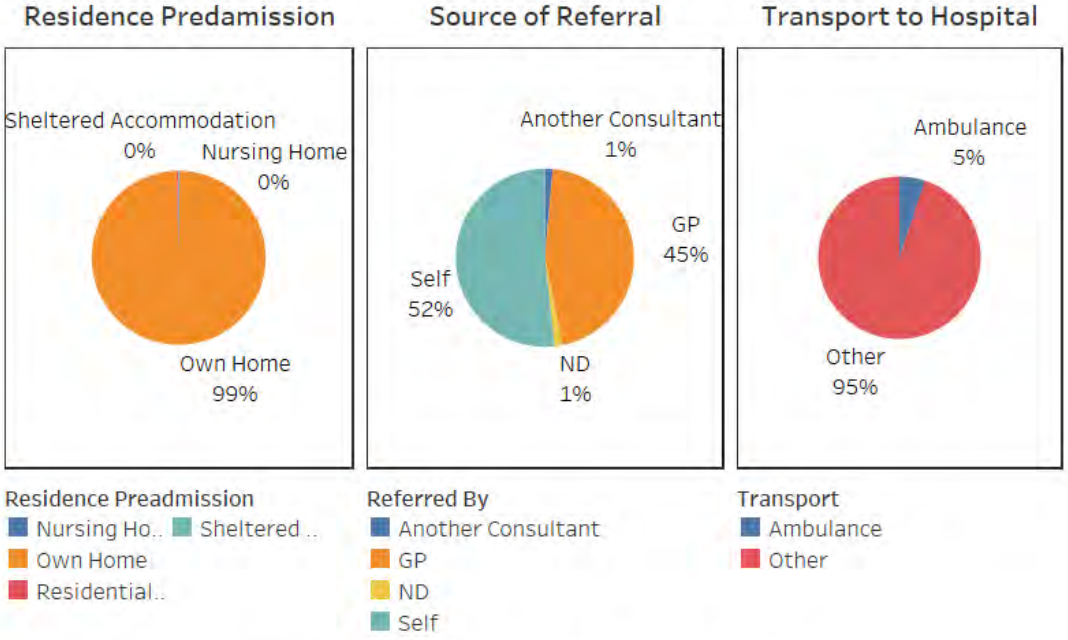

EGS Admissions 2019, 2020, 2021
(n=1,043)
Admissions per month
Count
40
30
20
10
0
200K
150K
100K
50K
0K
New COVID19 Cases
Measure Names
Count of admissions
New COVID19 Cases
June 2019
December 2019
June 2020
December 2020
June 2021
December 2021
Month
Admissions per Quarter
Hour of presentation
Admission per day
2019
2020
2021
Count
100
50
0
400K
300K
200K
100K
0K
Q1
Q2
Q3
Q4
Quarter
40
30
20
10
0
1
4
7
10
13
16
19
22
Hour
60
40
20
0
Monday
Tuesday
Wednesd..
Thursday
Friday
Saturday
Sunday
Day of Week
Year of Admission Date
2019
2021
2020

Age Distribution of EGS Admissions 2019, 2020, 2021 (n=1,041)

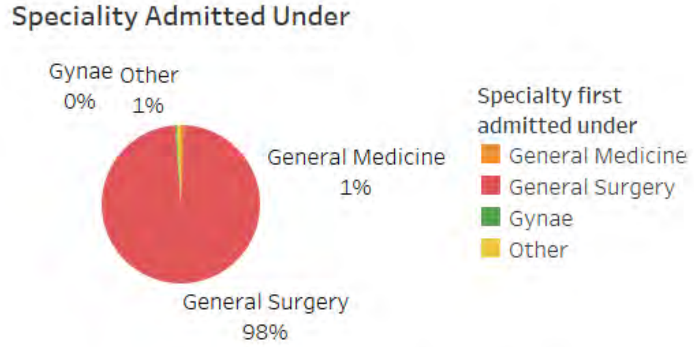


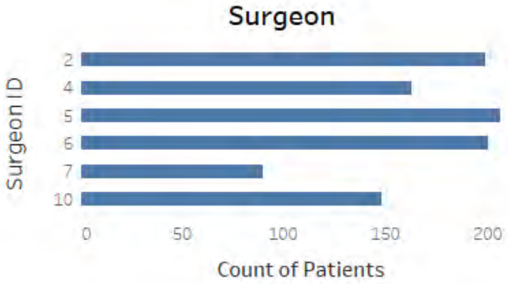
	Female	Male
Median Age	19.5	17

Patient Journey in 2019, 2020, 2021
(n=1,041)



Specialty & Surgeon 2019, 2020, 2021
(n=1,041)



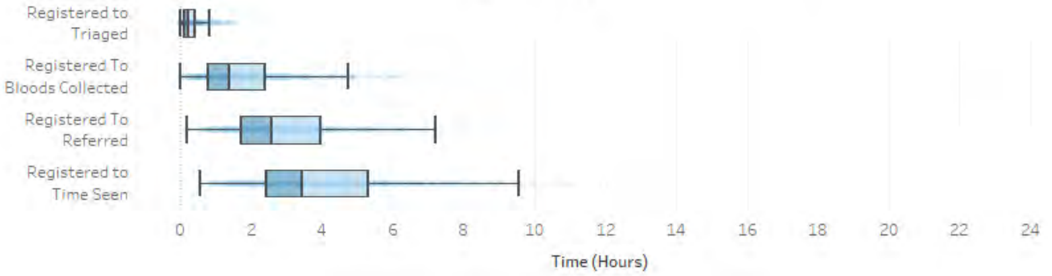


Surgeon by year

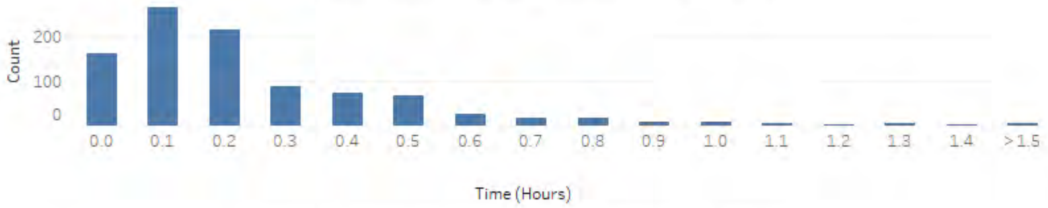
Consultant Surgeon	2019	2020	2021	Grand Total
2	82	58	59	199
4	60	63	40	163
5	66	73	67	206
6	89	49	62	200
7	90			90
10		72	76	148

*Due to rounding, 0% represent specialties with less than 1% of patients admitted

Emergency Department Times 2019, 2020, 2021 (n=908)

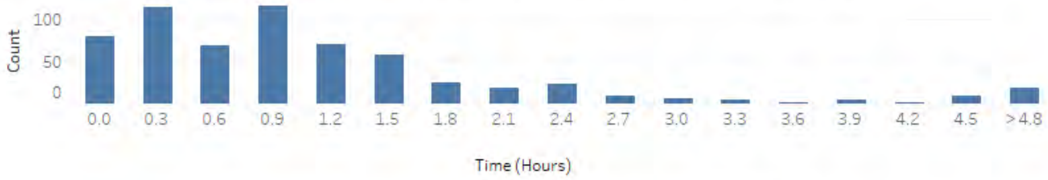


Registered to Triage (Median = 0.22 hrs)



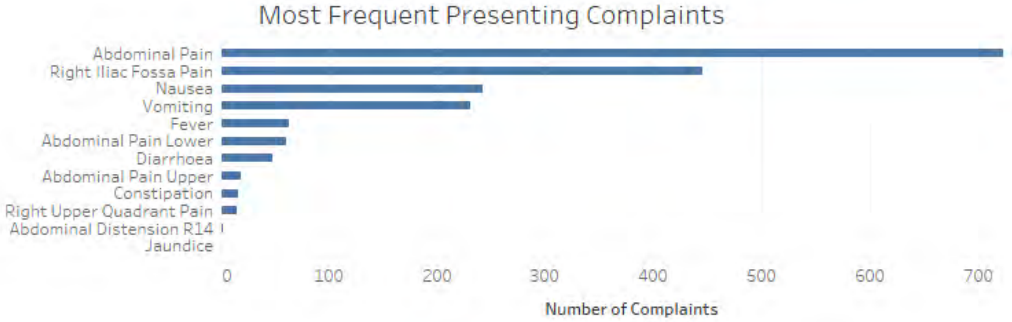
Triage to Bloods Collected (Median = 1.08 hrs)

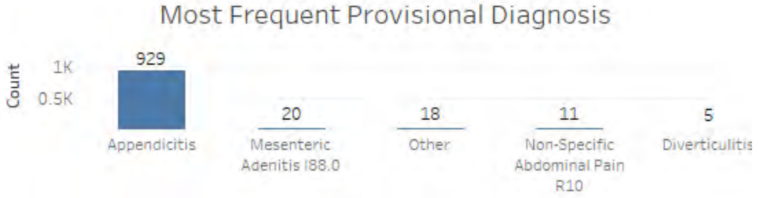
Bloods Collected to Time Referred (Median = 1.00 hrs)



Time Referred to Time Seen (Median = 0.63 hrs)

Presenting Complaints & Diagnoses 2019, 2020, 2021 (n=1,043)

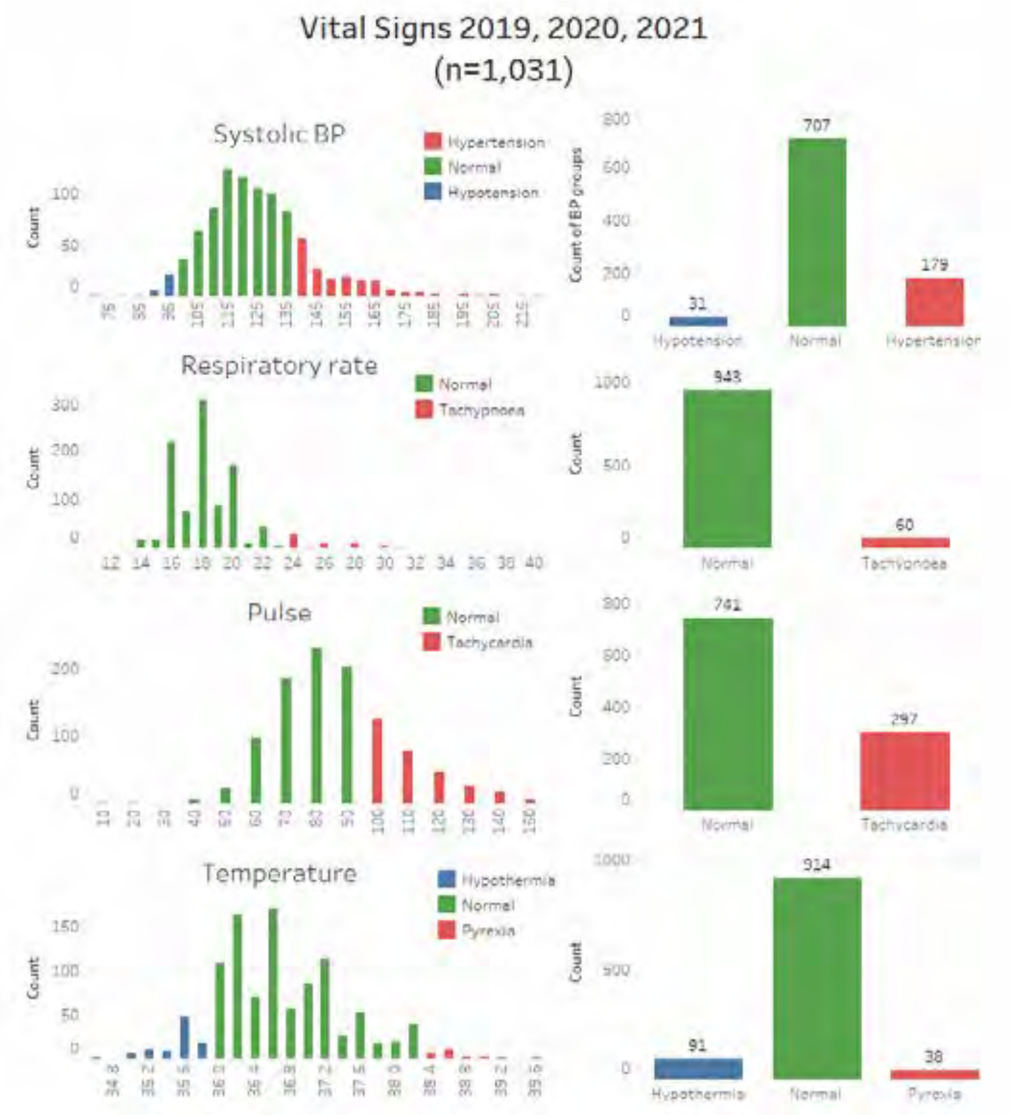

Most Frequent Presenting Complaints


Most Frequent Provisional Diagnosis


Most Frequent Final Diagnoses

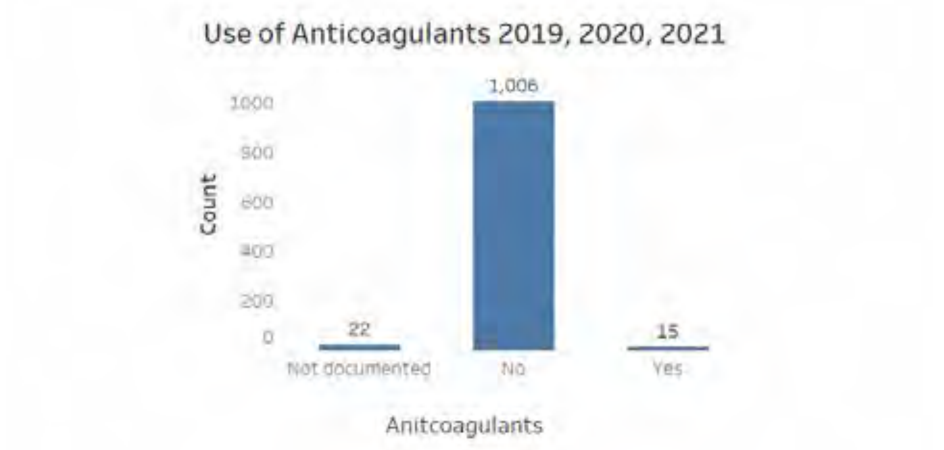
Final Diagnosis	Provisional Diagnosis				
	Appendicitis	Mesenteric Adenitis	Other	Non-Specific Abdominal Pain	Diverticulitis
Appendicitis K35	453	6	10	2	
Non-specific abdominal pain R10	145	6	5	6	
Other	135	4	10	1	
Mesenteric Adenitis I88.0	21	4	1	0	
Pelvic pathology R10.2	19	0	1	0	
Colitis K52	11	0	1	0	
Urology other N23	8	0	0	0	
Urology Stones N20	4	0	0	0	
Diverticulitis K57	3	0	1	0	
Cholecystitis K81	4	0	0	0	
SBO Adhesions	2	0	1	0	
Gastric Ulcer K25	2	0	0	0	

*Values in confusion table do not sum to adjacent histograms as they only show the most frequent provisional and final diagnoses



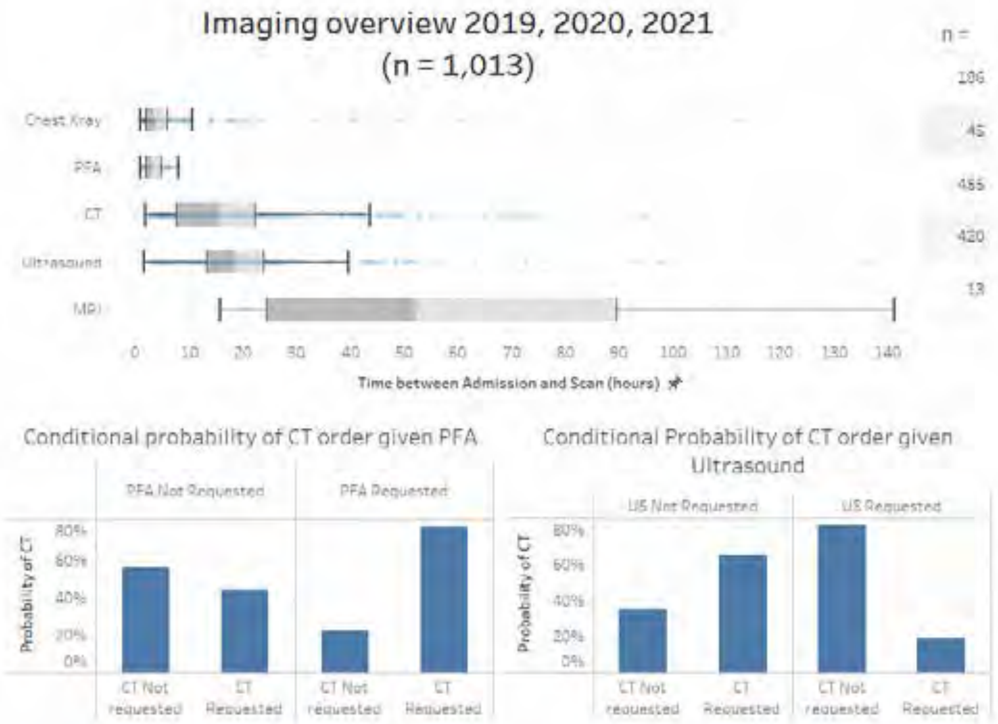
Vital Signs 2019, 2020, 2021 (n=1,031)

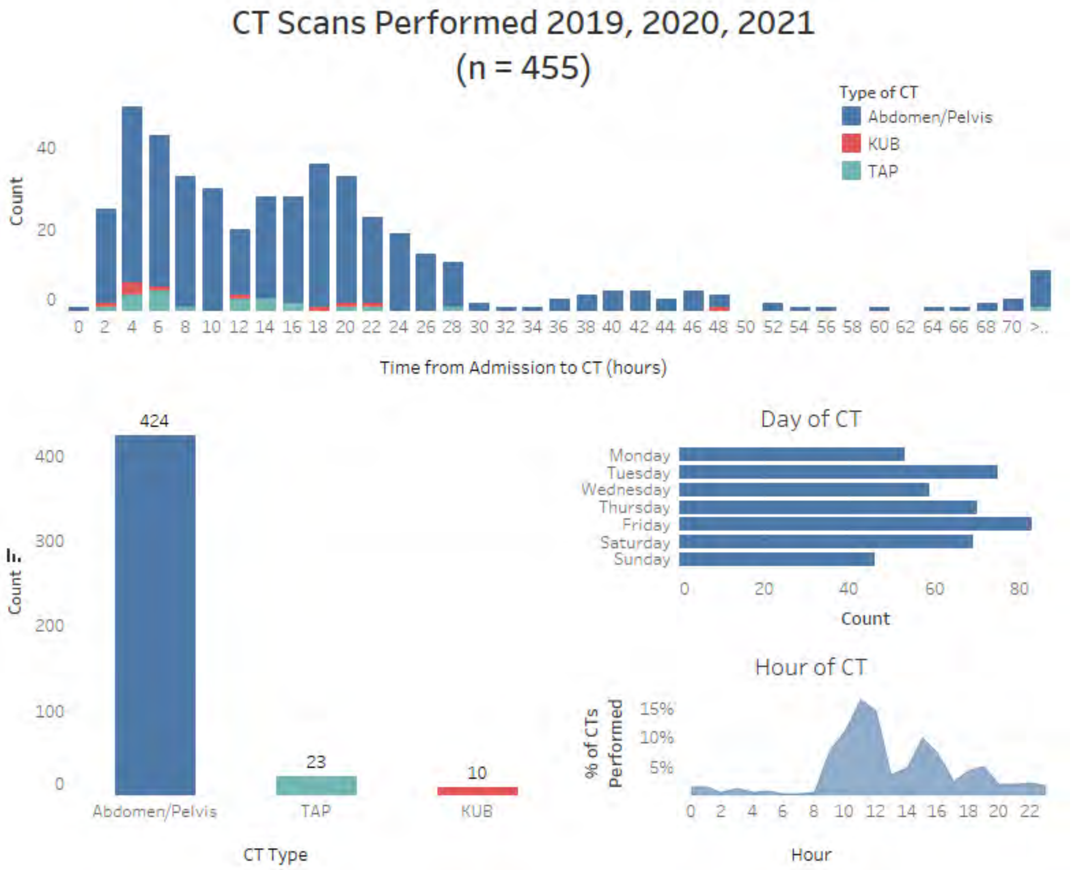
*Figure includes paediatric patient data

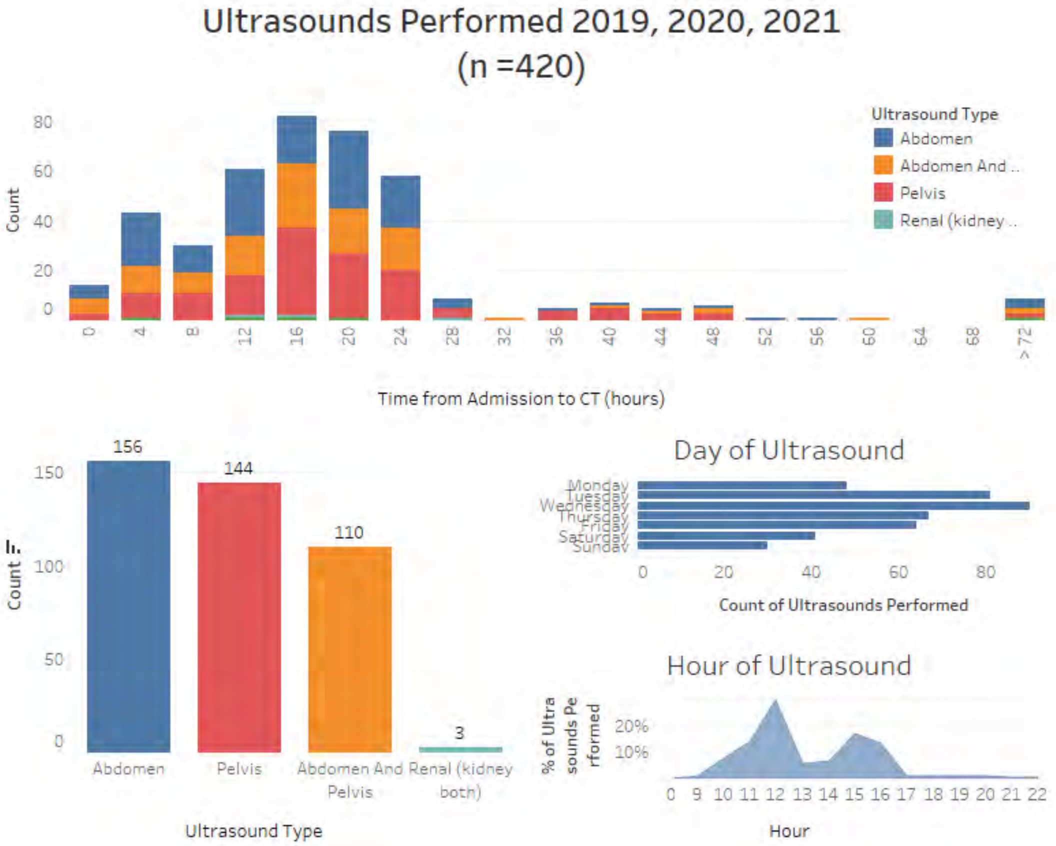


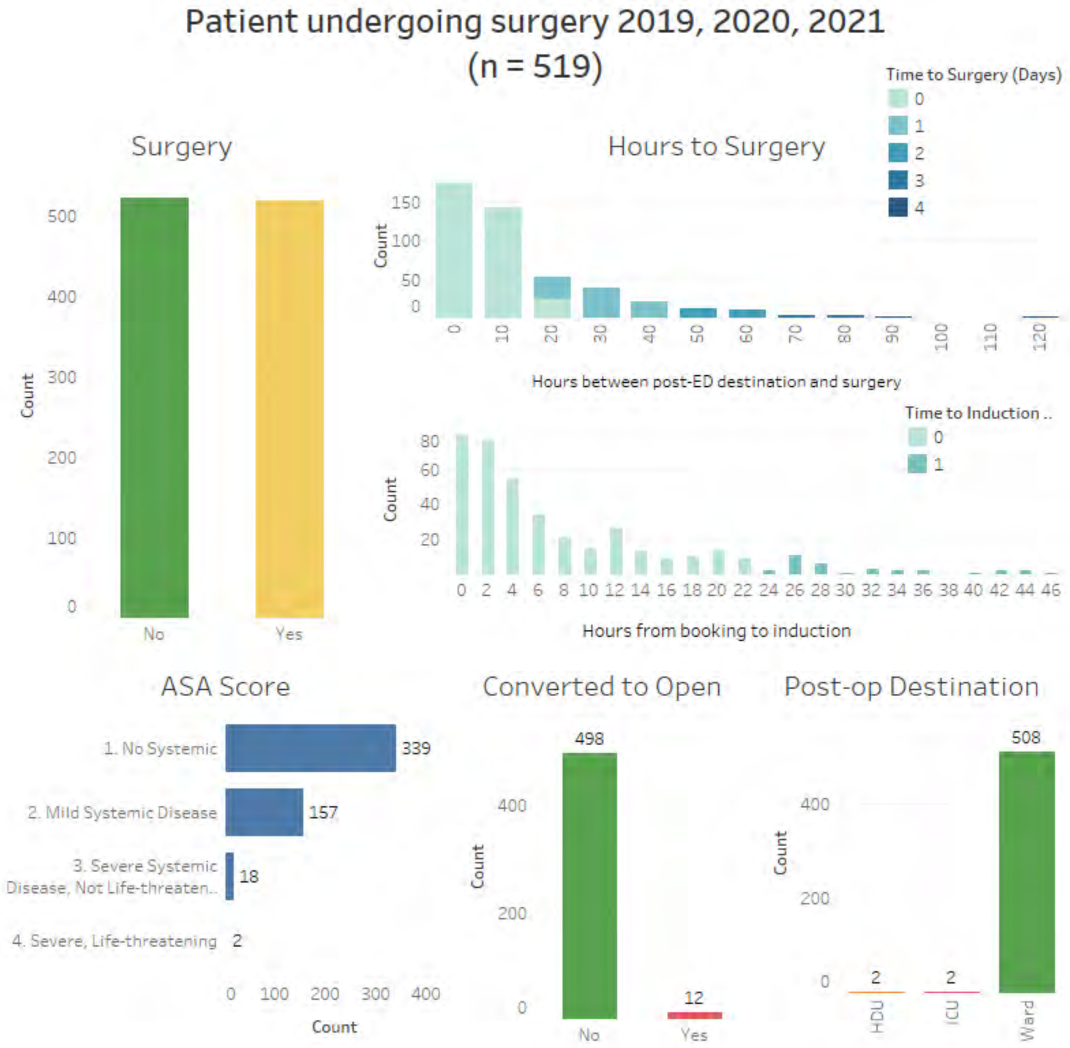
Use of Anticoagulants 2019, 2020, 2021

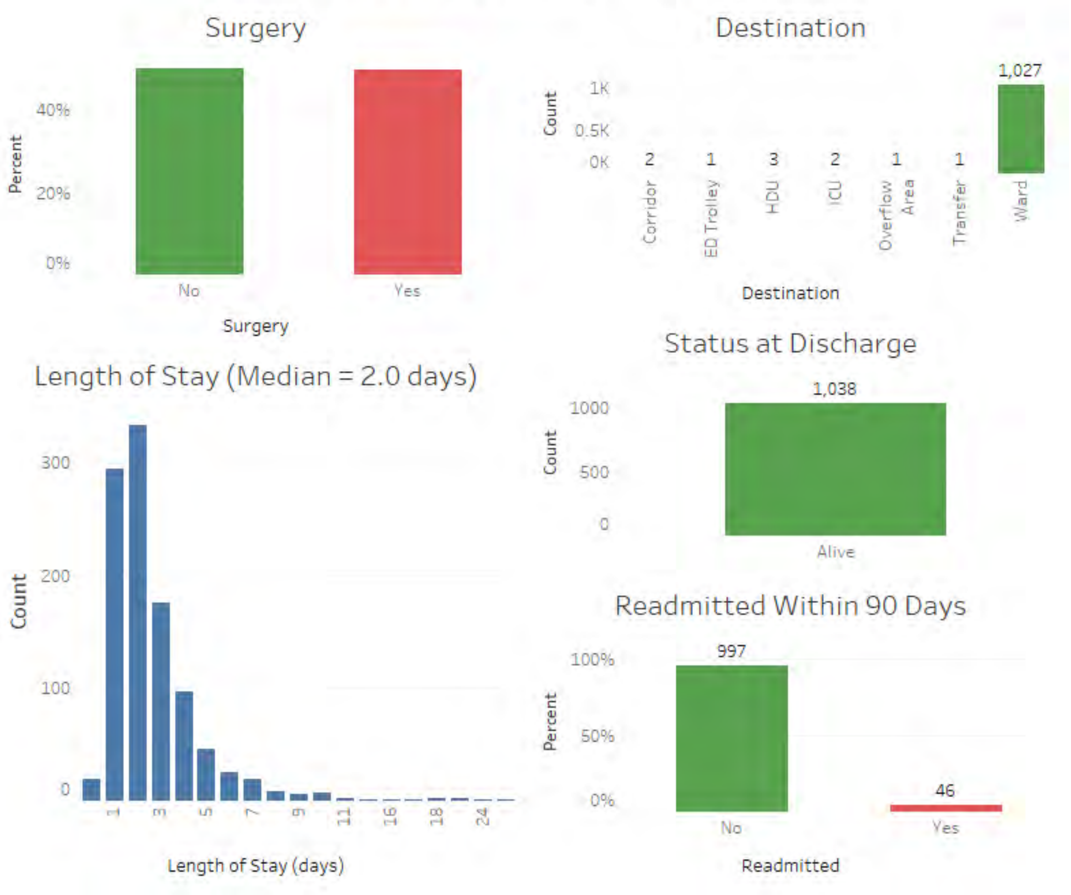
Lab Results 2019, 2020, 2021 (n=1,000)


Imaging overview 2019, 2020, 2021
(n = 1,013)
n =
Chest Xray
106
PFA
45
CT
455
Ultrasound
420
MRI
13
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Time between Admission and Scan (hours)
Conditional probability of CT order given PFA
PFA Not Requested
PFA Requested
Probability of CT
80%
60%
40%
20%
0%
CT Not requested
CT Requested
CT Not requested
CT Requested
Conditional Probability of CT order given Ultrasound
US Not Requested
US Requested
Probability of CT
80%
60%
40%
20%
0%
CT Not requested
CT Requested
CT Not requested
CT Requested


CT Scans Performed 2019, 2020, 2021
(n = 455)
Type of CT
Abdomen/Pelvis
KUB
TAP
Count
40
20
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 >..
Time from Admission to CT (hours)
424
400
300
200
100
0
Count
23
10
Abdomen/Pelvis
TAP
KUB
CT Type
Day of CT
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
20
40
60
80
Count
Hour of CT
% of CTs Performed
15%
10%
5%
0 2 4 6 8 10 12 14 16 18 20 22
Hour

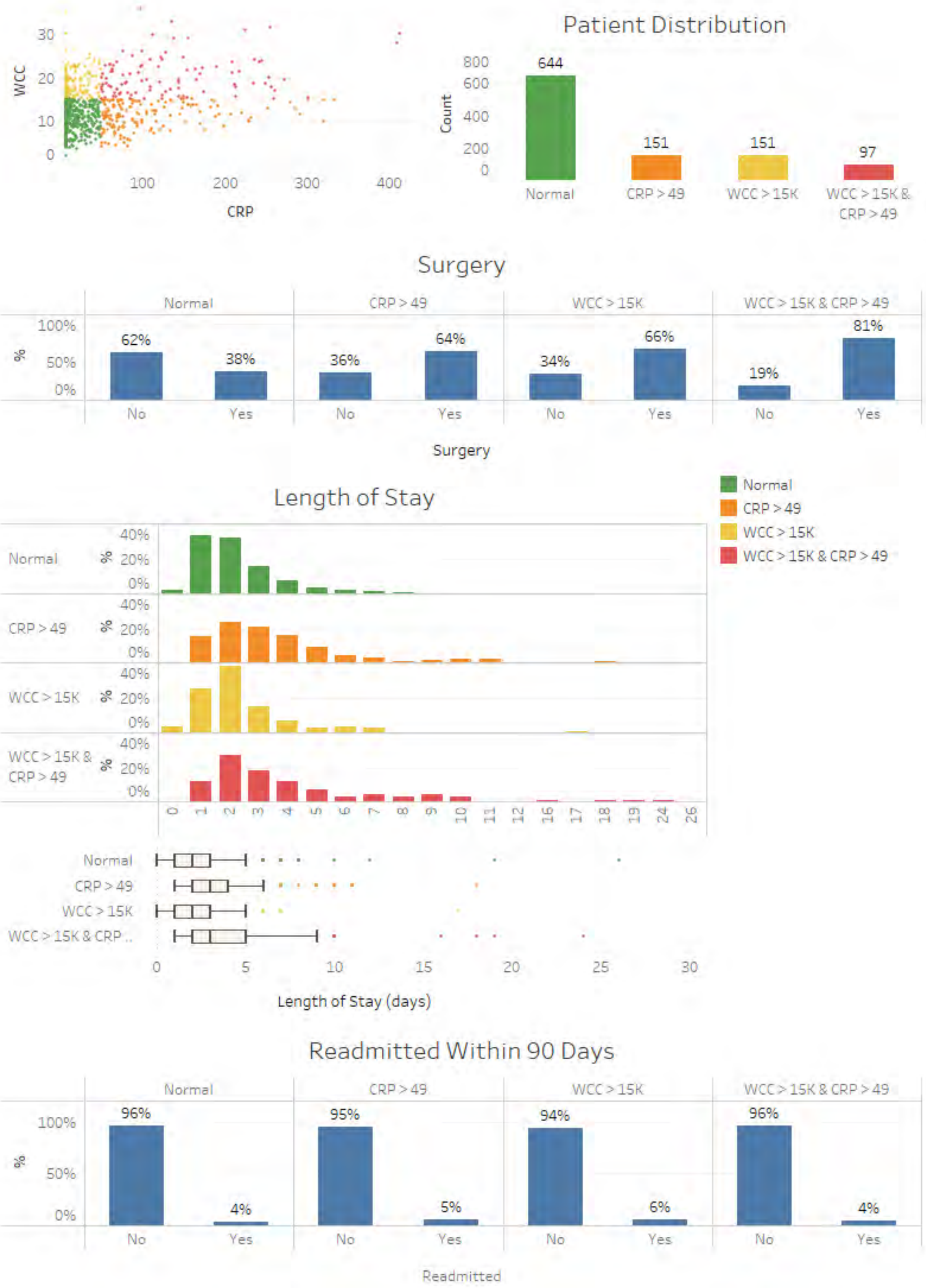

Ultrasounds Performed 2019, 2020, 2021
(n =420)
Count
80
60
40
20
0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
> 72
Time from Admission to CT (hours)
Ultrasound Type
Abdomen
Abdomen And ..
Pelvis
Renal (kidney ..
156
144
110
3
150
100
50
0
Count
Abdomen
Pelvis
Abdomen And Pelvis
Renal (kidney both)
Ultrasound Type
Day of Ultrasound
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
20
40
60
80
Count of Ultrasounds Performed
Hour of Ultrasound
% of Ultrasounds Performed
20%
10%
0 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Hour


Patient undergoing surgery 2019, 2020, 2021
(n = 519)
Surgery
Count
500
400
300
200
100
0
No
Yes
Hours to Surgery
Time to Surgery (Days)
0
1
2
3
4
Count
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
110
120
Hours between post-ED destination and surgery
Time to Induction ..
0
1
Count
80
60
40
20
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
Hours from booking to induction
ASA Score
1. No Systemic
339
2. Mild Systemic Disease
157
3. Severe Systemic Disease, Not Life-threaten..
18
4. Severe, Life-threatening
2
0
100
200
300
400
Count
Converted to Open
Count
498
400
200
0
12
No
Yes
Post-op Destination
Count
508
400
200
0
2
2
HDU
ICU
Ward



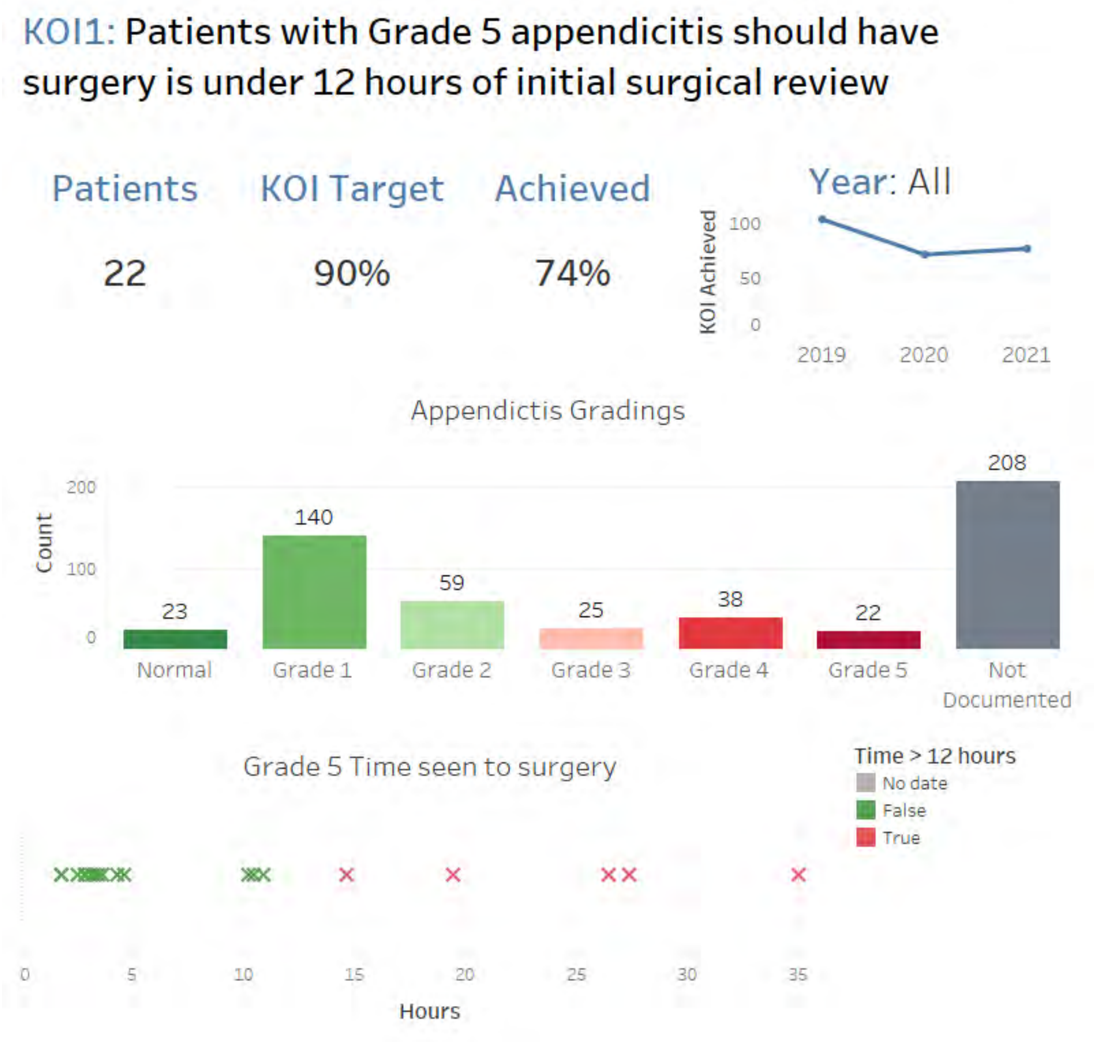
Patient Outcomes
2019, 2020, 2021 (n = 1,043)

Patient Outcomes by Lab Results
2019, 2020, 2021 (n = 1,043)



RIF Key Outcome Indicators

KEY OUTCOME INDICATOR		Target
Care Process		
1	Patients with Grade 5 appendicitis should have surgery is under 12 hours of initial surgical review	**90%**
2	RIF Pain Patients should have an appendicitis risk score documented	**90%**
Surgical Outcomes		
3	Laparoscopic Approach Used	**90%**
4	Laparoscopic Conversion Rate	**<3%**
5	Negative Appendectomy Rate	**< 10%**
Adverse Events		
6	30 day readmission following appendectomy	**<5%**



KOI1: Patients with Grade 5 appendicitis should have surgery is under 12 hours of initial surgical review

Patients	KOI Target	Achieved
22	90%	74%

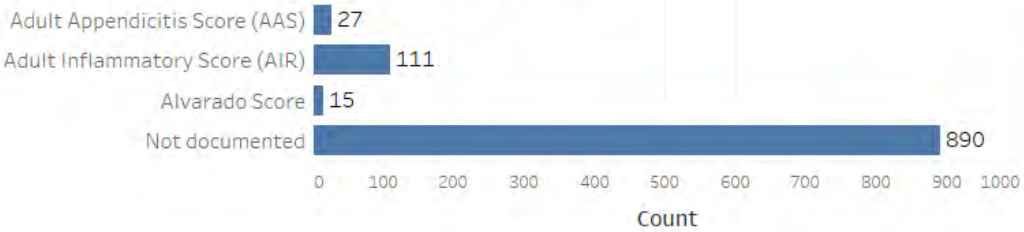
*Individual years are not reported given the low incidence of grade 5 appendicitis

KOI2: RIF Pain Patients should have an appendicitis risk score documented

Patients	KOI Target	Achieved
1,043	90%	15%

Year: All

Risk Score Used

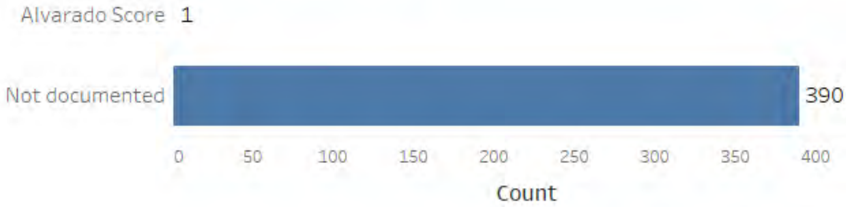


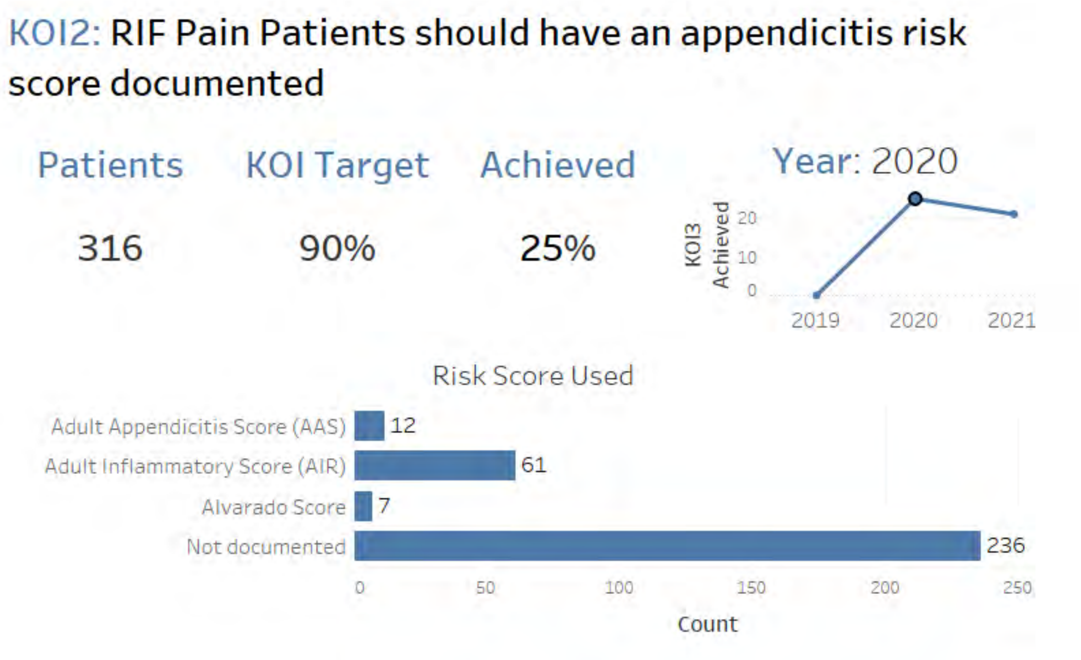
KOI2: RIF Pain Patients should have an appendicitis risk score documented

Patients	KOI Target	Achieved
391	90%	0%

Year: 2019

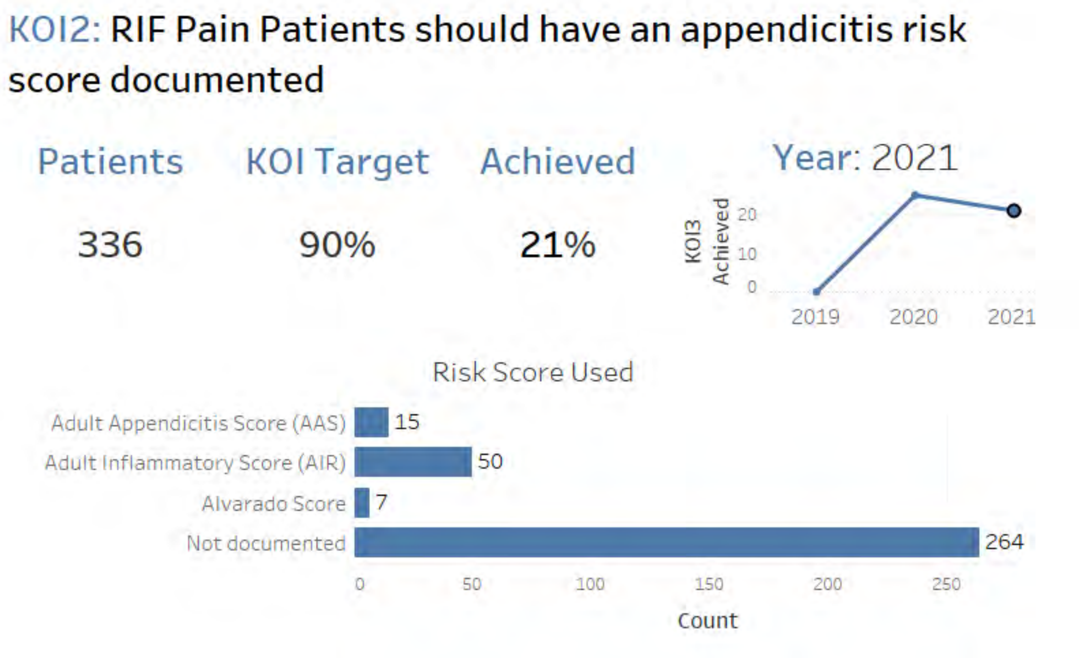
Risk Score Used





KOI2: RIF Pain Patients should have an appendicitis risk score documented

Patients	KOI Target	Achieved
316	90%	25%



KOI2: RIF Pain Patients should have an appendicitis risk score documented

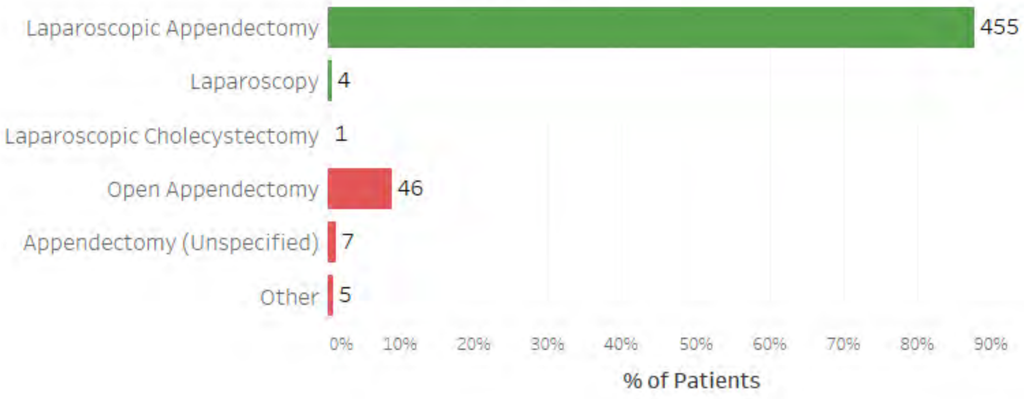
Patients	KOI Target	Achieved
336	90%	21%

KOI3: Laparoscopic Approach Used

Patients	KOI Target	Achieved
518	90%	89%

Year: All

Procedures

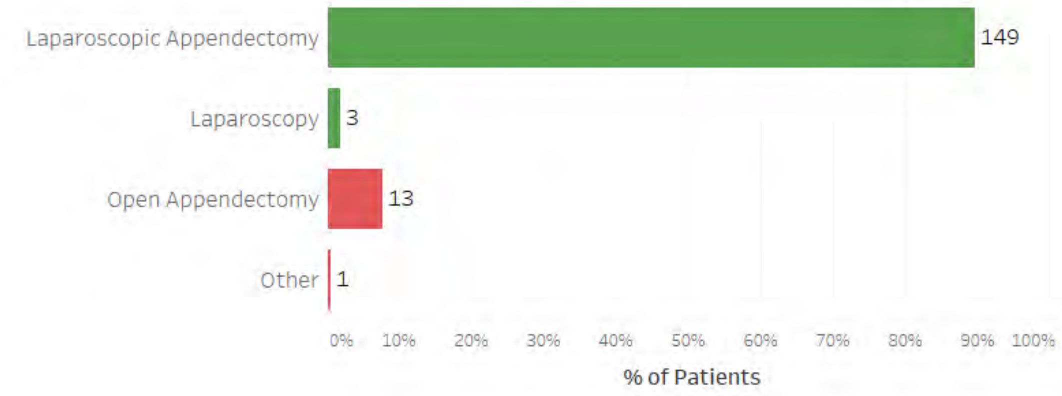


KOI3: Laparoscopic Approach Used

Patients	KOI Target	Achieved
166	90%	92%

Year: 2019

Procedures

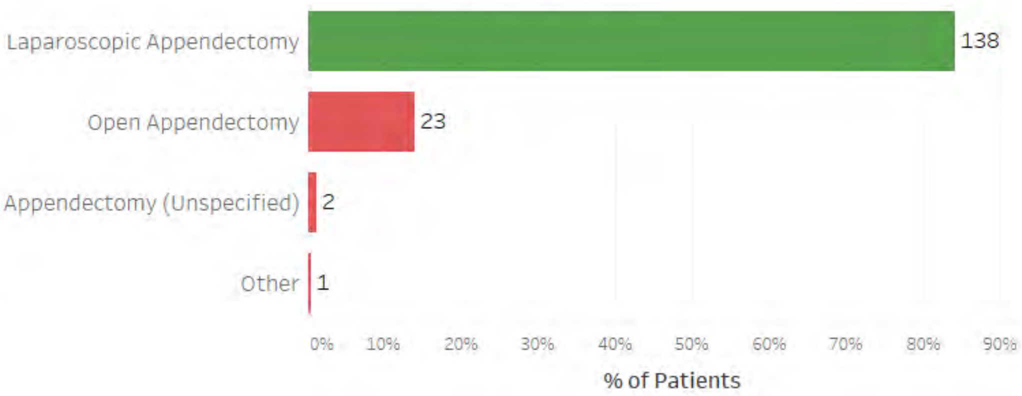


KOI3: Laparoscopic Approach Used

Patients	KOI Target	Achieved
164	90%	84%

Year: 2020

Procedures

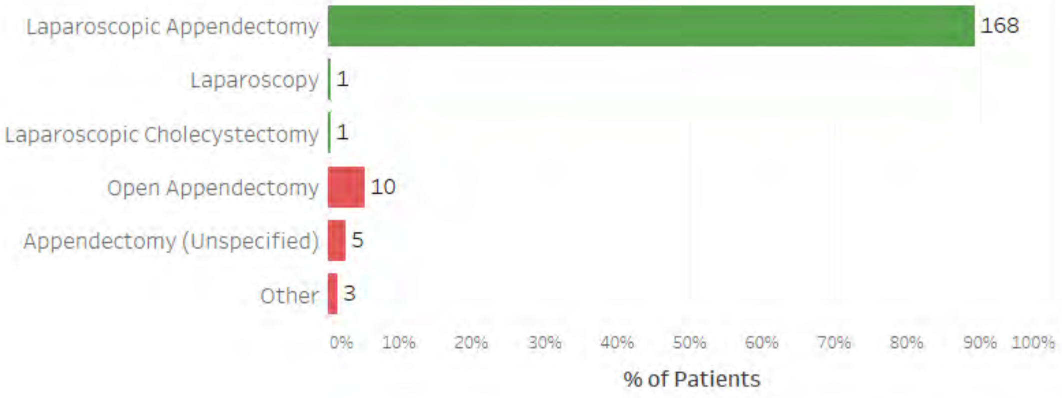


KOI3: Laparoscopic Approach Used

Patients	KOI Target	Achieved
188	90%	90%

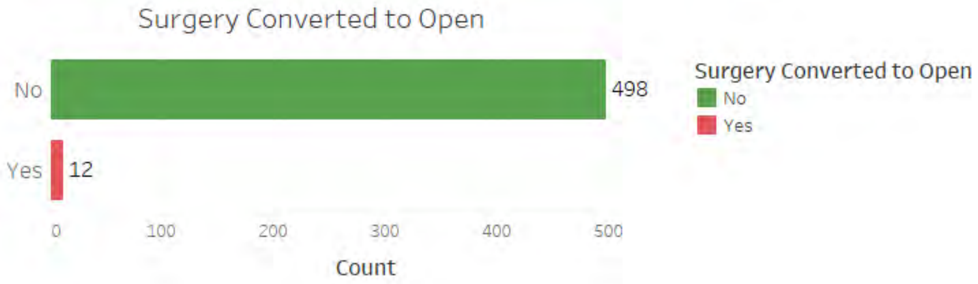
Year: 2021

Procedures



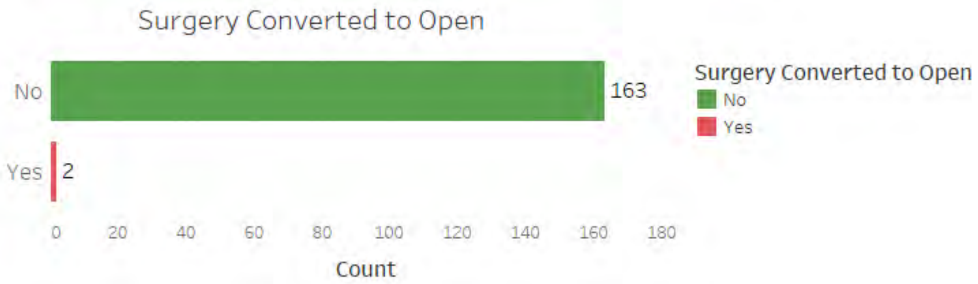
KOI4: Laparoscopic Conversion Rate

Patients	KOI Target	Achieved
518	< 3%	2%

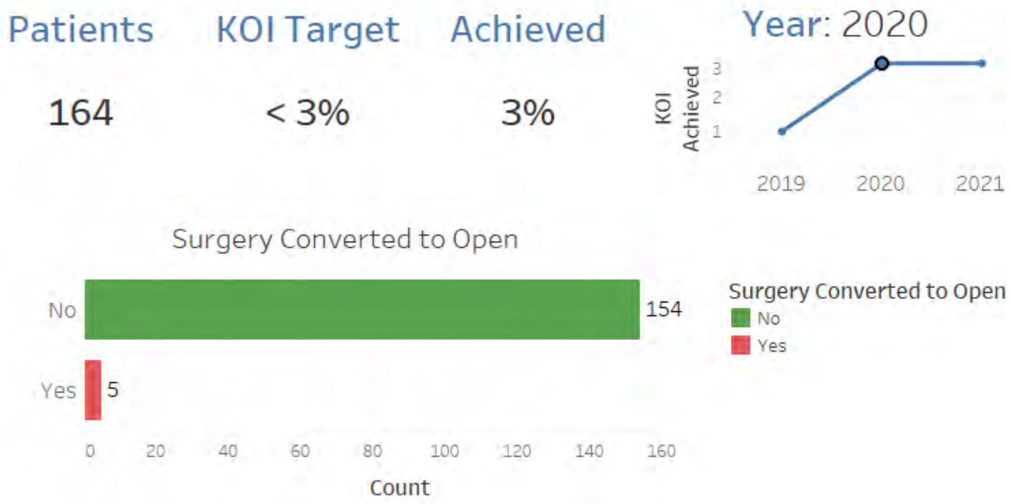


KOI4: Laparoscopic Conversion Rate

Patients	KOI Target	Achieved
166	< 3%	1%

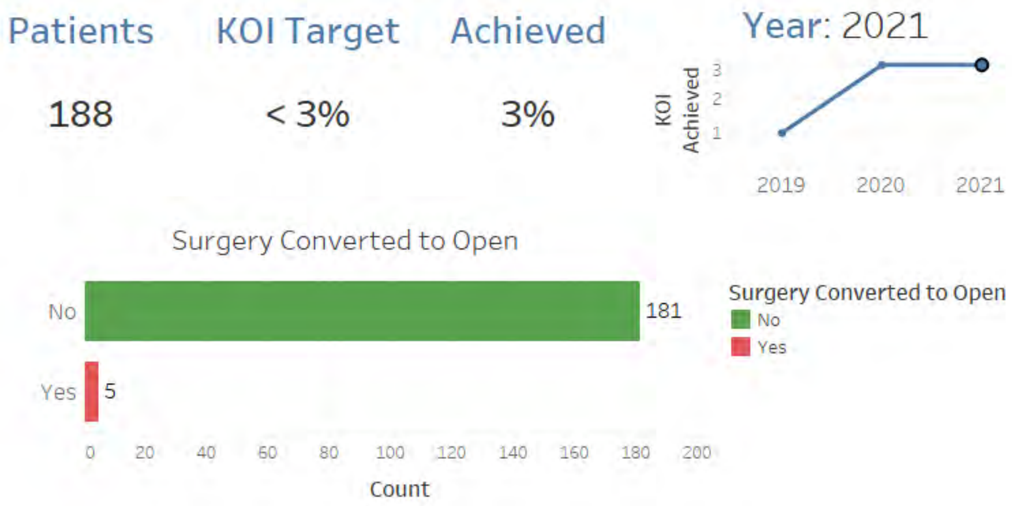


KOI4: Laparoscopic Conversion Rate



Patients	KOI Target	Achieved
164	< 3%	3%

KOI4: Laparoscopic Conversion Rate



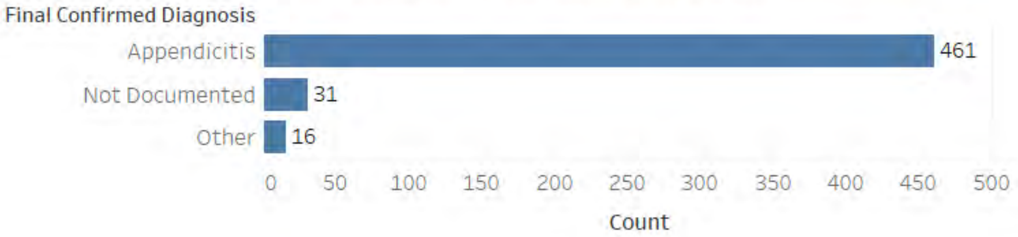
Patients	KOI Target	Achieved
188	< 3%	3%

KOI5: Negative Appendectomy Rate

Patients	KOI Target	Achieved
508	< 10%	9%

Procedure Group	Procedure	Final Confirmed Diagnosis		
		Appendicitis	Not Documented	Other
Appendectomy	Appendectomy	6	1	
	Laparoscopic	409	24	12
	Laparoscopic & Other	4		2
	Laparoscopy&Appendecto..	1	1	1
	Open	39	5	1
	Open & Laparoscopic	1		
	Other&Appendectomy Ope..	1		
	Total	461	31	16
Other	Lap Choly			1
	Laparoscopy		2	2
	Other		1	4
	Total		3	7

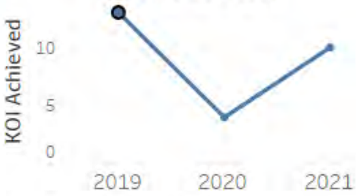
Final Diagnosis of Appendectomy Patients



KOI5: Negative Appendectomy Rate

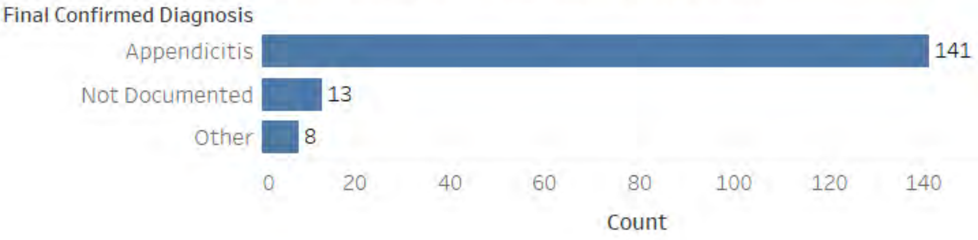
Patients	KOI Target	Achieved
162	< 10%	13%

Year: 2019



Procedure Group	Procedure	Final Confirmed Diagnosis		
		Appendicitis	Not Documented	Other
Appendectomy	Laparoscopic	127	12	6
	Laparoscopic & Other	1		2
	Open	12	1	
	Open & Laparoscopic	1		
	Total	141	13	8
Other	Laparoscopy		2	1
	Other			1
	Total		2	2

Final Diagnosis of Appendectomy Patients



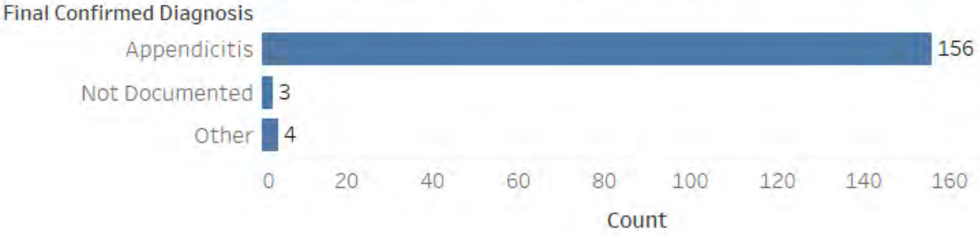
KOI5: Negative Appendectomy Rate

Patients	KOI Target	Achieved
163	< 10%	4%


Year: 2020

Procedure Group	Procedure	Final Confirmed Diagnosis		
		Appendicitis	Not Documented	Other
Appendectomy	Appendectomy	2		
	Laparoscopic	131	2	3
	Laparoscopic & Other	2		
	Open	21	1	1
	Total	156	3	4
Other	Other			1
	Total			1

Final Diagnosis of Appendectomy Patients

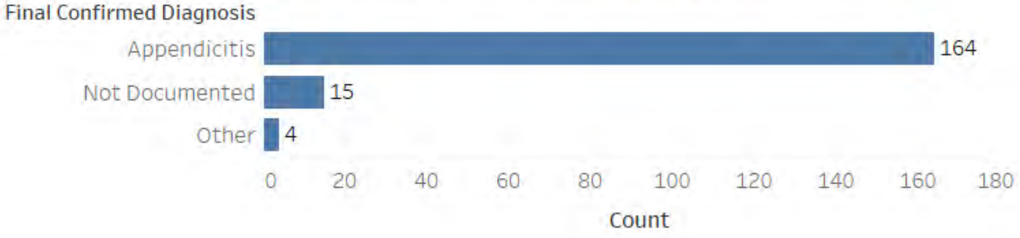


KOI5: Negative Appendectomy Rate

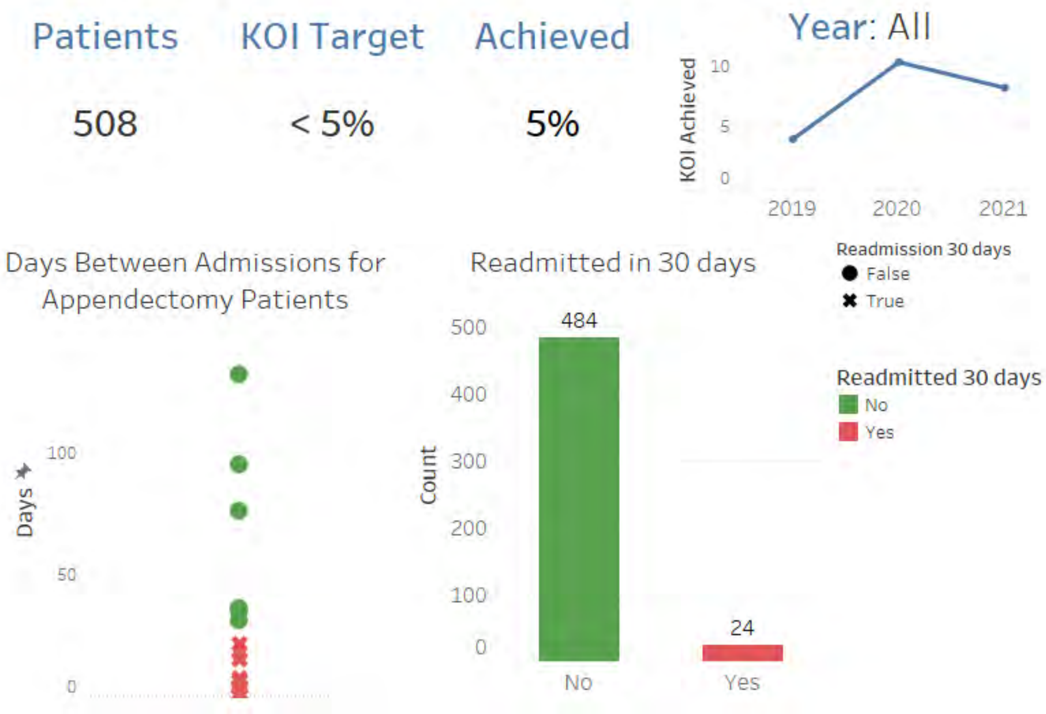
Patients	KOI Target	Achieved
183	< 10%	10%

Procedure Group	Procedure	Final Confirmed Diagnosis		
		Appendicitis	Not Documented	Other
Appendectomy	Appendectomy	4	1	
	Laparoscopic	151	10	3
	Laparoscopic & Other	1		
	Laparoscopy&Appendecto..	1	1	1
	Open	6	3	
	Other&Appendectomy Ope..	1		
	Total	164	15	4
Other	Lap Choly			1
	Laparoscopy			1
	Other		1	2
	Total		1	4

Final Diagnosis of Appendectomy Patients

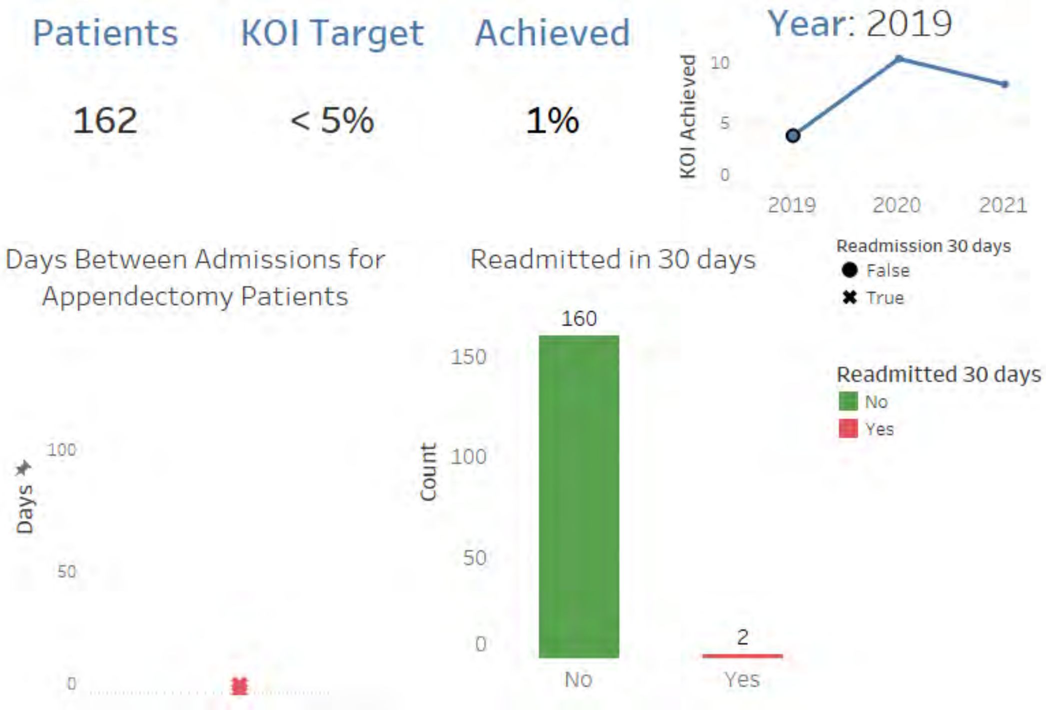


KOI6: 30-day re-admission following appendectomy



Patients	KOI Target	Achieved
508	< 5%	5%

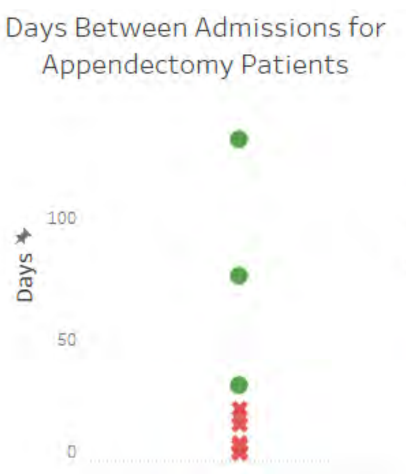
KOI6: 30-day re-admission following appendectomy

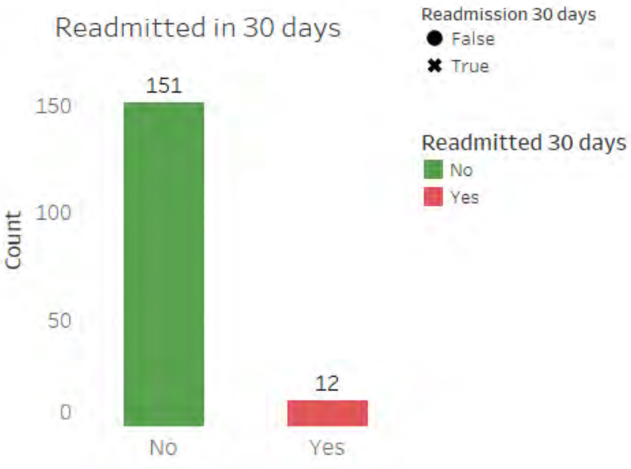


Patients	KOI Target	Achieved
162	< 5%	1%

KOI6: 30-day re-admission following appendectomy

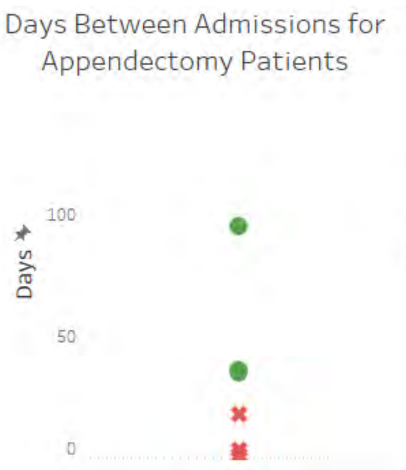
Patients	KOI Target	Achieved
163	< 5%	7%

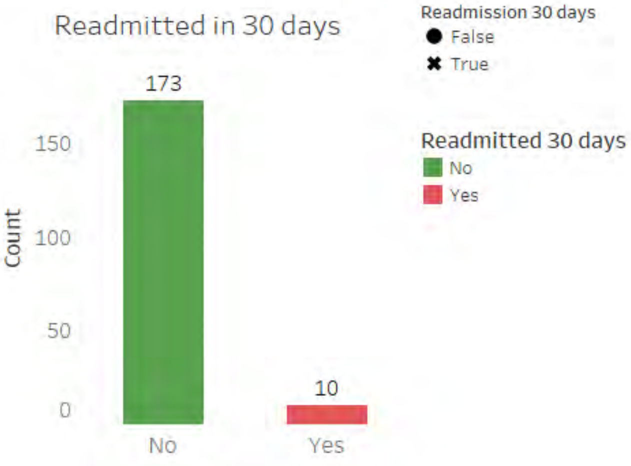




KOI6: 30-day re-admission following appendectomy

Patients	KOI Target	Achieved
183	< 5%	5%





Appendicitis – The implication of eSOAP Data

The next time you or a family member are admitted to an acute hospital with abdominal pain, what will concern you most? Will you worry more about the disease process or the delivery of care itself?

The eSOAP program is proud to combine invention with innovation to challenge the system through data analysis. Data analysis is creating a frontier that requires the policy makers in Health, not just in Ireland, Northern Ireland and Scotland to take ownership on what we have found in this EU funded project. So, when it comes to the management of appendicitis we can be very pleased with excellent elements in the delivery of care. As Dr Schwab stated in his overview we require leadership.

We have identified excellent diagnostic processes in Letterkenny University Hospital with an EGS digital registry that has huge potential to incorporate machine leaning and AI algorithms, already widely used outside Medicine, to aid management of complex abdominal problems. We can improve to reduce our negative appendectomy rates, unnecessary surgery, reduce our complication through the use of bundles and engaging with pathways. We can improve our diagnostic processes by timely imaging, and using new safety systems which incorporate laparotomy results and their trends into dynamic assessment systems.

All this threads of information need to be combined into agile scoring systems that are available at the clinical interface.

As Professor Curley says we need new paradigms and methodology. The eSOAP registry gives us a new bleeding edge digital innovation approach which can help systematically enable exponential change in our healthcare system.

In this section on appendicitis and throughout the entire report we have involvement from all the stakeholders, from junior residents, nursing staff, hospital administration, private industry and of course patients.

There is a great role for nursing in the initial care in an Acute Surgical Unit, which should be mandatory in hospitals accepting emergency surgery patients. Rein de Groot and his fellow patients need patient related outcomes to help the caring team to understand real world outcomes

Kabir and colleagues in a real-world review of appendicitis care, found positive outcomes but also identified the opportunity to improve diagnosis of acute appendicitis and potentially reduce variance among surgeons. This could be aided by decision tree pathways combined with the mandatory use of scoring systems shown to reduce negative appendectomy rate.

We need to change the way we image patients with RIF pain, avoiding plain abdominal x-rays in all patients, US focusing in females on pelvic rather than abdominal views and greater access to MRI scanning.

Ultrasound provides little benefit and its value outside female patients needs to be questioned.

Our CT scan rate is 40% which is keeping with European norms but much less that the US. Image reporting needs a standardised template matching a surgical grading system particularly to identify early, where possible complicated appendicitis.

All these systems need to be digitally linked to the Operating Room bookings and IT management systems. Surgery should be recorded and subject to occasional peer review at part of training. Public Private partnership if developed will enhance patient outcome through archiving of surgical procedures, which in turn create an ability for instantaneous second surgical opinions.

A re-admission prevention strategy needs to be implemented to reduce the rate of re-admission. Kabir's paper challenges concepts in surgeons' clinical responsibility, education and governance, which are all crucial in improving outcomes.

Key outcome indicators have identified the need for templated digital operating reporting stems which should include operative visual documentation. Currently the grade of appendicitis is recorded in only half of the patients. This limits the ability to interrogate data and outcomes. Risk scores are recorded in 15% of patients. This should be mandatory and this would be facilitated by the creation of a digital admission proforma. Letterkenny reported an excellent laparoscopic appendectomy rate and a very low conversion rate, which suggest a robust modern approach to appendicitis. The 9% negative appendectomy rate suggests that the eSOAP project has created a knowledge and awareness culture to improve the delivery of surgery.

The eSOAP registry has the power to interrogate trends, cost, outcomes between hospital and countries and with support from the European Society of Trauma and Emergency Surgery (ESTES) this vision could become a reality, together we can't change (not a typo) without leadership from the governing health authority. This report is a call to Government, Health Departments and learned Colleges to come together to create a safer future not just in appendicitis but in the 10% of hospital admissions which EGS currently make up.

life

MDPI

Article

Quality Outcomes in Appendicitis Care: Identifying Opportunities to Improve Care

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Abstract: Introduction: Appendicitis is one of the most common causes of acute abdominal pain requiring surgical intervention, but the variability of diagnosis and management continue to challenge the surgeons. *Aim*: This study assessed patients undergoing appendectomy to identify opportunities to improve diagnostic accuracy and outcomes. Methods: An ethically approved retrospective cohort study was undertaken between March 2016 and March 2017 at a single university hospital of all consecutive adult and paediatric patients undergoing appendectomy. Demographic data including age, gender, co-morbidities, presentation and triage timings along with investigation, imaging and operative data were analysed. Appendicitis was defined as acute based on histology coupled with intraoperative grading with the American Association for the Surgery of Trauma (AAST) grades. Complications using the Clavien–Dindo classification along with 30-day re-admission rates and the negative appendectomy rates (NAR) were recorded and categorised greater and less than 25%. The use of scoring systems was assessed, and retrospective scoring performed to compare the Alvarado, Adult Appendicitis Score (AAS) and the Appendicitis Inflammatory Response (AIR) score. *Results*: A total of 201 patients were studied, 115 male and 86 females, of which 136/201 (67.6%) were adults and 65/201 (32.3%) paediatric. Of the adult group, 83 were male and 53 were female, and of the paediatric group, 32 were male and 33 were female. Median age was 20 years (range: 5 years to 81 years) and no patient below the age of 5 years had an appendectomy during our study period. All patients were admitted via the emergency department and median time from triage to surgical review was 2 h and 38 min, (range: 10 min to 26 h and 10 min). Median time from emergency department review to surgical review, 55 min (range: 5 min to 6 h and 43 min). Median time to operating theatre was 21 h from admission (range: 45 min to 140 h and 30 min). Out of the total patients, 173 (86.1%) underwent laparoscopic approach, 28 (13.9%) had an open approach and 12 (6.9%) of the 173 were converted to open. Acute appendicitis occurred in 166/201 (82.6%). There was no significant association between grade of appendicitis and surgeons' categorical NAR rate (p = 0.07). Imaging was performed in 118/201 (58.7%); abdominal ultrasound (US) in 53 (26.4%), abdominal computed tomography (CT) in 59 (29.2%) and both US and CT in 6 (3%). The best cut-off point was 4 (sensitivity 84.3% and specificity of 65.7%) for AIR score, 9 (sensitivity of 74.7% and specificity of 68.6%) for AAS, and 7 (sensitivity of 77.7% and specificity of 71.4%) for the Alvarado score. Twenty-four (11.9%) were re-admitted, due to pain in 16 (58.3%), collections in 3 (25%), 1 (4.2%) wound abscess, 1 (4.2%) stump appendicitis, 1 (4.2%) small bowel obstruction and 1 (4.2%) fresh rectal bleeding. CT guided drainage was performed in 2 (8.3%). One patient had release of wound collection under general anaesthetic whereas another patient had laparoscopic drain placement. A laparotomy was undertaken in 3 (12.5%) patients with division of adhesions in 1, the appendicular stump removed in 1 and 1 had multiple collections drained. Conclusion: The negative appendectomy and re-admission rates were unacceptably high and need to be reduced. Minimising surgical variance with use of scoring systems and introduction of pathways may be a strategy to reduce NAR. New systems of feedback need to be introduced to improve outcomes.

Keywords: appendicitis; appendectomy; re-admission; Alvarado score; Appendicitis Inflammatory Response score; Adult Appendicitis Score; negative appendectomy rate

1. Introduction

Acute appendicitis remains one of the most common presentations of acute abdominal pain in both adults and children, with a prevalence of approximately 7% and an incidence of 11 cases/10,000 population per year [1]. History and physical examination, along with laboratory testing, remain the keys to diagnosis, aided with imaging and scoring modalities [2–4]. There is increasing recognition of the need to improve decision making in management of acute appendicitis and reduce the negative appendectomy rates which approach 25% [5–7]. Integrated scoring systems may reduce unnecessary surgery [4,8,9]. In addition, the identification of complicated appendicitis has become a further goal to avoid delay in surgery and reduce the increase in complications seen in that sub-group [10]. Delay in surgery in patients with complex appendicitis, especially those with perforation and peritonitis, may result in increased post-operative complications [11].

For centuries, acute appendicitis has been managed surgically [12], and a laparoscopic approach is now preferred due to lower complication rates [8,10]. With evolving strategies and development of performance indicators in managing appendicitis [13], it is clear we need to review management of this common entity to improve process of delivery of care, outcomes, and reduce hospital re-admissions [14].

This study assessed all patients undergoing appendectomy over a period of one year in a regional university hospital to identify opportunities to improve diagnostic accuracy and outcomes.

2. Methods

2.1. Study Design

This is an ethically approved retrospective cohort study of all consecutive patients, including both adult and paediatric presentations, undergoing appendicectomy between March 2016 and March 2017 at Letterkenny University Hospital in Ireland. It is a 330-bed regional hospital serving a population of 160,000, with a complement of five consultant surgeons in the surgical department, specialising in emergency and breast, colorectal, upper GI, and three general surgeons. During the study period, 8 consultant surgeons managed both adult and paediatric patients. The emergency roster is 1 week on in 5 and is consultant-led with 1 senior and 1 junior resident on rotating call from a pool of 14 residents. Imaging was always performed and reported by a consultant radiologist.

2.2. Patient Demographics

Data including age, gender, day of admission, time from admission to surgery in minutes and length of stay in days was collected. Paediatric patients were defined as aged between 0 and 15 years, and adults were defined as aged 16 years and above. The final radiological report was correlated with the final histology to calculate accuracy of radiological investigations. There was no standardised radiology reporting proforma. The Charlson Comorbidity Index (CCI) was used to classify patients based on severity of pre-existing conditions by assigning grade 0 for no comorbidities, 1 for a single chronic illness and 2 for more than 1 chronic illness [15].

2.3. Factors Associated with Operative Data

The preferred surgical approach was laparoscopic with all but one surgeon and conversion rates were recorded. Intraoperative findings were categorised using the American Association for the Surgery of Trauma (AAST) grades, where grade 1 was assigned to acutely inflamed appendix, grade 2 to gangrenous appendix, grade 3 to perforated appendix with local contamination, grade 4 to perforated appendix with peri appendiceal phlegmon or abscess and grade 5 to perforated appendix with generalised peritonitis [16]. Intraoperative reported findings of acute appendicitis had to be confirmed histologically before being deemed as true acute appendicitis. Negative appendicectomy (NA) was defined as histologically normal appendix. Enterobious vermicularis infestation in the absence of inflammation was classed as a normal appendix. Complications were recorded using the Clavien–Dindo grading system [17]. Patients admitted with right iliac fossa pain who did not have appendectomies were not included in the study.

2.4. Statistical Analysis

Data was expressed as mean and standard deviation for normally distributed data and medians and interquartile range for non-normal data. The area under the receiver operating curve (AUC) at the optimal cut-off threshold scores was calculated for the Alvarado score, Appendicitis Inflammatory Response (AIR) score, and Adult Appendicitis Score (AAS) [3,7–10]. The independent chi-square test was used to determine the relationship between the grade of appendicitis and the negative appendectomy rate (NAR) amongst individual consultants. The consultants were divided into two groups based on a NAR greater, less than and equal to 25%. A *p*-value of less than 0.05 was deemed statistically significant.

2.5. Results

A total of 201 patients were studied, 115 male and 86 females, of which 136/201 (67.6%) were adults and 65/201 (32.3%) paediatric. Of the adult group, 83 were male and 53 were female, and of the paediatric group, 32 were male and 33 were female. Median age was 20 years (range: 5 years to 81 years) and no patient below the age of 5 years had an appendectomy during our study period. All patients were admitted via the emergency department and median time from triage to surgical review was 2 h and 38 min, (range: 10 min to 26 h and 10 min). Median time from emergency department review to surgical review was 55 min (range: 5 min to 6 h and 43 min). Median time to operating theatre was 21 h from admission (range: 45 min to 140 h and 30 min). Out of the total, 173 patients (86.1%) underwent laparoscopic approach, 28 (13.9%) had an open approach and 12 (6.9%) of the 173 were converted to open. Acute appendicitis occurred in 166/201 (82.6%). The grade of appendicitis was 1 in 97 (58.4%), grade 2 in 17 (10.2%), grade 3 in 13 (7.8%), grade 4 in 10 (6%) and grade 5 in 29 (17.5%). The negative appendicectomy rate was 35/201 (17.4%) with the individual surgical consultant rates ranging from 6.5–38.9%. (Table 1) The independent chi-square test was performed to examine the relationship between the NAR of greater or less than or equal to 25% among individual consultants and the grade of appendicitis showed no significant association between the two parameters, X^2 (df4, $N = 166$) = 8.8, $p = 0.07$ (Table 2).

Table 1. Outcomes for individual consultants.

Consultant	Total Appendectomies	Laparoscopic	Open	Conversion to Open (%)	Negative Appendectomy	(NAR%) (Negative Appendectomy Rate)
1	49	38	5	6 (13.6)	4	8.2
2	36	32	1	3 (8.3)	14	38.9
3	31	30	1	0	2	6.5
4	27	26	1	0	4	14.8
5	19	17	1	1 (5.6)	5	26.3
6	15	8	5	2 (20)	2	13.3
7	13	0	13	0	1	7.7
8	11	10	1	0	3	27.3
Total	**201**	**161**	**28**	**12 (6.9)**	**35**	**17.4**

Table 2. Negative appendectomy rate (NAR) 25% and appendicitis grade (AAST) of consultants.

(NAR) > 25%								
Consultant	**NAR (%)**	**Total**	**Normal**	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
2	38.9	36	14	17	1	0	0	4
5	26.3	19	5	9	0	2	1	2
8	27.3	11	3	7	0	0	0	1
Total		**66**	**22**	**33**	**1**	**2**	**1**	**7**
(NAR) ≤ 25%								
Consultant	**NAR (%)**	**Total**	**Normal**	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
1	8.2	49	4	24	8	2	5	6
3	6.5	31	2	12	5	1	2	9
4	14.8	27	4	14	2	4	0	3
6	13.3	15	2	9	0	0	2	2
7	7.7	13	1	5	1	4	0	2
Total		**135**	**13**	**64**	**16**	**11**	**9**	**22**

Table 3. Diagnostic performance of imaging modalities.

	Patients Imaged (%) *	Male (%)	Female (%)	Sensitivity (%)	Specificity (%)	Accuracy (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
US	53 (26.4)	14 (26.4)	39 (73.6)	41.2	84.2	56.6	82.4	44.4
CT	59 (29.4)	33 (55.9)	26 (44.1)	98.2	88.9	96	96.5	94.1

* Total number of patients was 118/201 (58.7%) where 6 (3%) patients had both ultrasound and CT scan.

Imaging was performed in 118/201 (58.7%). Abdominal ultrasound (US) was undertaken in 53 (26.4%), of which 39 (73.6%) were female and 14 (26.4%) male. Abdominal CT was done in 59 (29.2%), with 33 (55.9%) male and 26 (44.1) female, and both US and CT in 6 (3%), with 3 (50%) male and 3 (50%) female. US correctly identified acute appendicitis in 14 patients (true positives) and failed to identify appendicitis in 20 patients (false negatives). US reported 16 patients correctly with a normal appendix (true negative), and incorrectly diagnosed 3 patients with appendicitis (false positives). US had a sensitivity of 41.2%, specificity of 84.2%, positive predictive value of 82.4%, negative predictive value of 44.4%, and an accuracy of 56.6%. CT correctly diagnosed acute appendicitis in 55 patients (true positives) and erroneously diagnosed it in 2 (false positives). One patient was correctly reported as normal appendix (true negatives) and one was inaccurately reported as normal (false negative). CT had a sensitivity of 98.2%, a specificity of 88.9%, positive predictive value of 96.5%, negative predictive value of 94.1% and an accuracy of 96%. In patients who had both, the US scan had missed acute appendicitis in 4 patients, and they were correctly diagnosed on CT. CT confirmed the normal appendix in 2 patients as their US was inconclusive, or normal. (Table 3).

The AUC for AIR score was 82.3%, 78.3% for AAS and 75.2% for Alvarado score (Figure 1). The best cut-off point was 4 for AIR, 9 for AAS, and 7 for Alvarado score. If the best cut-off was considered as an interpretation benchmark for these three scoring systems, AIR achieved sensitivity of 84.3% and specificity of 65.7%; AAS would have sensitivity of 74.7% and specificity of 68.6%; while sensitivity and specificity of the Alvarado score would be 77.7% and 71.4% respectively.

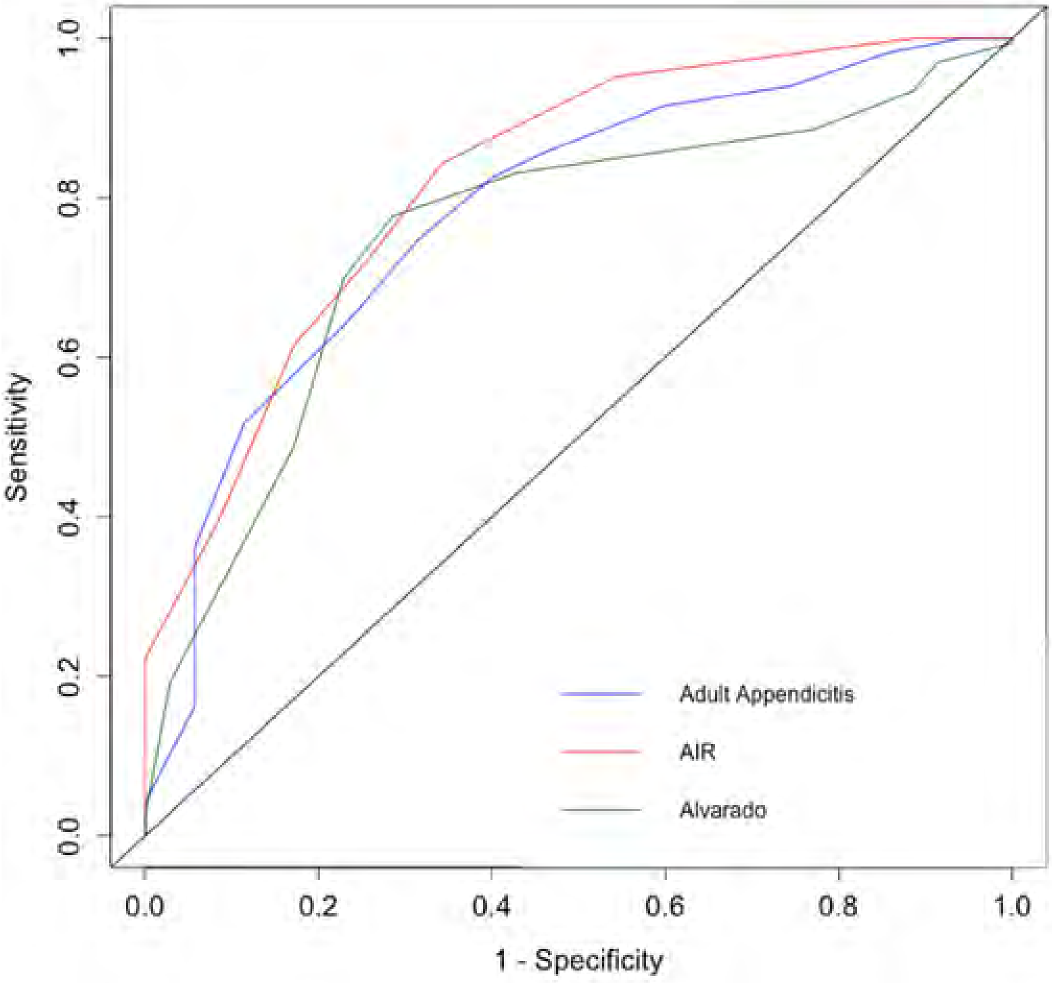

Figure 1. Combined receiver operating characteristic (ROC) curves for the AIR, AAS and Alvarado scoring systems.

Twenty-four (11.9%) were re-admitted, due to pain in 16 (58.3%), collections in 3 (25%), 1 (4.2%) wound abscess, 1 (4.2%) stump appendicitis, 1 (4.2%) small bowel obstruction and 1 (4.2%) fresh rectal bleeding. CT guided drainage was performed in 2 (8.3%). One patient had release of wound collection under general anaesthetic, whereas another patient had laparoscopic drain placement. A laparotomy was undertaken in 3 (12.5%) patients with division of adhesions in 1, the appendicular stump removed in 1 and 1 had multiple collections drained.

3. Discussion

This study at a medium-volume university hospital with a mixed general surgical practice, managing emergency surgical needs of both adult and paediatric populations through consistent consultant and trainee staff over a one-year period identified significant variation in outcomes. Appendicitis in this study population was predominantly an adult disease, where no infant, below five years of age, had an appendectomy. This is in keeping with other studies, suggesting that appendicitis is currently increasing in older age groups and it is no longer just in the realm of paediatric surgeons [18–20]. It reflects the increasing complexity of adult emergency general surgery decision making and the need for quality and performance [13,21]. Having guidelines, while commendable, needs to be supplemented by robust systems to ensure surgery, when performed, is actually required [7,10].

There has been debate about whether paediatric appendicitis and its management is a separate entity from adult appendicitis. It may pose a diagnostic dilemma, especially in non-verbal infants and younger children. Others have concluded that there may be no significant difference in diagnosis and management of children compared to adults [22–24]. Bansal et al. suggested that the very young patients present with more advanced appendicitis but are less likely to develop post-operative abscesses [24]. Peculiarly, patients below the age of five were not operated on in our cohort, and Pogorelic and colleagues, in their review of appendicitis, found that children under the age of 5 years account for less than 5.4% of the paediatric population [23]. Furthermore, with regards to diagnostic imaging and management, recent guidelines have suggested ultrasound should be the choice of initial imaging, and although previously debated, the use of laparoscopic approach tends to be favourable even for children [10]. We found that 81.5% (53/65) of all paediatric patients in our study were operated on via laparoscopic approach, which was also very similar to our adult cohort.

A laparoscopic approach was undertaken in 86.6%. This is slightly lower than the international average and reflects one surgeon's practice who maintains an open approach [21].

The acute appendicitis rate of 82.6% is consistent with the international literature, but recent studies suggest a slightly higher rate of negative appendectomies in the UK than in this current study [5,7,25]. A NAR of 17.4% is unacceptable. In adults this was 14.7% (20/136); 10.8% (9/83) in males and 20.8% (11/53) in females. The paediatric NAR was 23.1% (15/65); 12.5% (4/32) in boys and 33.3% (11/33) in girls. Our study is in keeping with the literature which shows female patients have higher negative appendectomy rates and morbidity associated with it [21,26–28]. Mackey et al. recently identified factors that may be associated with higher negative appendicectomies, including independent factors such as age below 27, duration of symptoms for more than 48 h, normal leucocyte count, use of single imaging modality (ultrasound or CT) and time to operation greater than 24 h. Combination of factors like symptoms more than 48 h, normal leucocyte count, and a macroscopically normal intraoperative appendix may also be associated with a negative appendicectomy, but they also discussed that an intraoperatively normal looking appendix was histologically confirmed as normal only in 41%, hence the decision to not perform an appendicectomy in the absence of other pathologies still requires further studies where long-term effects of the practice are highlighted [29].

The incidence of appendicitis globally is variable, but averages at about 100–112 per 100,000 person-years in the United States and Europe, respectively [5,19]. The literature also shows that appendicitis is more prevalent in males than females [18,27,30]. Despite being one of the most common presentations requiring acute surgical intervention, the diagnosis and surgical management of acute appendicitis remains challenging. Female patients may have multiple causes for presenting with lower abdominal pain and further investigation with ultrasound may be beneficial, but the risk of radiation exposure of CT scans leads the surgeons to choose diagnostic laparoscopy as an option, and hence, higher incidence of negative appendicectomies, as the literature has shown that intra operatively 'normal' looking appendix may still have histological evidence of inflammation in up to 29% of cases [26,31,32]. Therefore surgeons tend to perform appendectomies during diagnostic laparoscopies if no other explanation of pain is evident [26,33,34]. Furthermore, the range of negative appendectomy varied between surgeons in our study, which further indicates and confirms the complexity and variability that occurs in surgical decision making. The explanation of surgical variance and why three surgeons had a NAR of above 25% is challenging and probably multifactorial. The figures could be confounded by the concept of utilising a diagnostic laparoscopy and then removing a normal appendix, but this was not the intent in the cases in our study. Surgical decision making and assimilation of information from multiple sources, both clinical and laboratory, make the surgical decision open to interpretation and human error. It begs the question about the introduction of mandatory outcome measures. Sherratt et al., in their recent study, incorporating 147 stakeholders, both adult and paediatric surgeons, patients and their families, identified re-operation and recurrent intraabdominal abscesses as the most important negative outcomes, but also included NAR [35].

Our study identified that time to undertake patient review by the emergency department staff and surgical team was prompt. The median waiting time to theatre was 21 h from admission, which was slightly longer than Foley et al., who had a median waiting time of 18 h [36]. A recent meta-analysis by van Dijk et al. concluded that a waiting time of greater than 24 h may be acceptable for patients who do not show signs of complicated appendicitis at the time of admission [37]. Other studies have deemed 18 h as an upper limit for safe inpatient waiting times [38,39]. A new pathway with easier access to the emergency operating theatre needs to occur. Mackay et al. suggested that a delay in surgery beyond 48 h may be a predictor of negative appendicectomy, as the urgently operated patients usually have a clear presentation, whereas patients where diagnostic laparoscopy is the final investigation, an appendicectomy may be done contributing to morbidity associated with surgery. Instead, they suggest that the role of re-imaging needs consideration as a cost-effective and less invasive option [29].

The use of imaging is variable where a CT scan is almost universally performed in the United States as opposed to rarely performed in the UK [6]. In this study, it reflected the 'in between' picture with imaging performed in over half of the group. Ultrasound was found to have a sensitivity of only 36.8% and an overall accuracy of 54%; this is in keeping with literature as recent studies have shown a similar sensitivity of 36% [7,40]. However, point of care ultrasound may be a useful and cost-effective tool to aid in the diagnostic pathway [10]. CT scan, on the other hand, is highly accurate in diagnosing appendicitis but may have a significant impact on patients' long-term outcomes due to the exposure to radiation leading to risk of cancer, which is higher in the younger population [41,42]. To understand the impact of the ionising radiation dose, Smith-Birdman et al. explained that the long- term survivors of the Hiroshima and Nagasaki atomic bombs had a radiation exposure of 10–100 milliSieverts (mSv), and they had a higher risk for developing cancer [42]. The effective radiation dose received from a single CT abdomen and pelvis is highly variable between countries in Europe ranging from 7.3 mSv in Switzerland to 15.7 mSv in Israel. This, coupled with the fact that younger patients would have multiple scans throughout their life span, leads to significant increase in the risk of developing cancer. Therefore, a balance is suggested in the Jerusalem Guidelines, where US scanning may still help reduce CT scanning by 50% and also, backed by the OPTICAP study, utilisation of low-dose CT scanning may reduce the mean radiation dose to 3.33 mSv while maintaining the accuracy [10,43,44]. In our study, the combined conditional approach to CT was used in only 3%, whereas a combined approach may reduce negative appendicectomy rate as well, and may be considered as the approach of choice in the future [29].

Appendicitis scoring systems were not routinely undertaken or documented in this study, but were all retrospectively performed, where the AIR score had the highest sensitivity but the lowest specificity.

Bhangu and the Right Iliac Fossa Treatment (RIFT) study group attempted to validate 15 risk prediction models for patients with suspected acute appendicitis. AAS proved to have a high specificity for the female cohort with a false positive rate of less than 5%, and the AIR score was the optimal model for men with a false positive rate of 2.4%. They recommended the use of Shera's score for the paediatric patients [7]. It was pointed out by Anderson that it is recommended to repeat the scoring system during observation of patients with persistent symptoms and biochemical markers to come to a diagnostic decision [45]. The recent guidelines also suggest that the AIR and the AAS significantly aid in clinical diagnosis and have a potential for reducing negative appendectomy rates as well as limiting the use of imaging [10,46–49].

Unplanned 30-day re-admissions occurred in 11.4% and this was higher than the international average, as a recent meta-analysis by Bailey et al. identified an average re-admission rate of 4.5% as a benchmark [14,50,51]. The factors associated with a higher risk of re-admission are the presence of diabetes, an open surgical approach and complicated appendicitis [14,52]. Anticipating these risks and tailoring the approach to patients' clinical course could further help in reducing the re-admission rates. Furthermore, a robust system of data capturing that which identifies the cause of re-admission may help us focus on key elements for improvement. This study identified that the leading cause of re-admission was suboptimal pain management and intra-abdominal collection, which is similar to the results of Moghadamyeghaneh et al., who reported intra-abdominal infection and pain as the leading causes of re-admissions [53].

Limitations of the study include that it is a retrospective review and is institutional specific. Patient preferences and their satisfaction were not analysed in our study and including them in prospective analysis may help formulate better management strategies [54,55]. Long term follow-up was not undertaken.

4. Conclusions

This paper identified the opportunity to improve diagnosis of acute appendicitis and potentially reduce variance among surgeons. This could be aided by decision tree pathways combined with the mandatory use of scoring systems which have been shown to reduce negative appendectomy rate. Ultrasound provided little benefit and its value outside the female patients needs to be questioned. A re-admission prevention strategy needs to be implemented to reduce the rate of re-admission. The paper challenges concepts in surgeons' clinical responsibility, education and governance, which are all crucial in improving outcomes.

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A Systematic Review of Evidence-Based Right Iliac Fossa Appendicitis Care Pathways

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Abstract

Introduction: Improving delivery of care through evidence based pathways may reduce unacceptable variation in outcomes in patients with Right Iliac Fossa (RIF) pain. This study reviewed current guidelines to develop a RIF/ appendicular pathway and delineate Key Outcome Indicators (KOIs). **Methods:** Two systematic reviews of literature using Pubmed, Embase and Cochrane databases from January 2011 to December 2021, were undertaken. PRISMA guidelines were used to select guidelines for both RIF pain/appendicitis management and KOIs for appraisal by two independent authors using an AGREE II score of >70 and recommendations tabulated. Evidence based recommendations were used to develop a RIF pain/appendicular clinical pathway. KOIs were streamed into 3 areas; care process, surgical outcomes, and adverse events. **Results:** Six studies met inclusion criteria. Guidelines from these were used to design a pathway stratifying clinical risk of appendicitis into 5 categories based on clinical presentation, appendicitis scoring systems, and imaging features. These categories are; Possible, Probable, Definite appendicitis, Appendicular mass or diffuse peritonitis. KOIs were established across three domains; Care process, Surgical outcomes and Adverse events. These KOIs allow for meaningful cyclical audit of outcomes, evaluation of care, and can guide pathway redesign. **Conclusion:** This pathway for RIF pain management promotes evidence-based strategies to optimise care and, combined with KOIs, may help reduce variation in outcomes.

Keywords: Appendicitis; Clinical pathway; Patient outcomes; Surgical diagnosis; Right iliac fossa pain

Introduction

Appendicitis remains the most commonly occurring acute abdominal emergency in both children and adults globally occurring in 5.7-50/100,000 [1]. Although first described by Fitz in 1886, and despite its frequency and perceived simplicity, clinicians are not achieving acceptable diagnostic accuracy with almost 20% of patients undergoing unnecessary surgery [2,3]. Appendicitis presents across a diverse, heterogenous spectrum of acute severity from mild appendicitis to generalised peritonitis. There are further confounders such as age, where perforation risk is greater in younger children (30-75%) and older patients (50-70%) [2,3]. Apart from patient co-morbidities, delay in presentation and variable surgical management contributes to variable outcomes including re-admission rates which can approach 15% at 30 days [4-6].

To improve diagnostic and patient outcomes, pathway-driven surgical care, using combined clinical, laboratory, imaging and scoring systems should be incorporated into clinical care [7-9]. Clinical pathways, initially proposed by Vanhaecht and colleagues in 2007, lead to the development of the European Pathway Association (EPA) in 2008, which defines them to be a "complex intervention for the mutual decision making and organisation of care processes for a well-defined group of patients during a well-defined period" [10]. The Royal College of England has recommended formal pathways for delivery of standardised emergency surgical care and quality improvement [11]. Multiple studies have validated the utilisation of such pathways in improving clinical outcomes in all emergency surgical patients including both adult and paediatric patients presenting with appendicitis [12-16]. Key performance or outcome indicators including negative appendectomy rates and re-admission rates have been used as quality benchmarks in appendicitis. This allows comparison of patient care to set standards, which can, in turn, guide interventions with the aim of improving outcomes [9,16-19].

The aim of this study was to review current evidence base for RIF pain / appendicitis guidelines to develop a decision and management pathway with benchmarking Key Outcome Indicators (KOIs).

Methods

Two systematic reviews of literature were undertaken from January 2011 to December 2021 utilising the PRISMA guidelines to retrieve consensus statements and peer reviewed guidelines for the diagnosis and management of patients presenting with appendicular right iliac fossa pain [20]. Pubmed, EMBASE and Cochrane databases were searched using the key words "appendicitis", "guidelines", "consensus", "adult", "paediatric". Web searches and review of citations from relevant articles were also preformed.

The inclusion criteria of the study delineated that the studies should be in English, include guidelines that utilised critical appraisal of literature for development of recommendations, and be available as peer reviewed articles. In cases whereby there were multiple iterations of a guideline, only the most contemporaneous was used. (Figures 1,2). The included guidelines were assessed by using the Appraisal of Guidelines for Research and Evaluation (AGREE II) tool which is a framework designed to evaluate the quality of guidelines which can be reported and utilised to develop clinical practice recommendations and policies [21]. Its design comprises of 6 domains - scope and purpose, stakeholder involvement, rigor of development, clarity of presentation, applicability, and editorial independence, which take into account 23 outcomes on a Likert scale ranging from 1 to 7 representing strongly disagree to strongly agree respectively. Though no specific criteria are defined to determine each specific point, a guidance document provides instructions on assessing the different domains to delineate key aspects to score the guidelines appropriately. Each domain is then separately scored, and a guideline is deemed "High Quality" if the assessment of at least domain three accomplishes a score greater than 70. Two independent authors scored the guidelines (UK, JF), and a combined score was calculated for each domain. The guidelines deemed as high quality were used to extract statements and recommendations to develop an evidence based clinical pathway.

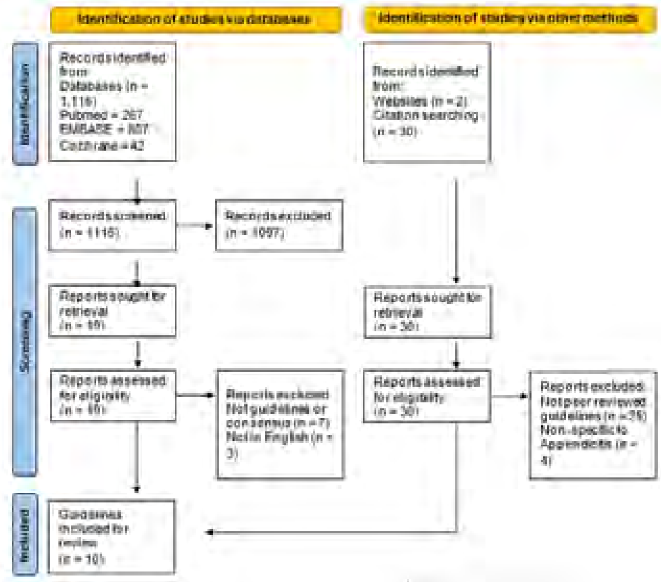


Figure 1: PRISMA flow diagram for the Literature Search Strategy for the Guidelines.

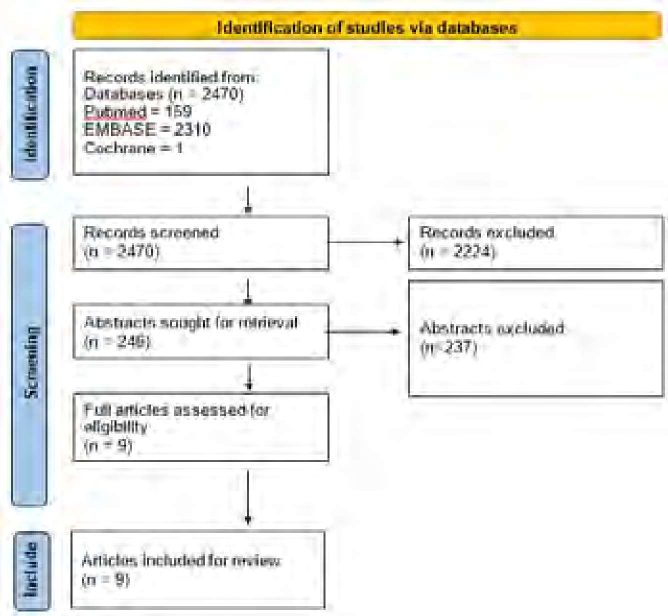


Figure 2: PRISMA flow diagram for the Literature Search Strategy for the Key Outcome Indicators.

Development of the Paper-Based Pathway

The development of a paper-based clinical pathway for patients presenting with right iliac fossa pain involved a Multidisciplinary Team (MDT) of surgical consultants, senior surgical trainees and registrars, and surgical nursing staff. Emergency physicians, radiology consultants and the eSOAP team including nurses, research fellows and an information and technology (IT) expert (MB) also formed an integral part of the MDT. Weekly meetings and clinical consensus focussing on evidence-based guidelines, utilisation of robust and cost effective scoring systems, and availability of hospital resources, including operating theatre access, Magnetic Resonance Imaging (MRI) and out of hours CT scanning were all taken into consideration during the design process. A process mapping approach helped formulate a decision tree model for a paper-based guidance tool to stratify patients presenting with right iliac fossa pain and also outline the KOIs (Table 1) that would help in defining quality of care for this cohort [1,19,22,23].

	Care Process	**Targets**
1	Enrolment of Patient to pathway before leaving Emergency	>90%
2	Patients with Grade 5 appendicitis should have surgery in <12 hours of initial surgical review in ED	>90%
3	RIF pain patients should have a appendicitis risk score documented on the admissions proforma	>90%
	Surgical Outcomes	**Targets**
4	Laparoscopic surgical approach	>90%
5	Laparoscopic conversion rates	<3%
6	Negative appendectomy rates	<10%
	Adverse Events	**Targets**
7	30-day Re-admission following appendectomy	<5%

Table 1: Key Outcome Indicators for patients presenting with right iliac fossa pain after consensus meeting.

Operators

The pathway was intended to serve as a clinical aid for emergency department physicians and surgeons by guiding assessment, diagnosis, and management of patients with RIF pain with a focus on prompt recognition and diagnosis of appendicitis, with severity stratification. It was designed for use by all levels of seniority with the goal of achieving low variance in care, and achievement of KOIs (Table 1). This paper based pathway was to be labelled and filed in the patients' medical records and the stage of the pathway clearly marked or encircled.

Implementation

The pathway was implemented on the 1st of January 2021 and the team continued to meet twice a week to discuss user feedback and modify the pathway accordingly until consensus was reached and a final approved pathway design re implemented on the 1st of March 2021.

Systematic Review to Determine Key Performance Indicators

Results

The search strategy yielded 1116 articles, and after review of abstracts, and application of inclusion criteria, 10 guidelines were identified for further evaluation (Table 2). The individual domain scores for each guideline are presented in Table 3. Rigour of development domain for six of the guidelines yielded a result greater than 70 and hence they were deemed as high-quality guidelines used to formulate statements and recommendations for the development of a clinical pathway. Four guidelines achieved a score below 70 and were not used in pathway designed. The lowest average scores were seen in the domains of stakeholder involvement and applicability with scores averaging to 46.95 and 48.5 respectively.

Number	Institution	Guideline	Publication	Abbreviation	Year
1	The European Association of Endoscopic Surgery (EAES)	EAES rapid guideline: appendicitis in the elderly	Surgical Endoscopy	EAES	2021
2	French Society of Digestive Surgery (SFCD) Society of Abdominal and Digestive Imaging (SIAD)	Adult appendicitis: Clinical practice guidelines from the French Society of Digestive Surgery and the Society of Abdominal and Digestive Imaging [24]	Journal of Visceral Surgery	SFCD SIAD	2021
3	Italian Polispecialistic Society of Young Surgeons (SPIGC)	Consensus Statement of the Italian Polispecialistic Society of Young Surgeons (SPIGC): Diagnosis and Treatment of Acute Appendicitis [25]	Journal of Investigative Surgery	SPIGC	2020
4	World Society of Emergency Surgery (WSES)	Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines [1].	World Journal of Emergency Surgery	WSES	2020
5	Eastern Association for the Surgery of Trauma (EAST) American College of Surgeons (ACS) American Association for the Surgery of Trauma (AAST)	Management of acute appendicitis in adults: A practice management guideline from the Eastern Association for the Surgery of Trauma [26]	Journal of Trauma and Acute Care Surgery	EAST	2019
6	XXIX National Congress of the Italian Society of Surgical Pathophysiology (SIFIPAC) Italian Society of Geriatric Surgery (SICG) World Society of Emergency Surgery (WSES) Italian Society of Emergency Medicine (SIMEU)	The SIFIPAC/WSES/SICG/SIMEU guidelines for diagnosis and treatment of acute appendicitis in the elderly (2019 edition) Open Access [27]	World Journal of Emergency Surgery	SIFIPAC	2019
7	American College of Radiology (ACR)	ACR Appropriateness Criteri® Suspected Appendicitis-Child [28]	Journal of the American College of Radiology	ACR	2019

8	American College of Radiology (ACR)	ACR Appropriateness Criteri® Right Lower Quadrant Pain-Suspected Appendicitis [29]	Journal of the American College of Radiology	ACR	2018
9	The European Association of Endoscopic Surgery (EAES)	Diagnosis and management of acute appendicitis. EAES consensus development conference 2015 [30]	Surgical Endoscopy	EAES	2016
10	Association of Italian Hospital Surgeons (ACOI)	Consensus conference on laparoscopic appendectomy: development of guidelines [31]	The Association of oloproctology of Great Britain and Ireland	ACOI	2011

Table 2: Guidelines assessed with AGREE II tool.

Guideline	Scope and Purpose	Stakeholder Involvement	Rigour of Development	Clarity of Presentation	Applic ability	Editorial Independence	Overall Assessment	Recommend for use
EAES (ELDERLY)	83.3	75	63.5	80.6	50	95.8	66.7	YM*
SFCD SIAD	52.8	33.3	70.8	80.6	39.6	100	58.3	Yes
SPIGC	50	36.1	62.5	94.4	47.9	83.3	75	Yes
WSES	88.9	52.8	82.3	94.4	58.3	100	83.3	Yes
EAST	97.2	58.3	83	75	77	100	58.3	YM*
SIFIPAC	97.2	38.9	80.2	94.4	52.1	100	83.3	YES
ACR HILD	83.3	36.1	48.9	69.4	33.3	37.5	66.7	YM*
ACR	80.5	30.6	48.9	69.4	35.4	33.33	66.7	YM*
EAES	80.6	52.8	75	75	39.6	75	58.3	YM*
ACOI	69.4	55.6	81.3	88.9	52.1	79.2	66.7	YM*
*Yes with modification								

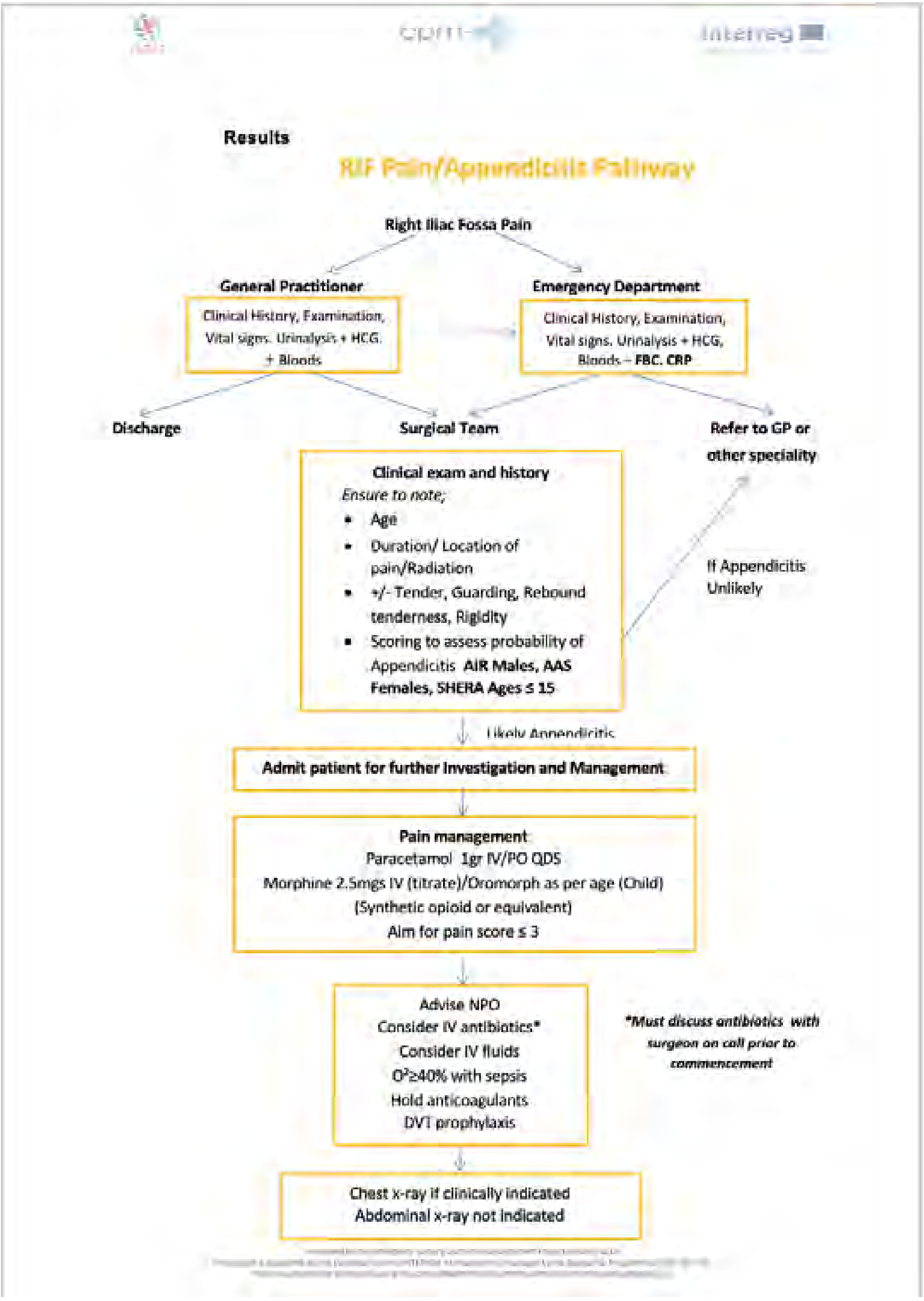
Table 3: AGREE II score results based on domain scores.

Development of the Right Iliac Fossa Decision Tree Model

The statements from the guidelines were tabulated utilising the levels of evidence and grades of recommendations (Appendix 1). The WSES and most other articles [1,26,27,30]. utilised the GRADE scoring methodology and the SFCD/SIAD French guidelines [24] developed a grading system for evidence based on the type of evidence where high quality evidence from meta-analysis was deemed grade A, retrospective studies were grade B, case studies were grade C and finally expert opinion was deemed the lowest type of recommendation where the evidence was weak. Based on these recommendations, the team developed the final decision tree process as follows:

Initial Presentation

The beginning of the pathway was outlined by the patient of acute right iliac fossa pain presenting to the primary care physician or the emergency department triage. The focus of the clinicians during this initial presentation would be to carry out a robust history and clinical examination followed by relevant laboratory tests to finally deem the patient either suitable for discharge back into the community, or referral onto a specialist service such as surgery, gynaecology or paediatrics (Figure 3).



Results

RIF Pain/Appendicitis Pathway

Right Iliac Fossa Pain

General Practitioner

Clinical History, Examination, Vital signs, Urinalysis + HCG, + Bloods

Emergency Department

Clinical History, Examination, Vital signs, Urinalysis + HCG, Bloods – **FBC, CRP**

Discharge

Surgical Team

Refer to GP or other speciality

Clinical exam and history

Ensure to note;

- Age
- Duration/ Location of pain/Radiation
- +/- Tender, Guarding, Rebound tenderness, Rigidity
- Scoring to assess probability of Appendicitis **AIR Males, AAS Females, SHERA Ages ≤ 15**

If Appendicitis Unlikely

Likely Appendicitis

Admit patient for further Investigation and Management

Pain management

Paracetamol 1gr IV/PO QDS

Morphine 2.5mgs IV (titrate)/Oromorph as per age (Child)

(Synthetic opioid or equivalent)

Aim for pain score ≤ 3

Advise NPO

Consider IV antibiotics*

Consider IV fluids

O^2≥40% with sepsis

Hold anticoagulants

DVT prophylaxis

Must discuss antibiotics with surgeon on call prior to commencement

Chest x-ray if clinically indicated

Abdominal x-ray not indicated

Figure 3: Pathway and Initial management of patients presenting with right iliac fossa pain.

Surgical Review

Appendicitis risk scoring systems are used as clinical adjuncts to aid in diagnosis; Appendicitis Inflammatory Response (AIR) score for males, Adult Appendicitis Score (AAS) for females and Shera score for paediatrics [32]. Following this, patients are assigned one of five distinct triaging categories (Figure 4).

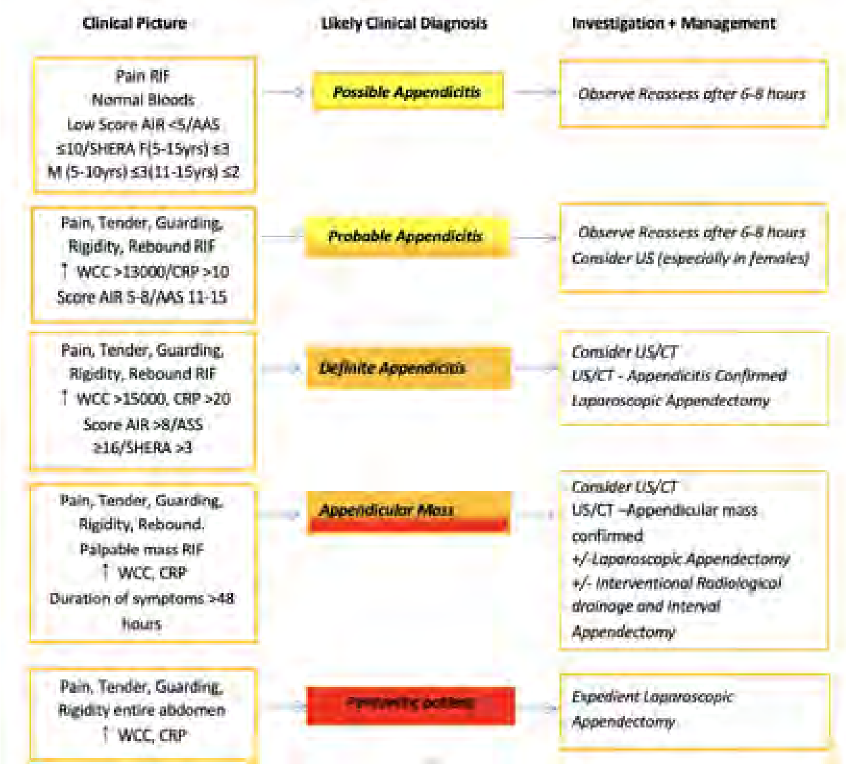


Figure 4: Five triage categories of patients presenting with right iliac fossa pain, based on the clinical, and laboratory findings along with utilisation of scoring systems.

Five Triaging Categories Defined

1. **Possible appendicitis:** The patient may have right iliac fossa pain but no guarding or rebound tenderness along with normal laboratory results. The male patient may have a low AIR score of less than 5 and a female may have an AAS score less than 10. The female paediatric patient aged 5-15 years may have a Shera score of less than or equal to 3. The male paediatric patient between the age of 5-10 years may have a Shera score of less than or equal to 3, and the age group between 11-15 may have a Shera score of less than or equal to 2
2. **Probable appendicitis:** These patients may have Right iliac fossa pain with rebound tenderness, guarding, or rigidity. The inflammatory markers would be raised, where the White Cell Count (WCC) is above 13000 and C- Reactive Protein (CRP) is above 10. The male patients may have an AIR score between 5-8 and the females may have an AAS score between 11-15
3. **Definite appendicitis:** Patients who have signs of rebound tenderness and guarding in the right iliac fossa with a raised WCC above 15000 and a CRP above 20 along with an AIR score above 8 for males, AAS score greater than or equal to 16 and children with a Shera score above 3 may be triaged to this category.
4. **Appendicular mass:** If the patient has similar features as the previous category along with fullness in the right iliac fossa on clinical examination and a history of duration of symptoms greater than 48 hours, this diagnosis may be considered.
5. **Peritonitic patient:** These patients may have signs of generalised peritonism on clinical exam along with the features of appendicitis.

Management

Management is guided by triaging category. All patients with likely appendicitis are admitted to hospital. These patients are kept fasting to facilitate possible surgery. Antibiotics may be considered in patients with a definitive appendicitis or after discussion with the senior surgeon on call. Fluid resuscitation and oxygen should follow the local sepsis protocol, followed by a chest x-ray if clinically indicated. Abdominal x-rays should not be done routinely (Figure 3). Once the patients have been triaged based on the proposed five categories, the management of the first two categories would be to reassess in six to eight hours with the consideration of a pelvic ultrasound especially for female patients. The diagnosis of definitive appendicitis in patients below the age of 35, may proceed to laparoscopic appendectomy, and patients above 35 may be considered for a CT scan. Patients with appendicular mass may have a step up approach of imaging with ultrasound followed by CT, and accordingly a laparoscopic appendectomy as an index operation or initial radiological drainage followed by interval appendectomy. Peritonitic patients should be managed by prompt surgical intervention (Figure 4).

Key Outcome Indicators

The systematic review yielded a total of 2470 results, out of which 246 were selected for review after application of the inclusion criteria. From these 246 abstracts, 9 articles were deemed eligible for our review as they contained generic information on key performance indicators for appendicitis [9,17,18-38]. From these articles, the KOIs were tabulated (Appendix 2) and a consensus meeting determined the KOIs for the audit and measurement of the performance of the pathway once implemented. These included 3 domains; 1. Care Process, that dealt with pathway enrolment and use of scoring systems, 2. Surgical Outcomes, which suggested laparoscopic approach with conversion to open rates below 3% and negative appendectomy rates below 10%, and finally, 3. Adverse events, which included 30-day re-admission rates following appendectomy to be less than 5% (Table 3).

Discussion

We identified six high quality guidelines using the AGREE II tool where the guidelines displayed a high standard in the rigour of development domain, and utilised their recommendations to develop a clinical pathway to facilitate clinicians in providing standardised patient care with optimal outcomes [12,16]. A rigorous process of systematic review was used to screen for guidelines to use in pathway design. These were then appraised and quality assessed using the readily available and user friendly AGREE II tool [21]. This tool has many benefits, as it helps delineates guidelines into defined, easily assessable domains which can be scored to provide an evaluation of quality, but the tool itself lacks clear thresholds or cutoffs to define guidelines as high, moderate, or low quality. Therefore, the more appraisers that a guideline may have, the better its scoring and quality assurance may be. Also, the experience of the appraisers and their clinical knowledge and practice also influences their scoring, and hence these biases still exist when the guidelines are appraised, and hence further research with increased number of appraisers may improve the guideline appraisal process.

Clinical pathways for appendicitis are not universal and multiple recommendations exist in different guidelines, and therefore, our study tailored a pathway based on expertise and resources from our institution [1,8,10,16]. The pathway is designed as a streamline for the patient journey from presentation to definitive treatment for those presenting RIF pain. Swift review of the low-risk group and discharge as appropriate leads to an increase in patient turnaround times. The high risk group would be recognised promptly with usage of a robust care pathway, with early antibiotics and theatre for standardised treatment and reduced complications. These important measures like patient demographics, time from triage to surgery, type of surgical approach, length of hospital stay, negative appendectomy rates and re admission rates along with complications, would be recorded onto a registry for further review on a digitalised platform which would generate annual reports and correlate these findings with the local morbidity and mortality meetings data to further audit the acute surgical care provided to patients presenting with appendicitis and over all improve outcomes related to patients, clinicians, and nursing staff. Key outcome indicators are a measurement metric that allows outcomes to govern patient care and helps shift focus of research to relevant measurable parameters that are well established and reproducible [39,40]. We utilised the previous literature and local expertise to determine KOIs for our study and hence have a system in place to audit our pathway. This is a limitation in our study, as the key to developing KOIs is through specific methodology like the Delphi or the modified Delphi method, where panels of experts determine the KOIs through multiple survey processes, and hence future research in determining KOIs could be undertaken after the audit of our pathways [41,42].

Conclusion

Appraisal of guidelines to establish an evidence base for the development and implementation of a robust pathway incorporating clinical, laboratory and radiological findings, which will be measurable against established key performance indicators, should set a template to improve quality care in appendicitis.

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Appendix 1: Summary of guidance statements and recommendations.

Statement	**Supporting Guideline**	**Grade of Evidence**
Clinical Diagnosis		
Right Iliac fossa pain and normal laboratory results (normal WCC and CRP) not sufficient to out rule appendicitis. A tailored individualized approach is recommended, depending on disease probability, gender, and age of the patient	SFCD/SIAD WSES	LoE low, GoR weak LoE: Moderate; GoR: Strong
Scoring Systems		
Clinical scoring systems recommended to exclude acute appendicitis and stratify intermediate- risk patients for further imaging. AIR scores and AAS scores are the best performing scoring systems and are recommended to be used in the diagnostic pathway	WSES	LoE High, GoR Strong
Imaging		
Ultrasound may be considered as a first line for children and female patients. CT scan is preferred for high-risk patients younger than 40 years old (with AIR score 9-12 and Alvarado score 9-10 and AAS ≥ 16). All elderly patients should have adequate diagnostic imaging and clinical scores and examination may not be sufficient to diagnose appendicitis accurately	WSES SFCD/SIAD SIFIPAC	LoE low, GoR weak
Management		
Laparoscopic approach is recommended for all patients over open approach if expertise and equipment is available and no other contraindications exist. In case of complicated appendicitis, non-operative management t may be considered it has risk of long term failure. Patients with complicated appendicitis should have surgery within 8 hours Recommendations are against post-operative abdominal drains	WSES SFCD/SIAD	LoE High GoR Strong LoE low GoR weak
Special Circumstances		
Pregnant women and children may benefit from ultrasound as a primary imaging investigation followed by MRI (subject to availability) to avoid unnecessary exposure to radiation	WSES SFCD/SIAD	LoE moderate, GoR weak
* LoE: Level of **evidence**, GoR: Grade of Recommendation		

Appendix 2: Summary of Key Performance indicators from the literature

Year	Author	Article	Key Performance Indicators (KOI)	Appendicitis Specific KOIs
2021	Jukic et al.	Incidence and causes of 30-day readmission rate from discharge as an indicator of quality care in paediatric surgery	30 day Re-admission rate	30 day Re-admission rate
2020	Sherratt et al	Core outcome set for uncomplicated acute appendicitis in children and young people	1. Adverse events	1. Adverse events
			a. Bowel obstruction	a. Bowel obstruction
			b. Wound infection	b. Wound infection
			c. Wound complication	c. Wound complication
			2. Pathophysiological manifestations	2. Pathophysiological manifestations
			a. Negative appendicectomy	a. Negative appendicectomy
			b. Recurrent appendicitis	b. Recurrent appendicitis
			c. Intra-abdominal abscess	c. Intra-abdominal abscess
			d. Antibiotic failure for non-operative management	d. Antibiotic failure for non-operative management
			3. Life impact	3. Life impact
			a. Child's quality of life	a. Child's quality of life
			b. Patient stress/psychological distress	b. Patient stress/psychological distress
			c. Time away from full activity	c. Time away from full activity
			4. Resource use	4. Resource use
			a. Length of hospital stay	a. Length of hospital stay
			b. Readmission to hospital	b. Readmission to hospital
			c. Reoperation (including interventional radiology procedure)	c. Reoperation (including interventional radiology procedure)
			5. Mortality	5. Mortality

2019	Hardy et al	The Impact of an Acute Care Surgical Service on the Quality and Efficiency of Care Outcome Indicators for Patients with General Surgical Emergencies	Efficiency of care variables:	1. 30-day Re-admission
			1. Time variables:	2. Pathology
			a. Transfer to hospital(from original hospital)	3. Type pf operation:
			b. Triage time	a. Laparoscopic
			c. Time to Emergency room physician (ERP) assessment	b. Open
			d. Time to imaging	c. Conversion rates
			e. Time to surgical consult	
			f. Surgical response time	
			g. Admission time	
			h. Time to Operating Room (OR) after surgical assessment	
			i. Duration of OR	
			j. Time of operation:	
			i.Day	
			ii.Evening	
			iii.Night	
			k. Time from OR to discharge	
			l. Length of stay (LOS)	
			2. Complications:	
			a. Intra-operative	
			b. Intervention-related	
			c. Postoperative (Clavien-Dindo Classification System on a scale of I through V)	
			d. 30-day hospital readmission rate	
			e. 30-day emergency room (ER) visits,	
			3. Risk of perforated appendicitis,	
			4. Pathology for appendectomy and cholecystectomy specimens.	
			5. Co Morbidities	
			6. Age	
			7. Gender	
			8. Type of Operation	
			a. Laparoscopic	
			b. Open	
			c. Conversion rates	

2019	Mears et al	Readmission within 30 days of discharge (ReAd): a quality-of-care indicator in paediatric surgery	30 day Re-admission rate	30 day Re-admission rate
2018	Mathur et al	Emergency general surgery and trauma: Outcomes from the first consultant-led service in Singapore	1. Case time (min) from booking to OT	1. Case time (min) from booking to OT
			2. Priority 1 (P1)	2. Priority 1 (P1)
			3. Priority 1 (P2)	3. Priority 1 (P2)
			4. Priority 3 (P3)	4. Priority 3 (P3)
			5. Time from ED referral to Surgical review (min)	5. Time from ED referral to Surgical review (min)
			6. Consultant in OT for major cases (%)	6. Consultant in OT for major cases (%)
			7. Cases performed at day/night time (%)	7. Cases performed at day/night time (%)
			a. Day (07:30-16:00)	a. Day (07:30-16:00)
			b. After hours (16:00-07:30)	b. After hours (16:00-07:30)
			8. Hospital Cost	8. Hospital Cost
			9. ICU length of stay (d)	9. ICU length of stay (d)
			10. Overall length of stay (d)	10. Overall length of stay (d)
			11. Re-admission rate (%)	11. Re-admission rate (%)
			12. Mortality	12. Mortality
2018	Balasubramanian et al	Impact of an acute surgical unit in appendicectomy outcomes: A systematic review and meta-analysis	1. Time to theatre	1. Time to theatre
			2. Negative appendectomy rate	2. Negative appendectomy rate
			3. Length of hospital stay	3. Length of hospital stay
			4. Postoperative complications	4. Postoperative complications
			5. Night time operating	5. Night time operating
			6. conversion to open surgery	6. conversion to open surgery

2016	Shilton et al	Is the acute surgical unit model feasible for Australian regional centres?	1. Gender	7. Gender
			2. Mean age	8. Mean age
			3. Time to theatre (mins)	9. Time to theatre (mins)
			4. Operating time (mins)	10. Operating time (mins)
			5. Day of operation	11. Day of operation
			a. Day 0	a. Day 0
			b. Day1	b. Day1
			c. Day 2	c. Day 2
			d. Day 3	d. Day 3
			e. >Day 3	e. >Day 3
			6. Time of operation	12. Time of operation
			a. 08.00-18.00 hours	a. 08.00-18.00 hours
			b. 18.00-24.00 hours	b. 18.00-24.00 hours
			c. 00.00-08.00 hours	c. 00.00-08.00 hours
			d. Total after-hours 18.00-08.00	Total after-hours 18.00-08.00
2014	Lancashire et al	Introduction of an Acute Surgical Unit: Comparison of Performance Indicators and Outcomes for Operative Management of Acute Appendicitis	1. Age (years)	1. Age (years)
			2. Female sex (%)	2. Female sex (%)
			a. Females aged 15-45 years	a. Females aged 15-45 years
			3. ED LOS (h)	3. ED LOS (h)
			a. Time from ED arrival to admission (h)	a. Time from ED arrival to admission (h)
			b. Time from admission to ED departure (h)	b. Time from admission to ED departure (h)
			c. Time from admission to operation start (h)	c. Time from admission to operation start (h)
			d. Time from ED arrival to operation start (h)	d. Time from ED arrival to operation start (h)
			4. Total admission LOS (days)	4. Total admission LOS (days)
			5. Postoperative LOS (days)	5. Postoperative LOS (days)
			6. Patients with preoperative imaging	6. Patients with preoperative imaging
			7. Patients without preoperative imaging	7. Patients without preoperative imaging
			8. Total admission costs	

2013	Pillai et al	Comparison of appendicectomy outcomes: acute surgical versus traditional pathway	1. Length of stay	1. Median age in years (range)
			2. Surgical complications	2. Gender (M : F)
			3. Return to theatre	3. ASA ≥ 2
			4. Re-admission	4. Perforated appendicitis
			5. Time to theatre	5. Median time to theatre (h)
			6. Weekend discharge rate	6. Duration of operation (min)
			7. Proportion of operations during daylight hours	7. Proportion daytime operations
			8. Duration of operation	8. Mean admission to consultation time (h)
			9. Time from referral to review	9. Trainee as primary surgeon
			10. Mortality	10. Total length of stay (days)
				11. Return to theatre
				12. 30-day readmission rate
				13. Surgical complications
				14. Wound complications
				15. Intra-abdominal collection
				16. Death

Appendicitis what residents need to do

Tessa Elizabeth Walton MBBCH (PYG 10)
Current: Surgical SHO Letterkenny University Hospital

A Resident's perspective on Acute Appendicitis and Right Iliac Fossa Pain

Appendicitis is a common cause of acute abdominal pain in adults and is the most common surgical cause of right sided abdominal pain in children. I am delighted to be asked to share a resident's perspective in this very comprehensive EGS report.

Between 2019-2021, 27.43 % of surgically admitted patients to Letterkenny University Hospital complained of right iliac fossa pain and were admitted for possible appendicitis. Acute appendicitis can prove difficult to diagnose and the diagnosis, work up and management differs around the world (WSES guidelines). The widely accepted management of appendicitis is surgery; the early and correct diagnosis of which is crucial to the outcome of the patient. Therefore, as a resident, my aim is to make the correct diagnosis of appendicitis in a timely manner.

In Letterkenny University Hospital, it is my experience that a surgical senior house officer (SHO) or registrar is called by an emergency department (ED) SHO to see a patient where appendicitis is suspected. Commonly the bloods, urinalysis and often even appendicitis scoring has already been completed by the emergency department doctor. The ED SHO often initiates intravenous fluids, analgesia and antiemetics if appropriate. In cases where the diagnosis of appendicitis is made clinically in an unwell patient, it would be appropriate for a doctor in the surgical team to be informed timeously and the patient to be seen by the surgical team within a quarter of an hour, examined and an urgent plan made without waiting on the laboratory results. If the patient has peritonitis the consultant should be notified immediately and laparoscopic appendectomy performed urgently.

The Emergency General Surgery (EGS) Admitting Proforma developed by eSOAP in 2018, is used by SHOs and Registrars in all patients for which appendicitis is suspected. Furthermore the "Right Iliac Fossa (RIF)/Appendicitis Pathway" is available to guide junior doctors in their initial diagnosis and management of the patient. This pathway is extremely valuable as different consultants have different preferences in the work up and management of appendicitis, therefore having a departmental standard protects both the SHO/Registrar and the patient from over or under investigation. It also ensures a standard of initial management.

Important information on history that guide the SHO/Registrar to the diagnosis of appendicitis include the age and sex of the patient, and the characteristic, duration, location and radiation of the pain. Clinical examination should pay careful attention to tenderness, guarding, rebound tenderness and any masses palpable in the RIF. Blood results and urinalysis including BhCG in females should be documented. Basic blood results of interest include the white cell count, differential count and C-reactive protein (CRP). White cells above 13000 and a CRP greater than 10 with clinical signs discussed above is probably appendicitis. However normal blood results do not rule out appendicitis as a diagnosis and probability scores should be utilised.

Scoring algorithms are used to determine the probability of appendicitis as the diagnosis and using these algorithms has shown a decrease in the rate of unnecessary imaging and number of negative appendectomies in low and intermediate risk patients (Anderson et. Al). As per the Appendicitis Pathway the AIR score is used for males, AAS score for females and SHERA for paediatric patients under the age of 15. One of the recommendations of this eSOAP EGS report is to incorporate AI and machine learning into the care pathway. This recommendation would be welcomed and valued by the residents.

The clinical picture with the added appendicitis score determines further investigation and management of the patient as per the RIF pathway. Patients who have no clinical signs with normal blood results are unlikely to have AA and the SHO/registrar can refer them to their family doctor with safety netting advice. The probability of AA is higher in patients with RIF pain, guarding, rigidity and rebound tenderness with a white cell count above 13000 and CRP >10. These patients should be observed and reassessed after 6-8 hours, and imaging should be considered. Ultrasound is the ideal imaging of choice for the diagnosis of AA in paediatrics and in females, however its limitations include operator dependency and patient factors (increased body mass index) (WSES guidelines). CT scan should be considered for patients over the age of 40 after discussion with the admitting consultant.

Patients with acute appendicitis require surgery, and a laparoscopic appendectomy is the surgery of choice. It is exceptionally rewarding to piece together the diagnosis of acute appendicitis and then physically remove an inflamed appendix in the operating theatre. The junior surgical team should attempt to follow up on patients they admit with appendicitis and if practical assist in the procedure, with the intention to ultimately be the surgeon performing the appendectomy.
It is both exciting and helpful to see the presentation of real world right iliac fossa data in this report which will in time change the way we approach patient care.

References:

1. Di Saverio, S., Podda, M., De Simone, B., Ceresoli, M., Augustin, G., Gori, A., Boermeester, M., Sartelli, M., Coccolini, F., Tarasconi, A., de' Angelis, N., Weber, D.G., Tolonen, M., Birindelli, A., Biffl, W., Moore, E.E., Kelly, M., Soreide, K., Kashuk, J., Ten Broek, R., Gomes, C.A., Sugrue, M.2020. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World Journal of Emergency Surgery 15, 27. https://doi.org/10.1186/s13017-020-00306-3
2. Cui, W., Liu, H., Ni, H., Qin, X., Zhu, L., 2019. Diagnostic accuracy of procalcitonin for overall and complicated acute appendicitis in children: a meta-analysis. Ital J Pediatr 45, 78. https://doi.org/10.1186/s13052-019-0673-3
3. Andersson, M., Kolodziej, B., Andersson, R.E., STRAPPSCORE Study Group, 2017. Randomized clinical trial of Appendicitis Inflammatory Response score-based management of patients with suspected appendicitis. Br J Surg 104, 1451–1461. https://doi.org/10.1002/bjs.10637

Improving diagnostic accuracy in Appendicitis, The view of a Surgical Registrar.

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Acute appendicitis is one of the most frequently encountered general surgical emergencies. The World Society of Emergency Surgery reported an incidence of 5.7-50 patients per 100,000 inhabitants in developed countries [1]. Despite the high prevalence making an accurate diagnosis is challenging every step of the way, especially for junior doctors. As a registrar, it is vital to combine a compatible history and supportive examination findings in making a diagnosis. It is also imperative to keep in mind the possibility of some other pathology particularly when the presentation is not classical.

When consulted minimizing delays in evaluation and treatment is important, as studies have shown that the risk of complications, such as perforation, increases as time elapses from the onset of symptoms to the provision of treatment. It is also important to differentiate between patients with uncomplicated versus those who presented with complicated appendicitis and may need immediate surgical intervention. The diagnosis of acute appendicitis is a two-stage process, the first is to confirm the presence of acute appendicitis and the second is to determine if it is complicated or not.

Lab tests and imaging are then planned to achieve a clearer picture of the problem. Lab tests like White Cell Count and CRP do not hold much value individually, but when combined with the clinical examination are a strong diagnostic predictor for appendicitis. The increasing levels of both WCC and CRP are highly suggestive of complicated appendicitis. The use of scoring systems by registrars is important. Adult Appendicitis Score (AAS) for females, Appendicitis Inflammatory Response (AIR) scoring system for males, and SHERA for ages less than 15years. The 2020 update of WSES Jerusalem guidelines for diagnosis and treatment of acute appendicitis recommend the use of the Appendicitis Inflammatory Response Score (AIRS) and the Adult Appendicitis Score (AAS) as diagnostic scores of acute appendicitis. The AIR score or the AAS score can be used to assess if a patient is at high, intermediate, or low risk of having appendicitis.

- High-risk patients who are aged <40 years, and have strong symptoms and signs of appendicitis, may go straight to surgery without imaging. However, local protocols should be checked as this varies in practice.
- Intermediate-risk patients may undergo further imaging and observation.
- Low-risk patients may be safely referred back to primary care without diagnostic imaging, as long as they have appropriate safety-netting.

Imaging has a very important role in diagnosing appendicitis and to differentiate between complicated and uncomplicated appendicitis. Although Ultrasound is cost-effective and does not have the disadvantage of radiation exposure it does not always yield definitive results, but can prove to be a useful tool in evaluating pelvic pathologies in females. A step-up approach to CT scan is ideal and should be considered only in patients in which diagnosis is not clear or when a complicated appendicitis is suspected. Studies have shown low-dose CT has comparable accuracy to normal-dose CT and should therefore be preferred[2].

MRI has similar sensitivity as the CT scan but has the disadvantage of cost and availability. MRI is a preferable method of imaging in pregnant women with suspected appendicitis. Plain film X-ray of the abdomen is not useful and should be avoided.

Nonoperative treatment for acute appendicitis NOTA was associated with a higher rate of abscess, readmission, and higher overall cost of care in uncomplicated appendicitis. Complicated appendicitis needs urgent resuscitation and prompt surgical intervention. Surgical site infections are common in emergency surgeries and implementing wound bundles ensures better outcomes. A log of all these patients should be maintained, operative findings noted and histopathology must be followed in order to improve the diagnostic accuracy in the form of fewer negative appendectomy rates and improved overall patient outcomes.

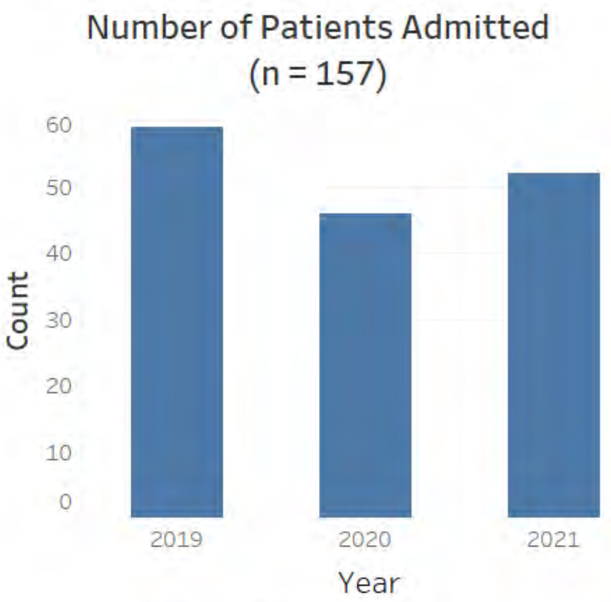
As a registrar, this report shares tremendous data and outlines a way to advance care and help surgical registrar improve their diagnostic and management performance. Attendance at the EASC course is a great way to upskill in the management of right iliac fossa pain. As a registrar, it is so special to work in a hospital that has the vision to improve EGS care.

References:

1. Di Saverio, S., Podda, M., De Simone, B. et al. (2020) Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World Journal of Emergency Surgery 15(1), 1-42
2. Sippola S, Virtanen J, Tammilehto V et al: The accuracy of low-dose computed tomography protocol in patients with suspected acute appendicitis: The OPTICAP study. Ann Surg 2020;271(2):332–338.

Small Bowel Obstruction Module

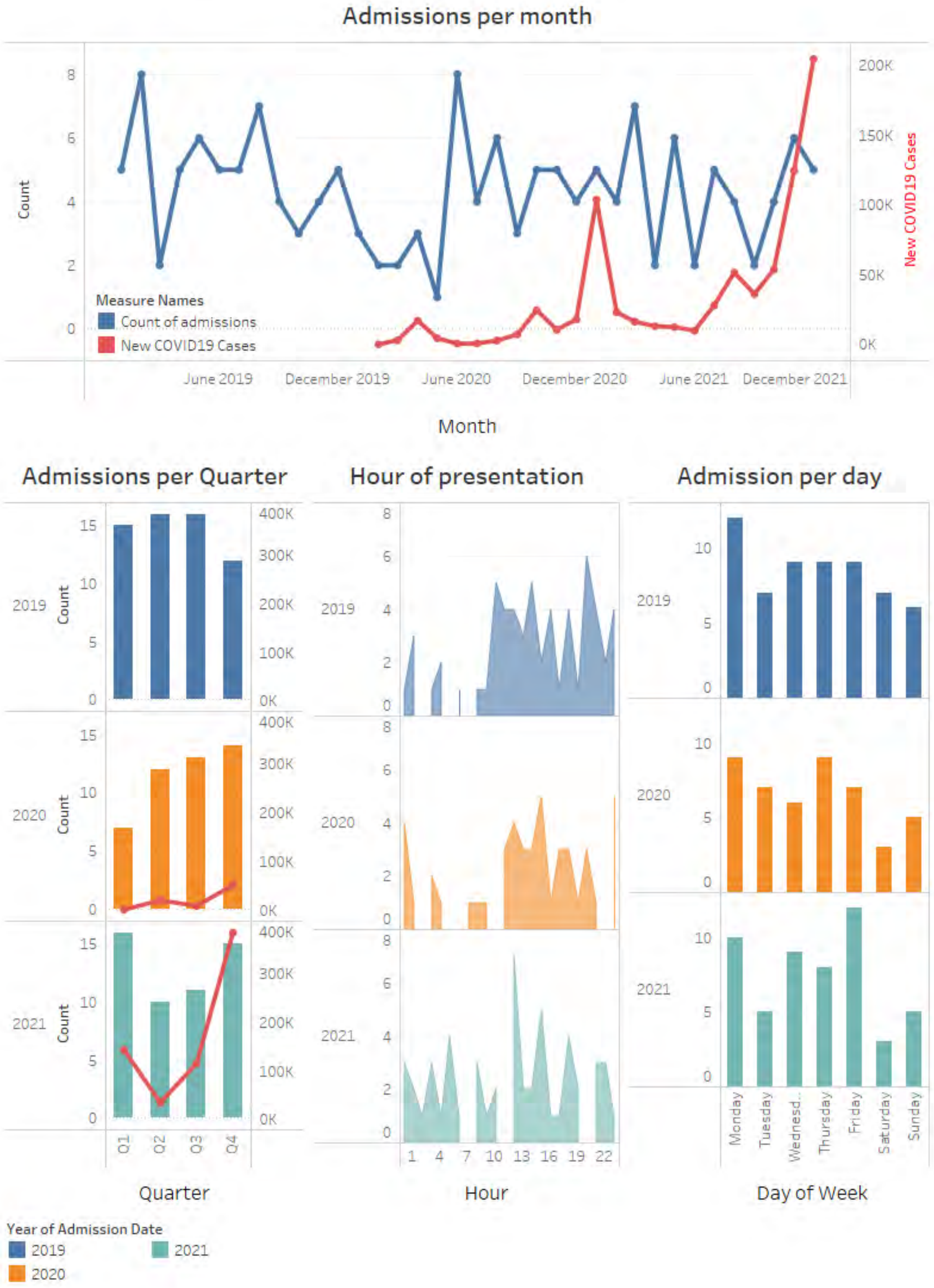
Overall Small Bowel Obstruction


Number of Patients Admitted (n = 157)


Registered ED time

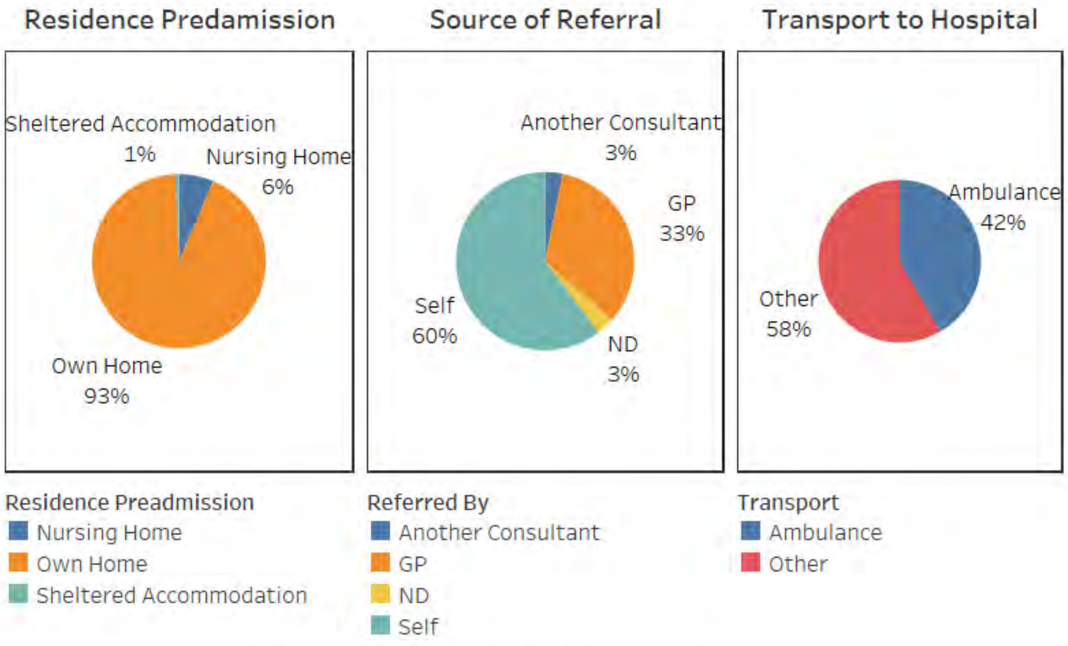
*Patients with Small Bowel Obstruction who also underwent a Laparotomy were prioritised for the Laparotomy module

EGS Admissions 2019, 2020, 2021
(n=157)

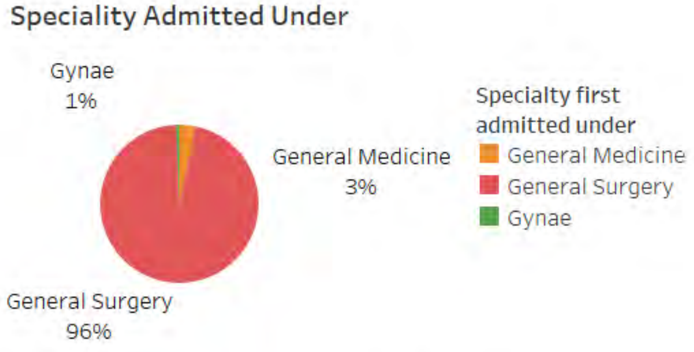


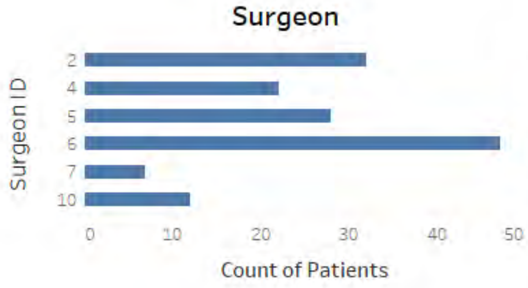
Age Distribution of EGS Admissions 2019, 2020, 2021 (n=156)

Patient Journey in 2019, 2020, 2021
(n=155)



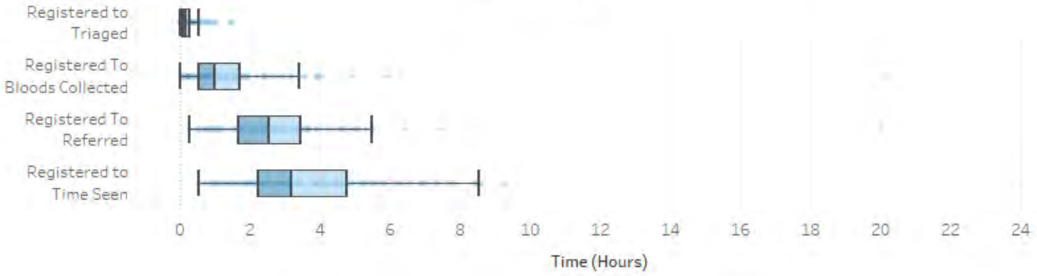
Specialty & Surgeon 2019, 2020, 2021
(n=155)





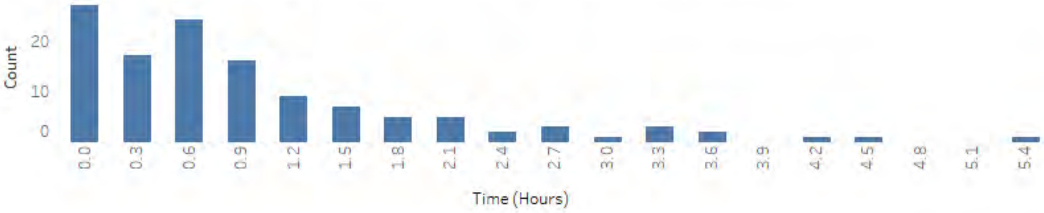
Surgeon by year

Consultant Surgeon	2019	2020	2021	Grand Total
2	16	6	10	32
4	7	7	8	22
5	12	9	7	28
6	14	17	16	47
7	7			7
10		7	5	12



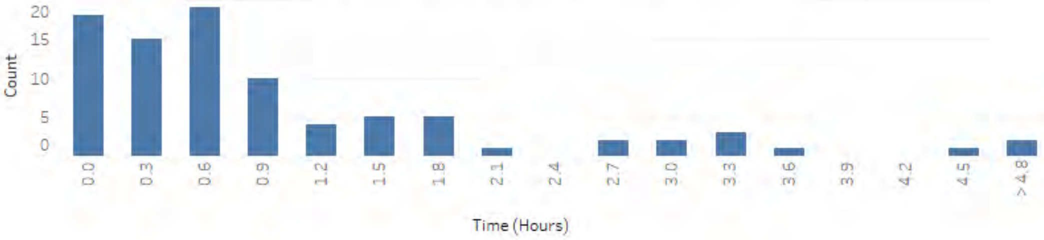
Emergency Department Times 2019, 2020, 2021 (n=131)

Registered to Triage (Median = 0.15 hrs)



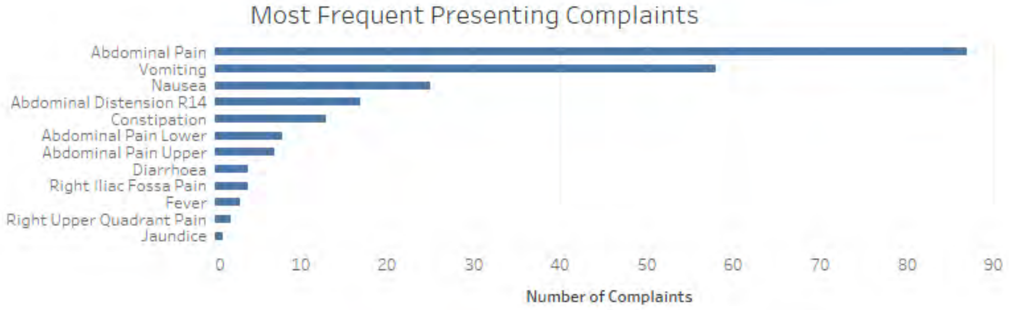
Triage to Bloods Collected (Median = 0.77 hrs)

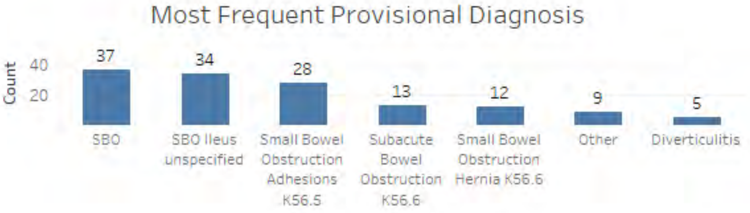
Bloods Collected to Time Referred (Median = 1.17 hrs)

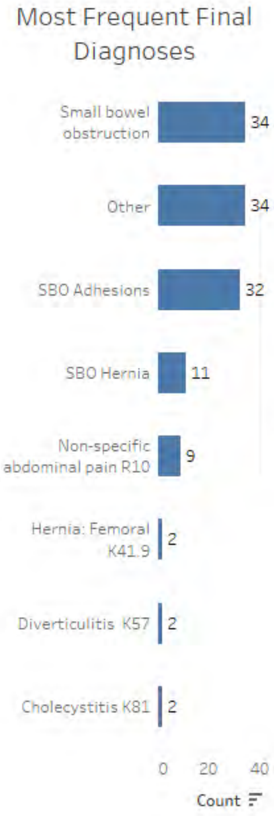


Time Referred to Time Seen (Median = 0.75 hrs)

Presenting Complaints & Diagnoses 2019, 2020, 2021 (n=156)


Most Frequent Presenting Complaints

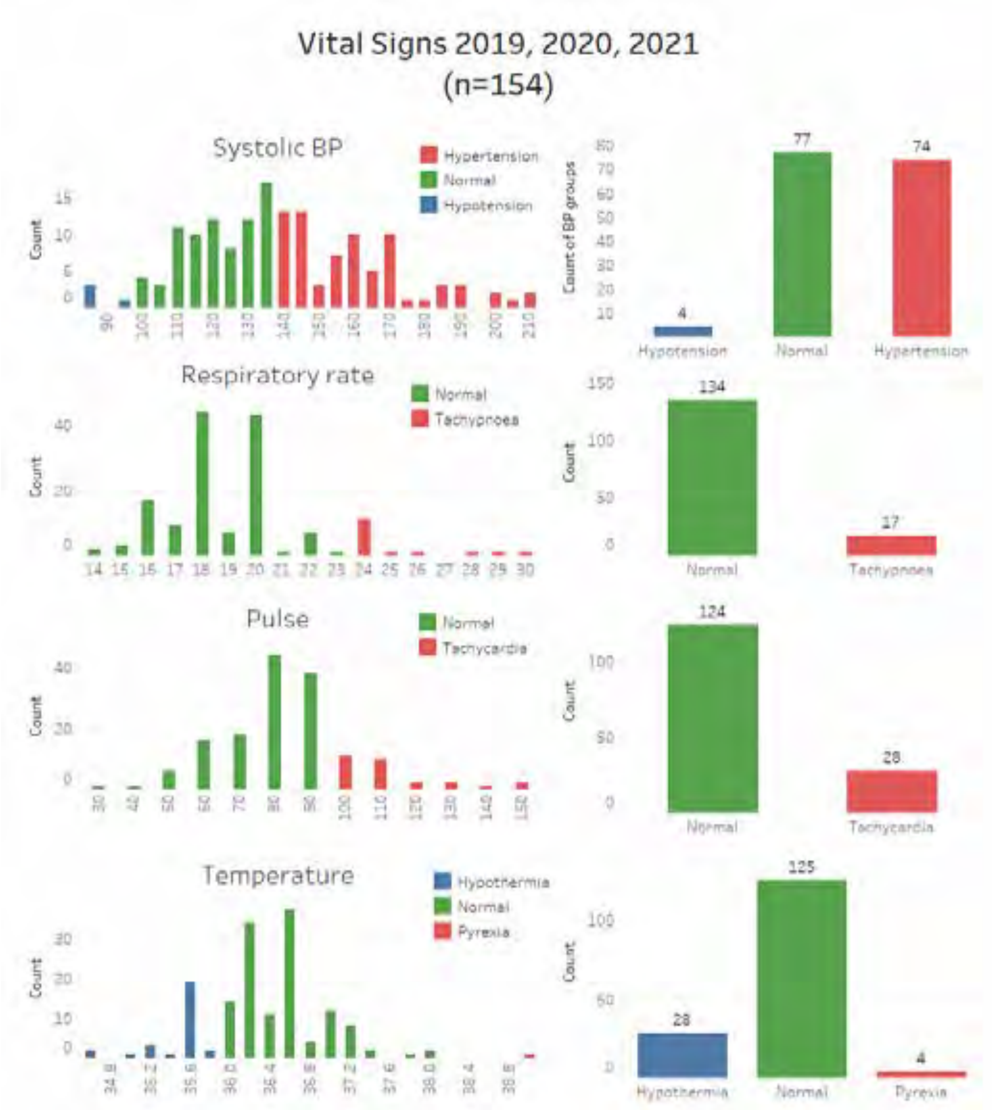

Most Frequent Provisional Diagnosis

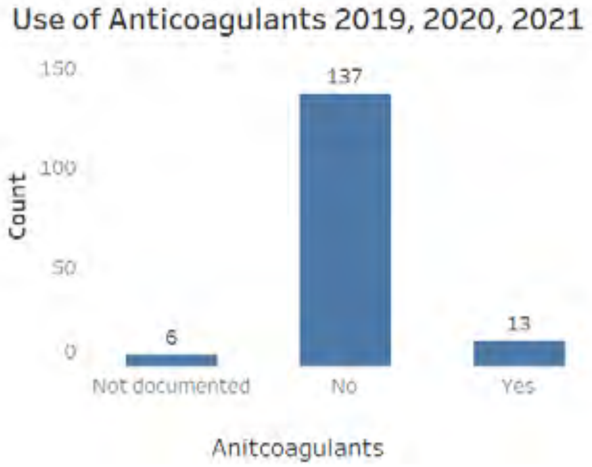

Most Frequent Final Diagnoses

Provisional Diagnosis

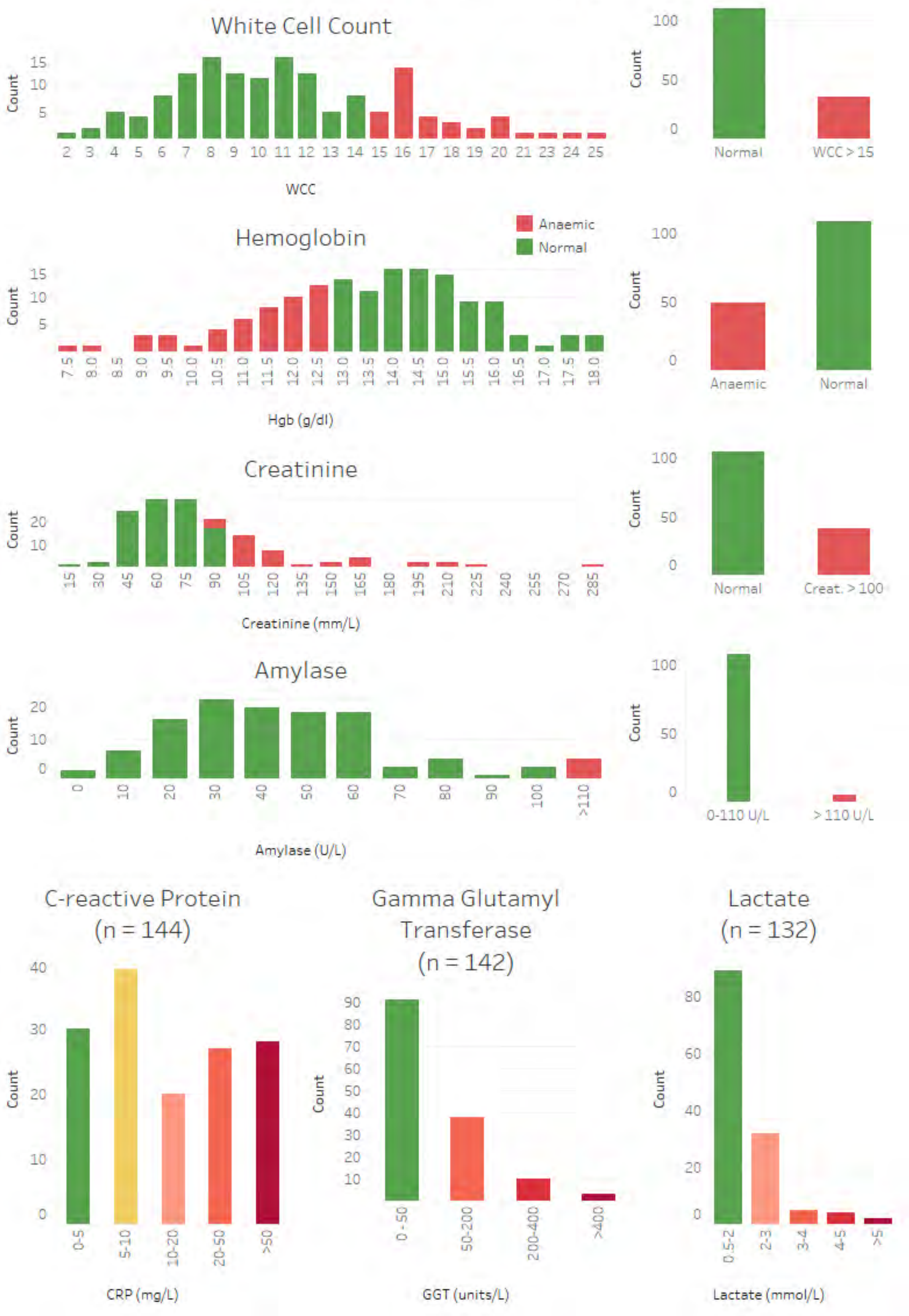
Final Diagnosis	Small Bowel Obstruction	SBO Ileus Unspecified	SBO Adhesions	Subacute Bowel Obstruction	SBO Hernia	Other	Diverticulitis
Small bowel obstruction	13	8	2	2	3	1	2
Other	10	8	3	2	2	7	0
SBO Adhesions	2	3	19	2	2	1	3
SBO Hernia	1	2	0	0	4	1	1
Non-specific abdominal pain R10	1	2	3	2	1	0	0
Hernia: Femoral K41.9	2	0	0	0	0	0	0
Diverticulitis K57	2	0	0	0	0	0	0
Cholecystitis K81	1	1	0	0	0	0	0

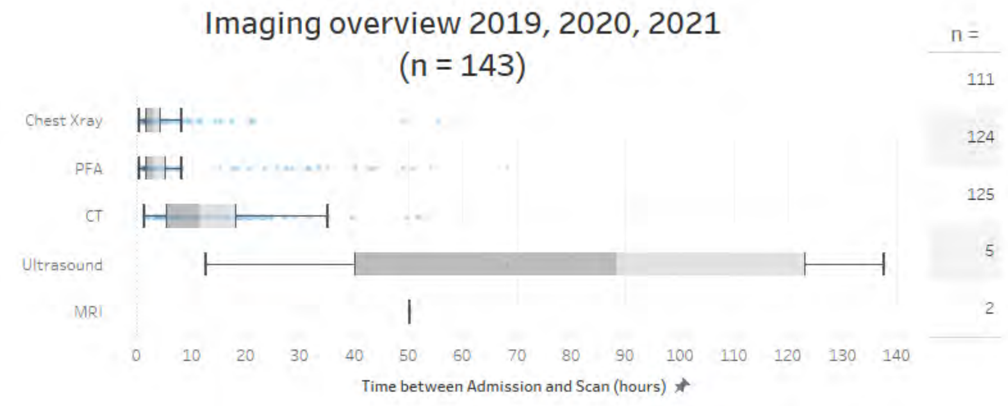
*Values in confusion table do not sum to adjacent histograms as they only show the most frequent provisional and final diagnoses

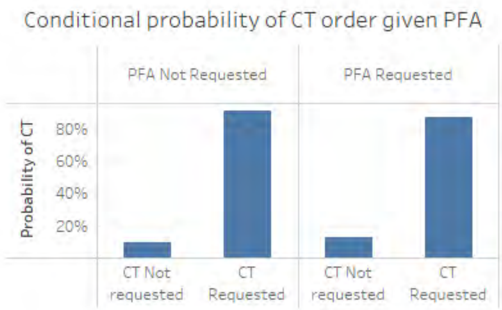

Vital Signs 2019, 2020, 2021
(n=154)
Systolic BP
🟥 Hypertension
🟩 Normal
🟦 Hypotension
Count
0
5
10
15
90
100
110
120
130
140
150
160
170
180
190
200
210
Count of BP groups
10
20
30
40
50
60
70
80
4
77
74
Hypotension
Normal
Hypertension
Respiratory rate
🟩 Normal
🟥 Tachypnoea
Count
0
20
40
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
Count
0
50
100
150
134
17
Normal
Tachypnoea
Pulse
🟩 Normal
🟥 Tachycardia
Count
0
20
40
30
40
50
60
70
80
90
100
110
120
130
140
150
Count
0
50
100
124
28
Normal
Tachycardia
Temperature
🟦 Hypothermia
🟩 Normal
🟥 Pyrexia
Count
0
10
20
30
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
Count
0
50
100
28
125
4
Hypothermia
Normal
Pyrexia

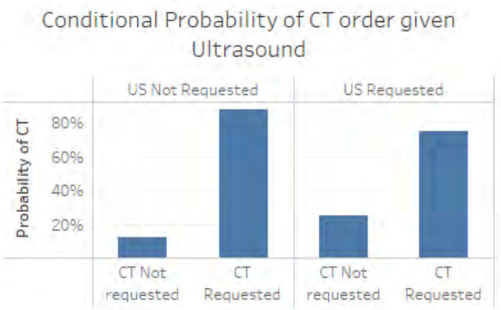

Use of Anticoagulants 2019, 2020, 2021
Count
0
50
100
150
6
137
13
Not documented
No
Yes
Anitcoagulants

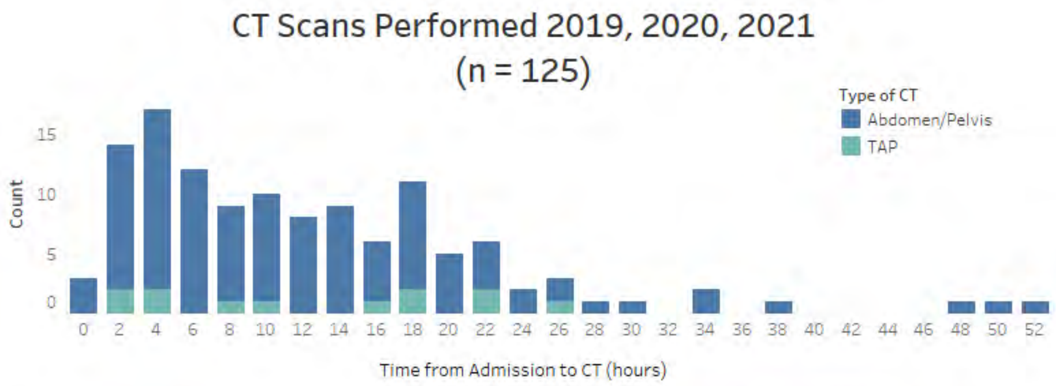
Lab Results 2019, 2020, 2021 (n=145)

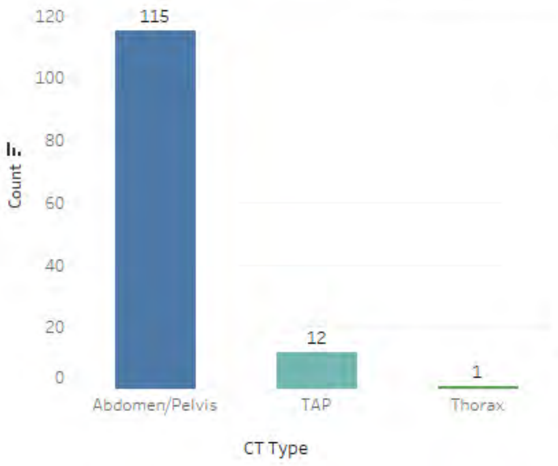


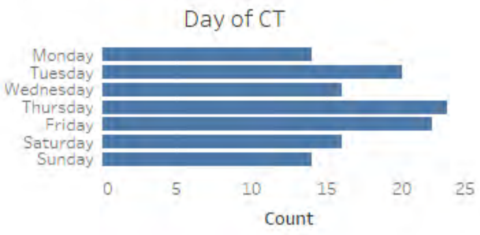

Imaging overview 2019, 2020, 2021
(n = 143)
n =
Chest Xray
PFA
CT
Ultrasound
MRI
111
124
125
5
2
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Time between Admission and Scan (hours)

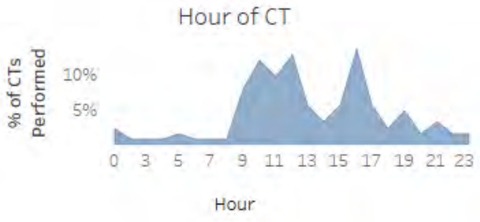

Conditional probability of CT order given PFA
PFA Not Requested
PFA Requested
Probability of CT
80%
60%
40%
20%
CT Not requested
CT Requested
CT Not requested
CT Requested

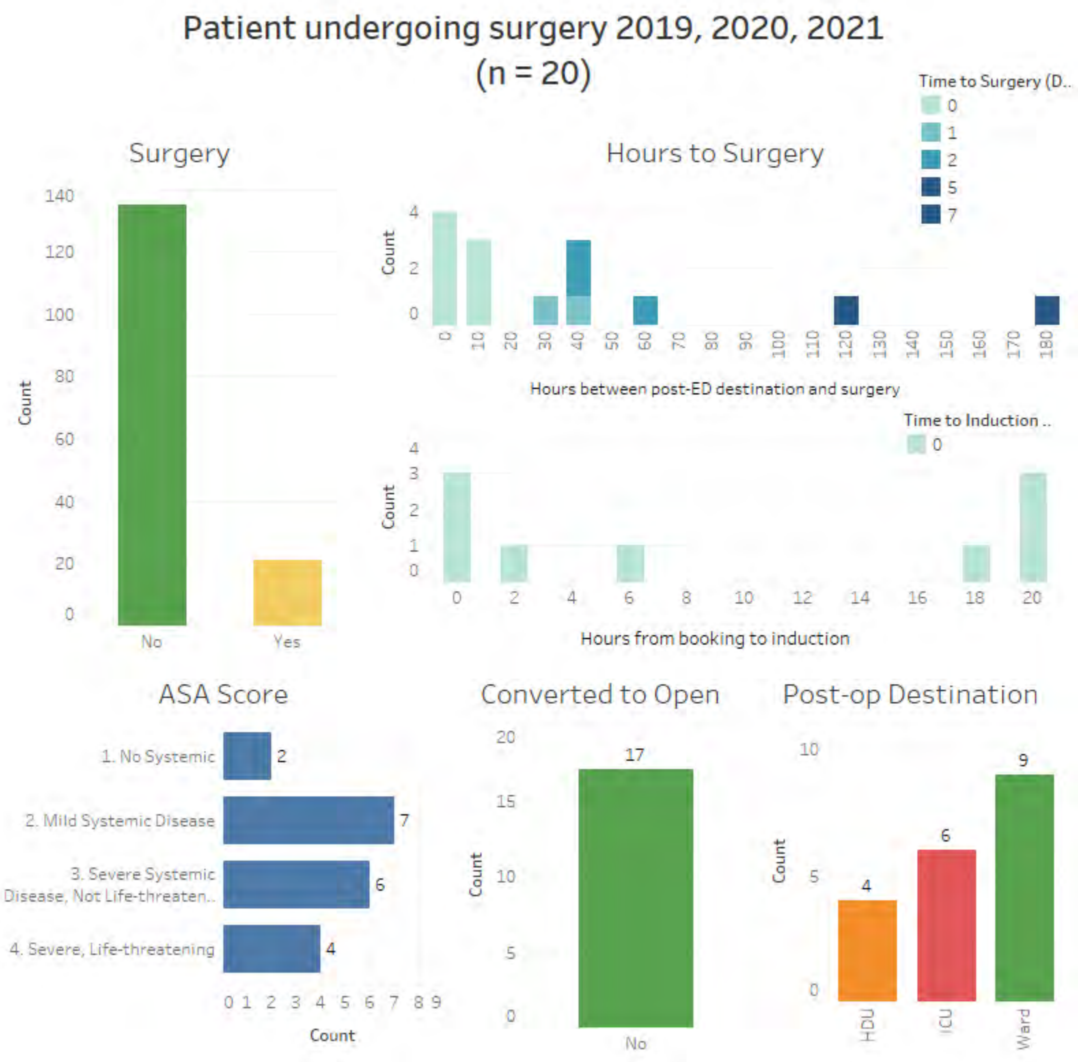

Conditional Probability of CT order given Ultrasound
US Not Requested
US Requested
Probability of CT
80%
60%
40%
20%
CT Not requested
CT Requested
CT Not requested
CT Requested


CT Scans Performed 2019, 2020, 2021
(n = 125)
Type of CT
Abdomen/Pelvis
TAP
Count
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
Time from Admission to CT (hours)

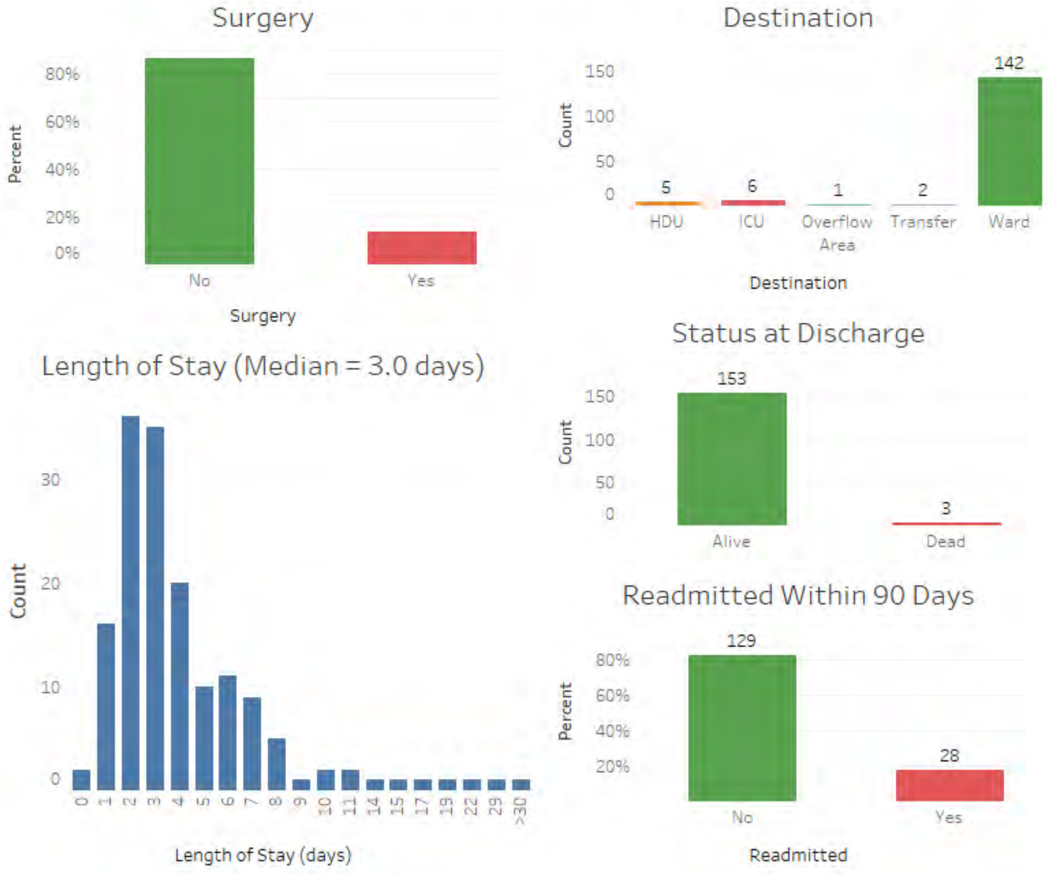

Count
120
100
80
60
40
20
0
115
12
1
Abdomen/Pelvis
TAP
Thorax
CT Type


Day of CT
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
5
10
15
20
25
Count

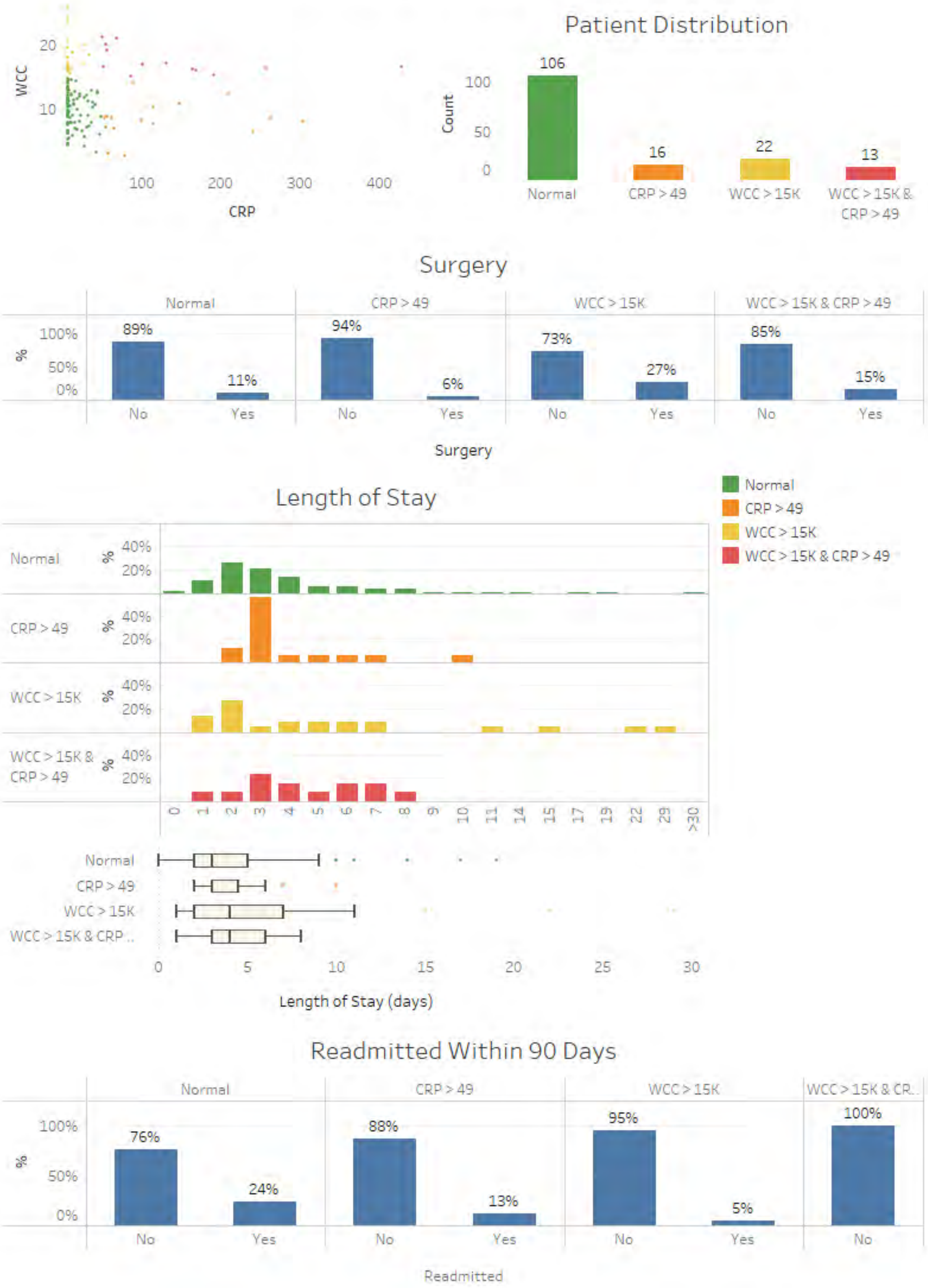

Hour of CT
% of CTs Performed
10%
5%
0
3
5
7
9
11
13
15
17
19
21
23
Hour


Patient undergoing surgery 2019, 2020, 2021
(n = 20)
Surgery
Count
140
120
100
80
60
40
20
0
No
Yes
Hours to Surgery
Time to Surgery (D..
0
1
2
5
7
Count
4
2
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
Hours between post-ED destination and surgery
Time to Induction ..
0
Count
4
3
2
1
0
0
2
4
6
8
10
12
14
16
18
20
Hours from booking to induction
ASA Score
1. No Systemic
2
2. Mild Systemic Disease
7
3. Severe Systemic Disease, Not Life-threaten..
6
4. Severe, Life-threatening
4
0 1 2 3 4 5 6 7 8 9
Count
Converted to Open
20
15
10
5
0
Count
17
No
Post-op Destination
10
5
0
Count
4
6
9
HDU
ICU
Ward

Patient Outcomes
2019, 2020, 2021 (n = 156)

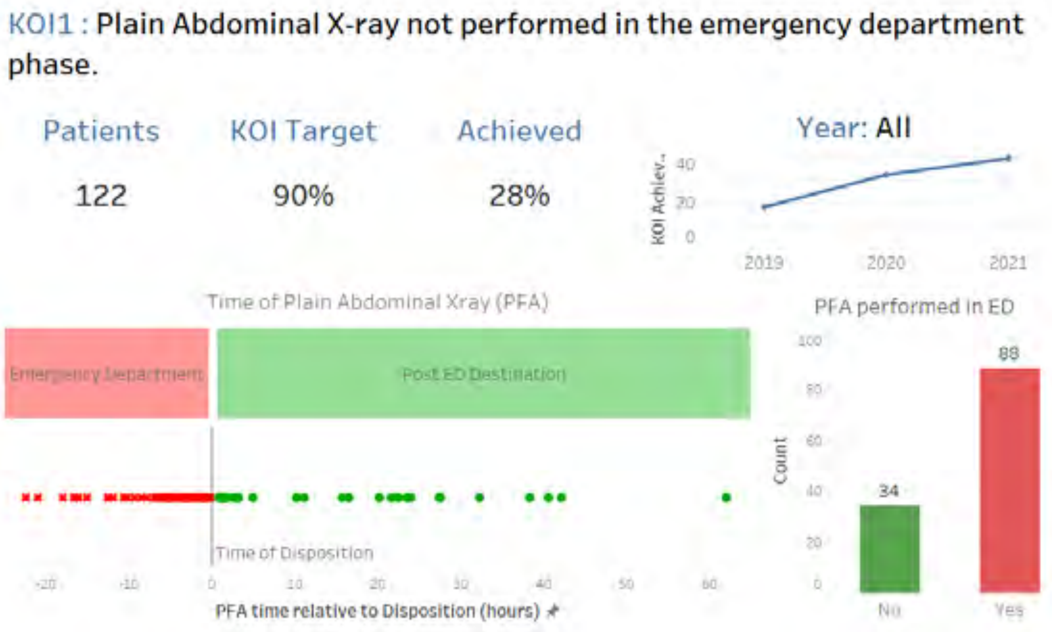


Patient Outcomes by Lab Results 2019, 2020, 2021 (n = 156)



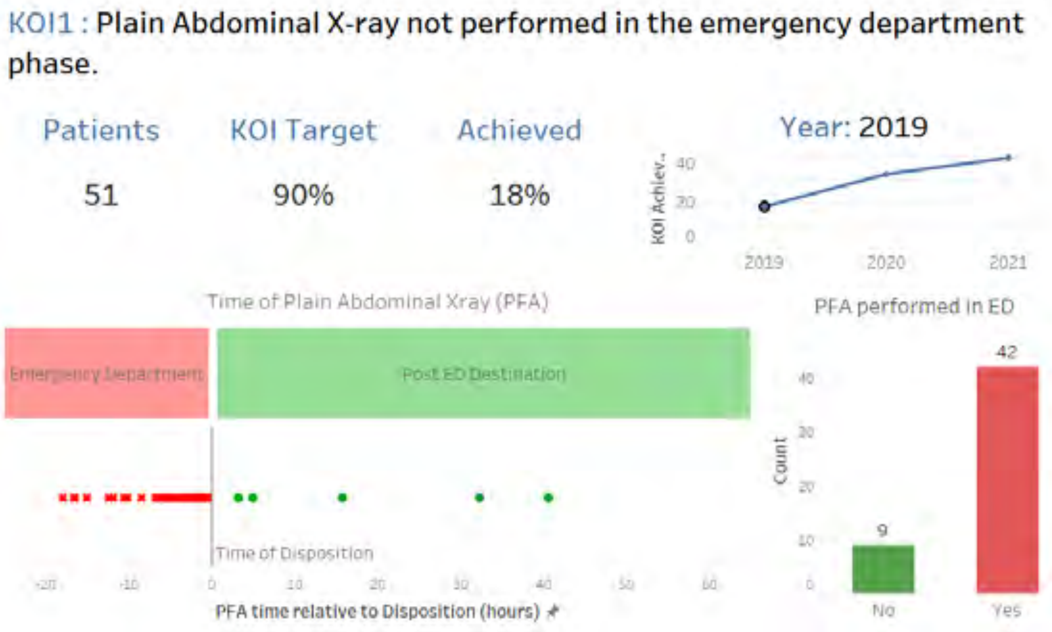
Small Bowel Obstruction Key Outcome Indicators

KEY OUTCOME INDICATOR		Target
Care Process		
1	Plain Abdominal X-ray not performed in the emergency department phase.	**90%**
2	Complicated SBO to have abdomen CT with contrast performed within 4 hours of surgical review	**80%**
Surgical Outcomes		
3	Surgery performed if SBO is unresolved 4 days post admission	**90%**
Resource Use		
4	30 day readmission	**<10%**



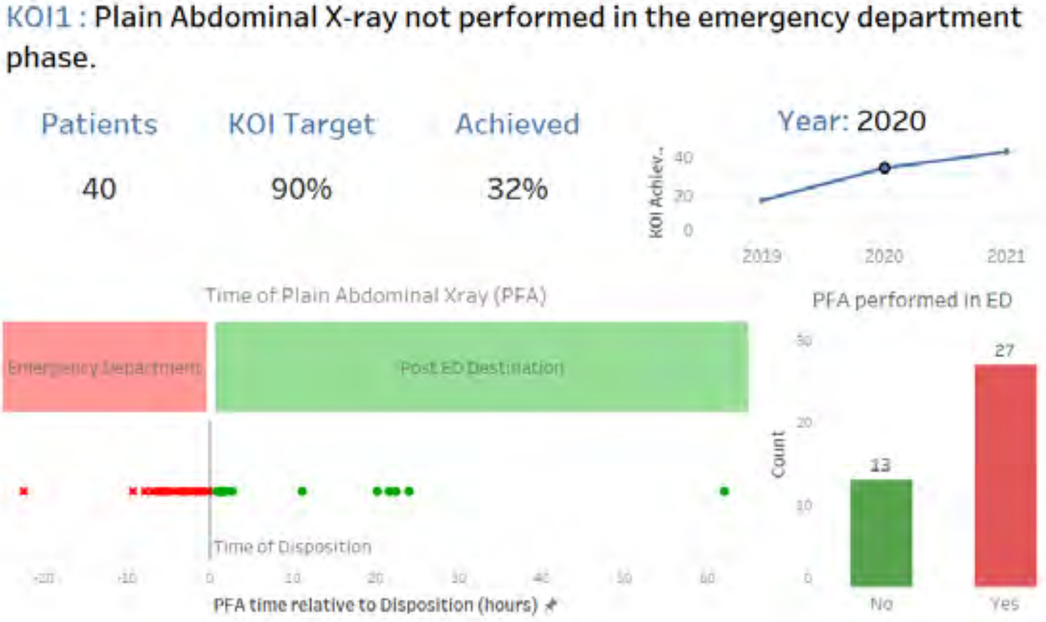
KOI1 : Plain Abdominal X-ray not performed in the emergency department phase.

Patients	KOI Target	Achieved
122	90%	28%



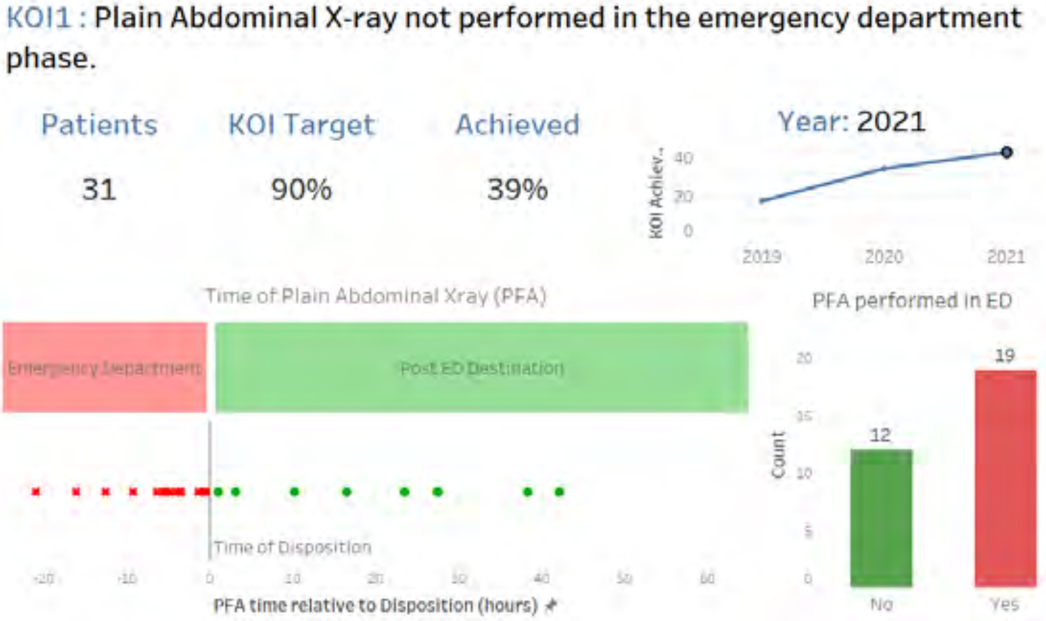
KOI1 : Plain Abdominal X-ray not performed in the emergency department phase.

Patients	KOI Target	Achieved
51	90%	18%



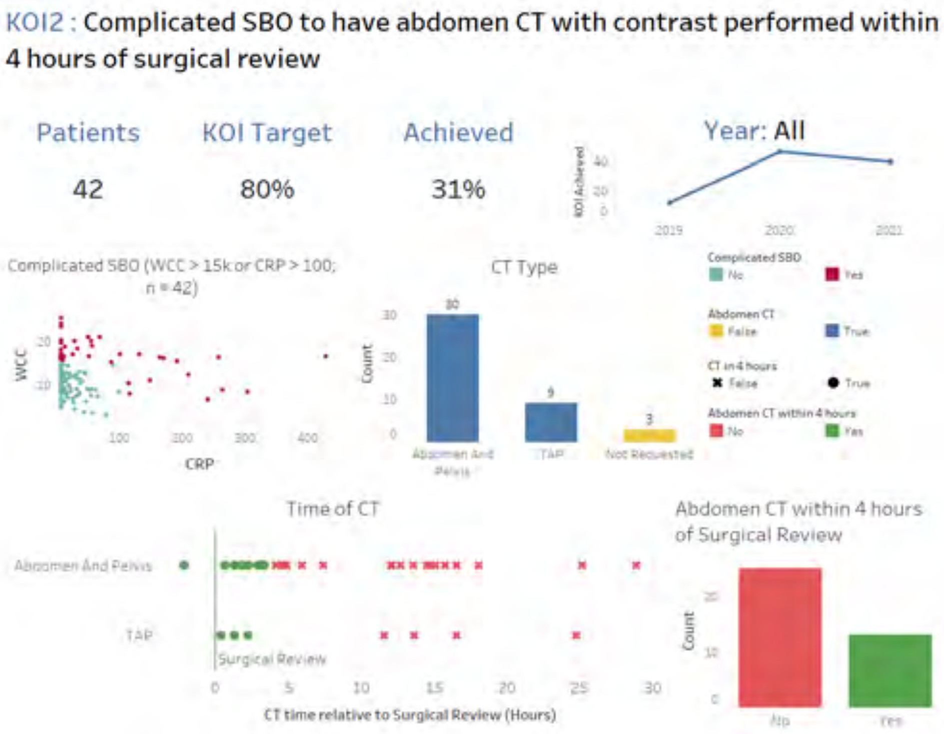
KOI1 : Plain Abdominal X-ray not performed in the emergency department phase.

Patients	KOI Target	Achieved
40	90%	32%



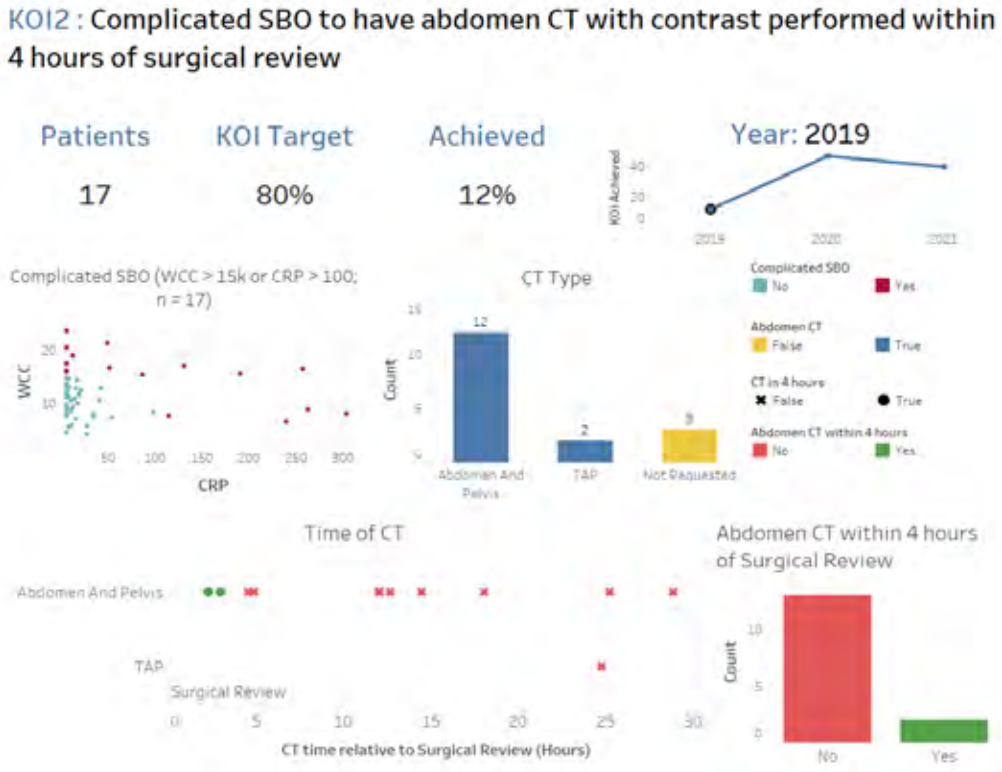
KOI1 : Plain Abdominal X-ray not performed in the emergency department phase.

Patients	KOI Target	Achieved
31	90%	39%



KOI2 : Complicated SBO to have abdomen CT with contrast performed within 4 hours of surgical review

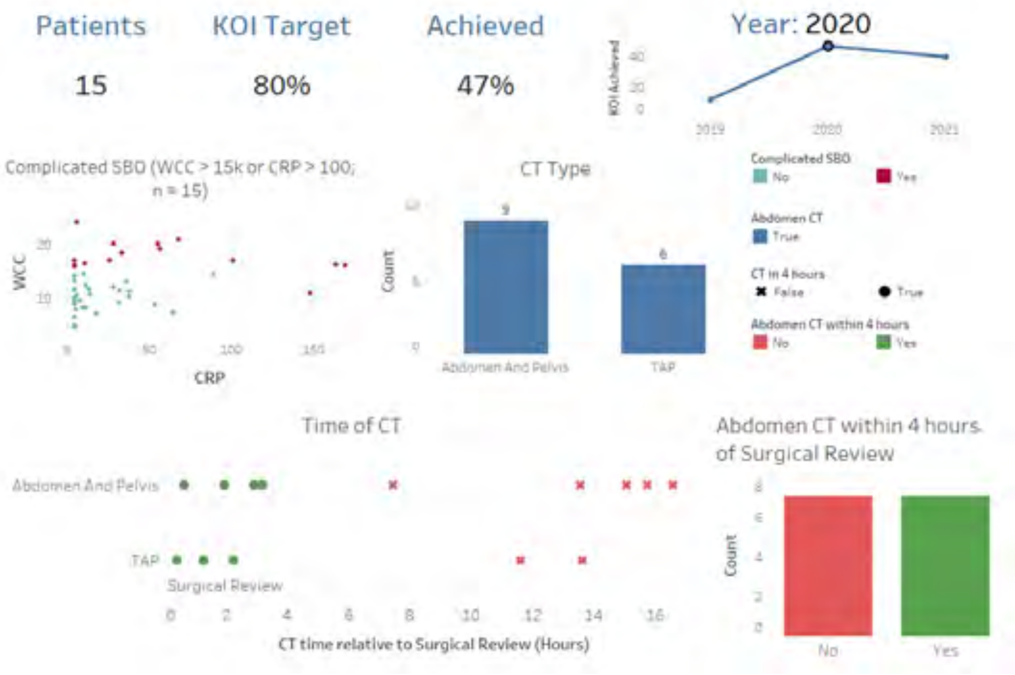
Patients	KOI Target	Achieved
42	80%	31%



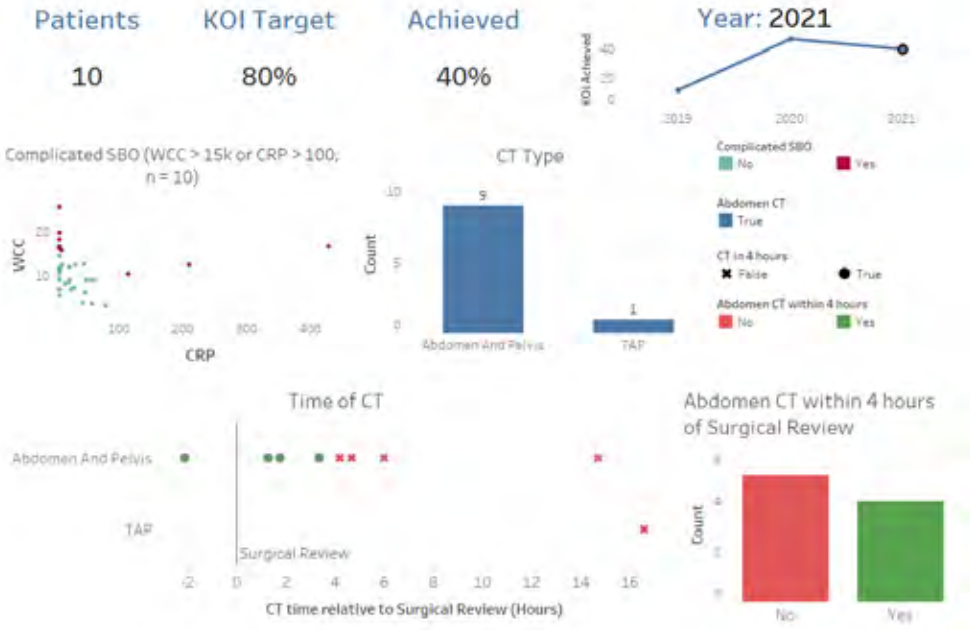
KOI2 : Complicated SBO to have abdomen CT with contrast performed within 4 hours of surgical review

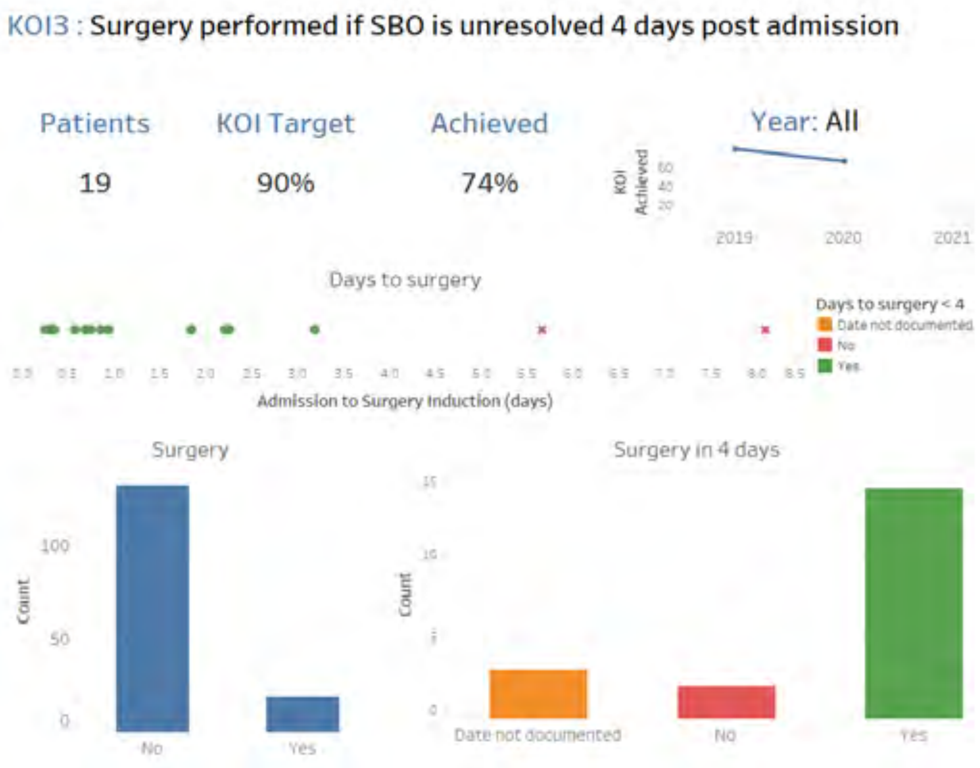
Patients	KOI Target	Achieved
17	80%	12%

KOI2 : Complicated SBO to have abdomen CT with contrast performed within 4 hours of surgical review



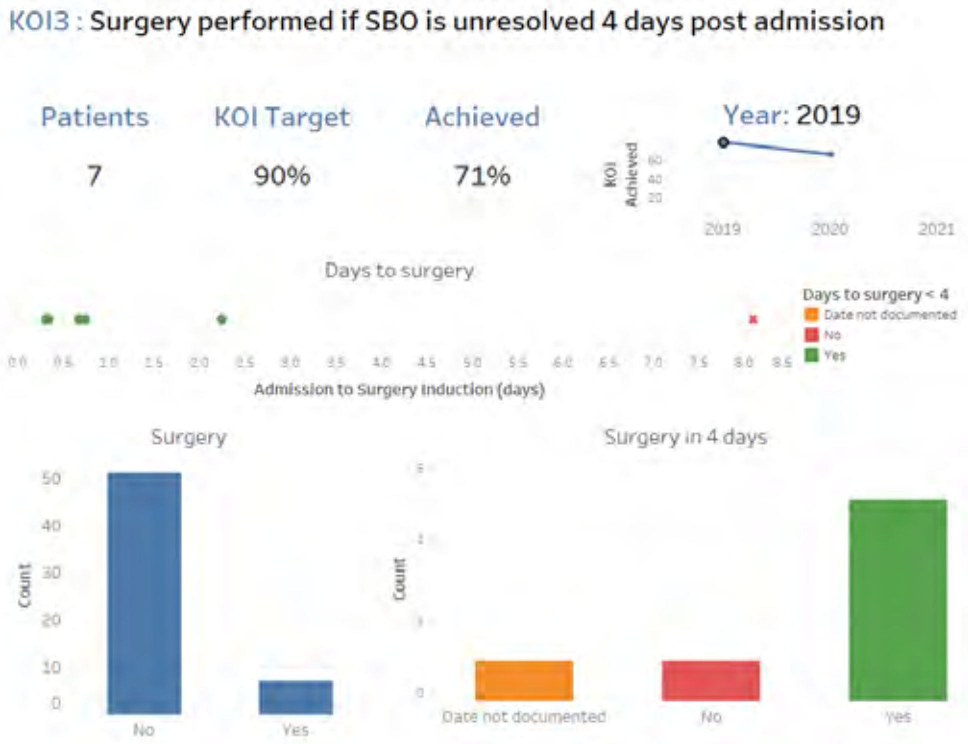
KOI2 : Complicated SBO to have abdomen CT with contrast performed within 4 hours of surgical review





KOI3 : Surgery performed if SBO is unresolved 4 days post admission

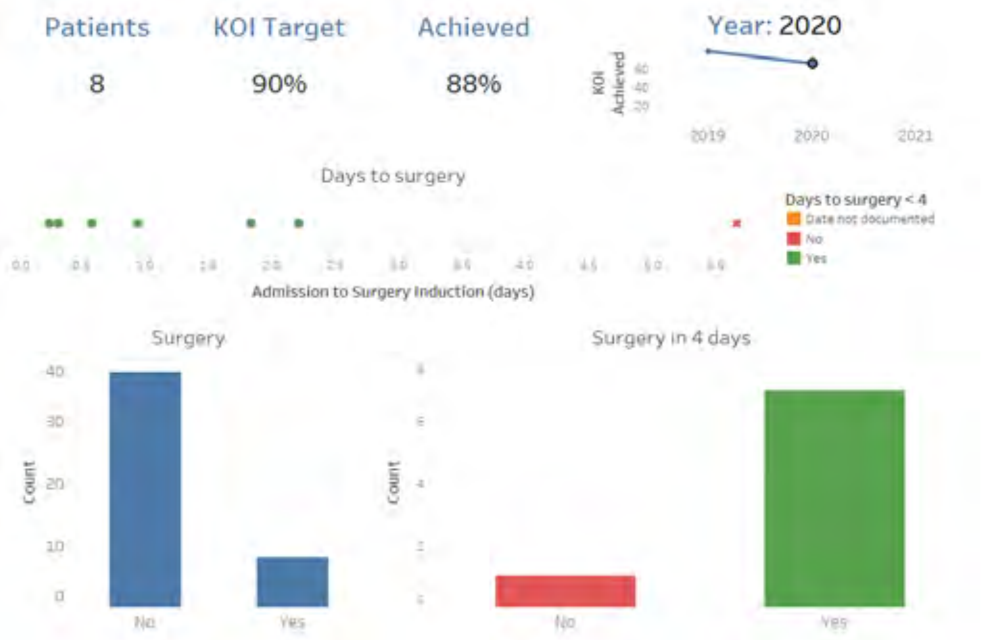
Patients	KOI Target	Achieved	Year: All
19	90%	74%	



KOI3 : Surgery performed if SBO is unresolved 4 days post admission

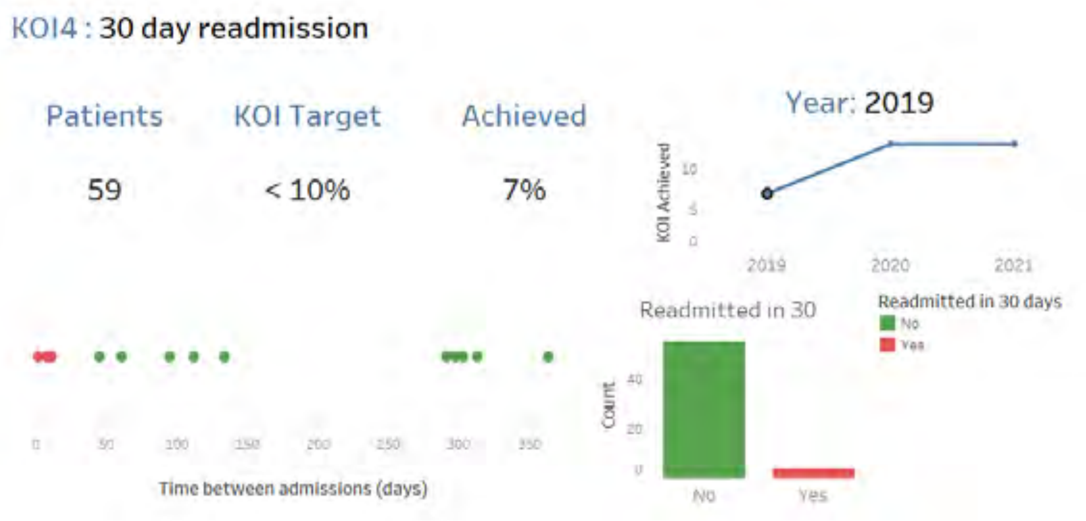
Patients	KOI Target	Achieved	Year: 2019
7	90%	71%	

KOI3 : Surgery performed if SBO is unresolved 4 days post admission



KOI4 : 30 day readmission

Patients	KOI Target	Achieved
152	< 10%	11%



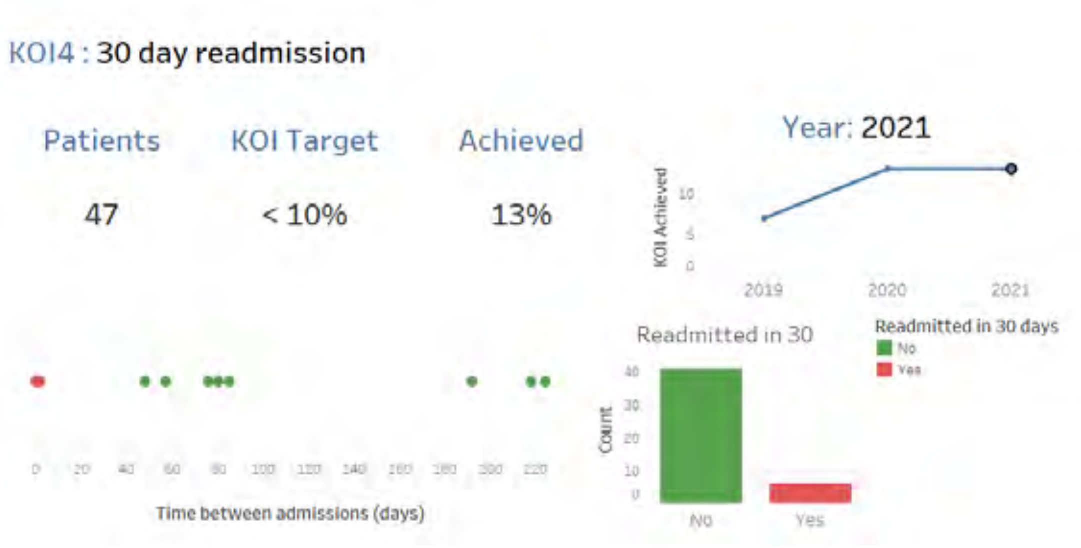
KOI4 : 30 day readmission

Patients	KOI Target	Achieved
59	< 10%	7%

KOI4 : 30 day readmission

Patients	KOI Target	Achieved
46	< 10%	13%

Year: 2020



KOI4 : 30 day readmission

Patients	KOI Target	Achieved
47	< 10%	13%

Year: 2021

Small bowel obstruction outcome data a key

Manvydas Varzgalis
MD Mch FEBS (Breast Surgery)

Small bowel obstruction (SBO) is one of most common emergency conditions leading to emergency operation. Strong evidence for managing this condition is limited by variable recording of outcomes in medical literature. There is a clear need for key outcomes set for managing small bowel obstruction.

No doubt there is significant variation in the delivery of care for patients with SBO between countries, health care institutions and individual surgeons. It could be explained not only by lack of robust evidence but as well difference in the provision of emergency service delivery. As SBO counts for around 50% of emergency laparotomies and two thirds of the patients are managed conservatively data for quality improvement is a priority[1].

Best available data on SBO already exists in USA and European guidelines (Evaluation and management of small-bowel obstruction: an Eastern Association for the Surgery of Trauma practice management guideline and Bologna guidelines for diagnosis and management of adhesive small bowel obstruction (ASBO)[23].

As the condition is not always as urgent as peritonitis and could be managed conservatively in majority of times significant delays occurs which could lead to unnecessary morbidity and mortality. Enrolling patients in SBO pathway on initial admission optimises outcomes.

The guidelines advocate for prompt early radiological diagnosis. While abdominal x-ray could be complementary to clinical examinations it's sensitivity on pathognomonic signs for high grade SBO such as air-fluid levels, distension of small bowel loops, and absence of gas in the colon is low (approximately 70%). Early radiological signs of SBO on abdominal x-ray have even lower sensitivity. Overall role of plain x-rays is limited and should be avoided in clinically suspected SBO. A CT scan with oral water-soluble contrast recommended technique of imaging in the initial evaluation. It has high sensitivity not only diagnosing SBO but also high accuracy in predicting need for urgent surgery.

Hypertonic oral contrast (e.g. Gastrografin 100ml) should be given to the patients 24 hours after admission. Multiple studies suggest water-soluble contrast agents not only have diagnostic value but attributes in therapeutic role. It can predict urgency for surgical management (If the contrast has not reached the colon 24 h following administration of the contrast) and reduce hospital stay. Evidence for optimal duration of conservative management is lacking but mostly appropriate for 72hours unless there are signs of peritonitis, strangulation or bowel ischaemia.

The use of a key outcome data sets for SBO and emergency general surgery, developed by eSOAP programme allows further analysis and compares valuable information and insight for clinicians and healthcare institutions aiming to reduce variation in delivery of care and improve patient outcomes.

References:

1. Lee MJ, Sayers AE, Drake TM on behalf of the NASBO Steering Group, et alUK-based, multisite, prospective cohort study of small bowel obstruction in acute surgical services: National Audit of Small Bowel Obstruction (NASBO) protocolBMJ Open 2017;7:e016796. doi: 10.1136/bmjopen-2017-016796
2. Maung AA, Johnson DC, Piper GL, Barbosa RR, Rowell SE, Bokhari F, Collins JN, Gordon JR, Ra JH, Kerwin AJ; Eastern Association for the Surgery of Trauma. Evaluation and management of small-bowel obstruction: an Eastern Association for the Surgery of Trauma practice management guideline. J Trauma Acute Care Surg. 2012 Nov;73(5 Suppl 4):S362-9. doi: 10.1097/TA.0b013e31827019de. PMID: 23114494.
3. Amara, Y., Leppaniemi, A., Catena, F. et al. Diagnosis and management of small bowel obstruction in virgin abdomen: a WSES position paper. World J Emerg Surg 16, 36 (2021). https://doi.org/10.1186/s13017-021-00379-8

Editorial Comment

The research work of eSOAP Team at Letterkenny University, Altnagelvin and Raigmore hospital have identified 157 patients in 3 year presenting with SBO to a one hospital in Ireland. This reflects the importance of this emergency surgical presentation within our region would translate to almost 1200 patients a year. 10% of these will die from what is a benign condition.

We need to improve outcomes and implementation of a small bowel pathway developed by Dr Hui, and Sister Rita Marren in conjunction with Mr Zeeshan and Mr Bodnar will do just that. This need to be implemented in an agile electronic registry with linked key outcome indicators and automated reporting to a governance structure in health which needs to take great cognisance of the importance of data and reaction to data.

Health Care Teams need to have a digital code of practice linked to safety mechanism with machine learning and AI, linked to laboratory and imaging results to ensure increasing safety for the patients. The combination of digital transformation, with education through EASC course at medical student, trainees, consultant and nursing levels will change this. There is a question you the reader of this report and those who decide national and international health policy, need to ask how long can we afford to wait for these changes to be implemented . Thank you to the European Union's INTERREG VA programme for allowing the team identify a pathway to improving outcomes and saving those lives; which could be yours or your families someday.

Michael Sugrue
February 2022

Developing an Evidence-Based Small Bowel Obstruction Pathway

Huilun Huan MBChB, Ian Stephens, Syed Mohammad Umar Kabir, Michael Broderick, Dineo Moiloa, Brendan Skelly, Michael Sugrue MB BCh BAO MD FRSCI FRACS

Small bowel obstruction (SBO) is a common general surgical condition with variable presentation and management strategies. As evidenced by one of the largest published reviews of SBO outcomes, the morbidity and mortality rate associated with SBO is significant. (1)

A recent report by the NCEPOD (2) identified a lack of guideline with variability in care and outcomes in the management of SBO. Factors identified that contribute to the mortality and morbidity rate of SBO include delay in expert review, delay in surgical intervention, presence of co-morbidities and poor nutritional status. There was also variation observed in radiological investigation of SBO and the initial use of water-soluble contrast in those treated conservatively. Improvement strategies on emergency laparotomy has demonstrated favourable results through comprehensive data capturing, identifying improvement areas and setting standard clinical guidance, as evidenced by a reduction of post-operative mortality rate and reduced length of stay annually (3). Similarly, the rate of morbidity and mortality with variation in the treatment of SBO prompts the need for clinical pathway with a primary aim of guiding timely and appropriate management, and the secondary aim of providing auditable data for quality improvement implementation to improve outcomes.

For our primary aim, we developed an evidence-based pathway that is based on validated international consensus guidelines that provided a framework in the management of SBO in our hospital setting.

Process mapping for the structure of a clinical pathway appropriate for our hospital setting was created in conjunction with the surgical and emergency department, involving consultants, non-consultant hospital doctors, and nursing staff. Subsequently, a systematic review of current SBO guidelines published between 2010 and 2021 was performed, which yielded six consensus guidelines following validation using a standardized guideline assessment tool (4) (Table 1). Guideline recommendations were tabulated and incorporated into the clinical pathway for use as part of our existing surgical admissions proforma to allow for data capturing. (Figure 1)

For our secondary aim, we developed a set of measurable factors involved in the care of SBO. Sugrue et al, in an international collaboration, outlined several key aspects in common emergency general surgery (EGS) conditions that acted as a basis for the development of key outcome indicators (KOI's)(5). Key factors involving care process, surgical outcomes, adverse events, and resource use were discussed at weekly MDT meetings to reach a consensus. (Table 2). This provides a platform to assess practice to standard and identify improvement areas in SBO management.

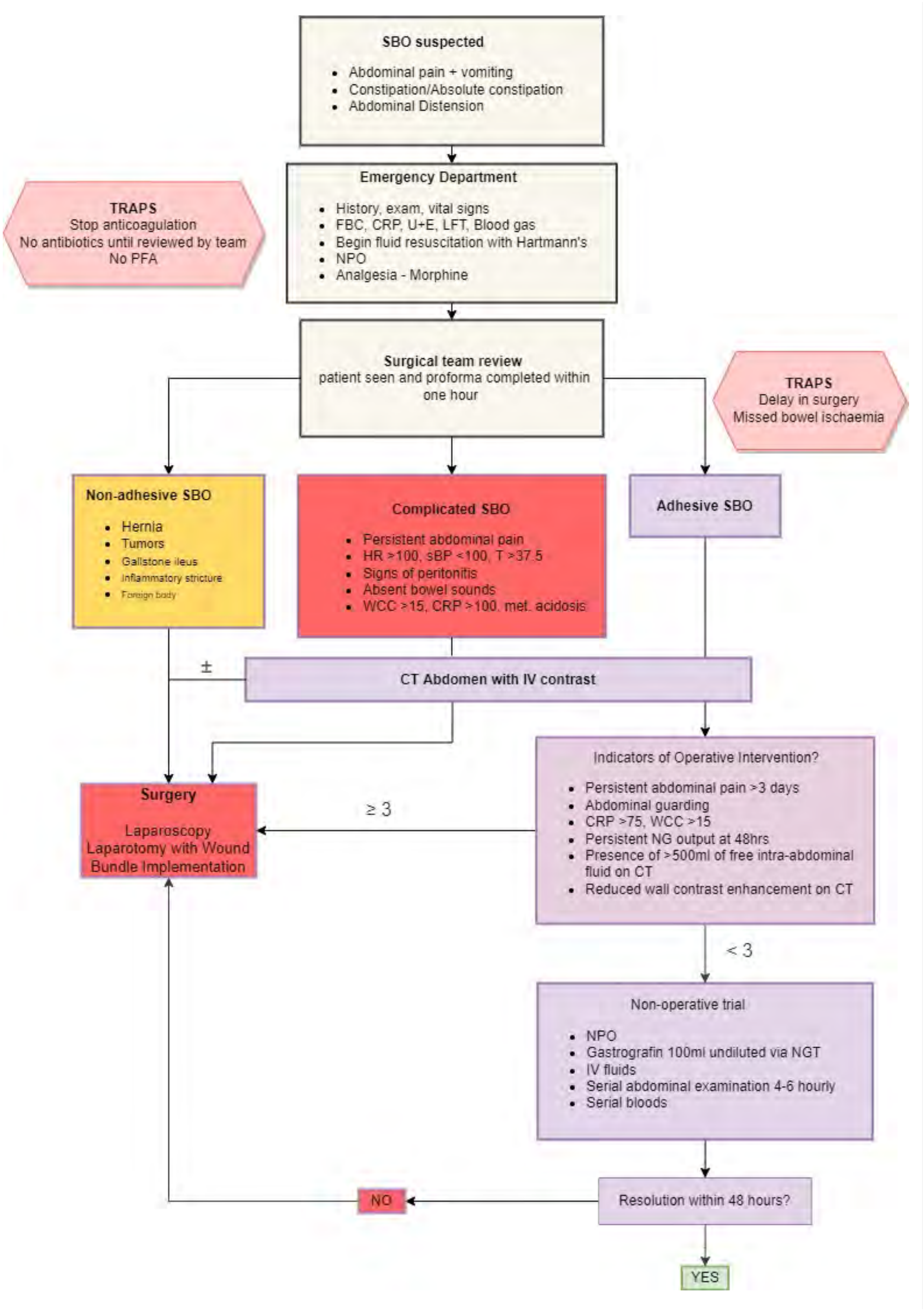
With this project, a collaborative effort was made to include latest evidence on SBO in literature, validating existing guidelines and utilizing them in conjunction with experts for a practical pathway that can used either directly, adapted or updated for use in various clinical institutions. With the implementation of this pathway and its provision of auditing data, we hope to provide a strategy that will improve outcomes in the treatment of SBO.

Table 1. AGREE II Assessment of included guidelines

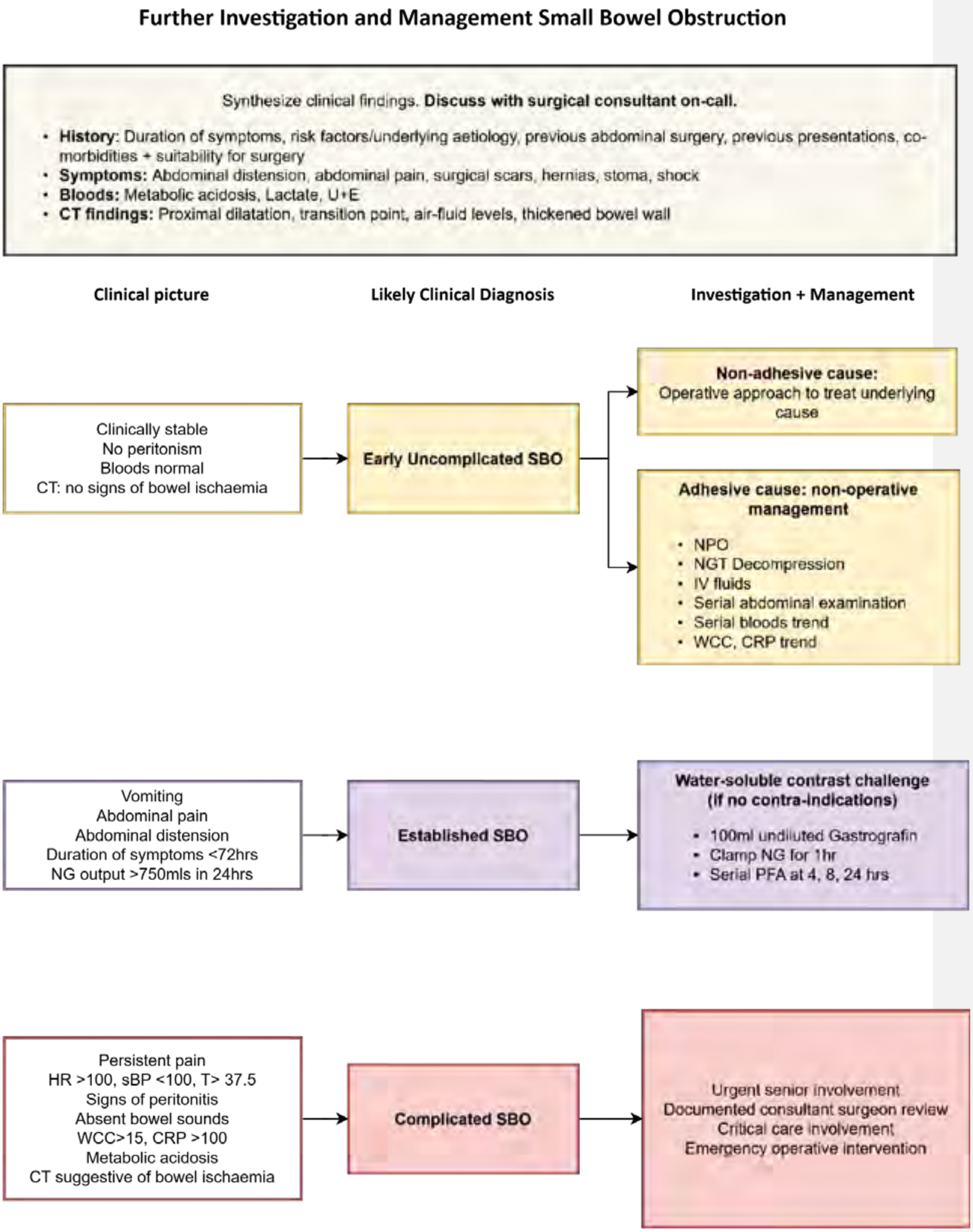
GUIDELINES	Domain 1 Scope and purpose	Domain 2 Stakeholder involvement	Domain 3 Rigour of development	Domain 4 Clarity of presentation	Domain 5 Applicability	Domain 6 Editorial independence	Overall score	Assesment
Elsolh 2019	**94%**	**47%**	**55%**	**83%**	**42%**	**17%**	**67%**	**R**
Ten Broek 2018	**64%**	**39%**	**56%**	**67%**	**31%**	**46%**	**67%**	**R**
Long 2018	**42%**	**14%**	**38%**	**69%**	**29%**	**4%**	**42%**	**RM**
Costa 2016	**47%**	**31%**	**45%**	**61%**	**29%**	**8%**	**25%**	**NR**
Azagury 2015	**53%**	**8%**	**25%**	**53%**	**48%**	**42%**	**50%**	**RM**
Maung 2012	**72%**	**33%**	**57%**	**69%**	**29%**	**42%**	**58%**	**RM**
Ventoretto 2012	**69%**	**72%**	**65%**	**72%**	**35%**	**8%**	**67%**	**R**
Mean %	**55.86** **(42-94)**	**34.86** **(8-72)**	**48.7** **(25-65)**	**67.71** **(53-83)**	**34.71** **(29-48)**	**23.8** **(4-46)**		

R = Recommended; RM = Recommended with modifications; NR = Not recommended

Figure 1. Pathway recommended by eSOAP for SBO Management



Small Bowel Obstruction Pathway



Further Investigation and Management Small Bowel Obstruction

Synthesize clinical findings. **Discuss with surgical consultant on-call.**

- **History**: Duration of symptoms, risk factors/underlying aetiology, previous abdominal surgery, previous presentations, co-morbidities + suitability for surgery
- **Symptoms:** Abdominal distension, abdominal pain, surgical scars, hernias, stoma, shock
- **Bloods:** Metabolic acidosis, Lactate, U+E
- **CT findings:** Proximal dilatation, transition point, air-fluid levels, thickened bowel wall

Clinical picture	Likely Clinical Diagnosis	Investigation + Management
Clinically stable No peritonism Bloods normal CT: no signs of bowel ischaemia	**Early Uncomplicated SBO**	**Non-adhesive cause:** Operative approach to treat underlying cause **Adhesive cause: non-operative management** • NPO • NGT Decompression • IV fluids • Serial abdominal examination • Serial bloods trend • WCC, CRP trend
Vomiting Abdominal pain Abdominal distension Duration of symptoms <72hrs NG output >750mls in 24hrs	**Established SBO**	**Water-soluble contrast challenge (if no contra-indications)** • 100ml undiluted Gastrografin • Clamp NG for 1hr • Serial PFA at 4, 8, 24 hrs
Persistent pain HR >100, sBP <100, T> 37.5 Signs of peritonitis Absent bowel sounds WCC>15, CRP >100 Metabolic acidosis CT suggestive of bowel ischaemia	**Complicated SBO**	Urgent senior involvement Documented consultant surgeon review Critical care involvement Emergency operative intervention

Table 3. Key Outcome Indicators

KEY OUTCOME INDICATOR		Target
Care Process		
1	Enrolment of patient on pathway in ED before leaving for the ward.	**100%**
2	Complicated SBO* seen by a consultant within 2 hours of surgical review documented in proforma/chart.	**90%**
3	Complicated SBO to have CT abdomen with contrast performed within 4 hours of surgical review.	**80%**
4	Gastrografin** given within 24 hours of admission for SBO that is unresolved by the next day of admission.	**90%**
Surgical Outcomes		
5	Persistent SBO operated on before 4 days have elapsed, or <72hrs for those coming to surgery.	**90%**
6	Complicated obstruction with peritonitis/strangulated hernia has surgery <4hrs from surgical referral.	**90%**
7	Patients post laparotomy admitted to HDU/ICU.	**90%**
8	Gastrografin** given within 24 hours of admission for SBO that is unresolved by the next day of admission.	**90%**
Adverse Events		
9	In-hospital wound complications <10%.	**100%**
Resource Use		
10	Plain abdominal X-Ray not performed in the emergency department phase.	**80%**
11	No readmission to hospital within 90 days.	**90%**

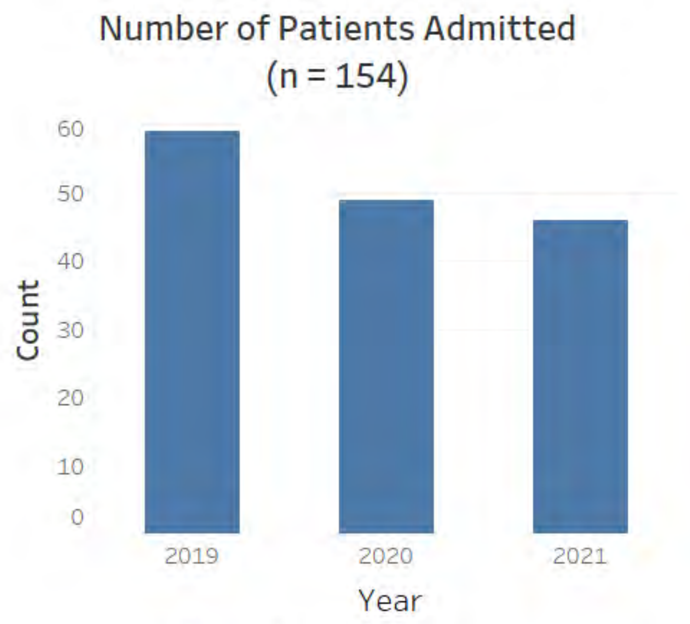
* WCC >20, CRP >150, tenderness with guarding and rebound on abdominal exam (2/3 criteria for complicated SB)

** Gastrografin 100ml, undiluted po/via nasogastric tube (14-16Fr)

References:

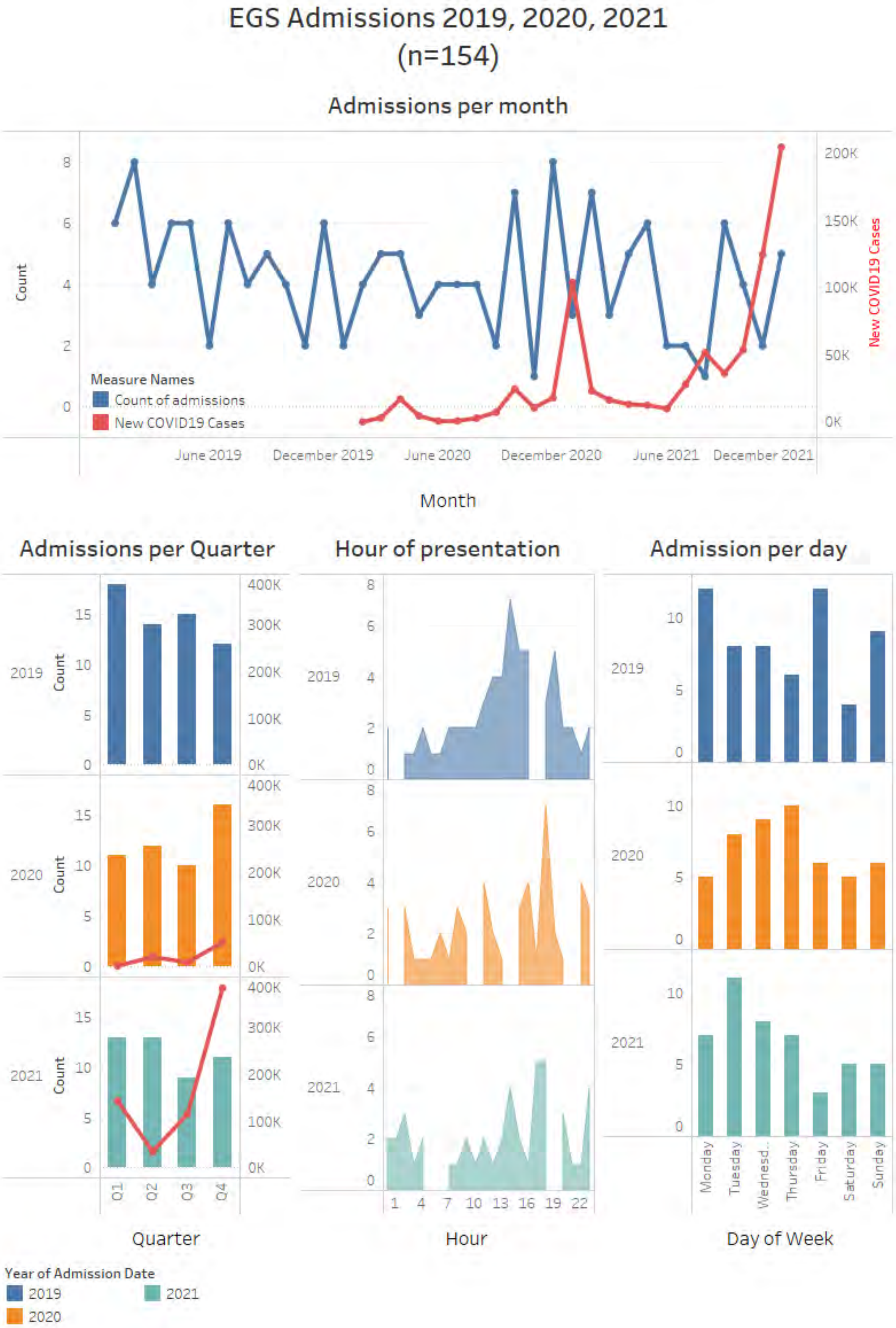
1. Lee M, Sayers A, Drake T et al (2019) National prospective cohort study of the burden of acute small bowel obstruction. BJS Open 3:354-366
2. Shotton H, Kelly K, Sinclair M, Michalski (2021) A Delay in transit: the NCEPOD review of care provided to patients with acute bowel obstruction. British Journal of Hospital Medicine 82:1-1
3. (2022) Seventh patient report of the National Emergency Laparotomy Audit – HQIP. In: HQIP. https://www.hqip.org.uk/resource/seventh-patient-report-of-the-national-emergency-laparotomy-audit/. Accessed 4 Feb 2022
4. Brouwers, M., Kho, M., Browman, G., Burgers, J., Cluzeau, F., Feder, G. et al, 2010. AGREE II: advancing guideline development, reporting and evaluation in health care. Canadian Medical Association Journal, 182(18), pp.E839-E842.
5. Sugrue, M., Maier, R., Moore, E., Boermeester, M., Catena, F., Coccolini. et al, 2017. Proceedings of resources for optimal care of acute care and emergency surgery consensus summit Donegal Ireland. World Journal of Emergency Surgery, 12(1)

Final Diagnosis: Pancreatitis



Number of Patients Admitted (n = 154)

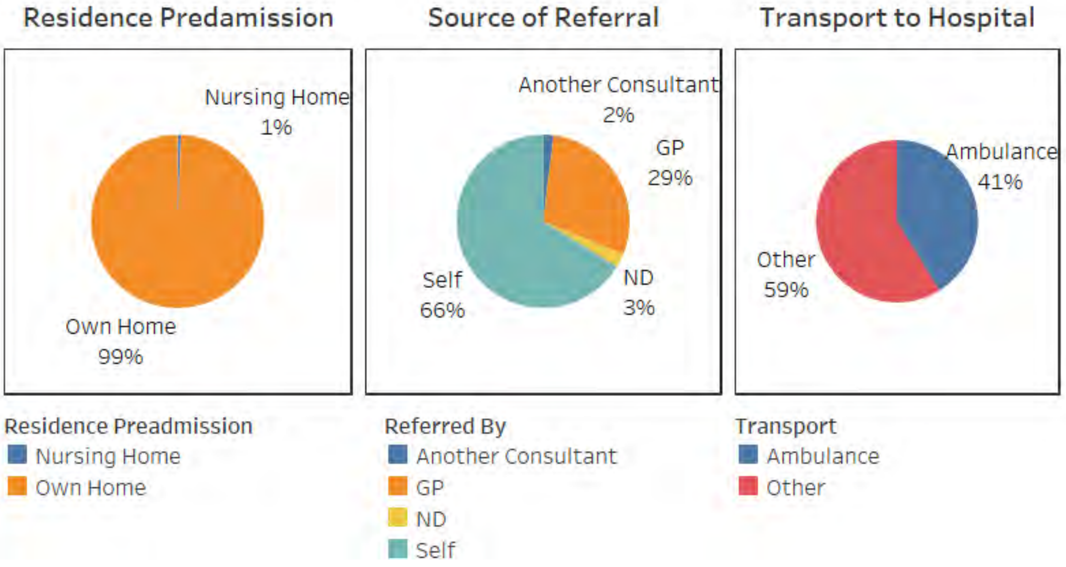
Registered ED time



EGS Admissions 2019, 2020, 2021
(n=154)
Admissions per month
Count
8
6
4
2
0
200K
150K
100K
50K
0K
New COVID19 Cases
Measure Names
Count of admissions
New COVID19 Cases
June 2019
December 2019
June 2020
December 2020
June 2021
December 2021
Month
Admissions per Quarter
Hour of presentation
Admission per day
2019
2020
2021
Count
15
10
5
0
400K
300K
200K
100K
0K
Q1
Q2
Q3
Q4
Quarter
8
6
4
2
0
1
4
7
10
13
16
19
22
Hour
10
5
0
Monday
Tuesday
Wednesd..
Thursday
Friday
Saturday
Sunday
Day of Week
Year of Admission Date
2019
2021
2020

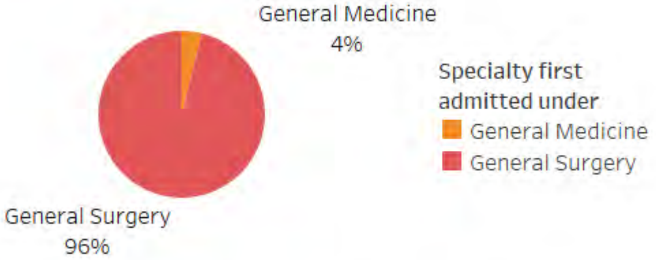
Age Distribution of EGS Admissions 2019, 2020, 2021 (n=154)

Patient Journey in 2019, 2020, 2021
(n=154)

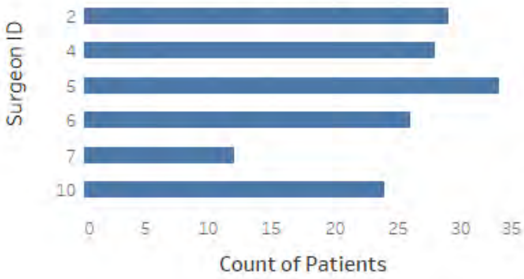


Specialty & Surgeon 2019, 2020, 2021
(n=154)

Speciality Admitted Under



Surgeon



Surgeon by year

Consultant Surgeon	2019	2020	2021	Grand Total
2	14	6	9	29
4	10	8	10	28
5	11	12	10	33
6	10	12	4	26
7	12			12
10	2	11	11	24

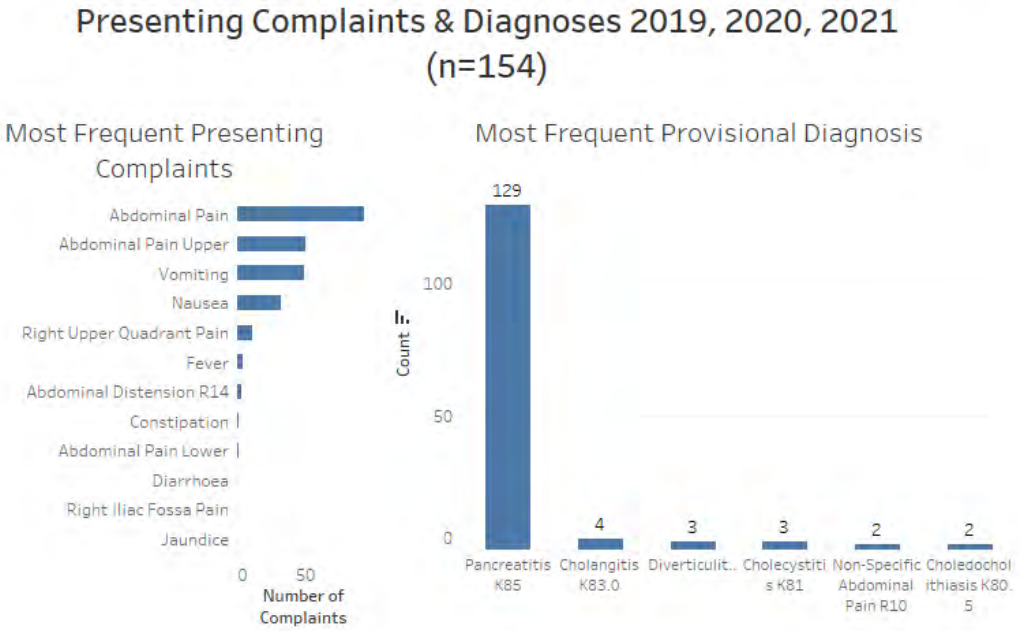
Emergency Department Times 2019, 2020, 2021 (n=128)

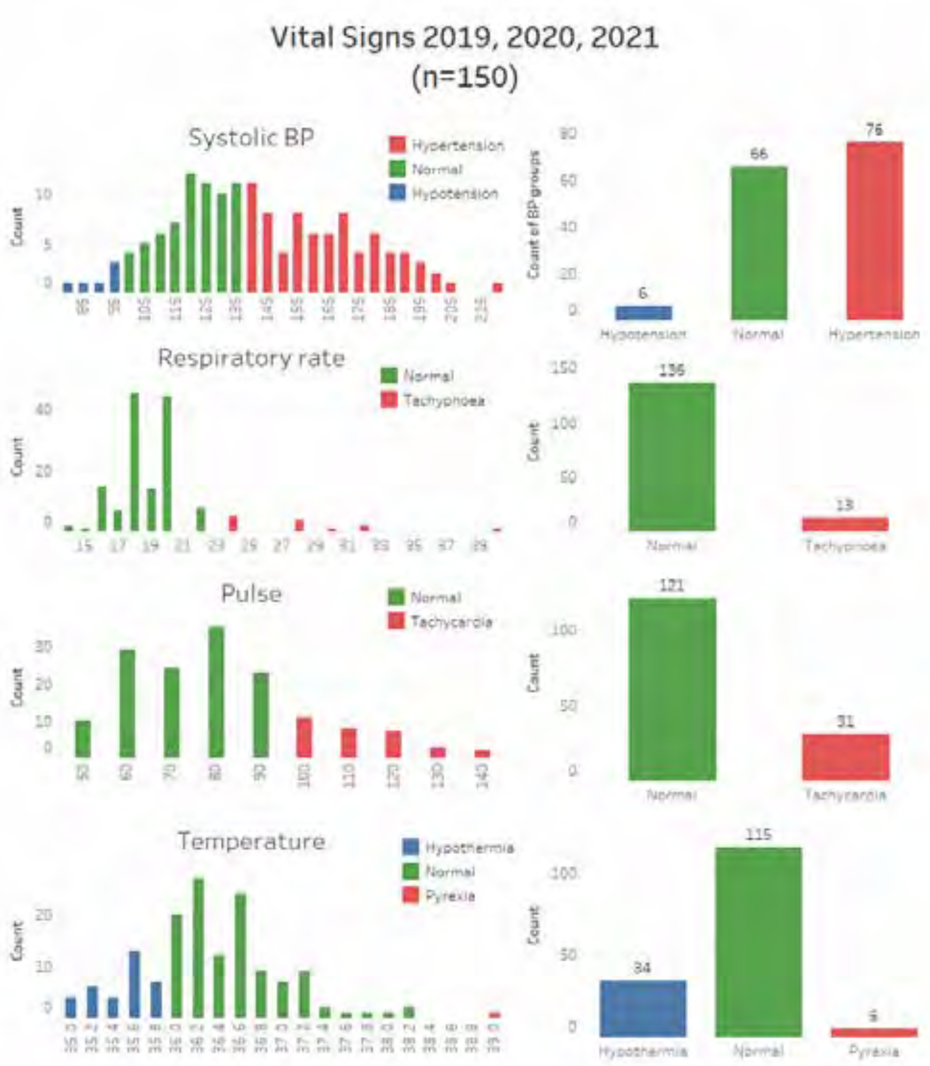
Registered to Triage (Median = 0.18 hrs)

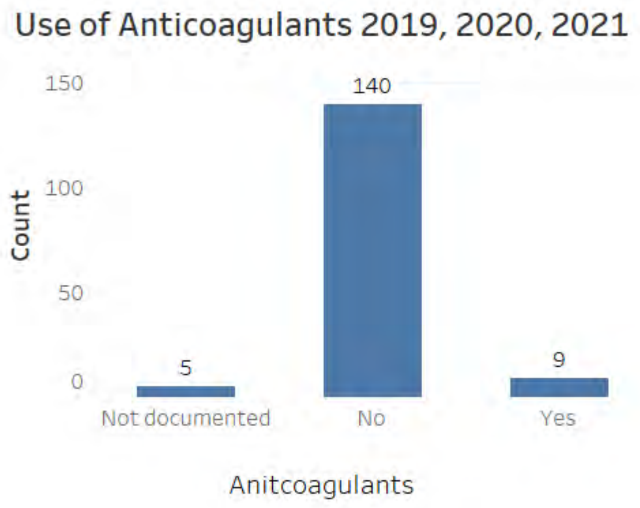
Triage to Bloods Collected (Median = 0.75 hrs)

Bloods Collected to Time Referred (Median = 1.51 hrs)

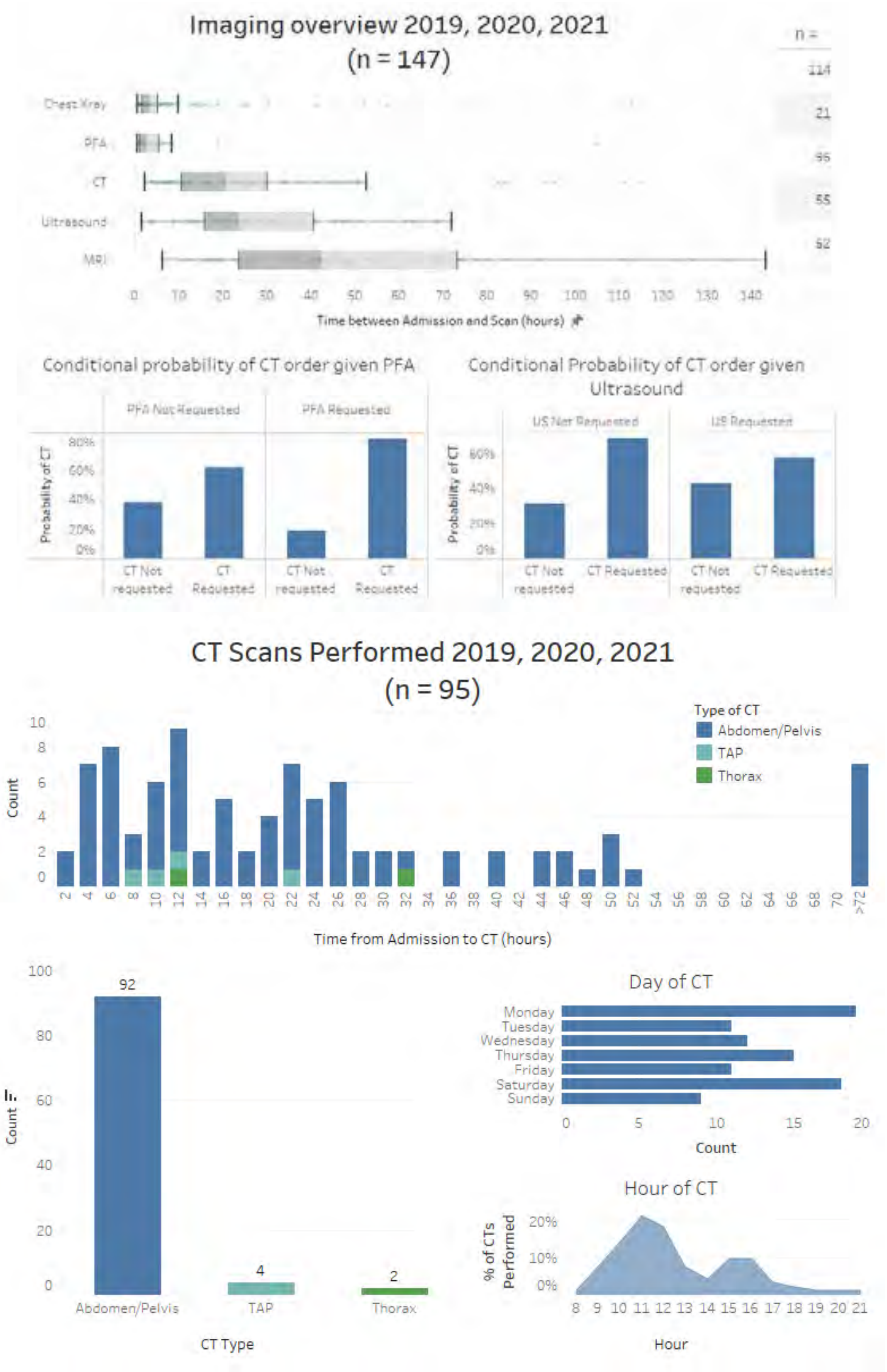
Time Referred to Time Seen (Median = 0.75 hrs)

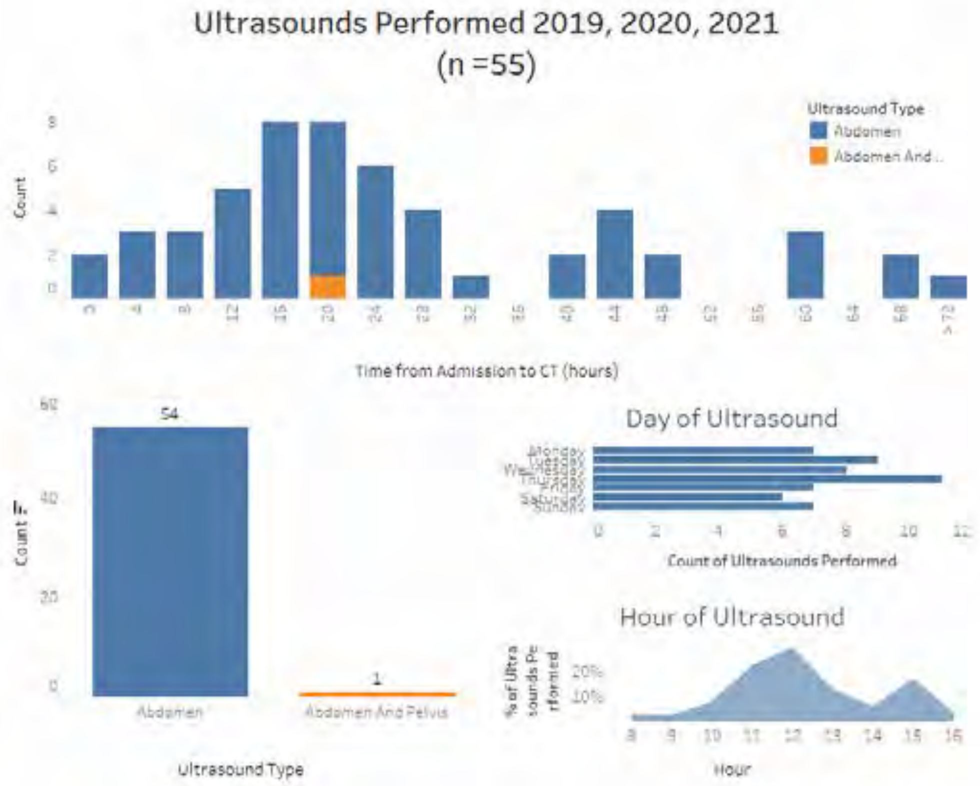

Presenting Complaints & Diagnoses 2019, 2020, 2021 (n=154)
Most Frequent Presenting Complaints
Abdominal Pain
Abdominal Pain Upper
Vomiting
Nausea
Right Upper Quadrant Pain
Fever
Abdominal Distension R14
Constipation
Abdominal Pain Lower
Diarrhoea
Right Iliac Fossa Pain
Jaundice
0
50
Number of Complaints
Most Frequent Provisional Diagnosis
Count
100
50
0
129
4
3
3
2
2
Pancreatitis K85
Cholangitis K83.0
Diverticulit..
Cholecystitis K81
Non-Specific Abdominal Pain R10
Choledocholithiasis K80.5


Vital Signs 2019, 2020, 2021
(n=150)
Systolic BP
Hypertension
Normal
Hypotension
Count
0
5
10
85
95
105
115
125
135
145
155
165
175
185
195
205
215
Count of BP groups
0
20
40
60
80
6
66
76
Hypotension
Normal
Hypertension
Respiratory rate
Normal
Tachypnoea
Count
0
20
40
15
17
19
21
23
25
27
29
31
33
35
37
39
Count
0
50
100
150
136
13
Normal
Tachypnoea
Pulse
Normal
Tachycardia
Count
0
10
20
30
50
60
70
80
90
100
110
120
130
140
Count
0
50
100
121
31
Normal
Tachycardia
Temperature
Hypothermia
Normal
Pyrexia
Count
0
10
20
Count
0
50
100
34
115
5
Hypothermia
Normal
Pyrexia


Use of Anticoagulants 2019, 2020, 2021
Count
0
50
100
150
5
140
9
Not documented
No
Yes
Anitcoagulants

Lab Results 2019, 2020, 2021 (n=151)

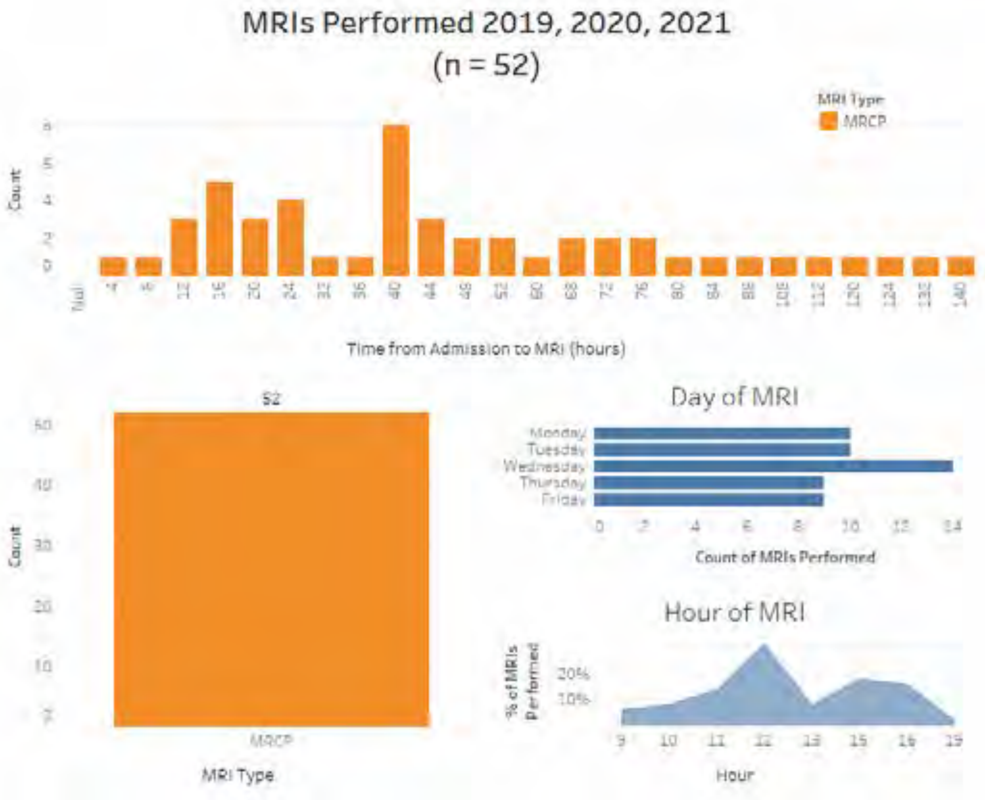

Imaging overview 2019, 2020, 2021
(n = 147)
n =
Chest Xray
PFA
CT
Ultrasound
MRI
114
21
95
55
52
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Time between Admission and Scan (hours)
Conditional probability of CT order given PFA
PFA Not Requested
PFA Requested
Probability of CT
80%
60%
40%
20%
0%
CT Not requested
CT Requested
Conditional Probability of CT order given Ultrasound
US Not Requested
US Requested
60%
40%
20%
0%
CT Not requested
CT Requested
CT Scans Performed 2019, 2020, 2021
(n = 95)
Type of CT
Abdomen/Pelvis
TAP
Thorax
Count
10
8
6
4
2
0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 >72
Time from Admission to CT (hours)
100
80
60
40
20
0
92
4
2
Abdomen/Pelvis
TAP
Thorax
CT Type
Day of CT
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0 5 10 15 20
Count
Hour of CT
% of CTs Performed
20%
10%
0%
8 9 10 11 12 13 14 15 16 17 18 19 20 21
Hour



Ultrasounds Performed 2019, 2020, 2021 (n =55)

Day of Ultrasound

Hour of Ultrasound

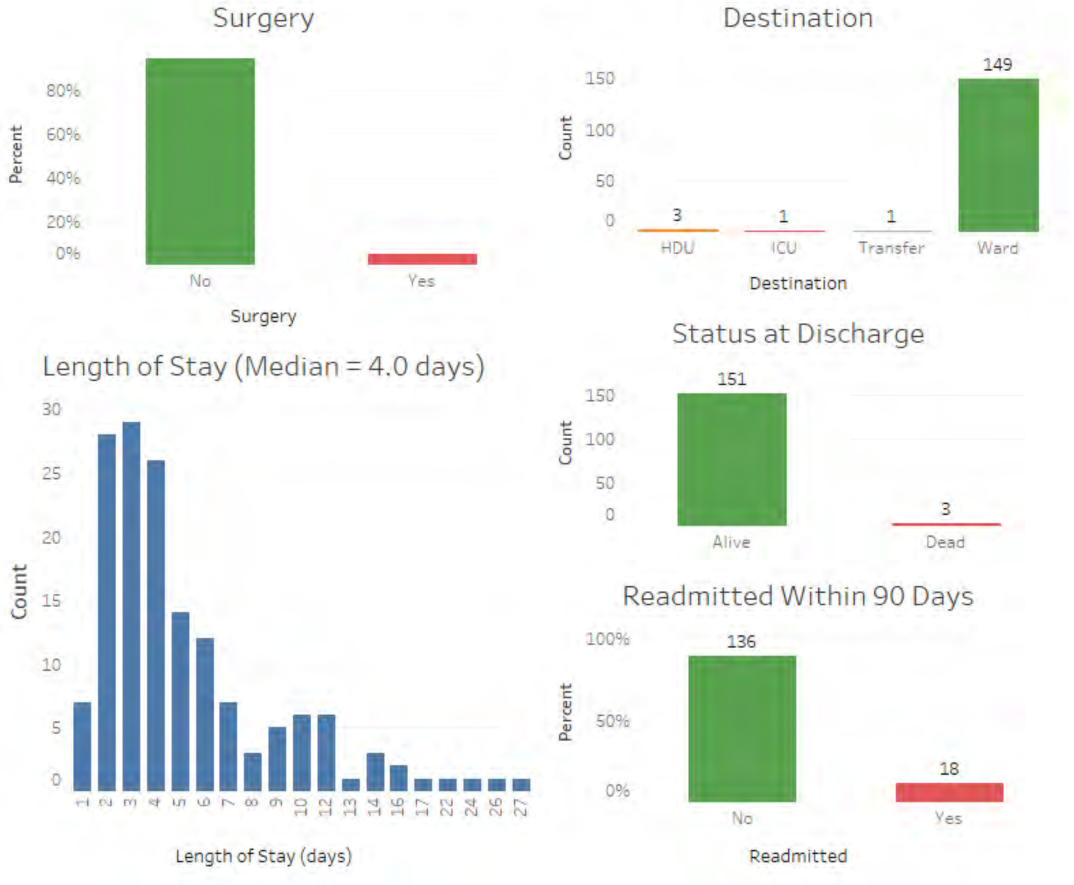


MRIs Performed 2019, 2020, 2021 (n = 52)

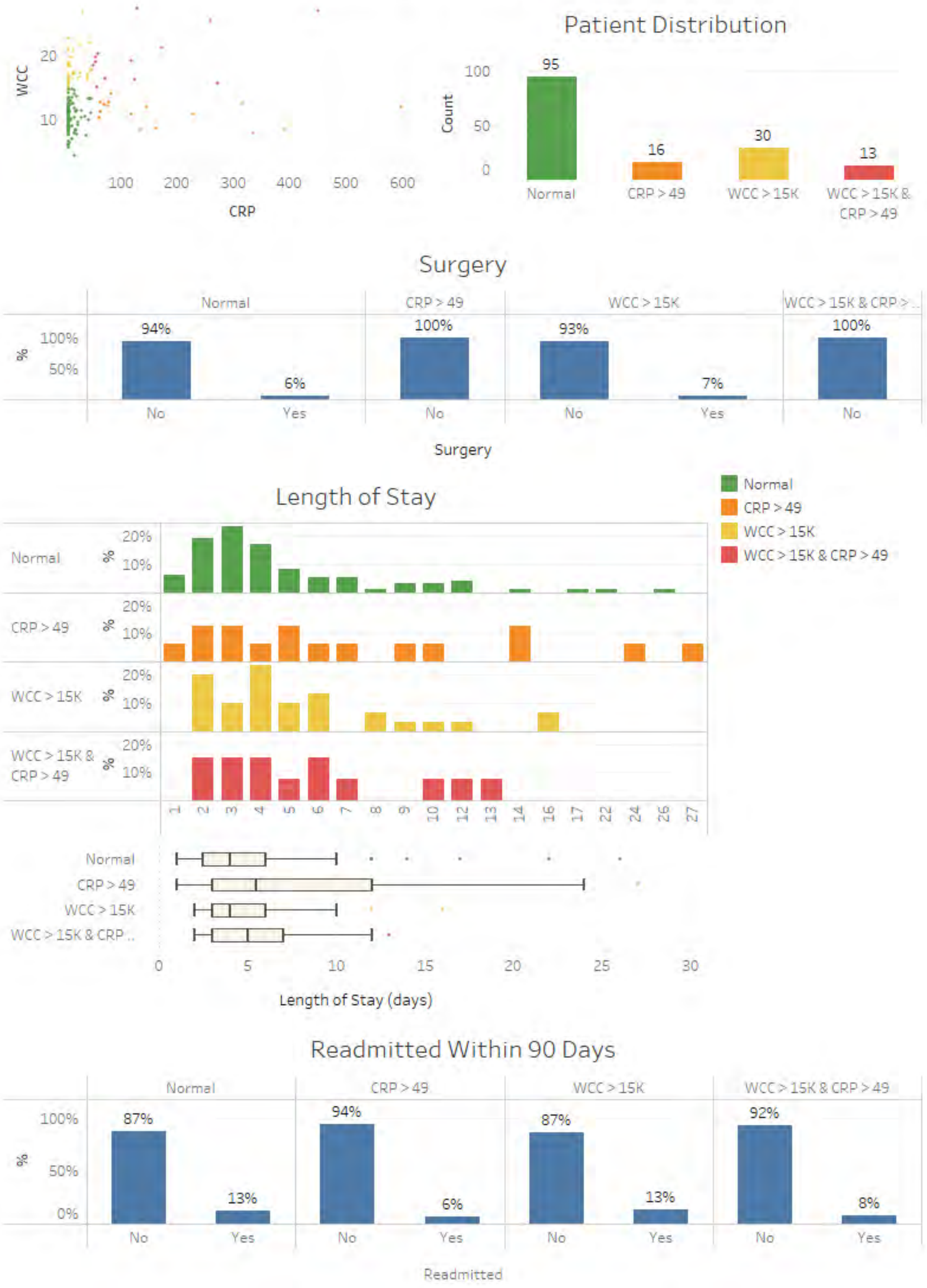
Day of MRI

Hour of MRI

Patient Outcomes
2019, 2020, 2021 (n = 154)



Patient Outcomes by Lab Results
2019, 2020, 2021 (n = 154)



Laparotomy

Time to have Monitoring of outcomes

As Surgeons and providers of EGS care we can be proud of our efforts to save patients dying from peritonitis and acute abdominal conditions. As a group we have a commitment in one of the most stressful and difficult areas in medicine to improve outcomes. The question is not can we improve further but how we can do this.

Quality indicators have existed in elective general surgery for some time particularly in relation to vascular surgery, breast and colorectal surgery. When it comes to emergency laparotomy however, quality indicators are less well embraced. The Resources for Optimal Care in Emergency Surgery Summit in Donegal, Ireland in 2016 outlined some key outcome indicators in patients admitted with a diagnosis in Emergency General Surgery (EGS). This summit attended by world leaders in EGS came up with over 100 key performance indicators. Further to this meeting key outcome data from the UK has shown how improvement can be achieved. The NELA process incorporating compulsory national emergency laparotomy audit (NELA) has been collecting and reporting data for almost 7 years. Recent data emulating from the Australian and New Zealand Laparotomy audit quality improvement working group describe outcomes in 24 Australian Hospitals reporting mortality rates between 2.3% and 13% with an average stay of over 2 weeks. They also report up to five fold variations in delivery of standards of care and differences between high and low performing hospitals. Specifically in their studies 40% of patients did not reach the operating theatre in expected guidelines, there were shortfalls in reporting imaging, critical care admissions and review in terms of elderly patients by Geriatric teams and up to 60% of patients needed later unplanned ICU care. This recent Australian study included only 25% of hospitals; however, in the UK the audits are compulsory and funded nationally.

The UK has seen a fall in mortality of 20% in patients undergoing an emergency laparotomy, equating to some 600 fewer deaths within 30 days of surgery per year. NELA reports a reduction in hospital stay of around 90,000 bed days annually. NELA has initiated quality improvement and research programmes at a hospital and national level having studied over 150,000 patients. The reduction in length of stay has been estimated to have saved almost £40 million in return for what is a small modest investment.

This eSOAP report section on Laparotomy includes 140 patients over a three year period showing the significant workload which occurs outside normal working hours, and consistently throughout the week. Patients undergoing Laparotomy are predominately an elderly population with median ages of 71 years in the female group and 61 in the male with 40% arriving by Ambulance. Almost a sixth enter the system as inpatient transfers from other disciplines. Patient length of stay exerts a significant burden on our hospital resources. This is particularly the case in laparotomy patients invariably requiring critical care, with high inflammatory markers and associated significant ASA, multiple co morbidities. It is pleasing to see the prompt referral process and rapid time in which patients were seen. The report raised question in this subgroup of patients is can we make marginal gains and this involves the time to diagnosis, diagnostic work-up and sepsis control?

This chapter on laparotomy, morbidity and outcomes lacks data on defined complications, and mortality data because of challenges in its collection and resistance at difference levels to incorporate morbidity and mortality meeting data into electronic and digital reporting system. A change in ethos and governance from a national strategy is required to ensure like our counterparts in the UK and Australia and increasingly in Europe there is compulsory reporting of laparotomy outcomes. This will ensure the collection of robust data allowing us to improve outcomes for this group of patients who have 20% mortality at one year and 30% mortality at 2 years; outcomes equating to the worst potential cancer outcomes that we see in other areas of medicine. It is time for us to change and embrace reporting and analysis of data.

Recommendations

1 National compulsory reporting of outcomes and data from patient undergoing EGS laparotomy

2 Development of EGS Response Team similar to the Trauma Team approach in patients with physical injury

3 Incorporation of outcome indicators and their reporting

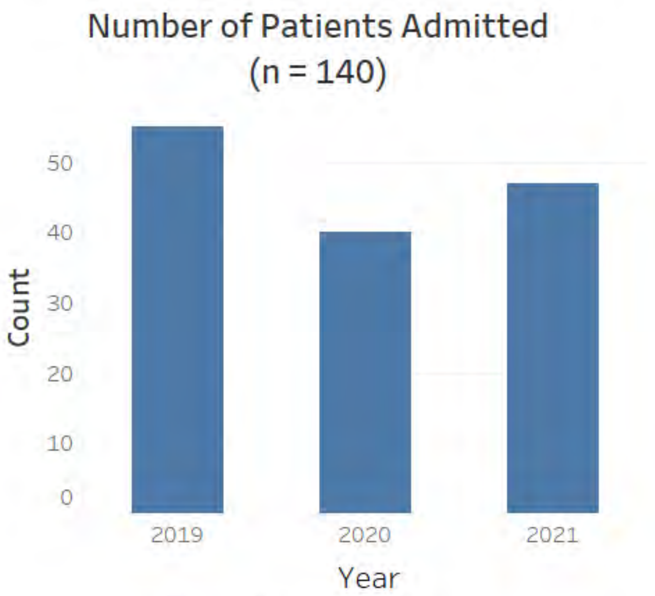
4 Utilization of digital decision pathways, with incorporation of machine learning and AI. Digital file recording of surgery.

5 Compulsory reporting of complications to include 30 day follow-up

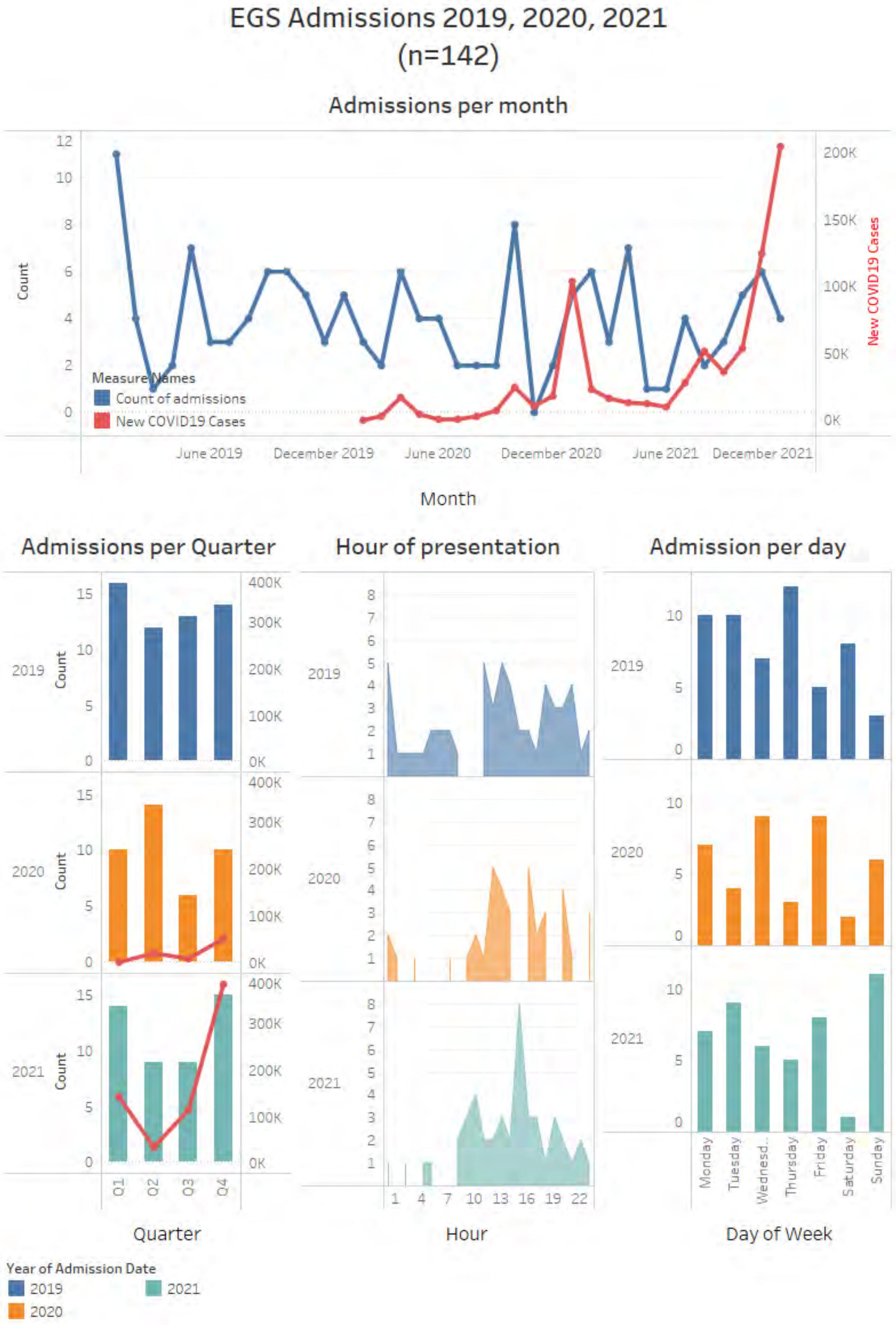
6 Reporting of Patients related outcome measures for patients undergoing laparotomy

7 Establishment of National Task Force on EGS to formulate national policies on EGS laparotomy

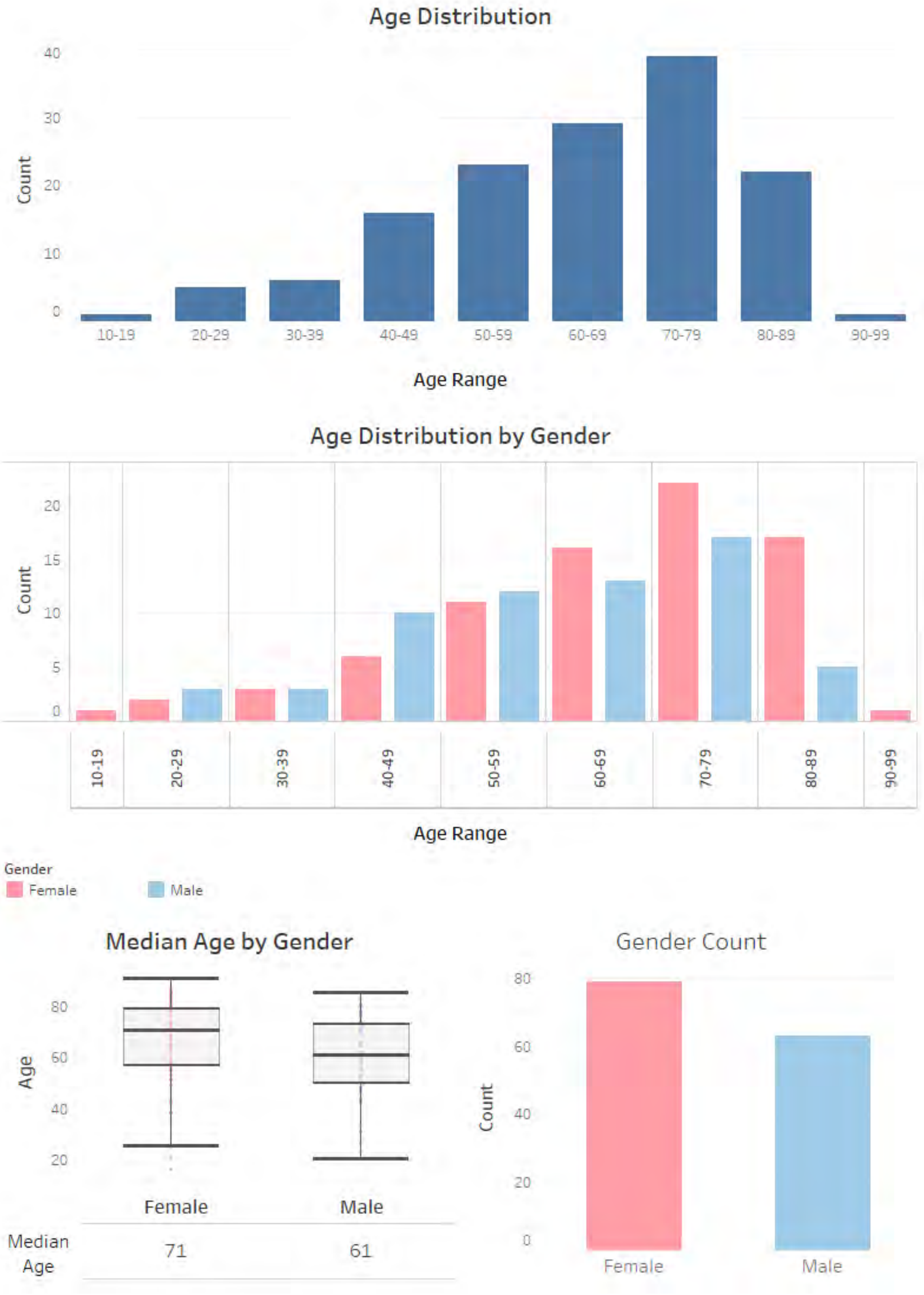
8 Integration with existing leaders such RCSI and ESTES to advice policy makers about implementation plans


Number of Patients Admitted
(n = 140)


Registered ED time


EGS Admissions 2019, 2020, 2021
(n=142)
Admissions per month
Count
12
10
8
6
4
2
0
200K
150K
100K
50K
0K
New COVID19 Cases
Measure Names
Count of admissions
New COVID19 Cases
June 2019
December 2019
June 2020
December 2020
June 2021
December 2021
Month
Admissions per Quarter
Hour of presentation
Admission per day
2019
2020
2021
Count
15
10
5
0
400K
300K
200K
100K
0K
Q1
Q2
Q3
Q4
Quarter
8
7
6
5
4
3
2
1
1
4
7
10
13
16
19
22
Hour
Monday
Tuesday
Wednesd..
Thursday
Friday
Saturday
Sunday
Day of Week
Year of Admission Date
2019
2020
2021

Age Distribution of EGS Admissions 2019, 2020, 2021 (n=142)



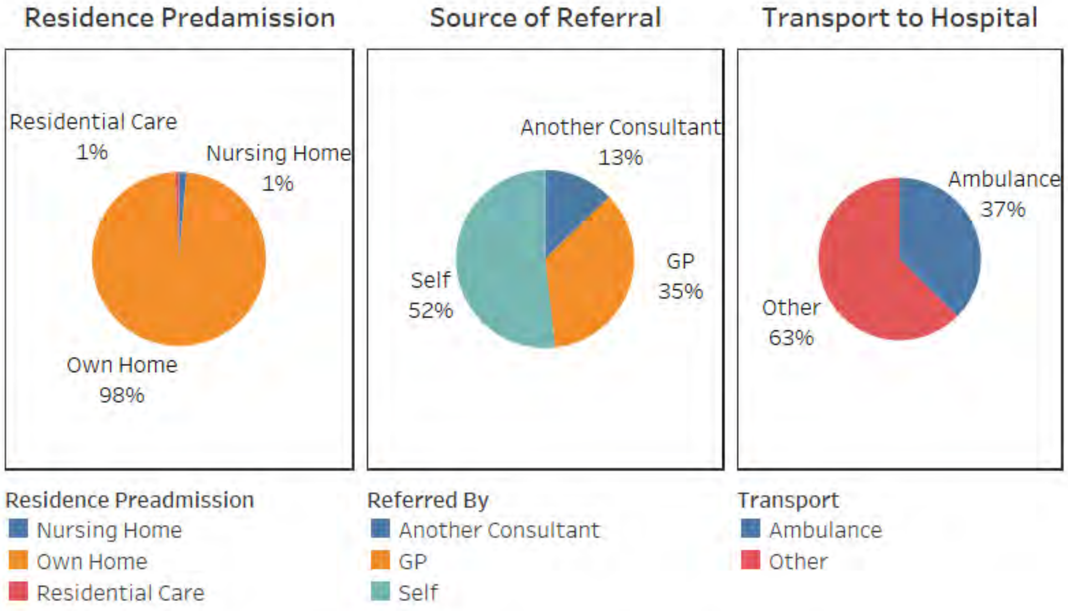
Age Distribution

Age Distribution by Gender

Median Age by Gender

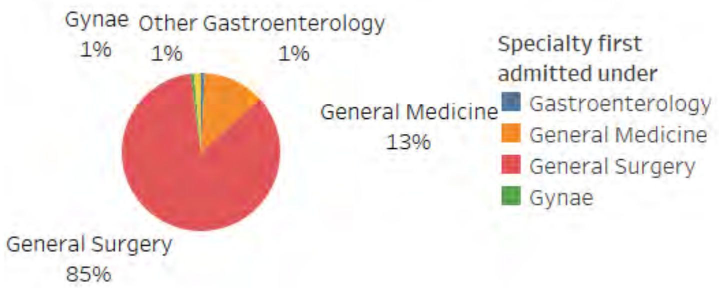
Gender Count

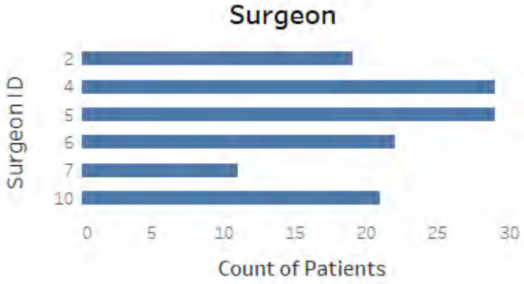
Patient Journey in 2019, 2020, 2021
(n=142)



Specialty & Surgeon 2019, 2020, 2021
(n=142)

Speciality Admitted Under

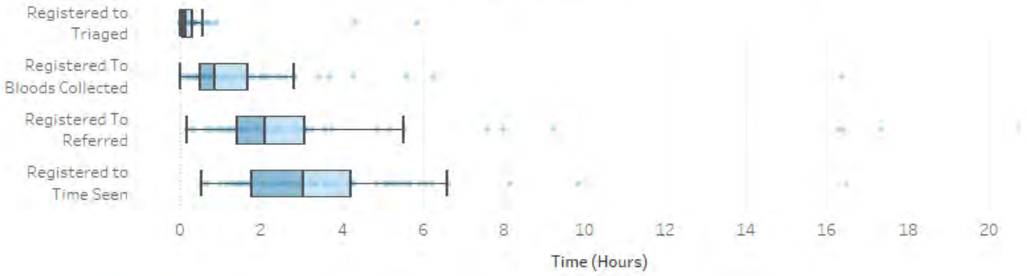




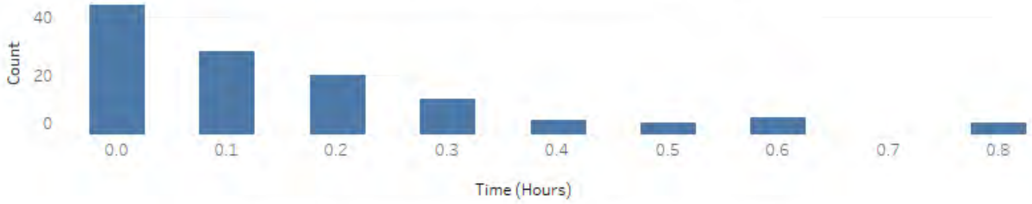
Surgeon by year

Consultant Surgeon	2019	2020	2021	Grand Total
2	9	4	6	19
4	15	7	7	29
5	12	10	7	29
6	8	7	7	22
7	11			11
10		12	9	21

Emergency Department Times 2019, 2020, 2021
(n=92)



Registered to Triage (Median = 0.15 hrs)

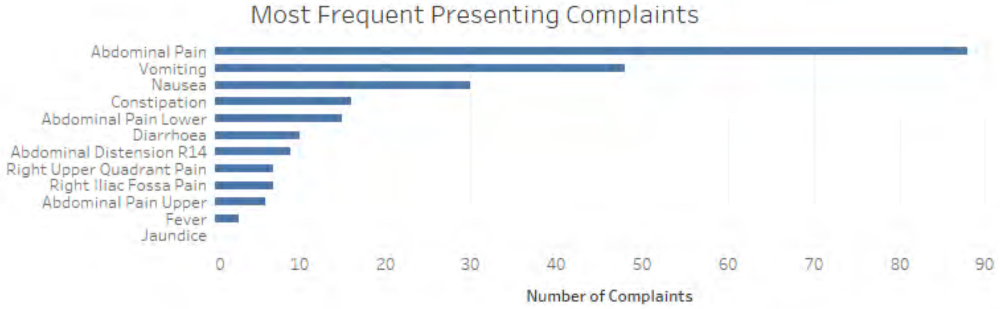


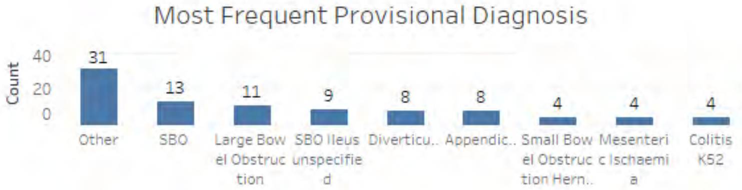
Triage to Bloods Collected (Median = 0.67 hrs)

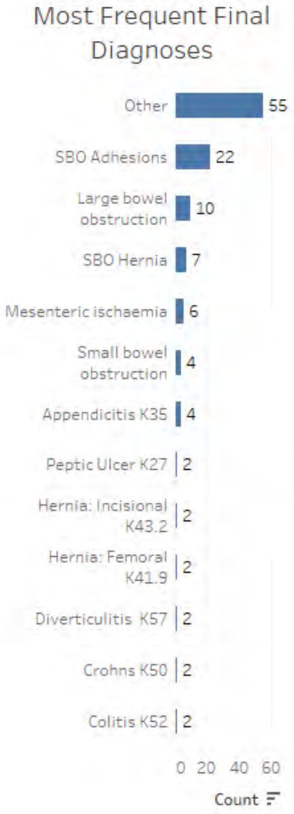
Bloods Collected to Time Referred (Median = 1.17 hrs)

Time Referred to Time Seen (Median = 0.88 hrs)

Presenting Complaints & Diagnoses 2019, 2020, 2021
(n=142)



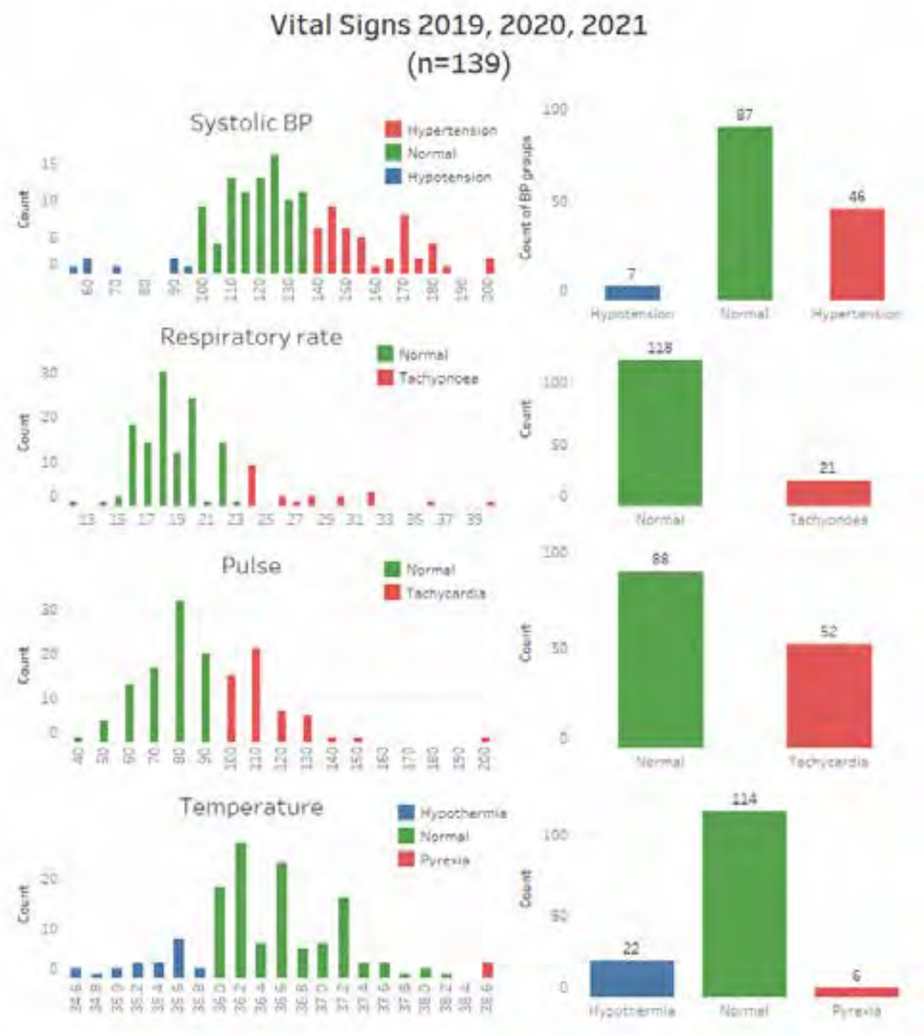


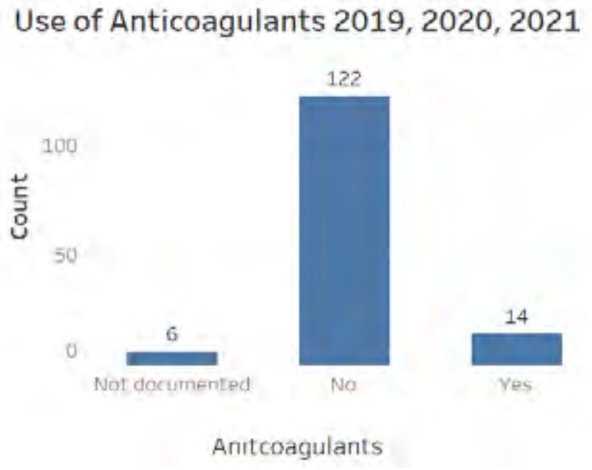


Provisional Diagnosis

Final Diagnosis	Other	Small Bowel Obstruction	SBO Ileus Unspecified	Large Bowel Obstruction	Appendicitis	Diverticulitis	Mesenteric Adenitis	Colitis
Other	21	6	1	4	5	7	0	2
SBO Adhesions	3	1	6	0	0	0	1	0
Large bowel obstruction	3	0	1	4	0	0	0	0
SBO Hernia	0	1	0	0	0	0	0	0
Mesenteric ischaemia	3	2	0	0	0	0	1	0
Small bowel obstruction	1	2	0	0	0	0	0	0
Appendicitis K35	1	0	0	0	2	0	0	0
Peptic Ulcer K27	0	0	0	0	0	1	1	0
Hernia: Incisional K43.2	1	0	0	0	1	0	0	0
Hernia: Femoral K41.9	2	0	0	0	0	0	0	0
Diverticulitis K57	1	0	0	1	0	1	0	0
Crohns K50	1	0	0	0	0	0	0	0
Colitis K52	0	0	0	0	0	0	0	2

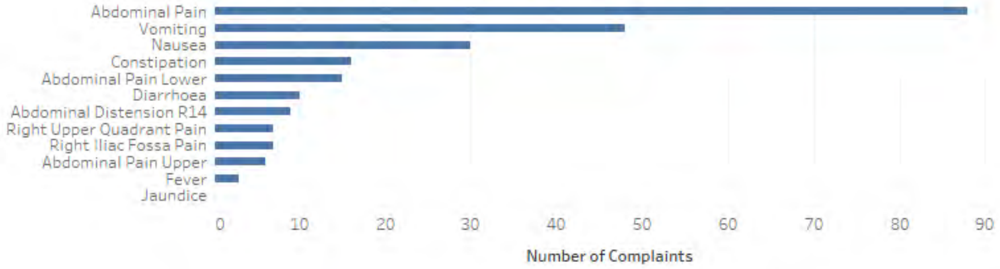
*Values in confusion table do not sum to adjacent histograms as they only show the most frequent provisional and final diagnoses


Vital Signs 2019, 2020, 2021
(n=139)
Systolic BP
Hypertension
Normal
Hypotension
Count
15
10
5
0
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Count of BP groups
100
50
0
7
87
46
Hypotension
Normal
Hypertension
Respiratory rate
Normal
Tachyponoea
30
20
10
0
13
15
17
19
21
23
25
27
29
31
33
35
37
39
118
21
Normal
Tachyponoea
Pulse
Normal
Tachycardia
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
88
52
Normal
Tachycardia
Temperature
Hypothermia
Normal
Pyrexia
20
10
0
22
114
6
Hypothermia
Normal
Pyrexia


Use of Anticoagulants 2019, 2020, 2021
Count
100
50
0
6
122
14
Not documented
No
Yes
Anitcoagulants

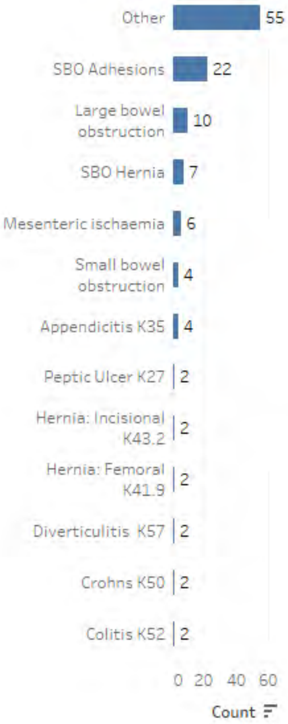
Presenting Complaints & Diagnoses 2019, 2020, 2021
(n=142)

Most Frequent Presenting Complaints



Most Frequent Provisional Diagnosis

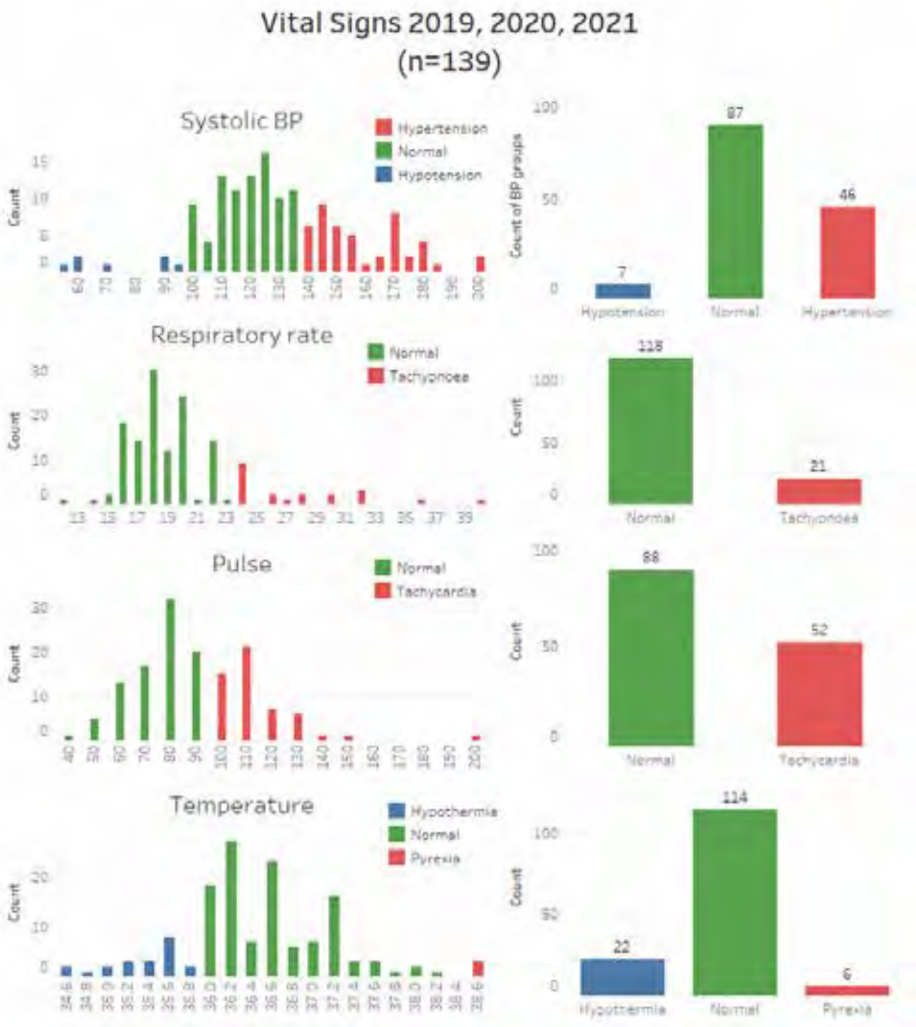
Most Frequent Final Diagnoses



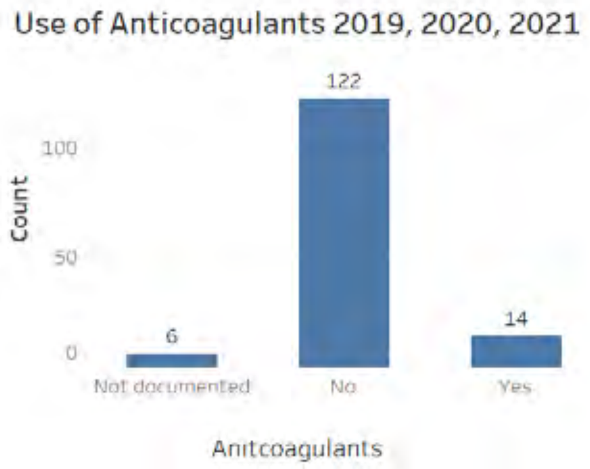
Provisional Diagnosis

Final Diagnosis	Other	Small Bowel Obstruction	SBO Ileus Unspecified	Large Bowel Obstruction	Appendicitis	Diverticulitis	Mesenteric Adenitis	Colitis
Other	21	6	1	4	5	7	0	2
SBO Adhesions	3	1	6	0	0	0	1	0
Large bowel obstruction	3	0	1	4	0	0	0	0
SBO Hernia	0	1	0	0	0	0	0	0
Mesenteric ischaemia	3	2	0	0	0	0	1	0
Small bowel obstruction	1	2	0	0	0	0	0	0
Appendicitis K35	1	0	0	0	2	0	0	0
Peptic Ulcer K27	0	0	0	0	0	1	1	0
Hernia: Incisional K43.2	1	0	0	0	1	0	0	0
Hernia: Femoral K41.9	2	0	0	0	0	0	0	0
Diverticulitis K57	1	0	0	1	0	1	0	0
Crohns K50	1	0	0	0	0	0	0	0
Colitis K52	0	0	0	0	0	0	0	2

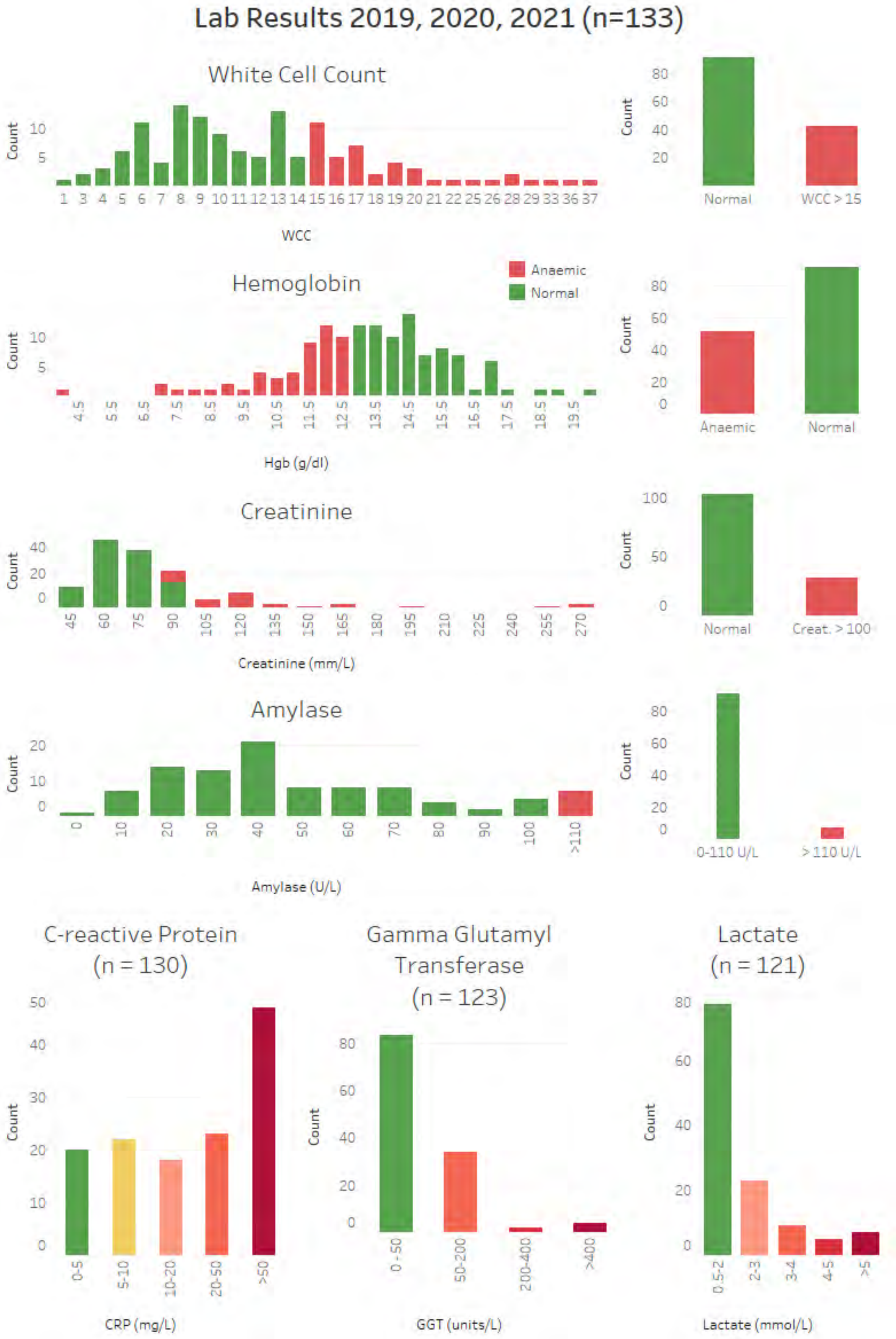
*Values in confusion table do not sum to adjacent histograms as they only show the most frequent provisional and final diagnoses



Vital Signs 2019, 2020, 2021 (n=139)



Use of Anticoagulants 2019, 2020, 2021



Lab Results 2019, 2020, 2021 (n=133)

White Cell Count

Hemoglobin

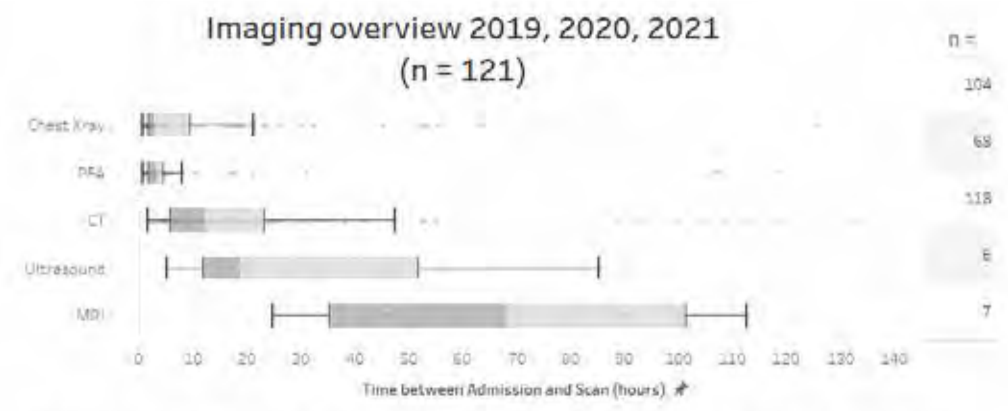
Creatinine

Amylase

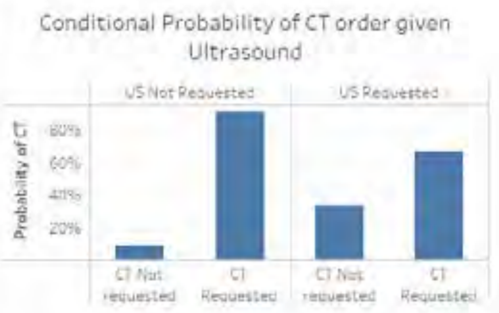
C-reactive Protein (n = 130)

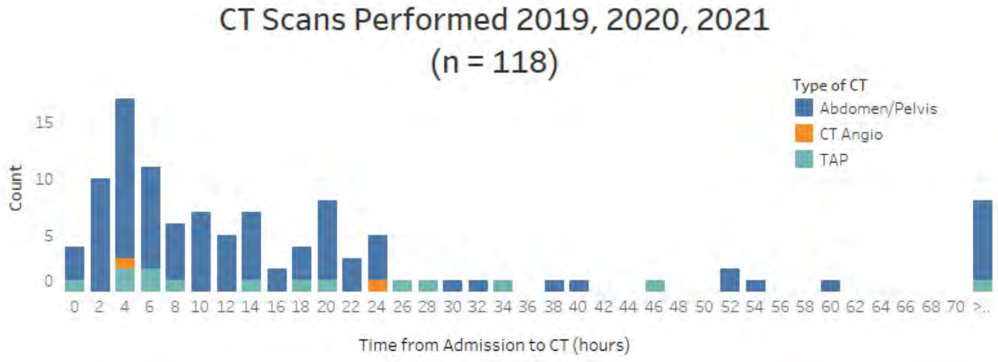
Gamma Glutamyl Transferase (n = 123)

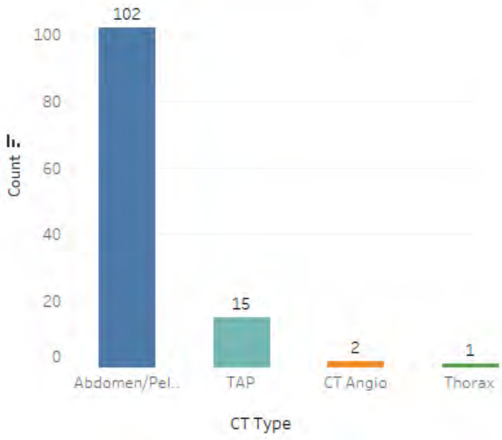
Lactate (n = 121)

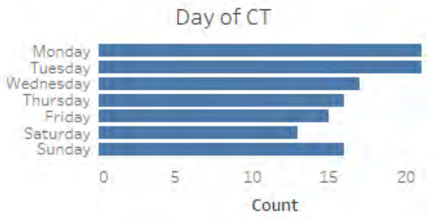

Imaging overview 2019, 2020, 2021
(n = 121)
n =
Chest Xray
PFA
CT
Ultrasound
MRI
104
68
118
6
7
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Time between Admission and Scan (hours)

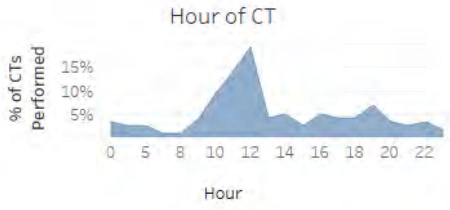

Conditional probability of CT order given PFA
PFA Not Requested
PFA Requested
Probability of CT
100%
50%
0%
CT Not requested
CT Requested
CT Not requested
CT Requested


Conditional Probability of CT order given Ultrasound
US Not Requested
US Requested
Probability of CT
80%
60%
40%
20%
CT Not requested
CT Requested
CT Not requested
CT Requested

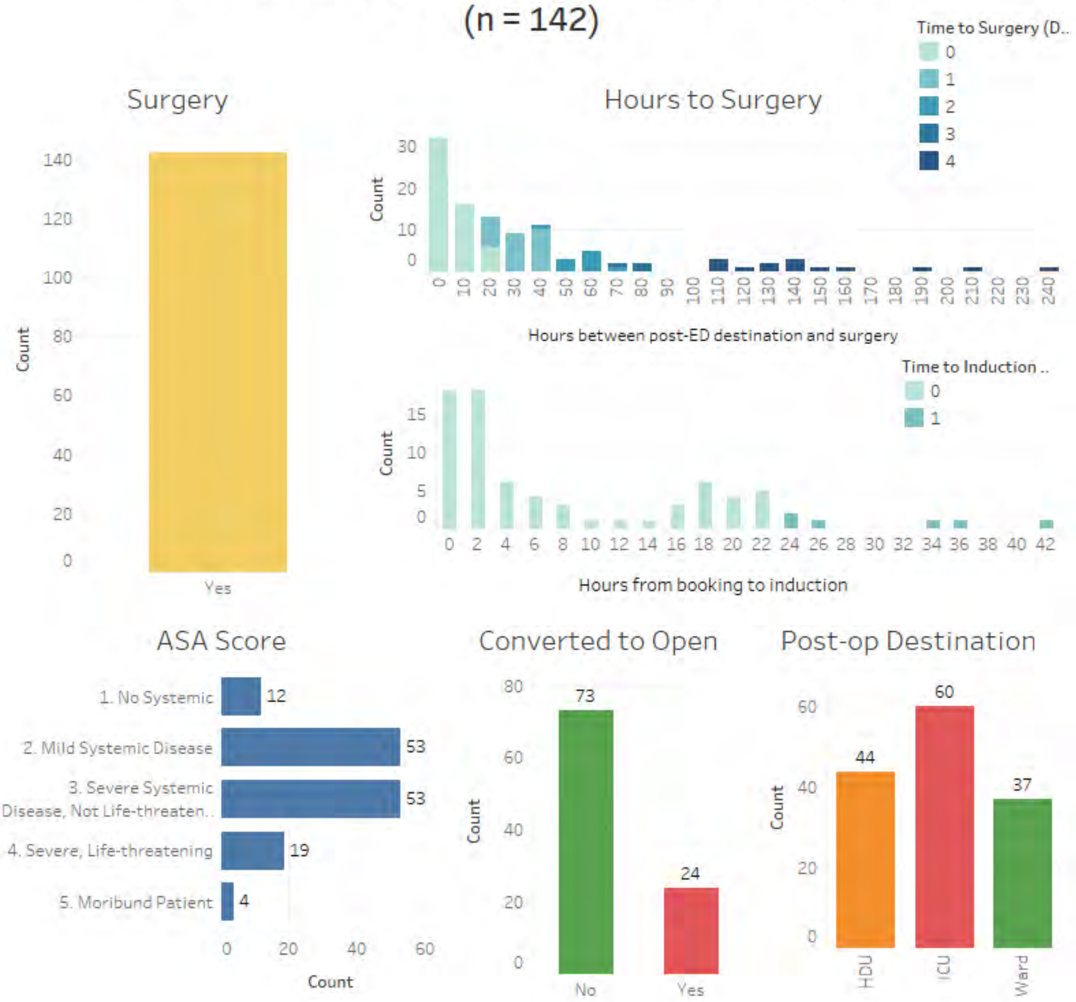

CT Scans Performed 2019, 2020, 2021
(n = 118)
Type of CT
Abdomen/Pelvis
CT Angio
TAP
Count
15
10
5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 >..
Time from Admission to CT (hours)

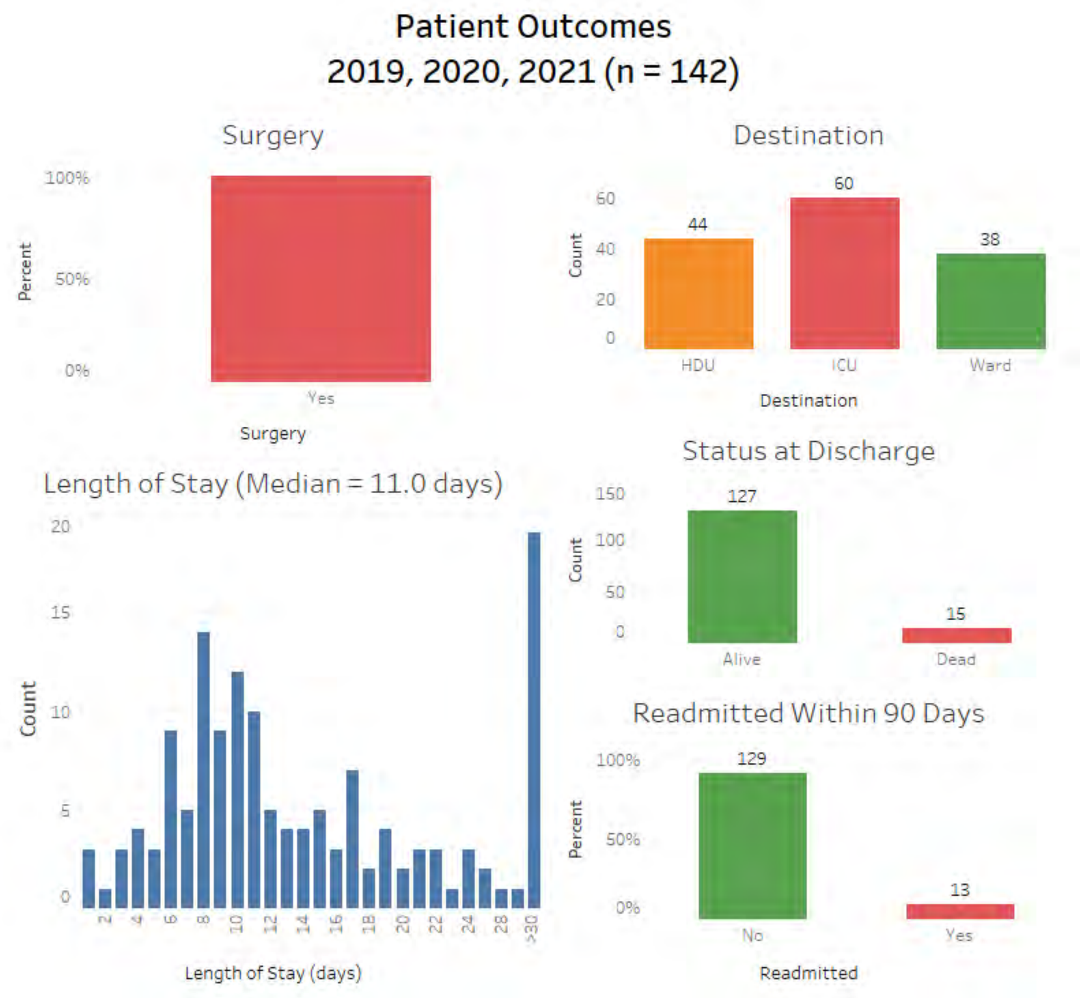

Count
100
80
60
40
20
0
102
15
2
1
Abdomen/Pel..
TAP
CT Angio
Thorax
CT Type


Day of CT
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
5
10
15
20
Count

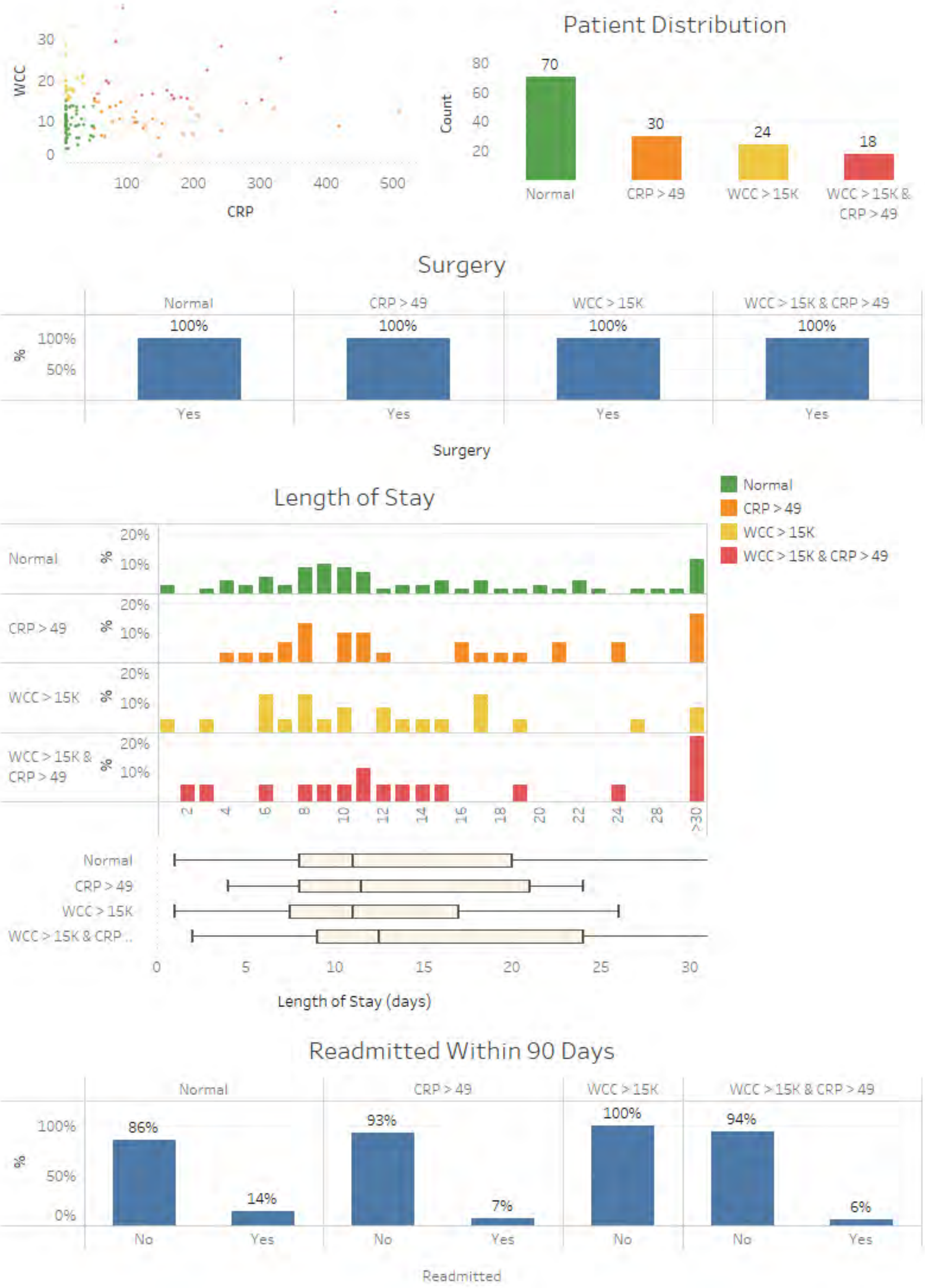

Hour of CT
% of CTs Performed
15%
10%
5%
0 5 8 10 12 14 16 18 20 22
Hour

Patient undergoing surgery 2019, 2020, 2021 (n = 142)




Patient Outcomes
2019, 2020, 2021 (n = 142)
Surgery
Percent
100%
50%
0%
Yes
Surgery
Destination
Count
60
40
20
0
44
60
38
HDU
ICU
Ward
Destination
Length of Stay (Median = 11.0 days)
Count
20
15
10
5
0
2
4
6
8
10
12
14
16
18
20
22
24
28
>30
Length of Stay (days)
Status at Discharge
Count
150
100
50
0
127
15
Alive
Dead
Readmitted Within 90 Days
Percent
100%
50%
0%
129
13
No
Yes
Readmitted

Patient Outcomes by Lab Results 2019, 2020, 2021 (n = 142)



Meta-analysis of the impact of postoperative infective complications on oncological outcomes in colorectal cancer surgery

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Background: **Cancer outcomes are complex, involving prevention, early detection and optimal multidisciplinary care. Postoperative infection and surgical site-infection (SSI) are not only uncomfortable for patients and costly, but may also be associated with poor oncological outcomes. A meta-analysis was undertaken to assess the oncological effects of SSI in patients with colorectal cancer.**

Methods: **An ethically approved PROSPERO-registered meta-analysis was conducted following PRISMA guidelines. PubMed and Scopus databases were searched for studies published between 2007 and 2017 reporting the effects of postoperative infective complications on oncological survival in colorectal cancer. Results were separated into those for SSI and those concerning anastomotic leakage. Articles with a Methodological Index for Non-Randomized Studies score of at least 18 were included. Hazard ratios (HRs) with 95 per cent confidence intervals were computed for risk factors using an observed to expected and variance fixed-effect model.**

Results: **Of 5027 articles were reviewed, 43 met the inclusion criteria, with a total of 154 981 patients. Infective complications had significant negative effects on overall survival (HR 1·37, 95 per cent c.i. 1·28 to 1·46) and cancer-specific survival (HR 2·58, 2·15 to 3·10). Anastomotic leakage occurred in 7·4 per cent and had a significant negative impact on disease-free survival (HR 1·14, 1·09 to 1·20), overall survival (HR 1·34, 1·28 to 1·39), cancer-specific survival (HR 1·43, 1·31 to 1·55), local recurrence (HR 1·18, 1·06 to 1·32) and overall recurrence (HR 1·46, 1·27 to 1·68).**

Conclusion: **This meta-analysis identified a significant negative impact of postoperative infective complications on overall and cancer-specific survival in patients undergoing colorectal surgery.**

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Introduction

Colorectal cancer affects 17 people per 100 000 worldwide and 30 per 100 000 in Europe[1], with an average 5-year survival rate of 65 per cent[2]. Optimizing cancer outcomes is a complex interaction involving key strategies: prevention, early detection and optimal management[3]. Many treatment paradigm shifts in both surgical and oncological treatment have improved cancer outcomes. Recurrence, which affects over 40 per cent of patients, has classically been associated with tumour stage, grade, emergency presentation and resection margin status[4,5].

Surgical-site infections (SSIs), including superficial, deep and organ space infections, are coming increasingly under the spotlight, causing discomfort for patients and family, anxiety for surgeons, and cost to healthcare systems[6]. In addition, they are associated with potential delay in, or omission of, adjuvant therapy.

A recent long-term analysis from the German Rectal Cancer Trial[7] suggested that surgical complications were associated with both oncological and overall outcomes. Immunological forces influence survival[8]. As SSI occurs in approximately 15 per cent of patients undergoing

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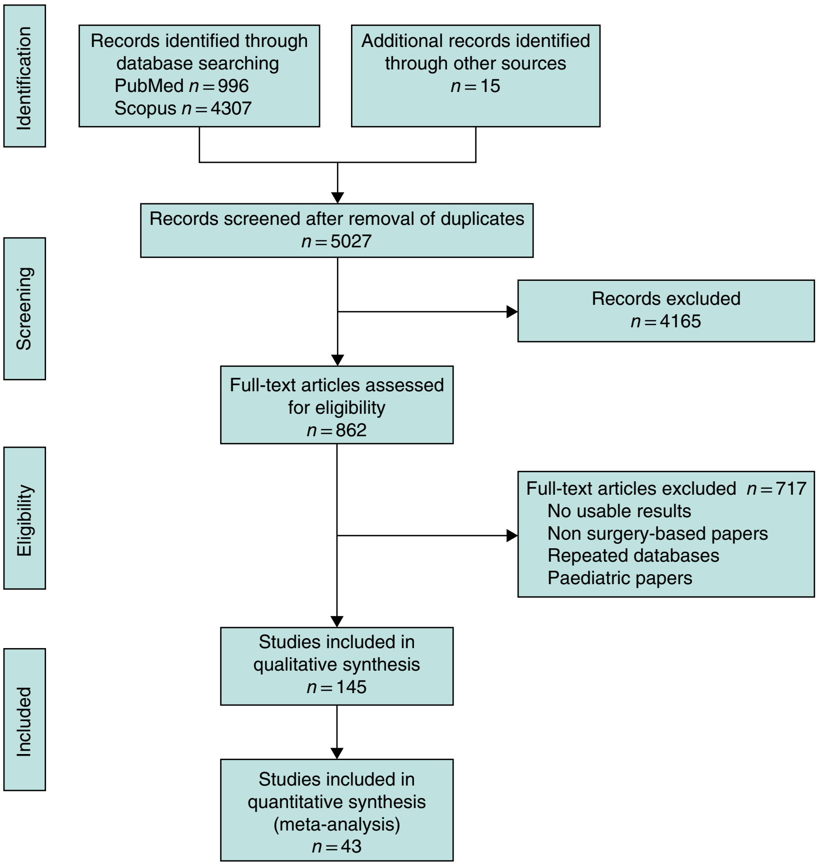
Fig. 1 **PRISMA flow chart showing selection of articles for review**



colorectal surgery, a clear understanding of any adverse relationship is important[9].

Although surgeons and patients alike fear the morbidity and mortality associated with postoperative complications, their potential negative impact on oncological outcomes is not widely understood or reported routinely[10,11]. A meta-analysis was undertaken to determine the impact of postoperative infections on oncological outcomes in colorectal cancer surgery.

Methods

A study was conducted to assess the impact of postoperative infective complications on oncological outcomes in colorectal cancer surgery. The study was registered with PROSPERO (registration number: 42017069038) and followed PRISMA guidelines[12]. PubMed and Scopus were searched for studies that met the eligibility criteria. Original articles, published between June 2007 and May 2017, which reported the effect of infective complications on oncological survival in both colonic and rectal cancer were identified. The search strategy used the following keywords: Colon Cancer, Colorectal Cancer, Rectal Cancer, Complication, Infection, Oncological Outcomes, Anastomotic Leak, Survival and SSI. Animal studies, review articles, non-English papers, duplicate data sets and results published only in abstracts were excluded. Details of the search strategy and data management are available in *Tables S1* and *S2* (supporting information).

Data extraction and quality assessment

The abstracts were screened by one author and full texts by three authors. The descriptive and quantitative data from the screened studies were extracted and papers were graded using the Methodological Index for Non-Randomized Studies (MINORS)[13]. The MINORS criteria have been designed to assess the quality of comparative and

Table 1 Study characteristics

Reference	Country	Study design	Multicentre database study	No. of patients	Anastomotic leak
Bertelsen *et al.*[17]	Denmark	Prospective	Yes	1494	163 (10·9)
Cone *et al.*[18]	USA	Prospective	Yes	24 730	
Espín *et al.*[19]	Spain	Prospective	Yes	1181	100 (8·5)
Jörgren *et al.*[20]	Sweden	Prospective	Yes	1977	172 (8·7)
Krarup *et al.*[21]	Denmark	Prospective	Yes	9333	593 (6·4)
Kube *et al.*[22]	Germany	Prospective	Yes	28 271	844 (3·0)
Aquina *et al.*[23]	USA	Retrospective	Yes	24 426	
Artinyan *et al.*[24]	USA	Retrospective	Yes	12 075	
Chu *et al.*[25]	USA	Retrospective	Yes	528	
Nordholm-Carstensen *et al.*[26]	Denmark	Retrospective	Yes	774	71 (9·2)
Boccola *et al.*[27]	Australia	Prospective	No	1576	110 (7·0)
Duron *et al.*[28]	France	Prospective	No	3322	
Eberhardt *et al.*[29]	USA	Prospective	No	177	59 (33·3)
Gong *et al.*[30]	China	Prospective	No	460	35 (7·6)
Gupta *et al.*[31]	Nepal	Prospective	No	272	18 (6·6)
Jannasch *et al.*[32]	Germany	Prospective	No	17 867	2134 (11·9)
Law *et al.*[33]	China	Prospective	No	1657	47 (2·8)
Law *et al.*[34]	China	Prospective	No	1580	60 (3·8)
Platt *et al.*[35]	UK	Prospective	No	454	
Ptok *et al.*[36]	Germany	Prospective	No	2044	303 (14·8)
Richards *et al.*[37]	UK	Prospective	No	423	18 (4·3)
Smith *et al.*[38]	USA	Prospective	No	1127	40 (3·5)
Smith *et al.*[39]	USA	Prospective	No	184	12 (6·5)
Thorgersen *et al.*[40]	Norway	Prospective	No	540	
Attiê *et al.*[41]	Brazil	Retrospective	No	106	
Ebinger *et al.*[42]	Switzerland	Retrospective	No	584	64 (11·0)
Goto *et al.*[43]	Japan	Retrospective	No	3364	85 (2·5)
Haruki *et al.*[44]	Japan	Retrospective	No	77	
Huang *et al.*[45]	China	Retrospective	No	215	
Jung *et al.*[46]	Korea	Retrospective	No	1391	35 (2·5)
Kang *et al.*[47]	Korea	Retrospective	No	1083	69 (6·4)
Katoh *et al.*[48]	Japan	Retrospective	No	1101	
Kerin Povšič *et al.*[49]	Slovenia	Retrospective	No	186	
Kulu *et al.*[50]	Germany	Retrospective	No	570	51 (8·9)
Lee *et al.*[51]	Korea	Retrospective	No	1278	51 (4·0)
Lim *et al.*[52]	Korea	Retrospective	No	2510	141 (5·6)
Marra *et al.*[53]	Switzerland	Retrospective	No	445	12 (2·7)
McMillan *et al.*[54]	UK	Retrospective	No	920	24 (2·6)
Miccini *et al.*[55]	Italy	Retrospective	No	479	34 (7·1)
Mrak *et al.*[56]	Austria	Retrospective	No	811	54 (6·7)
Nachiappan *et al.*[57]	UK	Retrospective	No	1048	99 (9·4)
Noh *et al.*[58]	Korea	Retrospective	No	1258	101 (8·0)
Tsujimoto *et al.*[59]	Japan	Retrospective	No	1083	29 (2·7)
Total				154 981	7·4 (2·5–33·3)%*

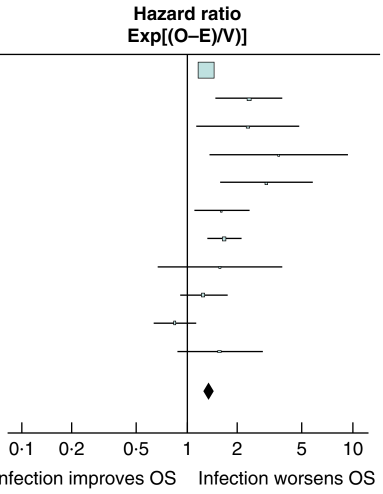
Values in parentheses are percentages unless indicated otherwise; *values are mean (range).

Fig. 2 Impact of surgical-site infection on overall survival

Reference	Infection Yes	Infection No	O–E	V	Weight (%)	Hazard ratio Exp[(O–E)/V)]
Artinyan *et al.*[24]	2714	9361	162·010	599·976	71·4	1·31 (1·21, 1·42)
Cone *et al.*[18]	206	24 524	16·503	18·851	2·2	2·40 (1·53, 3·77)
Duron *et al.*[28]	562	2546	6·824	7·947	0·9	2·36 (1·18, 4·73)
Haruki *et al.*[44]	10	67	5·401	4·203	0·5	3·61 (1·39, 9·40)
Huang *et al.*[45]	33	182	10·557	9·513	1·1	3·03 (1·61, 5·73)
Kerin Povšič *et al.*[49]	55	131	12·626	25·843	3·1	1·63 (1·11, 2·40)
Law *et al.*[33]	110	1547	39·948	76·131	9·1	1·69 (1·35, 2·12)
Platt *et al.*[35]	104	334	2·400	5·222	0·6	1·58 (0·67, 3·73)
Richards *et al.*[37]	105	318	8·452	36·573	4·4	1·26 (0·91, 1·74)
Thorgersen *et al.*[40]	104	436	–7·293	44·877	5·3	0·85 (0·63, 1·14)
Tsujimoto *et al.*[59]	65	1018	5·090	11·127	1·3	1·58 (0·88, 2·84)
Total	4068	40 464			100·0	1·37 (1·28, 1·46)

Heterogeneity: $\chi^2 = 34·39$, 10 d.f., $P < 0·001$; $I^2 = 71$%

Test for overall effect: $Z = 9·06$, $P < 0·001$



Hazard ratios are shown with 95 per cent confidence intervals. A fixed-effect model was used for meta-analysis. O-E, observed to expected; V, variance; OS, overall survival.

non-comparative surgical studies using a three-point scale (0, not reported; 1, reported but inadequate; 2, reported and adequate), with assessment of eight items for non-comparative studies and 12 items for comparative studies. The ideal global scores for comparative and non-comparative studies are 24 and 16 respectively.

Articles were graded by three reviewers initially, and only those that scored at least 18 of 24 were included in the statistical analysis. If there was disagreement on whether a paper should be included or not, another reviewer graded it and made the final decision. At the outset both rectal and colonic cancer procedures were grouped into a single category.

Results were separated into two key categories: infective complications (SSI, organ space infections, infectious complications, sepsis) and anastomotic leakage. SSI was defined according to the Centers for Disease Control and Prevention[14] definition, whereas anastomotic leak was defined as reported in each article.

Overall survival, disease-free survival, cancer-specific survival and cancer recurrence data were analysed for each outcome where data were available and applicable. Survival terms were defined in accordance with National Institutes of Health–National Cancer Institute definitions[15].

Statistical analysis

For oncological outcomes, hazard ratios (HRs) were taken from papers or calculated using the MedCalc® statistical calculator (MedCalc, Ostend, Belgium). Observed minus expected (O-E) values and variance were calculated[16], and used to compute statistical values for use in the analysis.

Statistical analysis was performed in Review Manager (RevMan) version 5 (Nordic Cochrane Centre, Cochrane Collaboration, Copenhagen, Denmark) using O-E and variance, a fixed-effect model for analysis and HR as effect measure, with 95 per cent confidence intervals. Significance was assessed at the two-sided 5 per cent level using HRs. The complication has a significant effect on the measured oncological outcome if the 95 per cent confidence interval of the HR does not include 1·00.

Results

A total of 5027 individual articles were reviewed in this study (*Fig. 1*), of which 145 were found to be relevant and underwent MINORS grading. Forty-three articles[17–59] met all inclusion criteria and were used in the data analysis, with a total cohort size of 154 981 patients (*Table 1*). Publications were from the USA (7), Korea (5), the UK (4), Japan (4), China (4), Germany (4) and other countries (15). There were 23 retrospective and 20 prospective studies in this meta-analysis. Ten studies were from multicentre databases (6 prospective, 4 retrospective).

Non-anastomotic infective complications

Sixteen papers reported SSI data that allowed meaningful analysis. Of these, 11 of 16 papers contained data on overall

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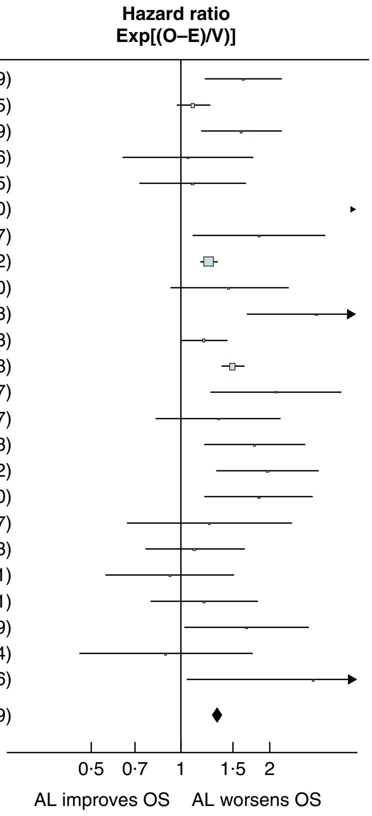
Fig. 3 Impact of anastomotic leakage on overall survival

Reference	Anastomotic leak Yes	Anastomotic leak No	O–E	V	Weight (%)	Hazard ratio Exp[(O–E)/V)]
Bertelsen *et al.*[17]	163	1331	21·323	43·657	1·8	1·63 (1·21, 2·19)
Boccola *et al.*[27]	110	1466	24·237	243·408	9·9	1·10 (0·97, 1·25)
Eberhardt *et al.*[29]	59	118	19·273	40·624	1·6	1·61 (1·18, 2·19)
Ebinger *et al.*[42]	64	520	0·875	15·016	0·6	1·06 (0·64, 1·76)
Espín *et al.*[19]	100	1053	2·202	23·107	0·9	1·10 (0·73, 1·65)
Gong *et al.*[30]	35	425	31·113	16·409	0·7	6·66 (4·11, 10·80)
Goto *et al.*[43]	85	3279	8·885	14·571	0·6	1·84 (1·10, 3·07)
Jannasch *et al.*[32]	2134	15 733	250·232	1136·49	46·1	1·25 (1·18, 1·32)
Jörgren *et al.*[20]	114	136	7·093	18·742	0·8	1·46 (0·93, 2·30)
Kang *et al.*[47]	69	1014	13·876	13·056	0·5	2·89 (1·68, 4·98)
Krarup *et al.*[21]	420	8169	22·269	122·143	5·0	1·20 (1·00, 1·43)
Kube *et al.*[22]	844	27 427	231·471	571·064	23·2	1·50 (1·38, 1·63)
Kulu *et al.*[50]	51	519	11·285	15·210	0·6	2·10 (1·27, 3·47)
Law *et al.*[33]	47	1610	4·823	16·479	0·7	1·34 (0·83, 2·17)
Lee *et al.*[51]	51	1227	14·723	25·481	1·0	1·78 (1·21, 2·63)
Lim *et al.*[52]	141	2369	16·663	24·594	1·0	1·97 (1·33, 2·92)
Marra *et al.*[53]	12	428	13·330	21·843	0·9	1·84 (1·21, 2·80)
McMillan *et al.*[54]	24	896	2·098	9·402	0·4	1·25 (0·66, 2·37)
Mrak *et al.*[56]	54	589	2·862	26·465	1·1	1·11 (0·76, 1·63)
Nachiappan *et al.*[57]	99	949	−1·294	15·523	0·6	0·92 (0·56, 1·51)
Noh *et al.*[58]	101	1157	4·090	22·485	0·9	1·20 (0·79, 1·81)
Nordholm-Carstensen *et al.*[26]	71	703	8·618	16·804	0·7	1·67 (1·04, 2·69)
Smith *et al.*[38]	40	1087	−1·003	8·607	0·3	0·89 (0·46, 1·74)
Smith *et al.*[39]	12	111	4·123	4·005	0·2	2·80 (1·05, 7·46)
Total	4900	72 316			100·0	1·34 (1·28, 1·39)

Heterogeneity: $\chi^2 = 98{\cdot}87$, 23 d.f., $P < 0{\cdot}001$; $I^2 = 77\%$

Test for overall effect: $Z = 14{\cdot}36$, $P < 0{\cdot}001$



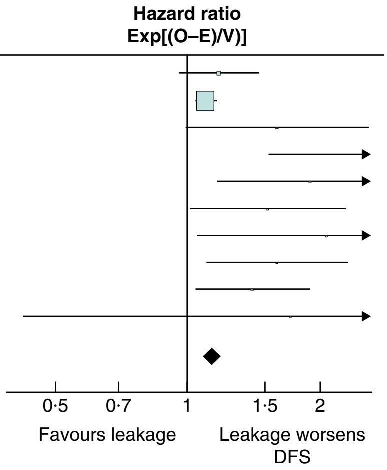
Hazard ratios are shown with 95 per cent confidence intervals. A fixed-effect model was used for meta-analysis. O-E, observed to expected; V, variance; OS, overall survival.

Fig. 4 Impact of anastomotic leakage on disease-free survival

Reference	Anastomotic leak Yes	Anastomotic leak No	O–E	V	Weight (%)	Hazard ratio Exp[(O–E)/V)]
Boccola *et al.*[27]	110	1466	14·580	89·654	5·3	1·18 (0·96, 1·45)
Jannasch *et al.*[32]	2134	15 733	138·988	1462·46	86·3	1·10 (1·04, 1·16)
Kang *et al.*[47]	69	1014	7·910	16·831	1·0	1·60 (0·99, 2·58)
Katoh *et al.*[48]	12	195	4·206	2·531	0·1	5·27 (1·54, 18·07)
Kulu *et al.*[50]	51	519	10·457	16·292	1·0	1·90 (1·17, 3·09)
Lee *et al.*[51]	51	1227	9·948	23·744	1·4	1·52 (1·02, 2·27)
Nachiappan *et al.*[57]	99	949	6·025	8·281	0·5	2·07 (1·05, 4·09)
Noh *et al.*[58]	101	1157	13·275	28·244	1·7	1·60 (1·11, 2·31)
Ptok *et al.*[36]	303	1741	14·911	43·924	2·6	1·40 (1·04, 1·89)
Smith *et al.*[38]	40	1087	1·051	1·959	0·1	1·71 (0·42, 6·94)
Total	2970	25 088			100·0	1·14 (1·09, 1·20)

Heterogeneity: $\chi^2 = 24{\cdot}49$, 9 d.f., $P = 0{\cdot}004$; $I^2 = 63\%$

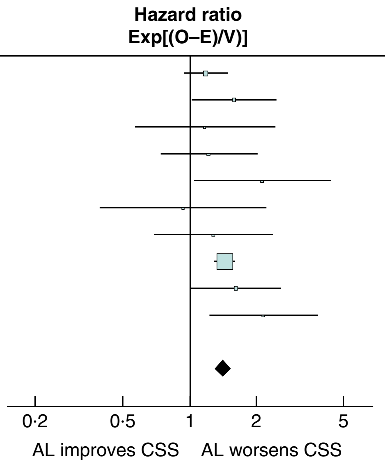
Test for overall effect: $Z = 5{\cdot}38$, $P < 0{\cdot}001$



Hazard ratios are shown with 95 per cent confidence intervals. A fixed-effect model was used for meta-analysis. O-E, observed to expected; V, variance; AL, anastomotic leak; DFS, disease-free survival.

Fig. 5 Impact of anastomotic leakage on cancer-specific survival

Reference	Anastomotic leak		O–E	V	Weight (%)	Hazard ratio Exp[(O–E)/V)]
	Yes	No				
Boccola *et al.*[27]	110	1466	13·305	74·544	14·3	1·20 (0·95, 1·50)
Eberhardt *et al.*[29]	59	118	9·626	20·482	3·9	1·60 (1·04, 2·47)
Ebinger *et al.*[42]	64	520	1·210	7·309	1·4	1·18 (0·57, 2·44)
Espín *et al.*[19]	100	1053	3·241	15·654	3·0	1·23 (0·75, 2·02)
Goto *et al.*[43]	85	3279	5·809	7·636	1·5	2·14 (1·05, 4·35)
Gupta *et al.*[31]	15	257	–0·327	5·177	1·0	0·94 (0·40, 2·22)
Jörgren *et al.*[20]	114	136	2·613	10·261	2·0	1·29 (0·70, 2·38)
Kube *et al.*[22]	844	27 427	131·145	350·035	67·2	1·45 (1·31, 1·62)
Law *et al.*[34]	60	1520	8·575	17·551	3·4	1·63 (1·02, 2·60)
McMillan *et al.*[54]	24	896	9·582	12·369	2·4	2·17 (1·24, 3·79)
Total	1475	36 672			100·0	1·43 (1·31, 1·55)

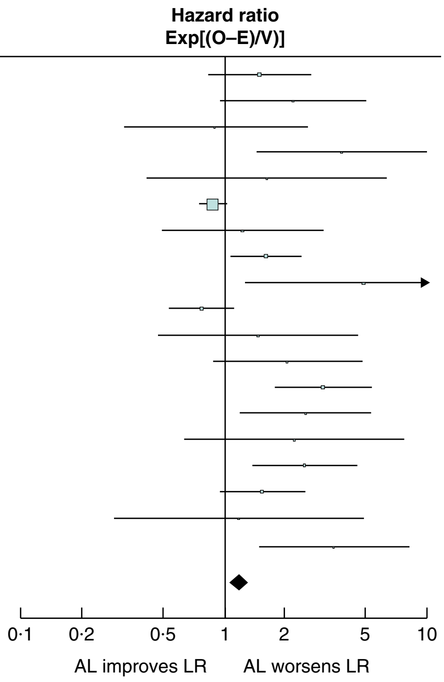


Heterogeneity: $\chi^2 = 8{\cdot}09$, 9 d.f., $P = 0{\cdot}52$; $I^2 = 0\%$
Test for overall effect: $Z = 8{\cdot}10$, $P < 0{\cdot}001$

Hazard ratios are shown with 95 per cent confidence intervals. A fixed-effect model was used for meta-analysis. O-E, observed to expected; V, variance; AL, anastomotic leak; CSS, cancer-specific survival.

Fig. 6 Impact of anastomotic leakage on local recurrence

Reference	Anastomotic leak		O–E	V	Weight (%)	Hazard ratio Exp[(O–E)/V)]
	Yes	No				
Bertelsen *et al.*[17]	163	1331	4·599	11·343	3·5	1·50 (0·84, 2·68)
Eberhardt *et al.*[29]	59	118	4·494	5·700	1·7	2·20 (0·97, 5·00)
Espín *et al.*[19]	100	1053	–0·332	3·524	1·1	0·91 (0·32, 2·59)
Goto *et al.*[43]	85	3279	5·576	4·177	1·3	3·80 (1·46, 9·91)
Gupta *et al.*[31]	15	257	1·026	2·096	0·6	1·63 (0·42, 6·32)
Jannasch *et al.*[32]	2134	15 733	–21·304	172·52	52·7	0·88 (0·76, 1·03)
Jörgren *et al.*[20]	114	136	0·996	4·632	1·4	1·24 (0·50, 3·08)
Kang *et al.*[47]	69	1014	11·977	24·991	7·6	1·61 (1·09, 2·39)
Katoh *et al.*[48]	12	195	3·395	2·136	0·7	4·90 (1·28, 18·73)
Krarup *et al.*[21]	420	8169	–7·549	30·383	9·3	0·78 (0·55, 1·11)
Kulu *et al.*[50]	51	519	1·179	3·009	0·9	1·48 (0·48, 4·58)
Law *et al.*[34]	60	1520	3·861	5·379	1·6	2·05 (0·88, 4·77)
Lim *et al.*[52]	141	2369	14·660	12·975	4·0	3·10 (1·80, 5·33)
Miccini *et al.*[55]	34	445	6·532	7·047	2·2	2·53 (1·21, 5·29)
Nachiappan *et al.*[57]	99	949	1·989	2·506	0·8	2·21 (0·64, 7·63)
Noh *et al.*[58]	101	1157	10·095	11·02	3·4	2·50 (1·38, 4·51)
Ptok *et al.*[36]	303	1741	7·185	16·768	5·1	1·53 (0·95, 2·48)
Smith *et al.*[38]	40	1087	0·333	1·914	0·6	1·19 (0·29, 4·91)
Tsujimoto *et al.*[59]	29	1018	6·646	5·330	1·6	3·48 (1·49, 8·13)
Total	4029	42 090			100·0	1·18 (1·06, 1·32)



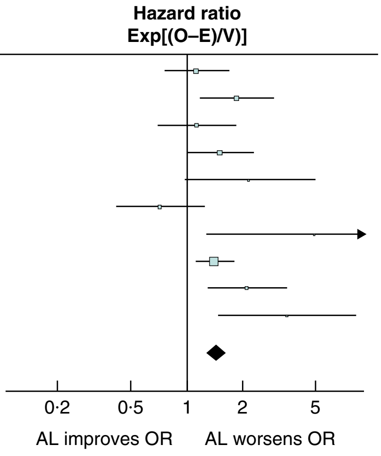
Heterogeneity: $\chi^2 = 67{\cdot}99$, 18 d.f., $P < 0{\cdot}001$; $I^2 = 74\%$
Test for overall effect: $Z = 3{\cdot}06$, $P = 0{\cdot}002$

Hazard ratios are shown with 95 per cent confidence intervals. A fixed-effect model was used for meta-analysis. O-E, observed to expected; V, variance; AL, anastomotic leak; LR, local recurrence.

Fig. 7 Impact of anastomotic leakage on overall recurrence

	Anastomotic leak					
Reference	**Yes**	**No**	**O–E**	**V**	**Weight (%)**	**Hazard ratio Exp[(O–E)/V)]**
Bertelsen *et al.*[17]	163	1331	2·941	24·060	12·1	1·13 (0·76, 1·69)
Eberhardt *et al.*[29]	59	118	11·647	18·661	9·4	1·87 (1·19, 2·94)
Espín *et al.*[19]	100	1053	2·132	16·269	8·2	1·14 (0·70, 1·85)
Goto *et al.*[43]	85	3279	9·207	21·892	11·0	1·52 (1·00, 2·32)
Jung *et al.*[46]	35	1356	4·620	5·963	3·0	2·17 (0·97, 4·84)
Jörgren *et al.*[20]	114	136	–4·307	13·111	6·6	0·72 (0·42, 1·24)
Katoh *et al.*[48]	12	195	3·395	2·136	1·1	4·90 (1·28, 18·73)
Krarup *et al.*[21]	420	8169	26·097	74·422	37·4	1·42 (1·13, 1·78)
Law *et al.*[33]	47	1610	12·817	17·166	8·6	2·11 (1·31, 3·39)
Tsujimoto *et al.*[59]	29	1018	6·646	5·330	2·7	3·48 (1·49, 8·13)
Total	1064	18 265			100·0	1·46 (1·27, 1·68)

Heterogeneity: $\chi^2 = 20{\cdot}77$, 9 d.f., $P = 0{\cdot}01$; $I^2 = 57\%$
Test for overall effect: $Z = 5{\cdot}33$, $P < 0{\cdot}001$



Hazard ratios are shown with 95 per cent confidence intervals. A fixed-effect model was used for meta-analysis. O-E, observed to expected; V, variance; AL, anastomotic leak.

survival. Three[37,40,44] of 11 articles reported disease-free survival and two[23,41] of 11 articles cancer-specific survival. Infective complications were shown to have a significant negative effect on overall survival (HR 1·37, 95 per cent c.i. 1·28 to 1·46) (*Fig. 2*) and cancer-specific survival (HR 2·58, 2·15 to 3·10). However, there was no significant association between infective complications and disease-free survival (HR 0·89, 0·74 to 1·08).

Anastomotic leakage

Anastomotic leakage data were suitable for analysis in 31 publications. The mean leak rate was 7·4 (range 2·5–33·3) per cent (*Table 1*). The effect of anastomotic leakage on overall survival could be assessed in 24 articles, and its effect on disease-free survival in ten of 31 studies. Cancer-specific survival was reported in ten of 31 articles. Nineteen of the 31 articles reported on local recurrence and ten on overall recurrence.

Anastomotic leakage had a negative impact on overall survival (HR 1·34, 95 per cent c.i. 1·28 to 1·39) (*Fig. 3*), disease-free survival (HR 1·14, 1·09 to 1·20) (*Fig. 4*), cancer-specific survival (HR 1·43, 1·31 to 1·55) (*Fig. 5*), local recurrence (HR 1·18, 1·06 to 1·32) (*Fig. 6*) and overall recurrence (HR 1·46, 1·27 to 1·68) (*Fig. 7*).

Discussion

This meta-analysis of 154 981 patients in 43 studies evaluated the impact of both wound-related non-anastomotic infective complications and anastomotic leakage, and identified a statistically significant negative oncological effect.

From the outset of this extensive literature review there were a number of limitations. In the overall cohort, narrowed by the quality of data and MINORS analysis, there was significant heterogeneity. SSI definitions are problematic, with variation from study to study. This is unfortunately common in all forms of surgery. In a 20-year period up to 2015, only 18 per cent of the top 50 cited peer-reviewed publications on ventral hernia were found to use a standardized definition of SSI and surgical-site occurrence after ventral hernia repair[60,61]. The absence of a common language impedes comparisons in the literature and accurate metrics of hospital quality measures[60]. In addition, the period of surveillance used to report SSI varies between 30 and 60 days[42,60]. Anastomotic leak itself has a heterogeneous spectrum of presentation, depending on the effort made to detect leakage and the criteria used, whether based on combined clinical, radiological or endoscopic features. This may give rise to heterogeneity representing a potential limitation of this meta-analysis. Few articles, in general, addressed the effect of SSI on oncological outcomes; some evaluated overall survival, a few reported disease-free survival and none considered the recurrence rate. Furthermore, owing to the limited numbers of papers, it was not possible to undertake a subset analysis for different stages of colorectal cancer, nor to differentiate between colonic and rectal cancers.

The mean leak rate was 7·4 per cent across the 31 articles included in the analysis of anastomotic leak; this is in keeping with the mean leak rate in international data[62]. Anastomotic leakage is increasingly topical; there have been paradigm shifts in surgical, prehabilitation, intraoperative and postoperative approaches to reducing leakage[62–64].

This meta-analysis reinforces the findings of a meta-analysis[65] in 2016, which showed that complication severity had a significant impact on both disease-free and overall survival. Three other studies[66–68] identified a negative impact of anastomotic leakage on long-term cancer-specific survival, particularly noting an increase in local recurrence. Current efforts at SSI management after colorectal surgery focus on compliance with guidelines and evaluation of infection rates, but Gantz and colleagues[69] recently suggested that improvement is needed. Martinez *et al.*[70] suggested establishing national SSI bundles. Historically, mechanical and oral bowel preparations were favoured, but then bowel preparation went out of vogue. Now there is the potential for reintroduction of bowel cleansing and recognition of the importance of other factors including those relating to the gut microbiome. The gut microbiome potentially has an effect on infection and also a separate oncological effect. A variety of environmental factors, including diet, antibiotics, bowel preparation and surgical stress, act on the microbiome, altering its architecture and function, with a negative effect on oncological outcomes after surgery[71]. It is clear from the present data that anastomotic leakage is associated with increased local recurrence and decreased overall survival. The recent German rectal trial CAO/ARO/AIO-94[7] showed that surgical complications are significantly associated with reduced overall survival. Patients with complications are more likely to have distant metastasis and local recurrences. The reason for this is somewhat unclear, although it is known that cancer cells shed from the bowel may embed themselves on stapling devices, leading to enhanced tumour dissemination in the event of anastomotic leak or reoperation. Exfoliated cancer cells have been detected in the colonic lumen and on stapling devices, suggesting that anastomotic leakage could enhance dissemination[72,73].

There are many confounders to the potential negative oncological effects of infection. Systemic inflammation has been shown to promote micrometastasis[74]. An infection-led inflammatory cascade will activate cytokines, and cell- and humoral-mediated immunity.

Local recurrence is an important clinical outcome for patients with colorectal cancer; many treatment modalities have been investigated with the aim of reducing pelvic occurrence from total mesorectal excision to neoadjuvant chemoradiotherapy. The present study has identified that additional measures and routine use of SSI prevention bundles need to be implemented to reduce infective complications[75]. Infection prevention should become a potential target for oncological improvement; opportunities to reduce deep wound infection need to be revisited, incorporating wound bundles, intraoperative protective measures such as use of wound protectors, potential antibiotic solution and rectal washouts, and closer monitoring with intra-abdominal pressure measurement after surgery.

This study had a number of limitations. An initial trawl of the literature identified almost 13 000 potential publications. On deeper analysis, including qualitative evaluation using the MINORS criteria, it was found that many of these papers lacked a definition of either SSI or anastomotic leakage[60,61] and, most importantly, no relationship between adverse events and oncological outcome was reported. In contrast, it is increasingly being recognized in other fields of oncology, such as breast cancer, that there may be a relationship between infection and cancer recurrence[76]. Surprisingly SSI data have not been included in cancer registries. Uniform data definitions and data analysis would make analysis easier. The small number of papers reporting infective complications may have led to bias in the present results. Subset analysis of SSI effects at different cancer stages was not possible.

This meta-analysis has identified a statistically significant association between both anastomotic leak and wound infection/SSI and adverse oncological outcomes. Oncological registries incorporating infective and adverse events as part of their outcome analysis may help in understanding the relationship between SSI and oncological outcomes. Reduction in SSI may prove to be a noteworthy part of adjuvant cancer therapy, and wound bundles should become mandatory. There needs to be greater adoption and monitoring of strategies that might reduce SSIs and their negative impact.

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Supporting information

Additional supporting information can be found online in the Supporting Information section at the end of the article.

Surgical Site Infection Wound Bundles Should Become Routine in Colorectal Surgery: A Meta-Analysis

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Abstract

Background: Surgical Site Infections (SSI) are a major source of post-operative complications and potentially affect oncological outcomes. Reducing SSI is multi-factorial, best served by the additive affect of individual wound bundle elements. With changing strategies and novel innovations ongoing meta-analyses are needed to inform current practice. This study undertook a meta-analysis of existing wound bundles impact on SSI in colorectal surgery.

Methods: A PROSPERO-registered (ID: CRD42018104923) meta-analysis following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines and using databases PubMed, Scopus and Web of Science, from January 2008 to July 2018, was undertaken. Articles scoring ≥ 17 using Methodological Index for non-randomised Studies (MINORS) criteria were included.

Results: 5,104 articles were reviewed, and 27 studies met inclusion criteria with a total cohort of 23851 patients. Wound bundles significantly decreased SSI rates from 17.5% to 9.7%. Sub-analysis identified greatest impact on superficial SSI (risk reduction of 54%; $p<0.00001$) and organ-space infections (risk reduction 42%; $p=0.0006$).Wound bundles also significantly reduced hospital length of stay ($MD=-0.79$; $p<0.00001$).

Conclusions: Colorectal wound bundles significantly reduce the risk of SSI and length of hospital stay. They should become routine in colorectal surgery. Future work encompasses the need for standardisation of wound complications, standardised follow-up of patients and internationally agreed research definitions.

Keywords: Care pathway; Colorectal surgery; Surgical site infections; Surgical outcomes; Wound bundles

List of Abbreviations: **ASA:** American Society of Anesthesiologists; **CDC:** Centres for Disease Control and Prevention; **CI:** Confidence Interval; **ECDC:** European Centres for Disease Control and Prevention; **IHI:** Institute of Healthcare Improvement; **MINORS:** Methodological Index for non-randomised Studies; **NSQIP:** National Surgical Quality Improvement Program; **PO:** Per Oral; **PRISMA:** Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines; **RR:** Relative Risk; **SSI:** Surgical Site Infection

Introduction

The global impact of Surgical Site Infection (SSI) is increasingly recognised, both in terms of post-operative complications and the effect on patient's outcomes. SSI rates vary internationally, related in part to variable definitions, different populations, co-morbidities and strategies utilised to reduce surgical site infection [1,2]. Surgical site infection may cause distress and inconvenience to patients, delay their discharge, increase risk of incisional hernia and re-admission to hospital [3,4]. Furthermore, the hospital or patients may be financially penalised. Recently the negative oncological impact of SSI is becoming increasingly reported [5-7]. A key to reducing SSI is a team approach, involving all providers, in every phase of care, with a cumulative additive benefit of each aspect in the bundle. A wound bundle, in general, will have more than three components and extend from pre-operative care through to rehabilitation. Newer concepts in colorectal surgery wound care include negative pressure therapy [8] and wound protective devices [9,10].

While several meta-analyses have been performed looking at bundles and surgical site infection, with the exception of Pop-Vicas, et al. [11], most relate to publications and interventions before 2016. The search strategy used in this paper differed from that of Pop-Vicas, et al. [11] in that it used different keywords and databases. This study therefore undertook a meta-analysis of bundle impact on SSI.

Methods

Search Strategy and Study Eligibility

A detailed meta-analysis of the literature was undertaken to incorporate articles relating to colorectal surgery wound care, surgical wound infection, and surgical site care bundles. Existing research optimizing wound care in colorectal surgery was reviewed to determine current bundle strategies to improve wound outcomes. A systematic review and meta-analysis of all published English articles was conducted using PubMed, Scopus, Web of Science and Cochrane electronic databases from 2008 to July 2018. A literature search was conducted using keywords; colorectal surgery, surgical site infections, wound bundles, compliance, care pathway, and surgical outcomes. Additional studies were identified by searching the reference lists of included articles.

Inclusion and Exclusion Criteria

The methods of the analysis and inclusion criteria were specified in advance and registered with the International Prospective Register of Systematic Reviews (PROSPERO) on 23/07/2018. This meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The Centres for Disease Control and Prevention (CDC) definitions for surgical site infection were used. They are classified into superficial, deep or organ/space in this study [12]. A wound care bundle was defined as three or more items combined to reduce wound infection as per the Institute for Healthcare Improvement [13]. For this meta-analysis, only studies with pre- and post-intervention SSI data for colorectal surgery were included, while studies that did not compare results to pre-intervention SSI rates were not included. Non-English articles were not included.

Eligibility Assessment and Data Extraction

Eligibility assessment was performed independently in a blinded standardised manner by two reviewers (DF and CMcI). Disagreements between reviewers were resolved by discussion between the two review authors and if no agreement could be reached, it was planned a third reviewer would decide (AJ), however a third reviewer was not required. Two reviewers (DF and CMcI) independently assessed each published study for the quality of study design by using the Methodological Index for non-randomised Studies (MINORS) score [14]. A MINORS score of ≥ 17 was considered the standard for inclusion. Information was extracted from each included study on SSI classifications, bundle elements, length of stay, bundle adherence rates, study design, country, study length, cohort sizes, and SSI rates pre- and post-intervention. The primary outcome was SSI rates following the use of wound bundles. Secondary outcomes were the effect of individual interventions included in the bundles and the SSI rates for superficial, deep and space organ infections.

Statistical Analysis

For comparison of SSI rates pre-and post-intervention risk ratios (RR) were calculated using Review Manager Version Five (RevMan5). Meta-analyses were performed by computing the RR using Mantel-Haenszel method and both fixed-effect models or random-effects models, depending on the heterogeneity of studies. Heterogeneity was assessed using the I^2 statistic where a value greater than 50% was considered high and a random-effect model was then used to combine variables of interest. RR and 95% Confidence Intervals (CI) for each classification of SSI was calculated, along with the p-value for which a value < 0.05 represented statistical significance. For the analysis of wound bundle elements, individual bundle elements in each study were reported in three phases of care: pre, peri- and post-operative care. However, any perioperative intervention that was only used once was not included in the table and was reported separately. The individual elements of each wound bundle were reviewed, and random-effect models were used to further explore the underlying effects of specific methodological features and intervention aspects of the care bundles on the rate of SSI. Some wound bundle features were identified that may explain some of the heterogeneity in the risk of SSI between studies.

Four studies provided sufficient raw data to carry out a meta-analysis on risk factors for SSI [15-18]. The following risk factors were analyzed: American Society of Anesthesiologists (ASA) physical status, diabetes mellitus and surgical approach (open vs. laparoscopic).

Results

This meta-analysis reviewed 5,104 articles. 46 studies were found to be potentially suitable and 27 studies [19-41] were included in this meta-analysis with a total cohort of 23851 patients (Figure 1).

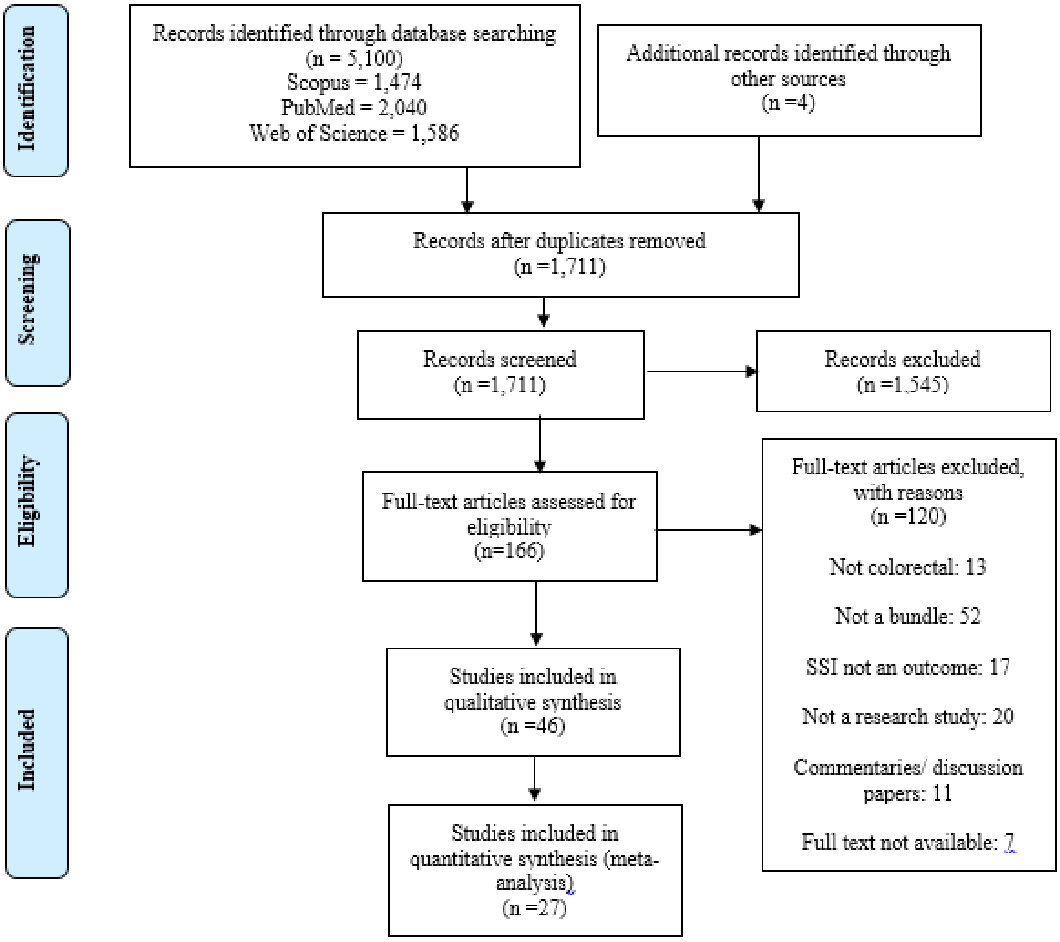


Figure 1: Identification, review and selection of articles included in the meta-analysis for impact of wound bundles on Surgical Site Infections in Colorectal Surgery**.**

19/46 studies were excluded from the meta-analysis: Seven studies stratified cohorts based primarily on compliance in using a bundle [42-48], six did not state colorectal specific SSI rates [49-54], 3 were deemed of low quality [55-57] and three did not provide pre-intervention cohort sizes [58-60]. Characteristics of included studies are shown in Table 1.

Author and year	Country	Study design	Sample group	Data collection period	Sample size baseline	Sample size cohort	SSI definition	Surveillance
Anthony 2011	USA	RCT	colorectal	2 yr, 8 months	97	100	CDC	30 days
Benlice 2016	USA	Cohort	colorectal	1 yr, 1 yr	986	1293	NSQIP	30 days

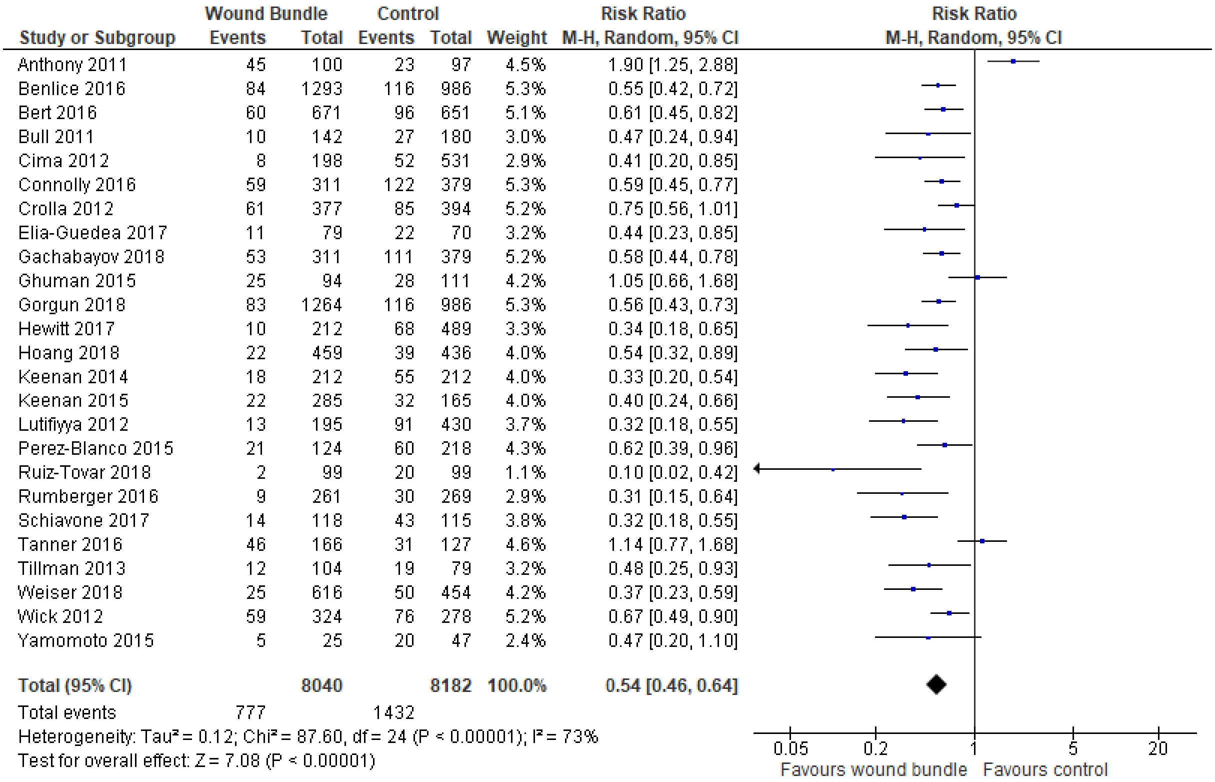
Bert 2016	Italy	Cohort	colorectal	1 yr	651	671	ECDC	30 days
Bull 2011	Australia	Cohort	colorectal	1yr, 1 yr	180	275	CDC	
Cima 2013	USA	Cohort	colorectal	1 yr, 2 yr	531	198	NSQIP	30 days
Connolly 2016	USA	Cohort	colorectal	3.5 yr, 3.5 yr	379	311	CDC	30 days
Crolla 2012	Netherlands	Cohort	colorectal	1.5 yr, 2.5 yr	394	377	CDC	30 days
Elia-Guedea 2017	Spain	Cohort	colorectal	3 mo, 3.5 mo	70	79	CDC	
Gachabayov 2018	USA	Cohort	colorectal resections	3 yr,3 yr	379	311	CDC	NSQIP
Ghuman 2015	Canada	Cohort	Colon resections		111	103	CDC	
Gorgun 2018	USA	Cohort	Colorectal	1 yr,1 yr	986	1264	NSQIP	30 days
Hewitt 2017	USA	Cohort	colorectal	2 yr, 1 yr	489	212	NSQIP	NSQIP
Hoang 2018	USA	Cohort	colorectal	2 yr, 4 yr	436	459	NSQIP	NSQIP
Keenan 2014	USA	Cohort	Colorectal	3 yr,1.5 yr	212	212	NSQIP	30 days
Keenan 2015	USA	Cohort	Colorectal	16 mo, 20 mo	165	285	NSQIP	
Lutifyya 2012	USA	Cohort	colorectal	4 yr, 1.5 yr	430	195	NSQIP	NSQIP-30 days
Perez-blanco 2015	Spain	Cohort	Colorectal	3 yr, 1 yr	218	124	CDC	
Reames 2015	USA	Cohort	colorectal	2 yr, 2 yr	2604	3119	CDC	
Rencüzoğulları 2018	USA	Cohort	colorectal	30 mo, 18 mo	1408	498	CDC	
Ruiz-Tovar 2018	Spain	RCT	Elective lap CRC cancer	2 yr	99	99	CDC	30 Days
Rumberger 2016	USA	Cohort	Colorectal	1 yr, 10 mo	269	261	CDC	30 days
Schiavone 2017	USA	Cohort	colorectal	1 yr, 1 yr	115	118	CDC	30 days
Tanner 2016	UK	Cohort	Colorectal	6 mo, 6 mo	127	166	HPA	30 days

Tillman 2013	USA	Cohort	colorectal	1 yr, 1 yr	79	104	NSQIP	
Weiser 2018	USA	Cohort	colorectal	10 mo,13 mo	454	616	CDC	30 days
Wick 2012	USA	Cohort	Colorectal	1 yr, 1 yr	278	324	NSQIP	
Yamamoto 2015	Japan	Cohort	Colorectal	3 yr, 2 yr	47	25	CDC	

Table 1: Characteristics of studies used in Meta-analysis.

Wound Bundle and their effect on Surgical Site Infection Rates

Overall SSI Rates: Of the 27 studies included in the meta-analysis two large studies (almost 8000 patients) only reported superficial SSI rates and were not included in the overall SSI rate analysis [39,41]. There was an overall decrease in SSI rates following the implementation of wound bundles (1432/8182 [17.5%] vs 777/8040 [9.7%]). There was significant heterogeneity between trials (I^2=73%) and a random-effects model was used. Despite the heterogeneity there was significant reduction in the risk of SSIs by 46% (RR=0.54; 95% CI, 0.46-0.64; p<.00001, I^2=73%) (Figure 2).



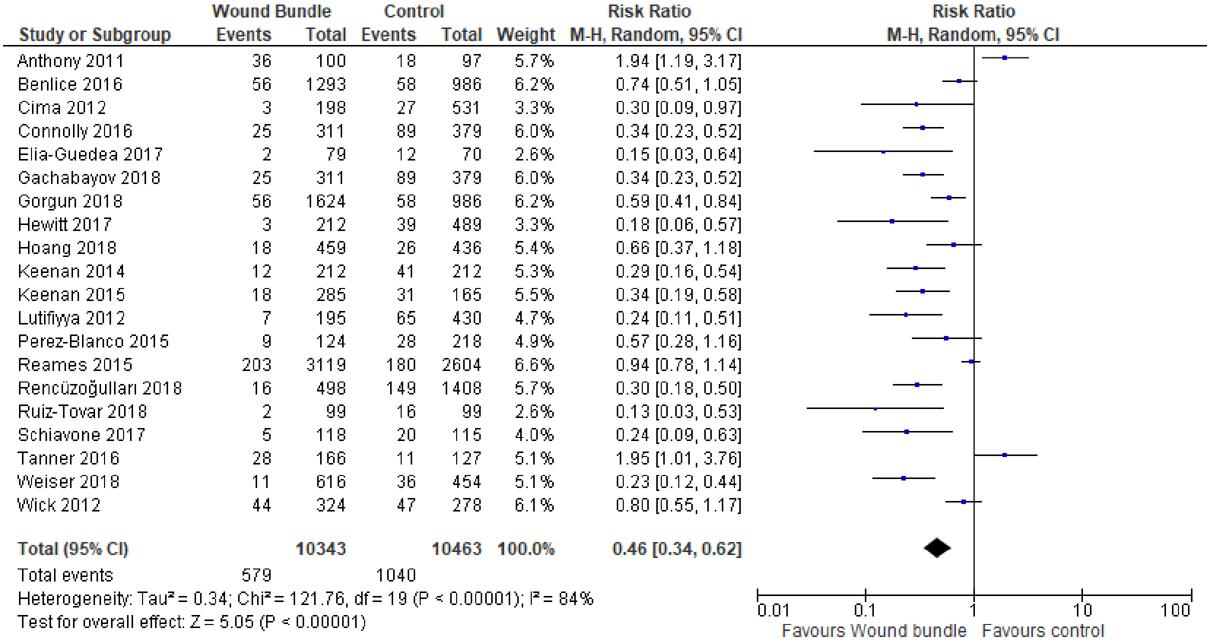
	Wound Bundle		Control			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
Anthony 2011	45	100	23	97	4.5%	1.90 [1.25, 2.88]
Benlice 2016	84	1293	116	986	5.3%	0.55 [0.42, 0.72]
Bert 2016	60	671	96	651	5.1%	0.61 [0.45, 0.82]
Bull 2011	10	142	27	180	3.0%	0.47 [0.24, 0.94]
Cima 2012	8	198	52	531	2.9%	0.41 [0.20, 0.85]
Connolly 2016	59	311	122	379	5.3%	0.59 [0.45, 0.77]
Crolla 2012	61	377	85	394	5.2%	0.75 [0.56, 1.01]
Elia-Guedea 2017	11	79	22	70	3.2%	0.44 [0.23, 0.85]
Gachabayov 2018	53	311	111	379	5.2%	0.58 [0.44, 0.78]
Ghuman 2015	25	94	28	111	4.2%	1.05 [0.66, 1.68]
Gorgun 2018	83	1264	116	986	5.3%	0.56 [0.43, 0.73]
Hewitt 2017	10	212	68	489	3.3%	0.34 [0.18, 0.65]
Hoang 2018	22	459	39	436	4.0%	0.54 [0.32, 0.89]
Keenan 2014	18	212	55	212	4.0%	0.33 [0.20, 0.54]
Keenan 2015	22	285	32	165	4.0%	0.40 [0.24, 0.66]
Lutfiyya 2012	13	195	91	430	3.7%	0.32 [0.18, 0.55]
Perez-Blanco 2015	21	124	60	218	4.3%	0.62 [0.39, 0.96]
Ruiz-Tovar 2018	2	99	20	99	1.1%	0.10 [0.02, 0.42]
Rumberger 2016	9	261	30	269	2.9%	0.31 [0.15, 0.64]
Schiavone 2017	14	118	43	115	3.8%	0.32 [0.18, 0.55]
Tanner 2016	46	166	31	127	4.6%	1.14 [0.77, 1.68]
Tillman 2013	12	104	19	79	3.2%	0.48 [0.25, 0.93]
Weiser 2018	25	616	50	454	4.2%	0.37 [0.23, 0.59]
Wick 2012	59	324	76	278	5.2%	0.67 [0.49, 0.90]
Yamomoto 2015	5	25	20	47	2.4%	0.47 [0.20, 1.10]
Total (95% CI)		**8040**		**8182**	**100.0%**	**0.54 [0.46, 0.64]**
Total events	777		1432			

Heterogeneity: Tau² = 0.12; Chi² = 87.60, df = 24 (P < 0.00001); I² = 73%
Test for overall effect: Z = 7.08 (P < 0.00001)

Figure 2: Forest plot: Surgical Care bundles Vs. Control to reduce the risk of Surgical Site Infections.

22 of the 25 studies had a statistically significant decrease in overall SSI rates following bundle implementation [16-20, 22-38]. Two studies showed no effect [21,40] and Anthony, et al. 2011 [15] reported a statistically significant increase in SSI after bundle implementation.

Superficial SSI Rates: Superficial SSI rates were reported in 20 studies with a cohort of 20,806 patients. The meta-analysis showed that wound bundles reduced superficial SSIs by 54% (RR= 0.46; 95% CI, 0.34-0.62; p<.00001, I^2=84%) (Figure 3).

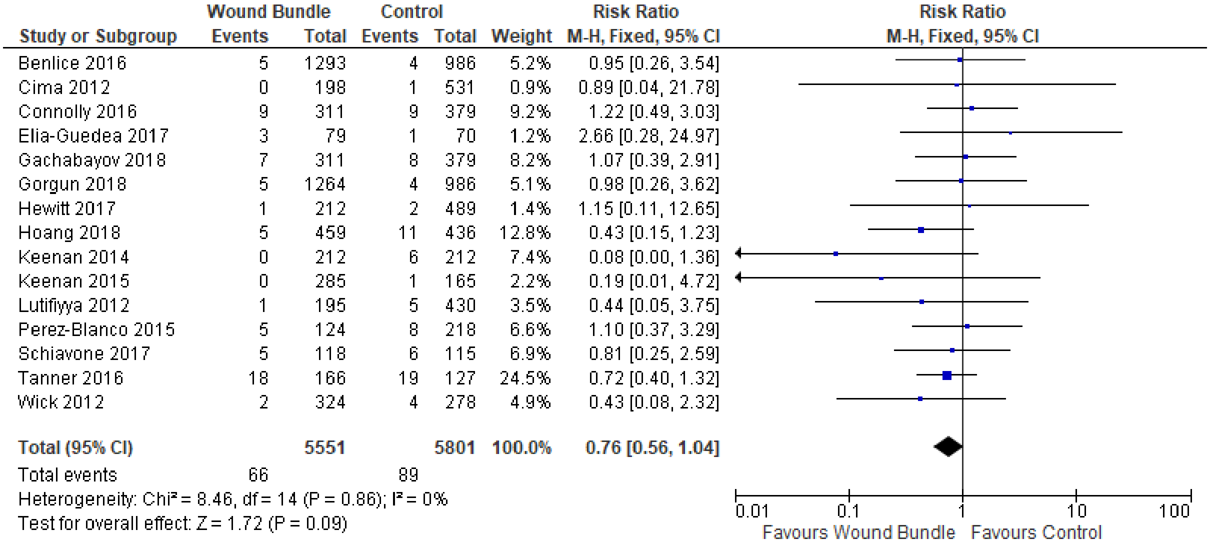


	Wound Bundle		Control			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
Anthony 2011	36	100	18	97	5.7%	1.94 [1.19, 3.17]
Benlice 2016	56	1293	58	986	6.2%	0.74 [0.51, 1.05]
Cima 2012	3	198	27	531	3.3%	0.30 [0.09, 0.97]
Connolly 2016	25	311	89	379	6.0%	0.34 [0.23, 0.52]
Elia-Guedea 2017	2	79	12	70	2.6%	0.15 [0.03, 0.64]
Gachabayov 2018	25	311	89	379	6.0%	0.34 [0.23, 0.52]
Gorgun 2018	56	1624	58	986	6.2%	0.59 [0.41, 0.84]
Hewitt 2017	3	212	39	489	3.3%	0.18 [0.06, 0.57]
Hoang 2018	18	459	26	436	5.4%	0.66 [0.37, 1.18]
Keenan 2014	12	212	41	212	5.3%	0.29 [0.16, 0.54]
Keenan 2015	18	285	31	165	5.5%	0.34 [0.19, 0.58]
Lutifiyya 2012	7	195	65	430	4.7%	0.24 [0.11, 0.51]
Perez-Blanco 2015	9	124	28	218	4.9%	0.57 [0.28, 1.16]
Reames 2015	203	3119	180	2604	6.6%	0.94 [0.78, 1.14]
Rencüzoğulları 2018	16	498	149	1408	5.7%	0.30 [0.18, 0.50]
Ruiz-Tovar 2018	2	99	16	99	2.6%	0.13 [0.03, 0.53]
Schiavone 2017	5	118	20	115	4.0%	0.24 [0.09, 0.63]
Tanner 2016	28	166	11	127	5.1%	1.95 [1.01, 3.76]
Weiser 2018	11	616	36	454	5.1%	0.23 [0.12, 0.44]
Wick 2012	44	324	47	278	6.1%	0.80 [0.55, 1.17]
Total (95% CI)		**10343**		**10463**	**100.0%**	**0.46 [0.34, 0.62]**
Total events	579		1040			

Heterogeneity: Tau² = 0.34; Chi² = 121.76, df = 19 (P < 0.00001); I² = 84%
Test for overall effect: Z = 5.05 (P < 0.00001)

Figure 3: Forest plot: Surgical Care bundles Vs. Control to reduce the risk of Superficial Surgical Site Infections.

Deep SSI Rates: Fifteen studies [16,18,20-22,25,26,28-32,34,36-38] included data on deep SSIs, with only one study [37] showing a statistically significant decrease in deep SSI rates. Overall there was not a statistically significant reduction in the risk of deep SSI and this meta-analysis required a fixed-effect model due to its heterogeneity of I^2=0% (RR=0.76; 95% CI, 0.56-1.04; p= 0.09, I^2=0%) (Figure 4).

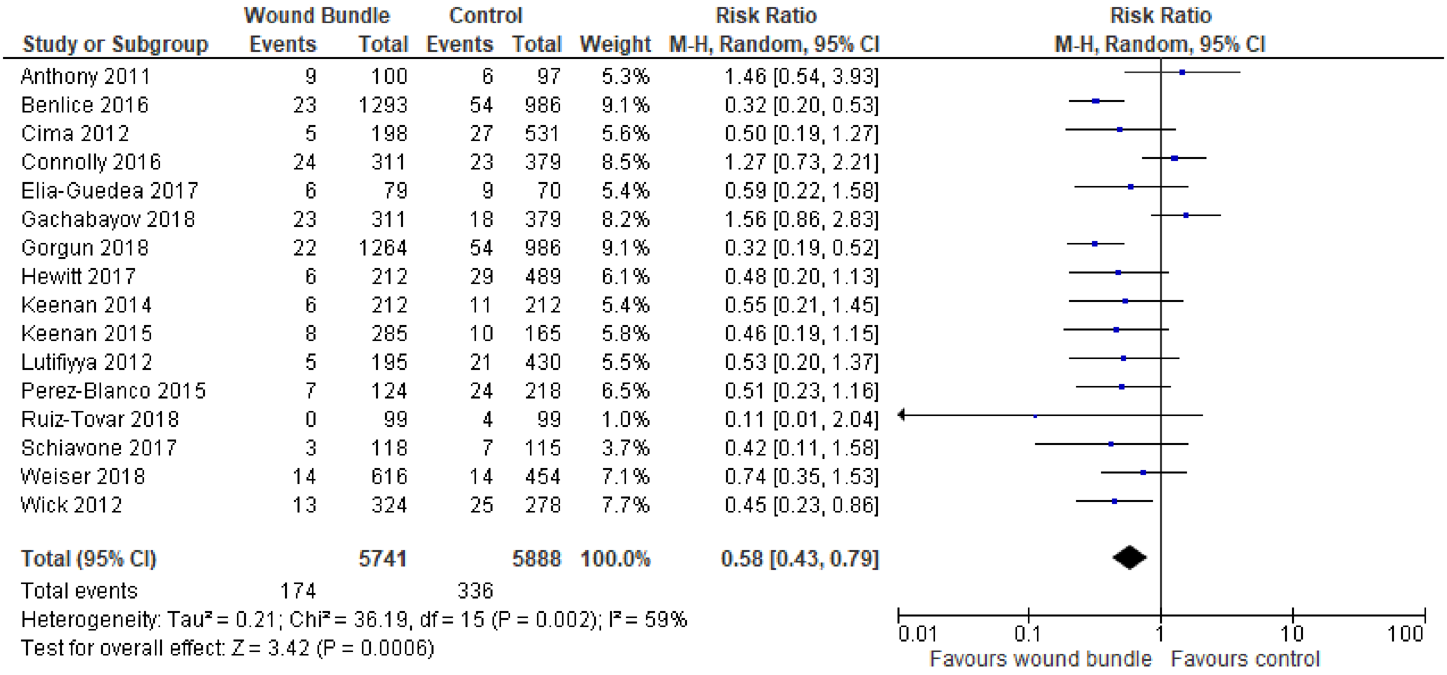


	Wound Bundle		Control			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Benlice 2016	5	1293	4	986	5.2%	0.95 [0.26, 3.54]
Cima 2012	0	198	1	531	0.9%	0.89 [0.04, 21.78]
Connolly 2016	9	311	9	379	9.2%	1.22 [0.49, 3.03]
Elia-Guedea 2017	3	79	1	70	1.2%	2.66 [0.28, 24.97]
Gachabayov 2018	7	311	8	379	8.2%	1.07 [0.39, 2.91]
Gorgun 2018	5	1264	4	986	5.1%	0.98 [0.26, 3.62]
Hewitt 2017	1	212	2	489	1.4%	1.15 [0.11, 12.65]
Hoang 2018	5	459	11	436	12.8%	0.43 [0.15, 1.23]
Keenan 2014	0	212	6	212	7.4%	0.08 [0.00, 1.36]
Keenan 2015	0	285	1	165	2.2%	0.19 [0.01, 4.72]
Lutifiyya 2012	1	195	5	430	3.5%	0.44 [0.05, 3.75]
Perez-Blanco 2015	5	124	8	218	6.6%	1.10 [0.37, 3.29]
Schiavone 2017	5	118	6	115	6.9%	0.81 [0.25, 2.59]
Tanner 2016	18	166	19	127	24.5%	0.72 [0.40, 1.32]
Wick 2012	2	324	4	278	4.9%	0.43 [0.08, 2.32]
Total (95% CI)		**5551**		**5801**	**100.0%**	**0.76 [0.56, 1.04]**
Total events	66		89			

Heterogeneity: Chi² = 8.46, df = 14 (P = 0.86); I² = 0%
Test for overall effect: Z = 1.72 (P = 0.09)

Figure 4: Forest plot: Surgical Care bundles Vs. Control to reduce the risk of Deep Surgical Site Infections.

Organ Space SSI Rates: Sixteen studies [15,16,18,20,22,23,25,27-32,34,36,38] reported organ space SSI rates. The meta-analysis showed a statistically significant reduction in the risk of organ/space SSIs by 42% (RR=0.58; 95% CI, 0.43-0.79; p=.0006, I^2=59%) (Figure 5).

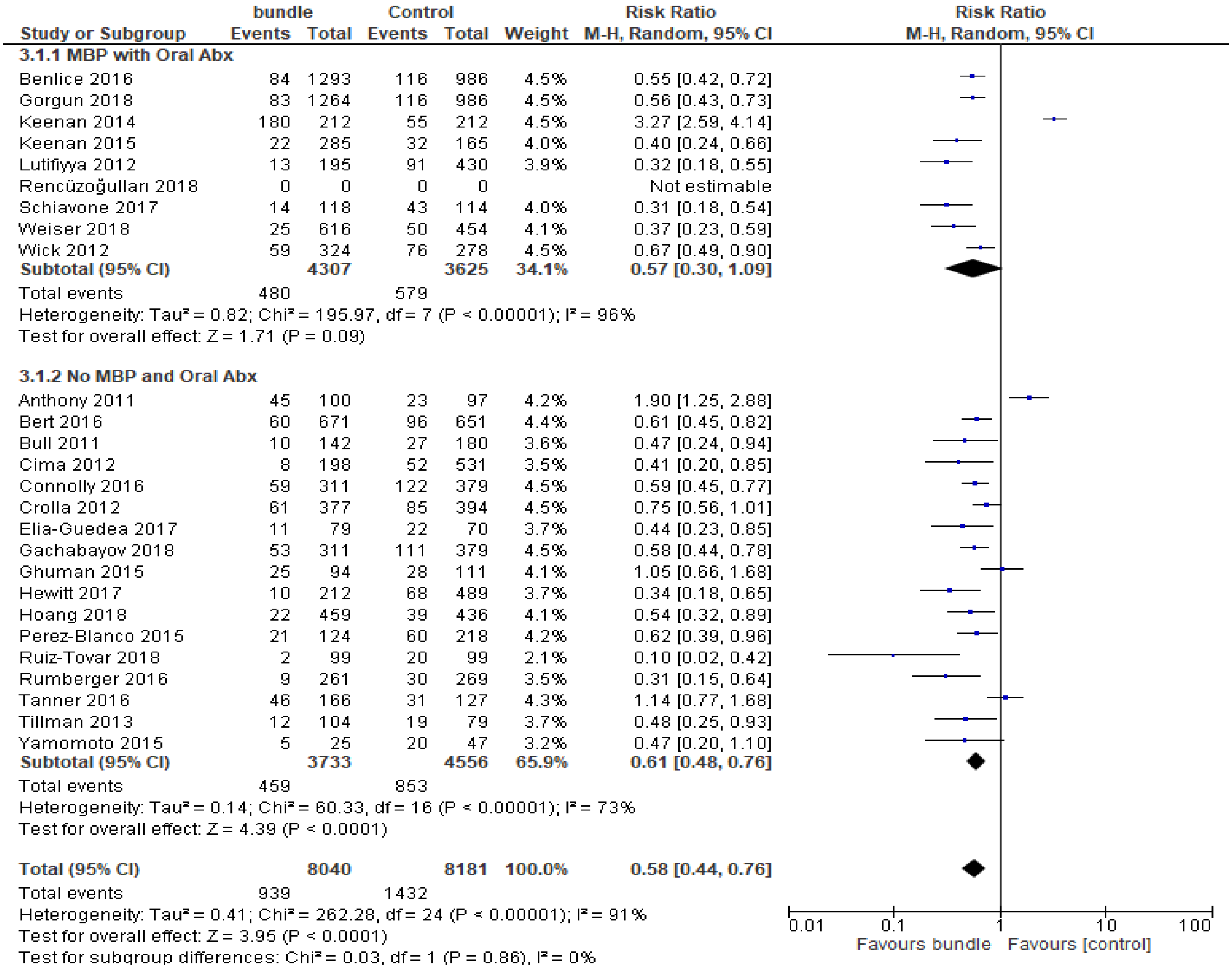


	Wound Bundle		Control			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
Anthony 2011	9	100	6	97	5.3%	1.46 [0.54, 3.93]
Benlice 2016	23	1293	54	986	9.1%	0.32 [0.20, 0.53]
Cima 2012	5	198	27	531	5.6%	0.50 [0.19, 1.27]
Connolly 2016	24	311	23	379	8.5%	1.27 [0.73, 2.21]
Elia-Guedea 2017	6	79	9	70	5.4%	0.59 [0.22, 1.58]
Gachabayov 2018	23	311	18	379	8.2%	1.56 [0.86, 2.83]
Gorgun 2018	22	1264	54	986	9.1%	0.32 [0.19, 0.52]
Hewitt 2017	6	212	29	489	6.1%	0.48 [0.20, 1.13]
Keenan 2014	6	212	11	212	5.4%	0.55 [0.21, 1.45]
Keenan 2015	8	285	10	165	5.8%	0.46 [0.19, 1.15]
Lutifiyya 2012	5	195	21	430	5.5%	0.53 [0.20, 1.37]
Perez-Blanco 2015	7	124	24	218	6.5%	0.51 [0.23, 1.16]
Ruiz-Tovar 2018	0	99	4	99	1.0%	0.11 [0.01, 2.04]
Schiavone 2017	3	118	7	115	3.7%	0.42 [0.11, 1.58]
Weiser 2018	14	616	14	454	7.1%	0.74 [0.35, 1.53]
Wick 2012	13	324	25	278	7.7%	0.45 [0.23, 0.86]
Total (95% CI)		**5741**		**5888**	**100.0%**	**0.58 [0.43, 0.79]**
Total events	174		336			

Heterogeneity: Tau² = 0.21; Chi² = 36.19, df = 15 (P = 0.002); I² = 59%
Test for overall effect: Z = 3.42 (P = 0.0006)

Figure 5: Forest plot: Surgical Care bundles Vs. Control to reduce the risk of Organ Space Surgical Site Infections.

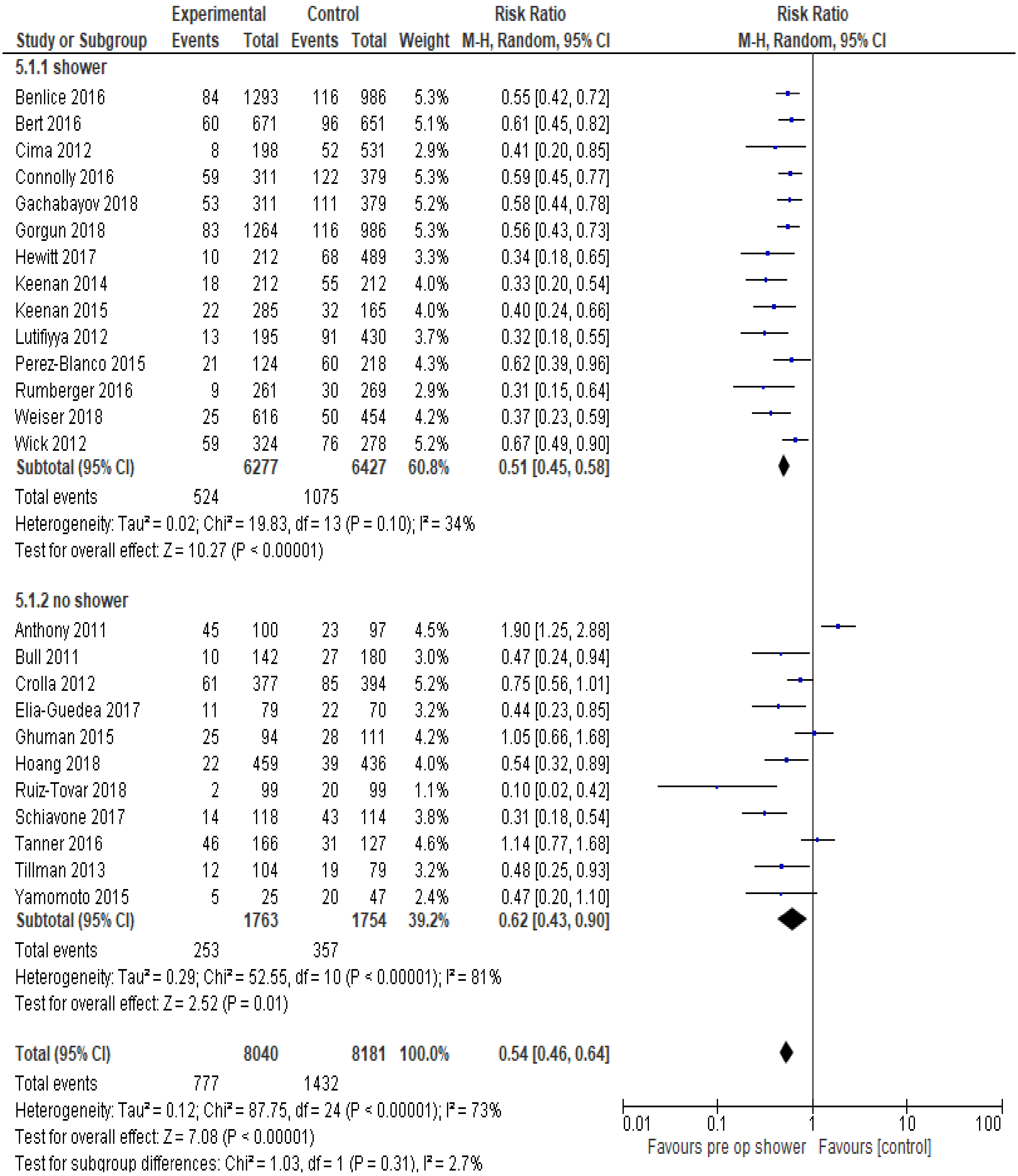
Bundle Elements Results: We identified the following study features that may explain some of heterogeneity in the risk of SSI between studies: the use of Mechanical Bowel Preparation (MBP) and oral antibiotics, wound protectors, instruments for closure, and the implementation of pre-operative shower/wipes with chlorhexidine. Eight studies used both MBP and oral antibiotics. Care bundles including MBP and oral antibiotics had greater risk reduction in SSI then bundles without but the difference was not statistically significant (RR 0.57 vs 0.61, p-value 0.86) (Figure S1).



Study or Subgroup	bundle Events	bundle Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
3.1.1 MBP with Oral Abx						
Benlice 2016	84	1293	116	986	4.5%	0.55 [0.42, 0.72]
Gorgun 2018	83	1264	116	986	4.5%	0.56 [0.43, 0.73]
Keenan 2014	180	212	55	212	4.5%	3.27 [2.59, 4.14]
Keenan 2015	22	285	32	165	4.0%	0.40 [0.24, 0.66]
Lutifiyya 2012	13	195	91	430	3.9%	0.32 [0.18, 0.55]
Rencüzoğulları 2018	0	0	0	0		Not estimable
Schiavone 2017	14	118	43	114	4.0%	0.31 [0.18, 0.54]
Weiser 2018	25	616	50	454	4.1%	0.37 [0.23, 0.59]
Wick 2012	59	324	76	278	4.5%	0.67 [0.49, 0.90]
Subtotal (95% CI)		**4307**		**3625**	**34.1%**	**0.57 [0.30, 1.09]**
Total events	480		579			
Heterogeneity: Tau^2 = 0.82; Chi^2 = 195.97, df = 7 ($P < 0.00001$); I^2 = 96%						
Test for overall effect: Z = 1.71 (P = 0.09)						
3.1.2 No MBP and Oral Abx						
Anthony 2011	45	100	23	97	4.2%	1.90 [1.25, 2.88]
Bert 2016	60	671	96	651	4.4%	0.61 [0.45, 0.82]
Bull 2011	10	142	27	180	3.6%	0.47 [0.24, 0.94]
Cima 2012	8	198	52	531	3.5%	0.41 [0.20, 0.85]
Connolly 2016	59	311	122	379	4.5%	0.59 [0.45, 0.77]
Crolla 2012	61	377	85	394	4.5%	0.75 [0.56, 1.01]
Elia-Guedea 2017	11	79	22	70	3.7%	0.44 [0.23, 0.85]
Gachabayov 2018	53	311	111	379	4.5%	0.58 [0.44, 0.78]
Ghuman 2015	25	94	28	111	4.1%	1.05 [0.66, 1.68]
Hewitt 2017	10	212	68	489	3.7%	0.34 [0.18, 0.65]
Hoang 2018	22	459	39	436	4.1%	0.54 [0.32, 0.89]
Perez-Blanco 2015	21	124	60	218	4.2%	0.62 [0.39, 0.96]
Ruiz-Tovar 2018	2	99	20	99	2.1%	0.10 [0.02, 0.42]
Rumberger 2016	9	261	30	269	3.5%	0.31 [0.15, 0.64]
Tanner 2016	46	166	31	127	4.3%	1.14 [0.77, 1.68]
Tillman 2013	12	104	19	79	3.7%	0.48 [0.25, 0.93]
Yamomoto 2015	5	25	20	47	3.2%	0.47 [0.20, 1.10]
Subtotal (95% CI)		**3733**		**4556**	**65.9%**	**0.61 [0.48, 0.76]**
Total events	459		853			
Heterogeneity: Tau^2 = 0.14; Chi^2 = 60.33, df = 16 ($P < 0.00001$); I^2 = 73%						
Test for overall effect: Z = 4.39 ($P < 0.0001$)						
Total (95% CI)		**8040**		**8181**	**100.0%**	**0.58 [0.44, 0.76]**
Total events	939		1432			
Heterogeneity: Tau^2 = 0.41; Chi^2 = 262.28, df = 24 ($P < 0.00001$); I^2 = 91%						
Test for overall effect: Z = 3.95 ($P < 0.0001$)						
Test for subgroup differences: Chi^2 = 0.03, df = 1 (P = 0.86), I^2 = 0%						

Figure S1: Forest plot: Surgical Care bundles including MBP and Oral Antibiotics Vs. Surgical Care Bundles without.

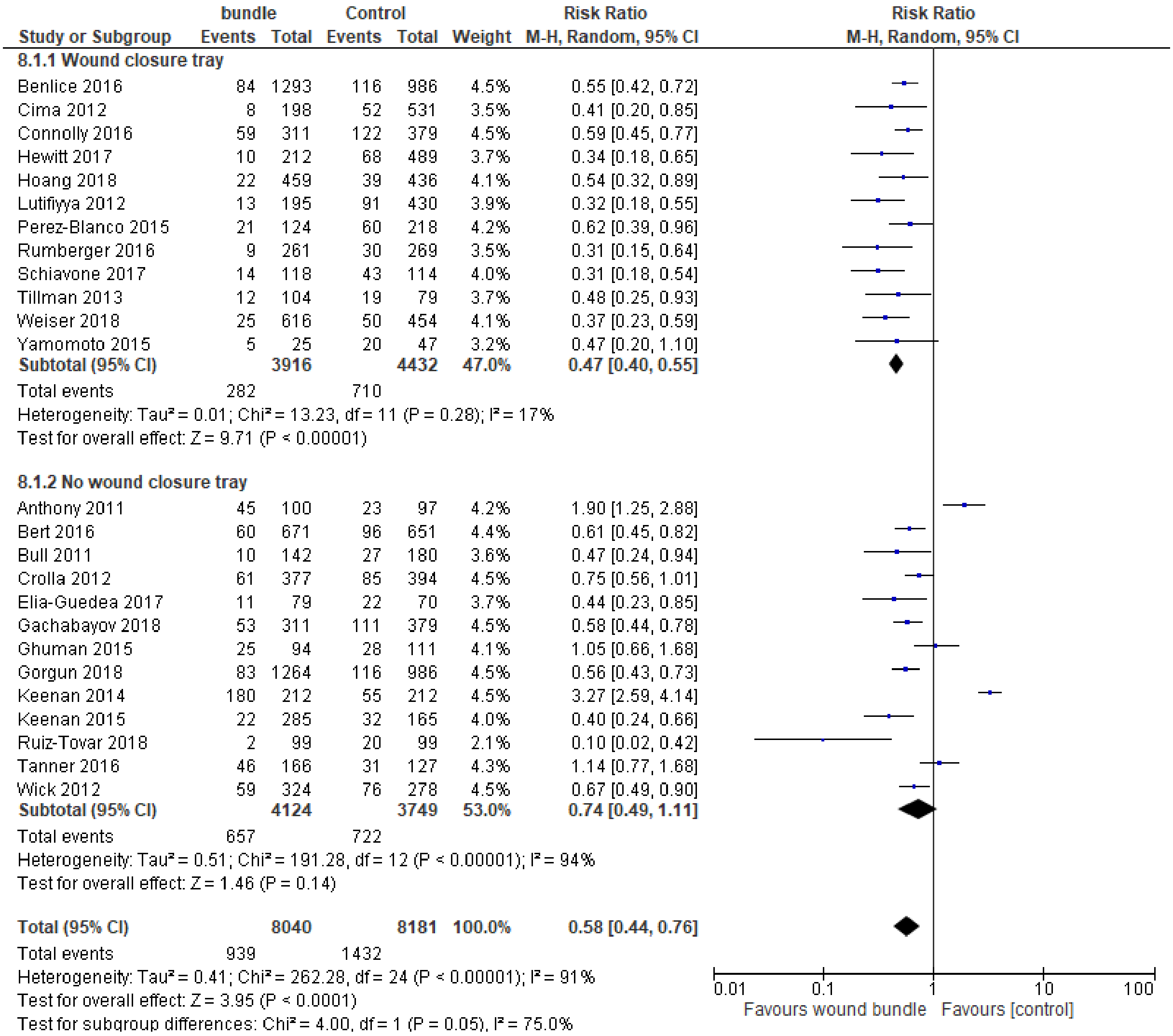
Fourteen studies implemented pre-operative shower/wipes with chlorhexidine gluconate. There was a greater risk reduction in SSI in care bundles using chlorhexidine gluconate than bundles without but the difference was not statistically significant (RR 0.51 vs 0.62, p-value 0.31) (Figure S2).



Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
5.1.1 shower						
Benlice 2016	84	1293	116	986	5.3%	0.55 [0.42, 0.72]
Bert 2016	60	671	96	651	5.1%	0.61 [0.45, 0.82]
Cima 2012	8	198	52	531	2.9%	0.41 [0.20, 0.85]
Connolly 2016	59	311	122	379	5.3%	0.59 [0.45, 0.77]
Gachabayov 2018	53	311	111	379	5.2%	0.58 [0.44, 0.78]
Gorgun 2018	83	1264	116	986	5.3%	0.56 [0.43, 0.73]
Hewitt 2017	10	212	68	489	3.3%	0.34 [0.18, 0.65]
Keenan 2014	18	212	55	212	4.0%	0.33 [0.20, 0.54]
Keenan 2015	22	285	32	165	4.0%	0.40 [0.24, 0.66]
Lutifiyya 2012	13	195	91	430	3.7%	0.32 [0.18, 0.55]
Perez-Blanco 2015	21	124	60	218	4.3%	0.62 [0.39, 0.96]
Rumberger 2016	9	261	30	269	2.9%	0.31 [0.15, 0.64]
Weiser 2018	25	616	50	454	4.2%	0.37 [0.23, 0.59]
Wick 2012	59	324	76	278	5.2%	0.67 [0.49, 0.90]
Subtotal (95% CI)		**6277**		**6427**	**60.8%**	**0.51 [0.45, 0.58]**
Total events	524		1075			
Heterogeneity: Tau² = 0.02; Chi² = 19.83, df = 13 (P = 0.10); I² = 34%						
Test for overall effect: Z = 10.27 (P < 0.00001)						
5.1.2 no shower						
Anthony 2011	45	100	23	97	4.5%	1.90 [1.25, 2.88]
Bull 2011	10	142	27	180	3.0%	0.47 [0.24, 0.94]
Crolla 2012	61	377	85	394	5.2%	0.75 [0.56, 1.01]
Elia-Guedea 2017	11	79	22	70	3.2%	0.44 [0.23, 0.85]
Ghuman 2015	25	94	28	111	4.2%	1.05 [0.66, 1.68]
Hoang 2018	22	459	39	436	4.0%	0.54 [0.32, 0.89]
Ruiz-Tovar 2018	2	99	20	99	1.1%	0.10 [0.02, 0.42]
Schiavone 2017	14	118	43	114	3.8%	0.31 [0.18, 0.54]
Tanner 2016	46	166	31	127	4.6%	1.14 [0.77, 1.68]
Tillman 2013	12	104	19	79	3.2%	0.48 [0.25, 0.93]
Yamomoto 2015	5	25	20	47	2.4%	0.47 [0.20, 1.10]
Subtotal (95% CI)		**1763**		**1754**	**39.2%**	**0.62 [0.43, 0.90]**
Total events	253		357			
Heterogeneity: Tau² = 0.29; Chi² = 52.55, df = 10 (P < 0.00001); I² = 81%						
Test for overall effect: Z = 2.52 (P = 0.01)						
Total (95% CI)		**8040**		**8181**	**100.0%**	**0.54 [0.46, 0.64]**
Total events	777		1432			
Heterogeneity: Tau² = 0.12; Chi² = 87.75, df = 24 (P < 0.00001); I² = 73%						
Test for overall effect: Z = 7.08 (P < 0.00001)						
Test for subgroup differences: Chi² = 1.03, df = 1 (P = 0.31), I² = 2.7%						

Figure S2: Forest plot: Surgical Care bundles including CHG shower/wipes Vs. Surgical Care Bundles without.

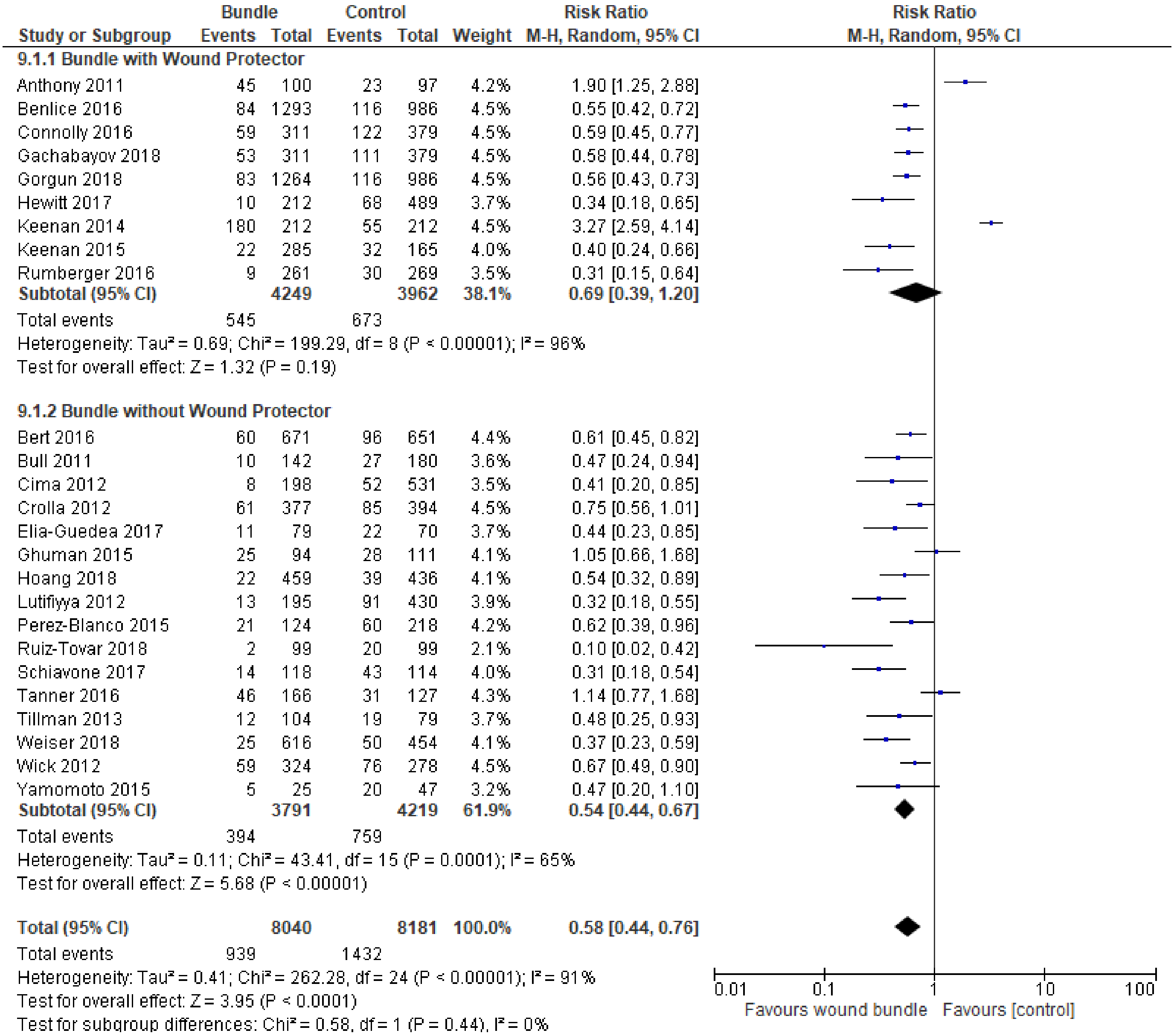
12 studies reported outcomes of a dedicated wound closure instrument tray. There was a greater risk reduction in SSI in care bundles using wound closure tray (RR 0.47 vs 0.74, p-value 0.05) (Figure S3).



	bundle		Control			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
8.1.1 Wound closure tray						
Benlice 2016	84	1293	116	986	4.5%	0.55 [0.42, 0.72]
Cima 2012	8	198	52	531	3.5%	0.41 [0.20, 0.85]
Connolly 2016	59	311	122	379	4.5%	0.59 [0.45, 0.77]
Hewitt 2017	10	212	68	489	3.7%	0.34 [0.18, 0.65]
Hoang 2018	22	459	39	436	4.1%	0.54 [0.32, 0.89]
Lutifiyya 2012	13	195	91	430	3.9%	0.32 [0.18, 0.55]
Perez-Blanco 2015	21	124	60	218	4.2%	0.62 [0.39, 0.96]
Rumberger 2016	9	261	30	269	3.5%	0.31 [0.15, 0.64]
Schiavone 2017	14	118	43	114	4.0%	0.31 [0.18, 0.54]
Tillman 2013	12	104	19	79	3.7%	0.48 [0.25, 0.93]
Weiser 2018	25	616	50	454	4.1%	0.37 [0.23, 0.59]
Yamomoto 2015	5	25	20	47	3.2%	0.47 [0.20, 1.10]
Subtotal (95% CI)		**3916**		**4432**	**47.0%**	**0.47 [0.40, 0.55]**
Total events	282		710			
Heterogeneity: Tau² = 0.01; Chi² = 13.23, df = 11 (P = 0.28); I² = 17%						
Test for overall effect: Z = 9.71 (P < 0.00001)						
8.1.2 No wound closure tray						
Anthony 2011	45	100	23	97	4.2%	1.90 [1.25, 2.88]
Bert 2016	60	671	96	651	4.4%	0.61 [0.45, 0.82]
Bull 2011	10	142	27	180	3.6%	0.47 [0.24, 0.94]
Crolla 2012	61	377	85	394	4.5%	0.75 [0.56, 1.01]
Elia-Guedea 2017	11	79	22	70	3.7%	0.44 [0.23, 0.85]
Gachabayov 2018	53	311	111	379	4.5%	0.58 [0.44, 0.78]
Ghuman 2015	25	94	28	111	4.1%	1.05 [0.66, 1.68]
Gorgun 2018	83	1264	116	986	4.5%	0.56 [0.43, 0.73]
Keenan 2014	180	212	55	212	4.5%	3.27 [2.59, 4.14]
Keenan 2015	22	285	32	165	4.0%	0.40 [0.24, 0.66]
Ruiz-Tovar 2018	2	99	20	99	2.1%	0.10 [0.02, 0.42]
Tanner 2016	46	166	31	127	4.3%	1.14 [0.77, 1.68]
Wick 2012	59	324	76	278	4.5%	0.67 [0.49, 0.90]
Subtotal (95% CI)		**4124**		**3749**	**53.0%**	**0.74 [0.49, 1.11]**
Total events	657		722			
Heterogeneity: Tau² = 0.51; Chi² = 191.28, df = 12 (P < 0.00001); I² = 94%						
Test for overall effect: Z = 1.46 (P = 0.14)						
Total (95% CI)		**8040**		**8181**	**100.0%**	**0.58 [0.44, 0.76]**
Total events	939		1432			
Heterogeneity: Tau² = 0.41; Chi² = 262.28, df = 24 (P < 0.00001); I² = 91%						
Test for overall effect: Z = 3.95 (P < 0.0001)						
Test for subgroup differences: Chi² = 4.00, df = 1 (P = 0.05), I² = 75.0%						

Figure S3: Forest plot: Surgical Care bundles including dedicated wound closure tray Vs. Surgical Care Bundles without.

9 studies reported outcomes of wound bundles that included wound protectors. There was no greater risk reduction in SSI in these care bundles than bundles without wound protectors (RR 0.69 vs 0.54, p-value 0.44) (Figure S4). Analyses of wound bundle elements are shown in supplementary Tables S1-S2.



	Bundle		Control			Risk Ratio
Study or Subgroup	**Events**	**Total**	**Events**	**Total**	**Weight**	**M-H, Random, 95% CI**
9.1.1 Bundle with Wound Protector						
Anthony 2011	45	100	23	97	4.2%	1.90 [1.25, 2.88]
Benlice 2016	84	1293	116	986	4.5%	0.55 [0.42, 0.72]
Connolly 2016	59	311	122	379	4.5%	0.59 [0.45, 0.77]
Gachabayov 2018	53	311	111	379	4.5%	0.58 [0.44, 0.78]
Gorgun 2018	83	1264	116	986	4.5%	0.56 [0.43, 0.73]
Hewitt 2017	10	212	68	489	3.7%	0.34 [0.18, 0.65]
Keenan 2014	180	212	55	212	4.5%	3.27 [2.59, 4.14]
Keenan 2015	22	285	32	165	4.0%	0.40 [0.24, 0.66]
Rumberger 2016	9	261	30	269	3.5%	0.31 [0.15, 0.64]
Subtotal (95% CI)		**4249**		**3962**	**38.1%**	**0.69 [0.39, 1.20]**
Total events	545		673			
Heterogeneity: Tau² = 0.69; Chi² = 199.29, df = 8 (P < 0.00001); I² = 96%						
Test for overall effect: Z = 1.32 (P = 0.19)						
9.1.2 Bundle without Wound Protector						
Bert 2016	60	671	96	651	4.4%	0.61 [0.45, 0.82]
Bull 2011	10	142	27	180	3.6%	0.47 [0.24, 0.94]
Cima 2012	8	198	52	531	3.5%	0.41 [0.20, 0.85]
Crolla 2012	61	377	85	394	4.5%	0.75 [0.56, 1.01]
Elia-Guedea 2017	11	79	22	70	3.7%	0.44 [0.23, 0.85]
Ghuman 2015	25	94	28	111	4.1%	1.05 [0.66, 1.68]
Hoang 2018	22	459	39	436	4.1%	0.54 [0.32, 0.89]
Lutifiyya 2012	13	195	91	430	3.9%	0.32 [0.18, 0.55]
Perez-Blanco 2015	21	124	60	218	4.2%	0.62 [0.39, 0.96]
Ruiz-Tovar 2018	2	99	20	99	2.1%	0.10 [0.02, 0.42]
Schiavone 2017	14	118	43	114	4.0%	0.31 [0.18, 0.54]
Tanner 2016	46	166	31	127	4.3%	1.14 [0.77, 1.68]
Tillman 2013	12	104	19	79	3.7%	0.48 [0.25, 0.93]
Weiser 2018	25	616	50	454	4.1%	0.37 [0.23, 0.59]
Wick 2012	59	324	76	278	4.5%	0.67 [0.49, 0.90]
Yamomoto 2015	5	25	20	47	3.2%	0.47 [0.20, 1.10]
Subtotal (95% CI)		**3791**		**4219**	**61.9%**	**0.54 [0.44, 0.67]**
Total events	394		759			
Heterogeneity: Tau² = 0.11; Chi² = 43.41, df = 15 (P = 0.0001); I² = 65%						
Test for overall effect: Z = 5.68 (P < 0.00001)						
Total (95% CI)		**8040**		**8181**	**100.0%**	**0.58 [0.44, 0.76]**
Total events	939		1432			
Heterogeneity: Tau² = 0.41; Chi² = 262.28, df = 24 (P < 0.00001); I² = 91%						
Test for overall effect: Z = 3.95 (P < 0.0001)						
Test for subgroup differences: Chi² = 0.58, df = 1 (P = 0.44), I² = 0%						

Figure S4: Forest plot: Surgical Care bundles including wound protector Vs. Surgical Care Bundles without.

Author and Year	Preoperative CHG Wipes/ Shower	Risk assessment for SSI	Pre-operative infection screen	Smoking Cessation	Omission of Mechanical Bowel Preparation	Bowel preparation with oral antibiotics	Mechanical Bowel preparation	Pre-operative glycemic screen/ control	preoperative normothermia	Pre-operative Checklist	Pre-operative patient education
Anthony 2011					✓				✓		
Benlice 2016	✓					✓	✓				
Bert 2016	✓										
Bull 2011								✓	✓		
Cima 2012	✓										✓
Connolly 2016	✓										
Crolla 2012									✓		
Elia-Guedea 2017											
Gachabayov 2018	✓						✓	✓		✓	
Ghuman 2015											
Gorgun 2018	✓					✓	✓				
Hewitt 2017	✓		✓	✓		✓		✓	✓	✓	
Hoang 2018						✓		✓			
Keenan 2014	✓					✓	✓	✓			✓
Keenan 2015	✓					✓	✓	✓			
Lutifiyya 2012	✓			✓		✓	✓	✓	✓		✓
Perez-Blanco	✓							✓			
Reames 2015											
Rencüzoğulları 2018						✓	✓				
Ruiz-Tovar 2018							✓				
Rumberger 2016	✓							✓			
Schiavone 2017						✓	✓	✓			
Tanner 2016	✓ **		✓					✓			
Tillman 2013											
Weiser 2018	✓	✓				✓	✓				
Wick 2012	✓					✓	✓				
Yamamoto 2015											

Table S1: Study and their Preoperative Interventions.

Author and Year	Peri-op Glycemic control	Hair removal with clippers	Skin Preparation with CHG in alcohol	Antibiotic prophylaxis <60 minutes before surgery	Antibiotic re-dose within 2-4 hours if required	Intra-operative normothermia	Wound protectors	Triclosan Sutures	Double gloving	Glove and/or Gown change	New wound closure tray	Suction tip change and wound washout	Limited OR Traffic	Antibiotic irrigation of Abdomen	redraping/ draping	Supple-mental Oxygen	Checklist fulfilment
Anthony 2011				✓		✓	✓									✓	
Benlice 2016				✓			✓			✓		✓					
Bert 2016		✓		✓		✓											
Bull 2011	✓			✓		✓									✓	✓	
Cima 2013			✓	✓	✓					✓	✓						
Connolly 2016	✓	✓	✓	✓		✓	✓			✓	✓		✓				
Crolla 2012		✓		✓		✓							✓				
Elia-Guedea 2017				✓	✓					✓	✓		✓				
Gachabayov 2018		✓	✓			✓	✓			✓	✓		✓		✓		✓
Ghuman 2015							✓			✓	✓				✓		
Gorgun 2018			✓	✓			✓			✓	✓	✓					
Hewitt 2017	✓	✓	✓	✓		✓	✓			✓	✓			✓	✓	✓	✓
Hoang 2018	✓	✓		✓	✓	✓					✓					✓	
Keenan 2014			✓	✓		✓	✓			✓	✓		✓				
Keenan 2015			✓	✓		✓	✓			✓	✓						
Lutifiyya 2012	✓	✓	✓	✓	✓	✓			✓							✓	
Perez-Blanco	✓		✓	✓	✓	✓				✓							
Reames 2015	✓	✓		✓		✓											
Rencüzoğulları 2018				✓			✓										
Ruiz-Tovar 2018			✓	✓		✓		✓	✓					✓			✓
Rumberger 2016		✓	✓	✓	✓	✓										✓	
Schiavone 2017	✓		✓	✓	✓					✓	✓						
Tanner 2016	✓	✓	✓	✓		✓									✓		
Tillman 2013	✓	✓		✓		✓											
Weiser 2018	✓	✓		✓	✓	✓					✓						
Wick 2012			✓			✓				✓	✓						
Yamamoto 2015				✓	✓			✓	✓								

Table S2: Study and their Intraoperative Interventions.

Length of Stay Results: There were seven studies that included data on the length of hospital stay in both pre-intervention and post-intervention cohorts [18,22,23,25,27,31,34]. The mean difference between the length of hospital stay pre- and post-intervention was calculated in a meta-analysis. Two studies [22,34] provided the mean and standard deviation (mean ± SD) for the number of hospital days. The other five studies provided the median with either the full range or interquartile range. For these five studies [18,23,25,27,31], the mean ± SD were calculated from the data provided, according to calculations set out in the following studies: Hozo, et al. (2005) [61], Luo, et al. (2017) [62] and Wan, et al. (2014) [63]. This is based on an assumption of normal distribution in these studies. There was a statistically significant mean difference between the two groups in favour of the wound bundle (MD=−0.79; 95% CI: −1.10 to -0.49; p<0.00001) (Figure S5).

Figure S5: Forest plot: Surgical Care bundles Vs. Control to reduce the length of hospital stay after colorectal surgery

Risk Factor Results: Four studies provided sufficient raw data to carry out a meta-analysis on risk factors for SSI [18,20,23,30]. The American Society of Anaesthesiologists Physical Status classification ≥III was found to be a significant preoperative risk factor (OR=1.66, CI=1.32-2.09, p<0.0001) (Figure S6).

Figure S6: Forest plot: ASA Grade >III Vs. ASA Grade <III.

A meta-analysis of diabetes was also carried out which showed a statistically insignificant decrease in SSI in patients with diabetes mellitus (OR=.40, CI=.12-1.33, p=0.13) (Figure S7).

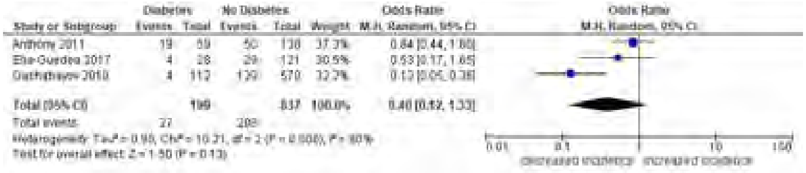
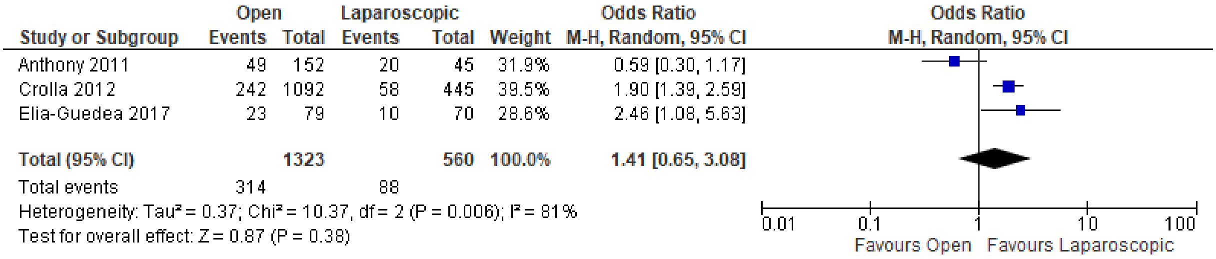


Figure S7 : Forest plot : Diabetes Mellitus Vs. Non-Diabetes Mellitus.

Another meta-analysis was carried out on open surgical approach vs. laparoscopic approach which showed an increased incidence in SSI in open approach however it was statistically insignificant. (OR=1.41, CI=.65-3.08, p=0.38) (Figure S8).



Study or Subgroup	Open Events	Open Total	Laparoscopic Events	Laparoscopic Total	Weight	Odds Ratio M-H, Random, 95% CI
Anthony 2011	49	152	20	45	31.9%	0.59 [0.30, 1.17]
Crolla 2012	242	1092	58	445	39.5%	1.90 [1.39, 2.59]
Elia-Guedea 2017	23	79	10	70	28.6%	2.46 [1.08, 5.63]
Total (95% CI)		**1323**		**560**	**100.0%**	**1.41 [0.65, 3.08]**
Total events	314		88			

Heterogeneity: Tau² = 0.37; Chi² = 10.37, df = 2 (P = 0.006); I² = 81%

Test for overall effect: Z = 0.87 (P = 0.38)

Figure S8: Forest plot: Open Approach Vs. Laparoscopic Approach.

A number of studies had insufficient data for forest plot analysis. Bert, et al. [17] reported the following significant risk factors for SSIs; intervention technique (endoscopic vs. open) (OR, 2.07; CI, 1.25-3.62), ASA score ≥ 3 (OR, 1.80; CI, 1.26-2.57), urgent procedures (OR, 1.81; CI, 1.22-2.66) and contamination class ≥3 (OR, 2.32; CI, 1.62-3.31). Ghuman, et al. [40] found that smoking (OR, 3.75; CI, 1.54-9.13; p = 0.004), diabetes mellitus (OR, 2.75; CI, 1.28-5.95; p = 0.009), and incision location (OR, 1.37; CI, 1.04-1.83; p = 0.03) were significant risk factors. Hewitt, et al. [26] reported that using a laparoscopic approach is a significant factor in reducing SSI (OR, .43; CI, .24-.77). Rencuzogullari, et al. [39] reported that open surgical approach (OR, 2.15; CI, 1.27-3.60; p=0.004), wound class III-IV (OR 13.2; 95% CI, 8.36-21.0; p<0.001) and BMI (OR 1.30; 95% CI, 1.14-1.49; <0.001) were found to be independent risk factors for SSI occurrence.

Discussion

This meta-analysis evaluated the efficacy of wound bundles in SSI reduction, based on a ten-year literature review, yielded 27 publications meeting quantitative criteria. Two were RCT and 25 were retrospective cohort studies. The overwhelming evidence supports the use of wound bundles, even with the recognised heterogeneity of the studies. Surgical site infection, including superficial, deep and organ space, is one of the most common complications following open and colorectal cancer surgery [64]. At the outset, there is a global challenge in relation to the definition and heterogeneity of both superficial and deep SSIs. The lack of standardization of wound event reporting is common both in colorectal and other areas of surgery [65]. DeBord, in an editorial review of the issue, looks at the concept of proposals to classify surgical site events and surgical site occurrences requiring procedural interventions [66]. Of the 27 papers used in our meta-analysis, 15 papers used the Centres for Disease Control and Prevention (CDC) definitions for SSI [12]. A further ten papers used the National Surgical Quality Improvement Program (NSQIP) which uses the CDC definition for the types of SSI. The two remaining papers used the European ECDC definition which is again the CDC definition.

Definitions and reporting of surgical site occurrences, first defined by the Ventral Hernia Working Group (VHWG) in 2010 [67] to include seroma, wound dehiscence, and enterocutaneous fistula have not been widely adopted thus far [66]. Only one study, Anthony et al. 2011**,** showed an increase in SSIs following application of wound bundles, which may have been due to their failure to include mechanical bowel preparation or oral antibiotic preparation.

There is a significant increase in SSI rate in urgent or emergency procedures due to a myriad of confounding factors such as poor preoperative preparation and both clean contaminated and dirty operations [17,68,69]. Watanabe, et al. [70] have suggested that in cases of colon perforation with generalised contamination, delayed primary skin closure or leaving an incision open to heal by secondary intention should be considered. This is increasingly challenged by more use of comprehensive wound bundles that include wound irrigation and incisional negative pressure therapies [71]. However, despite this, a significant proportion of dirty wounds (without fasciitis) are not closed primarily. In a study by Alkaaki, et al. [72], more than half (30/55 [54%]) of the infected patients in their study underwent emergency surgery and they found that emergency surgery increased the risk of SSI fivefold compared to elective surgery. Ensuring strict adherence of preventative wound bundles, especially in emergency procedures, may see a very significant reduction in SSI globally. Successful implementation of clinical guidelines to reduce hospital acquired infections is challenging. Some have evolved using protocol-driven reduction [73] and others have looked at multiple different implementation strategies [74]. The Institute of Healthcare Improvement (IHI) developed a concept of bundles. A bundle generally uses more than three evidence-based measures which implemented together are more effective than in isolation. Recently, Tomsic, et al. suggested that bundle size itself is important and in their analysis suggested that a bundle with more than eleven items have additional stand-alone benefit in surgical site reduction [75]

In our meta-analysis we identified that surgical site infections were significantly reduced with the use of wound bundles. With sub-analysis of SSI into superficial SSI, deep SSI and organ space SSI, there were differences in outcome. Superficial SSI and organ space SSI were significantly reduced by the bundle, whereas there was only a trend for deep SSI. The reason for this is not entirely clear and may relate to the variability in bundle elements used. Many studies did not use negative wound pressure dressings. Recently, Murphy and colleagues [76] in Canada identified that negative pressure in the Neptune study had no associated effect on SSI. They report a very high SSI rate, approaching 32-34%. However, in their study they did not report or use any wound bundle. This may account for the failure to obtain a significant reduction in infection. Ideally, bundles target areas for reduction in variation in the delivery of care focusing on three key phases pre-operative, intra-operative and post-operative. Bundles should not just involve the patient but also their family. Pop-Vicas and colleagues [11] published a recent meta-analysis on colorectal bundles for surgical site infection prevention in the journal of Infection Control and Hospital Epidemiology. Multiple papers on the same topic are important to reinforce an important clinical issue. Given the potential implications in terms of cost, prolonged hospital stay, patient discomfort, and the potential adverse oncological and survival effects of both superficial and deep SSI, it is important that surgeons and those involved in the primary care of colorectal cancer and colorectal benign patients implement aspects of care bundles that are proven.

Wound protectors are commonly used in colorectal surgery and are recommended in open abdominal surgery in the ACS and SIS Guidelines [60]. However, there are some conflicting results on this in the literature [60,77-79]. The combination of MBP and antibiotic (PO) preparation is recommended for all elective colectomies according to ACS and SIS guidelines [77]. Other surgical techniques such as quilting or killing the dead space to reduce seroma and the use of subcuticular suturing should be looked at with increasing evidence that these may reduce wound infection rates [80,81]. This paper did not specifically look at laparoscopic versus open colorectal surgery and this is something that will need to be done into the future, stratifying cohorts or having separate or comparative studies [82]. Although we found that colorectal wound bundles significantly reduce the risk of SSI and length of hospital stay our study has several limitations. Firstly the vast majority of the included studies were retrospective cohort studies with heterogeneous interventions; no assessment of risk of bias was carried out. Secondly the primary outcome measure of SSI does not have a specified length of follow-up. Thirdly only four studies provided sufficient raw data to carry out a meta-analysis on risk factors for SSI; a small number of patients were included in each analysis. In addition, the effect on wound bindle efficacy in patients with immune compromise, or ongoing Covid infection has not been widely studied.

Conclusion

This meta-analysis has identified significant reductions in wound infections with implementation of wound bundles. As Surgeons we have the responsibility to ensure we routinely use wound bundles which should become routine in colorectal surgery. Future work encompasses the need for standardisation of wound complications, standardised follow-up of patients and internationally agreed research definitions.

References

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Mesenteric Ischaemia-Data the key

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Acute Mesenteric Ischaemia

Acute mesenteric ischaemia (AMI) is a notorious disease of the elderly with the highest mortality rates of all diagnoses, usually reported between 50% and 80%. According to recent experiences, it is very likely that mortality can be significantly lowered by enhancing local protocols. Patients should be diagnosed and managed before vast bowel necrosis and acute organ dysfunctions have developed. Avoiding delays in all phases is of utmost importance.

AMI may have an arterial or venous aetiology. Venous disease is less common and generally it has a more subtle presentation. The arterial AMI is further classified into occlusive superior mesenteric artery (SMA) thromboembolism and nonocclusive mesenteric ischaemia. This text focuses solely on occlusive arterial AMI. When looking at all the emergency department visits, AMI may be considered rare (1:1000). However, the incidence rises exponentially with age. In fact, in patients older than 75 years complaining abdominal pain, it is more likely to diagnose AMI than acute appendicitis.

AMI patients should be referred, as early as possible, into a surgical unit with capabilities of definitive management. Optimal management requires a truly multidisciplinary approach and a well-staffed and well-equipped hospital, preferably with nonstop access to hybrid operating theatres. The key components to lowering mortality in AMI are fast diagnosis with appropriate CT imaging and decisive revascularization without delay.

Everything starts with a high index of suspicion and widespread awareness of AMI. Not just in large hospitals, but in all units with emergency visits. A suspicion should rise if an elderly patient with cardiovascular risk factors presents with mid-abdominal pain, often accompanied with vomiting or diarrhea. The pain is often out of proportion compared to palpation.

When suspicion rises, patient should be immediately referred to a competent unit. Diagnostic imaging is pursued simultaneously with fluid resuscitation, oxygen, and broad-spectrum antibiotics. The diagnosis is made by a tri-phase CT angiography with precise interpretation. The quality of the radiology report is enhanced if AMI suspicion is written on the referral. Intravenous contrast enema is given regardless of kidney function. Laboratory exams are not diagnostic but reflect disease severity, the results should not be waited before imaging decision is made.

Once the diagnosis or justified suspicion of AMI is reached, the focus needs to be on revascularization. Revascularization is optimally performed in a hybrid operating theatre with endovascular and open surgical options as well as sufficient expertise either by endovascularly trained vascular surgeon or interventional radiologist. When AMI is caused by embolism, the embolectomy may be performed endovascularly or with open embolectomy. In case of thrombosis, the preferred revascularization method is endovascular stenting of the SMA either via percutaneous access or open surgical retrograde access. If these are unsuccessful or impossible, open bypass surgery is the next option. The result of the revascularization is controlled and documented with control angiogram of flow measurement. Appropriate anticoagulative and/or antithrombotic medications are used.

In case of suspected transmural necrosis, laparotomy is done, and necrotic bowel segments are resected. In most cases the demarcation line of the necrosis is not clear in the early phases and damage control – strategy is advised, i.e. leaving stapled bowel ends without continuity and using open abdomen management with a negative pressure wound therapy device. Postoperatively patients are optimally managed in an intensive care unit. Relaparotomy is performed approximately 48 hours after the index operation when the abdomen is left open. Only approximately half of AMI patients require bowel resection and laparotomy is not mandatory in all patients. In those cases, close observation after successful endovascular revascularization procedure is mandatory.

The management of AMI is truly multidisciplinary and resource intensive. Locally trimmed prespecified protocols have shown to improve diagnostic process, shorten delays, enhance revascularization, and, hence, lower mortality. A clear division of labor between specialties is mandatory for effective management. Patients need to be considered as surgical emergencies of highest priority despite their clinical status, comparable to penetrating trauma or ischemic stroke. Improving and maintaining good results depends on continuous training and enhanced regional awareness of AMI.

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Improving outcomes in abdominal wall surgery

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Midline laparotomy and its sequent closer is one of the first, and most fundamental, skills we are taught in our training and practice as general and emergency surgeons. Despite over 30 years of minimally invasive techniques, it remains the workhorse incision for abdominal surgery. Basic scientific research, both biomechanical and clinical, has interrogated each step in the process from skin incision to breaching the peritoneum, maintaining and maximising sterility throughout the procedure, and the ultimate abdominal closure. As practicing surgeons, we must stay up to date with evolving practice and evidence to ensure we minimise the risks of wound infection, dehiscence, and incisional hernia for our patients.

The STITCH trial has been a significant step towards a paradigm shift in our approach to abdominal closure. Conventional mass closure techniques with large diameter sutures has been demonstrated to carry with it a higher risk of incisional hernia at 1 year, when compared to so-called "small-bite" (5mm separation, 5mm wide) closure technique (21% vs 13%). This has convinced many of us that it is time to revisit our approach and pivot from the methods we were taught in training.

Surgical wound care bundles have been demonstrated to substantially reduce surgical site infections following laparotomy from as high as to 17% to 4%. These modest interventions entail a bundled approach to pre-operative, intra-operative and post-operative patient management and operative technique. Pre-operative chlorhexidine shower, use of alcohol based aseptic solution, patient hair preparation, perioperative antibiotic prophylaxis, intraoperative glucose control, use of a wound protector, intraoperative irrigation, fresh closure instruments, small-bite closure techniques, and use for negative pressure wound therapy systems are an example of wound care bundles components with considerable evidence basis to support their use. The use of prophylactic mesh placement is emerging as a safe approach in further augmenting and reducing the risk of incisional hernia, however, reservations regarding mesh related complications has resulted in inertia regarding its widespread intervention amongst the surgical community particularly given the media attention given to meshes over the last decade. Accurate recording of wound related complications – most notably infection, dehiscence, and hernia – is essential to ensure correct auditing of post operative outcomes and databasing. We need to be recording intraoperative and classifying our wound infections when they occur. Emergency surgery departments need to design localised protocols for surgical wound care bundles, wound related complication data collection, and robust clinical audit to ensure optimised patient outcomes. Multidisciplinary team buy in from surgeons, anaesthetists, ward and theatre nursing, and clinical directorates is essential to the success of these programs.

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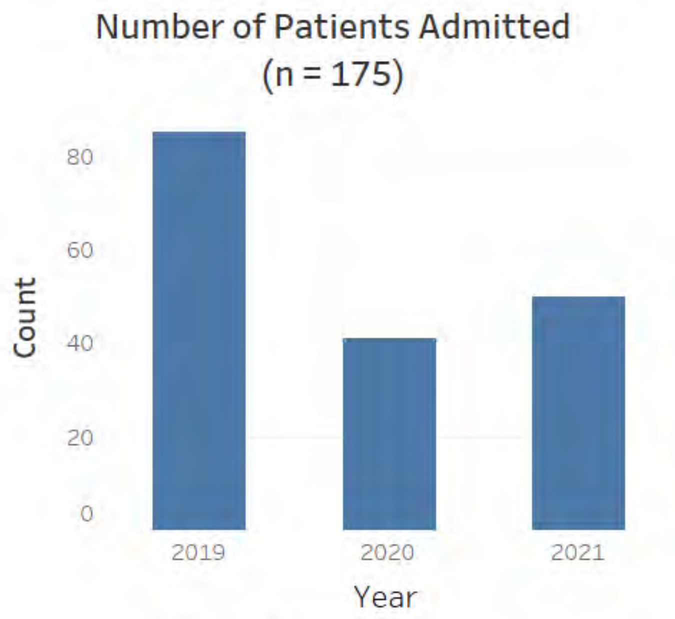
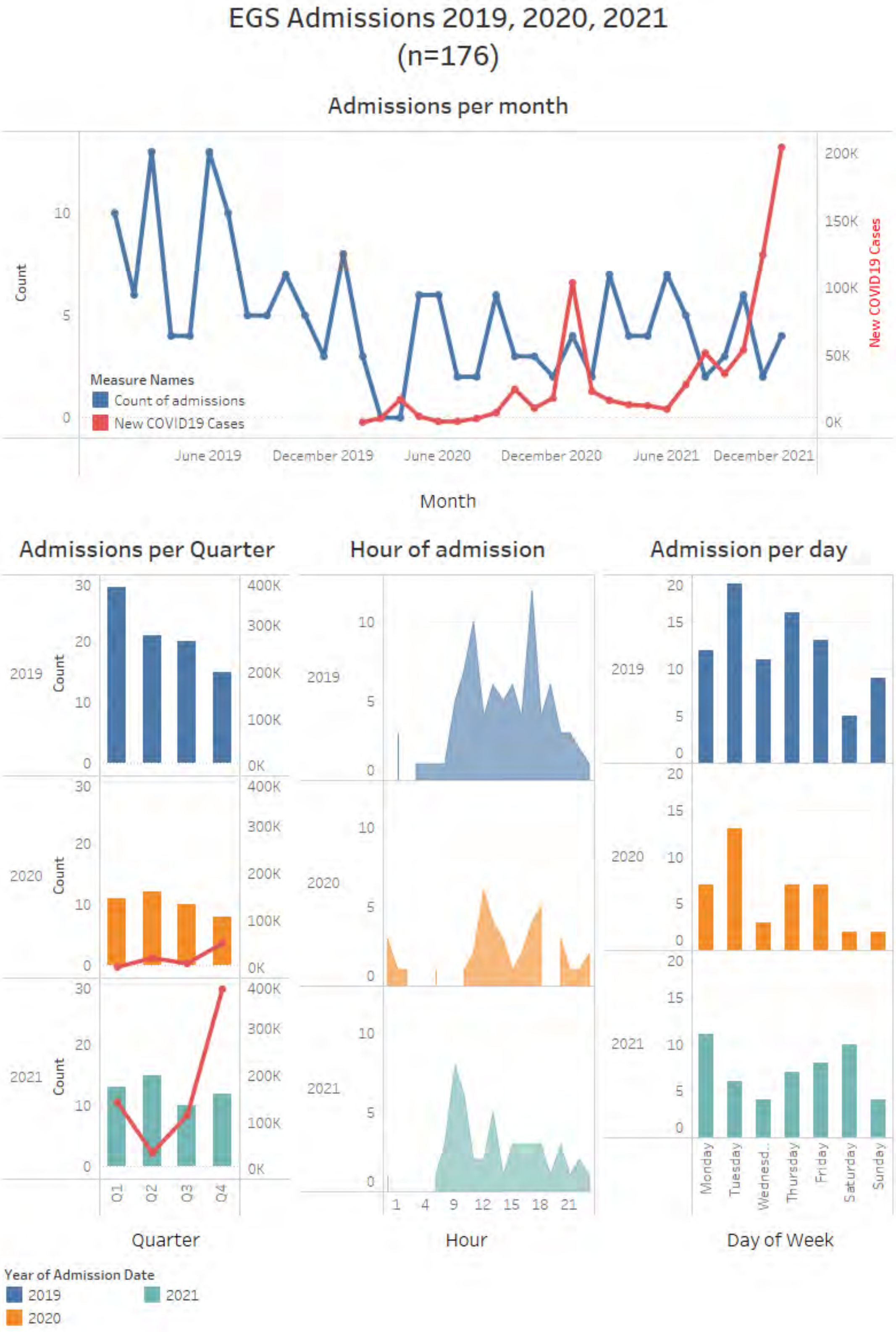
Final Diagnosis: Diverticulitis



Number of Patients Admitted
(n = 175)

Registered ED time

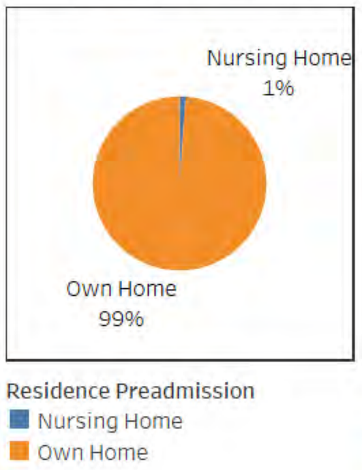

EGS Admissions 2019, 2020, 2021
(n=176)
Admissions per month
Count
10
5
0
200K
150K
100K
50K
0K
New COVID19 Cases
Measure Names
Count of admissions
New COVID19 Cases
June 2019
December 2019
June 2020
December 2020
June 2021
December 2021
Month
Admissions per Quarter
Hour of admission
Admission per day
2019
2020
2021
Count
30
20
10
0
400K
300K
200K
100K
0K
Q1
Q2
Q3
Q4
Quarter
1
4
9
12
15
18
21
Hour
Monday
Tuesday
Wednesd..
Thursday
Friday
Saturday
Sunday
Day of Week
Year of Admission Date
2019
2021
2020

Age Distribution of EGS Admissions 2019, 2020, 2021 (n=176)

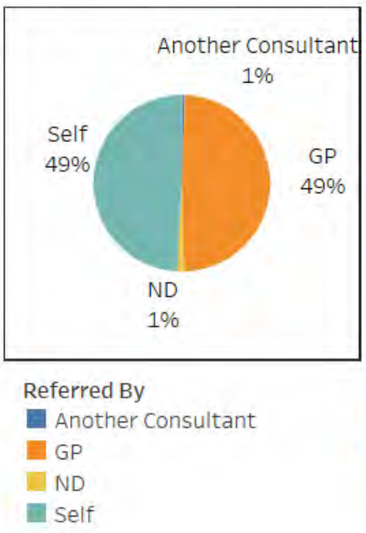
	Female	Male
Median Age	66	55

Patient Journey in 2019, 2020, 2021
(n=176)

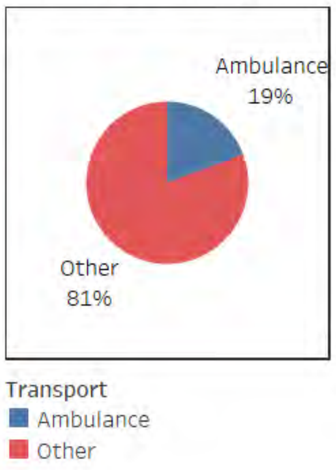
Residence Predamission



Source of Referral

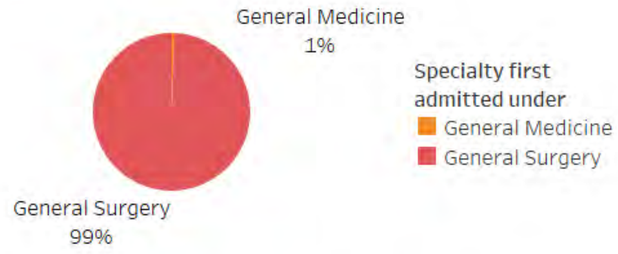


Transport to Hospital

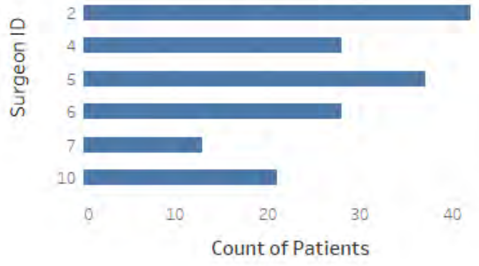


Specialty & Surgeon 2019, 2020, 2021
(n=176)

Speciality Admitted Under

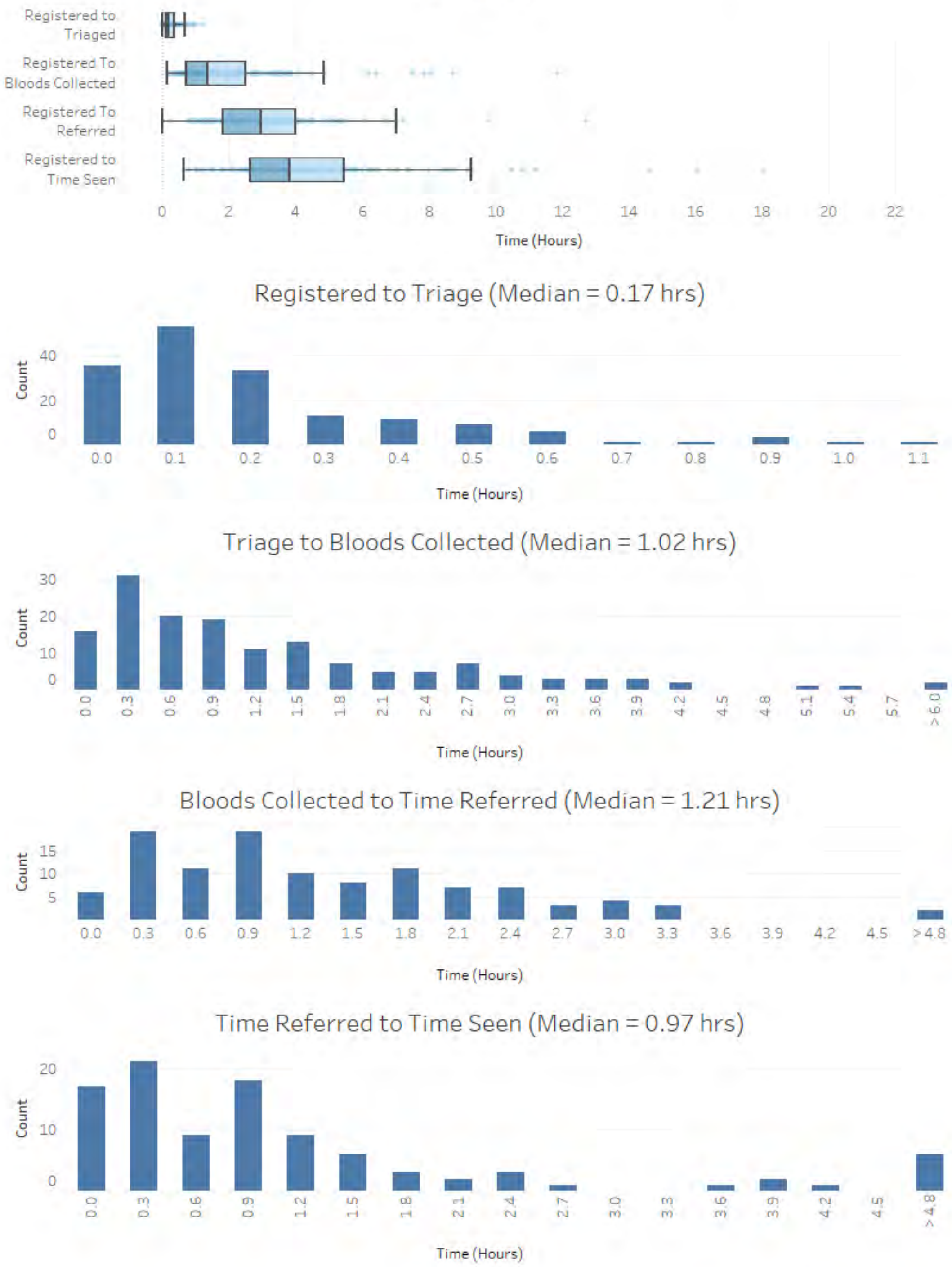


Surgeon



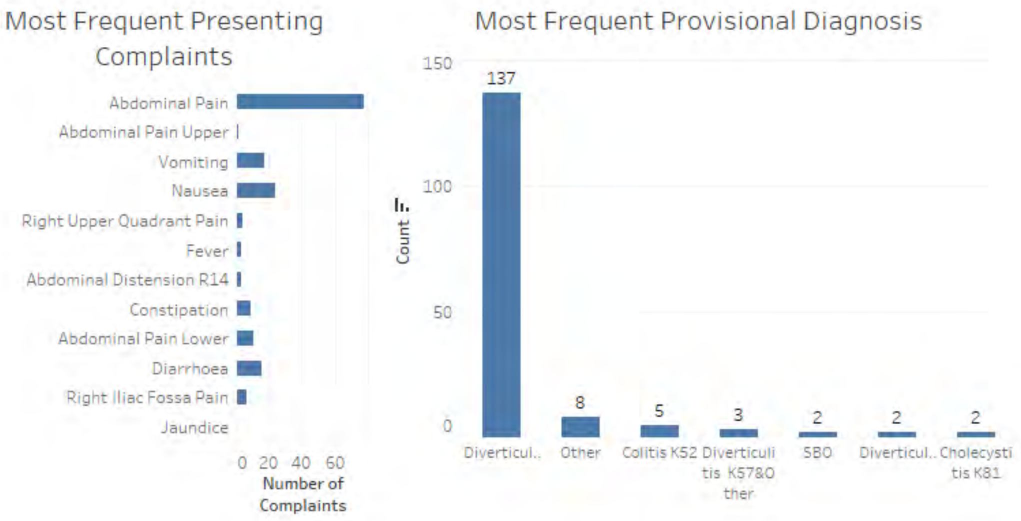
Surgeon by year

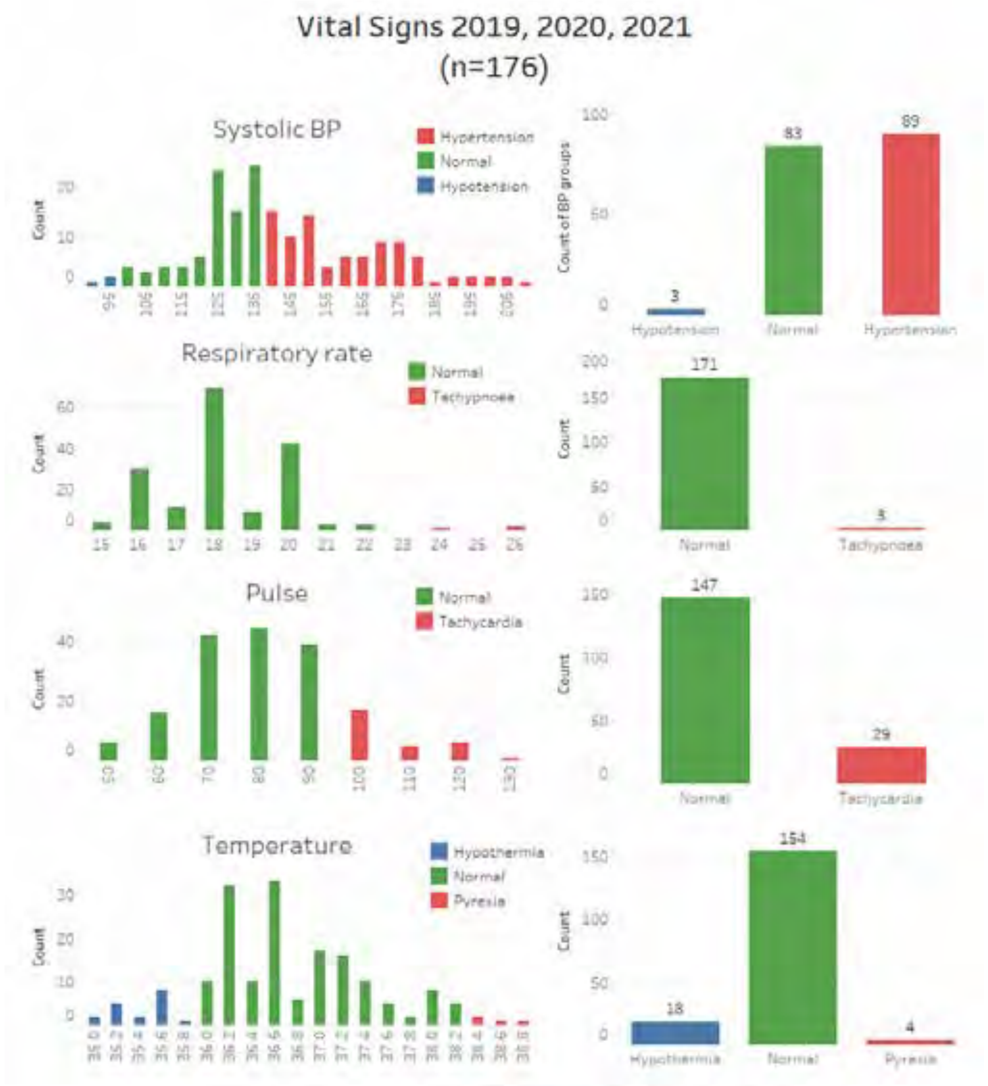
Consultant Surgeon	2019	2020	2021	Grand Total
2	28	4	10	42
4	13	12	3	28
5	15	7	15	37
6	14	5	9	28
7	13			13
10		13	8	21

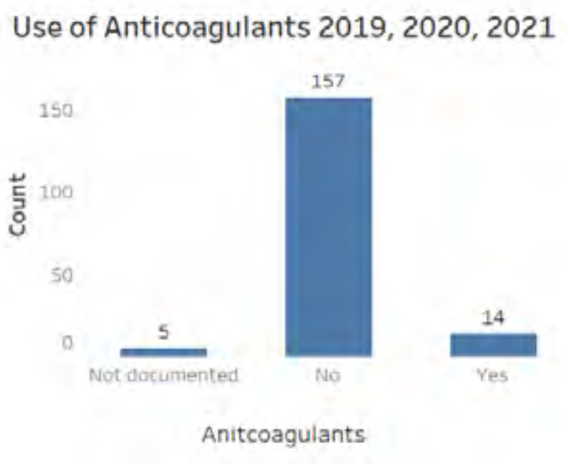


Emergency Department Times 2019, 2020, 2021 (n=149)

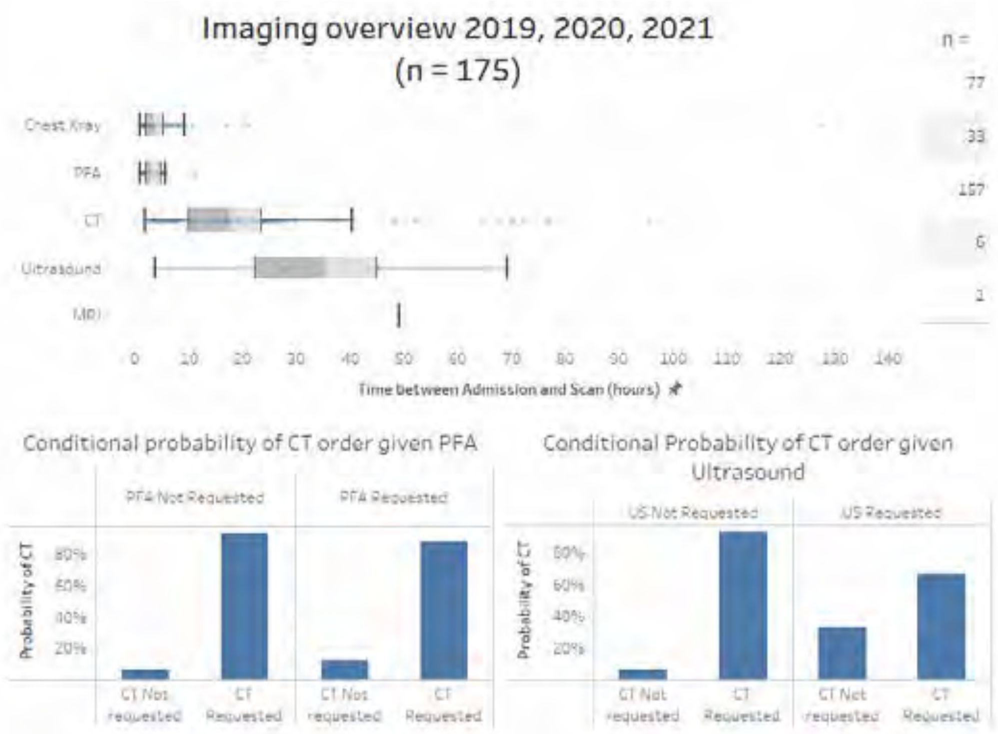
Presenting Complaints & Diagnoses 2019, 2020, 2021 (n=176)

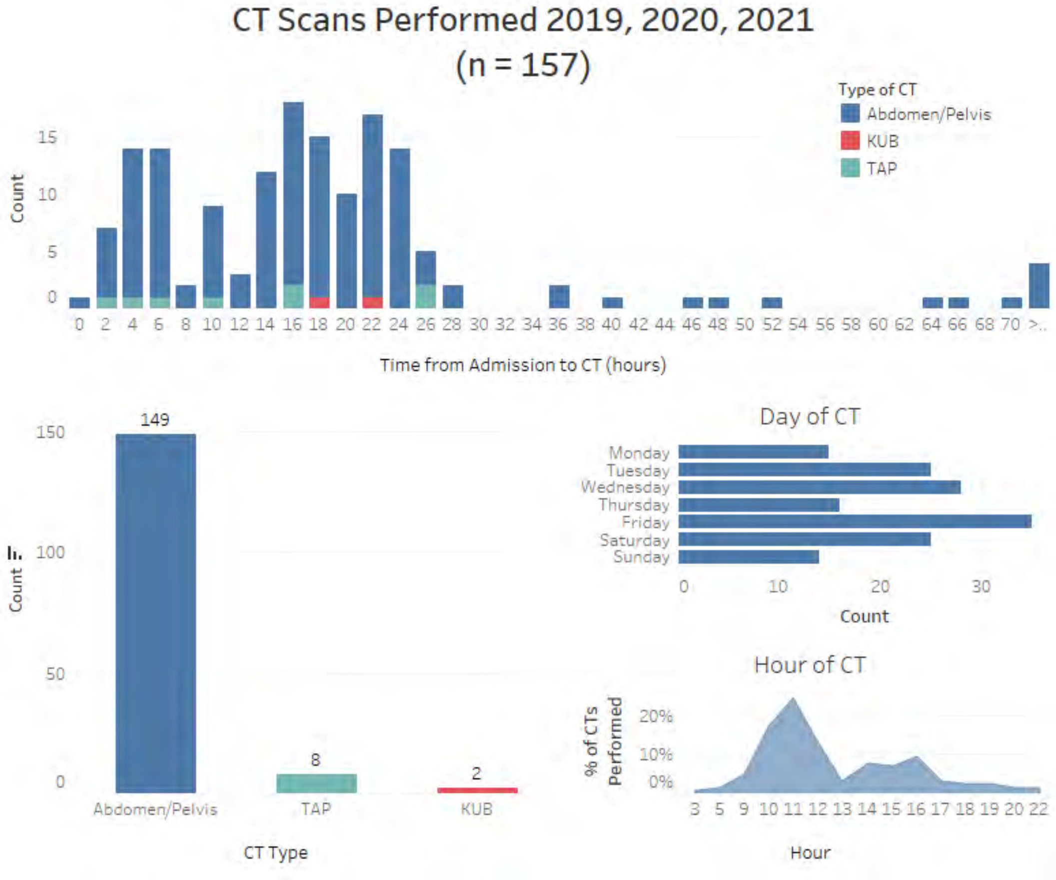



Vital Signs 2019, 2020, 2021
(n=176)
Systolic BP
🟥 Hypertension
🟩 Normal
🟦 Hypotension
Count
0
10
20
95
105
115
125
135
145
155
165
175
185
195
205
Count of BP groups
0
50
100
3
83
89
Hypotension
Normal
Hypertension
Respiratory rate
🟩 Normal
🟥 Tachypnoea
Count
0
20
40
60
15
16
17
18
19
20
21
22
23
24
25
26
Count
0
50
100
150
200
171
3
Normal
Tachypnoea
Pulse
🟩 Normal
🟥 Tachycardia
Count
0
20
40
50
60
70
80
90
100
110
120
130
Count
0
50
100
150
147
29
Normal
Tachycardia
Temperature
🟦 Hypothermia
🟩 Normal
🟥 Pyrexia
Count
0
10
20
30
Count
0
50
100
150
18
154
4
Hypothermia
Normal
Pyrexia

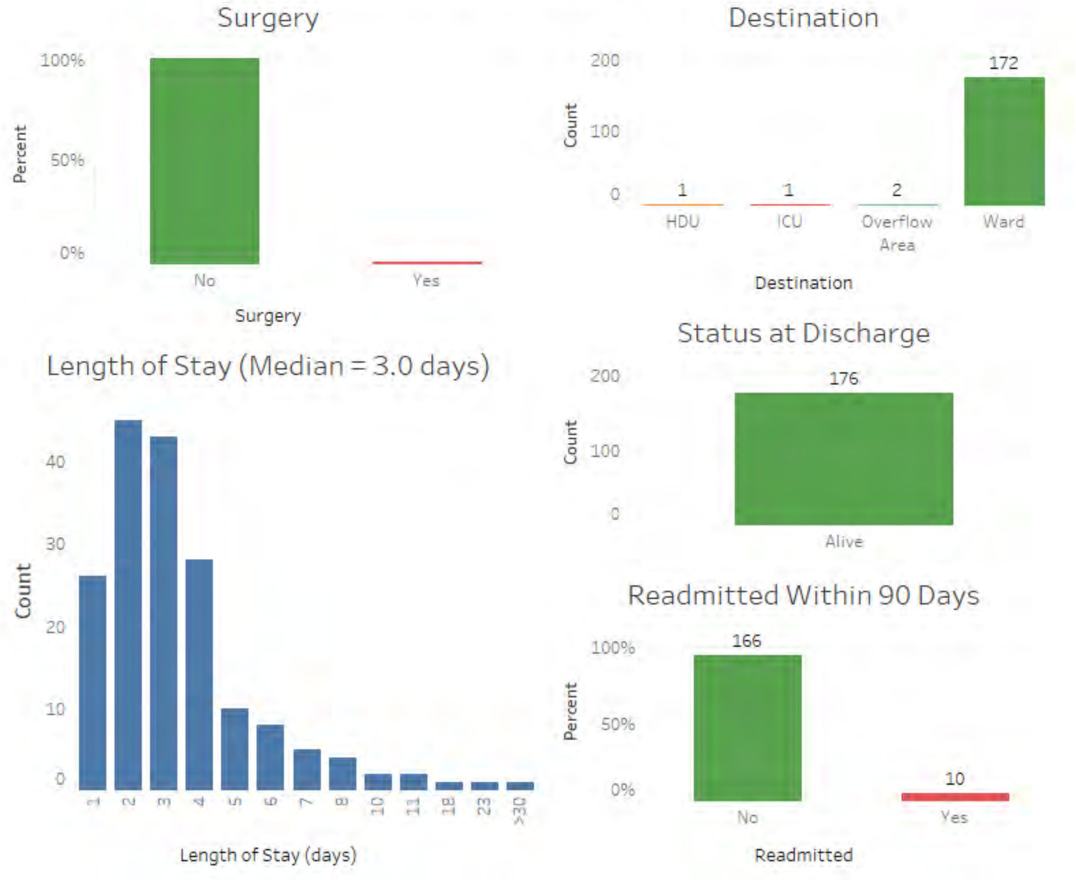

Use of Anticoagulants 2019, 2020, 2021
Count
0
50
100
150
5
157
14
Not documented
No
Yes
Anitcoagulants

Lab Results 2019, 2020, 2021 (n=172)


Imaging overview 2019, 2020, 2021
(n = 175)
n =
Chest Xray
77
PFA
33
CT
157
Ultrasound
6
MRI
1
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
Time between Admission and Scan (hours)
Conditional probability of CT order given PFA
PFA Not Requested
PFA Requested
Probability of CT
80%
60%
40%
20%
CT Not requested
CT Requested
CT Not requested
CT Requested
Conditional Probability of CT order given Ultrasound
US Not Requested
US Requested
Probability of CT
80%
60%
40%
20%
CT Not requested
CT Requested
CT Not requested
CT Requested


CT Scans Performed 2019, 2020, 2021
(n = 157)
Type of CT
Abdomen/Pelvis
KUB
TAP
Count
15
10
5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 >..
Time from Admission to CT (hours)
149
150
100
50
0
Count
8
2
Abdomen/Pelvis
TAP
KUB
CT Type
Day of CT
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0
10
20
30
Count
Hour of CT
% of CTs Performed
20%
10%
0%
3 5 9 10 11 12 13 14 15 16 17 18 19 20 22
Hour

Patient Outcomes
2019, 2020, 2021 (n = 176)



Patient Outcomes by Lab Results
2019, 2020, 2021 (n = 176)

Diverticultis where we need to go

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Diverticula are small outpouchings of the lumen of the colonic wall which are usually asymptomatic. When one or more diverticula become inflamed, this is called acute diverticulitis. In other words, diverticulitis is an inflammatory complication of diverticulosis. Acute diverticulitis can be divided into uncomplicated or complicated. It is crucial to initially differentiate between uncomplicated and complicated diverticulitis as treatment differs.

Acute diverticulitis and its treatment are surrounded by beliefs and traditions, partly because of previous scarce or low quality of evidence on several topics. Although diverticulitis research did not reach its end, a great deal is to be gained by replacing expert opinion by evidence-based management.

The recent European Society of Coloproctology (ESCP) guideline recommends CT as the first-line investigation in suspected diverticulitis. [1] CT has a high sensitivity and specificity in the diagnosis of acute diverticulitis. Ultrasound (US) and MRI are alternatives. US has a good specificity for acute diverticulitis in general but a more limited sensitivity, has the advantages of avoiding ionizing radiation and can be useful in pregnancy, same as MRI. However, US is less accurate for abscess identification and other forms of complicated diverticulitis, and exclusion of other gastrointestinal disorders. A plain radiograph is not useful in the evaluation of acute abdominal pain because of its very limited sensitivity and ultralow specificity.

Non-antibiotic treatment of uncomplicated acute diverticulitis is one of those topics. Traditionally, all patients were treated with antibiotics but benefits of this strategy have never been proven. Following the Scandinavian randomized AVOD trial in 2012, the Dutch DIABOLO trial in 2017, and the IPDMA of both trials in 2020, clearly no benefit can be found of antibiotics on short- and long-term, quality of life or in costs. [2] Observational treatment of uncomplicated diverticulitis opens the door for outpatient treatment of uncomplicated diverticulitis; this has resulted in low readmission rates and very low rates of complications. Furthermore, healthcare cost savings of outpatient treatment of uncomplicated diverticulitis are substantial. Currently, there is inconsistency among guidelines whether or not to treat uncomplicated diverticulitis with antibiotics. The ESCP guideline states that patients with acute uncomplicated diverticulitis do not require antibiotics routinely. Antibiotic treatment should be reserved for immunocompromised patients and patients with sepsis (evidence level 1, strong recommendation, consensus 100%). Patients with radiological signs of complicated diverticulitis should normally be treated with antibiotics (evidence level 3, conditional recommendation and consensus 100%). [1] Nevertheless, some guidelines such as the also recent EAES/SAGES guideline [3] are still leaning towards antibiotic treatment for uncomplicated diverticulitis because of unfounded doubts about the generalisability of the findings to the American population. The downsides of antibiotics are adverse effects, effects on gut microbiome and antimicrobial resistance, and may be underestimated and underreported. This should receive a more important role in the decision making on (non-)antibiotic treatment. Whereas in other diverticulitis topics more research is needed, the evidence on omitting antibiotics for uncomplicated diverticulitis mainly needs solid implementation in coming years.

In the current trend towards more conservative treatment of acute diverticulitis, selection of patients that may not be candidates for conservative treatment becomes more important. By identifying these patients, individualized rather than routine treatment strategies become feasible in the future. Almost no research had been done on the identification of patients with initially uncomplicated diverticulitis that progresses into complicated diverticulitis. Most of the published research is cross-sectional research focussing on risk factors for complications at presentation. Although observational cohort studies may be more difficult or time consuming to perform than cross-sectional studies, such studies are needed to provide the direct evidence for use in daily practice. In a secondary analysis of the DIABOLO trial, patients with a complicated course of initially uncomplicated diverticulitis more frequently have fluid collections (25 vs. 0%; $p = 0.009$) and have a longer inflamed colon segment (86 ± 26 mm vs. 65 ± 21 mm; $p = 0.007$) on their initial CT compared to an uncomplicated course of disease. Pericolic extraluminal air is no predictive factor.

Whereas the treatment of uncomplicated diverticulitis and perforated diverticulitis has been studied in several RCTs in recent years, the treatment of diverticular abscesses still needs an evidence-based approach. Since approximately 15% of all acute diverticulitis patients present with an abscess, it is a highly relevant research topic. A relatively large number of studies have been performed on this topic; however, they are all observational cohort studies mainly focussing on the natural course of diverticular abscesses. Because of a very high risk of selection bias for the treatment strategies (antibiotics, percutaneous drainage, or surgical drainage), outcomes of these treatment options cannot be compared with each other.

Retrospective analysis of prospective data assessed the natural course of abscesses up to five centimetres and found that abscesses smaller than three centimetres may not need invasive treatment, whereas abscesses larger than three centimetres do need percutaneous drainage. More research is needed to assess which abscesses are likely to fail percutaneous drainage and may initially need surgery. Ideally, a RCT comparing these treatment strategies in patients with diverticular abscesses would be performed. However, this may be difficult to do successfully given the relatively low number of patients and the struggles of several other RCTs on diverticulitis to recruit patients in an emergency setting.

Standard treatment for perforated faecal acute diverticulitis (Hinchey IV) is surgical resection, using a laparoscopic or open procedure dependent on the expertise of the surgeon. Laparoscopic lavage is feasible in selected patients with Hinchey III peritonitis, according to the results of at least three RCTs with long-term follow-up. Associated with this treatment strategy is a much lower stoma rate compared to acute resection, and the acceptance that about 1 in 4 to 5 patients need reoperation (mostly for resection) after laparoscopic lavage.

In past decades, patients underwent a sigmoid resection to prevent recurrent diverticulitis. Currently, they are managed conservatively more often and is debate focussed on the right moment to offer a patient a resection. Although the DIRECT trial recently has shown that surgery improves the quality of life in patients with several previous acute diverticulitis episodes compared to conservative treatment, the selection of patients who indeed may benefit from surgery remains difficult. Pharmacological prevention of recurrent diverticulitis, if proven effective, seems therefore to be preferable over surgery. However, despite several attempts to find a pharmacological agent to prevent recurrences, no clear successes have been accomplished. Rifaximin, a poorly resorbable antibiotic agent, shows to be ineffective in a proof-of-concept RCT. Four RCTs on mesalazine, an anti-inflammatory agent, also show no reduction in recurrent diverticulitis or persistent complaints. Furthermore, probiotics show no beneficial effects either. All these therapies have been tested because of different theories about the pathophysiology of acute diverticulitis. Despite its very frequent occurrence, the pathophysiology of acute diverticulitis still is unknown. In recent years, the hypothesis that acute diverticulitis may be an inflammatory bowel disease and gut microbiome may play an important role, gained ground. Rather than testing random new treatment strategies, it may be more appropriate to focus on revealing the pathophysiology of acute diverticulitis first. With this information, future studies can study pharmacological agents specifically focussed on the origin of acute diverticulitis. Prevention of acute diverticulitis altogether may be a goal in the future. However, since only 4% to 7% of patients with diverticulosis develop acute diverticulitis, it is unlikely that having diverticulosis would motivate otherwise healthy patients to take medication to prevent such a small risk of acute diverticulitis. Due to the transient nature of uncomplicated acute diverticulitis, prevention probably needs to be focussed on the prevention of complications in patients with an acute episode of diverticulitis and prevention of recurrent disease.

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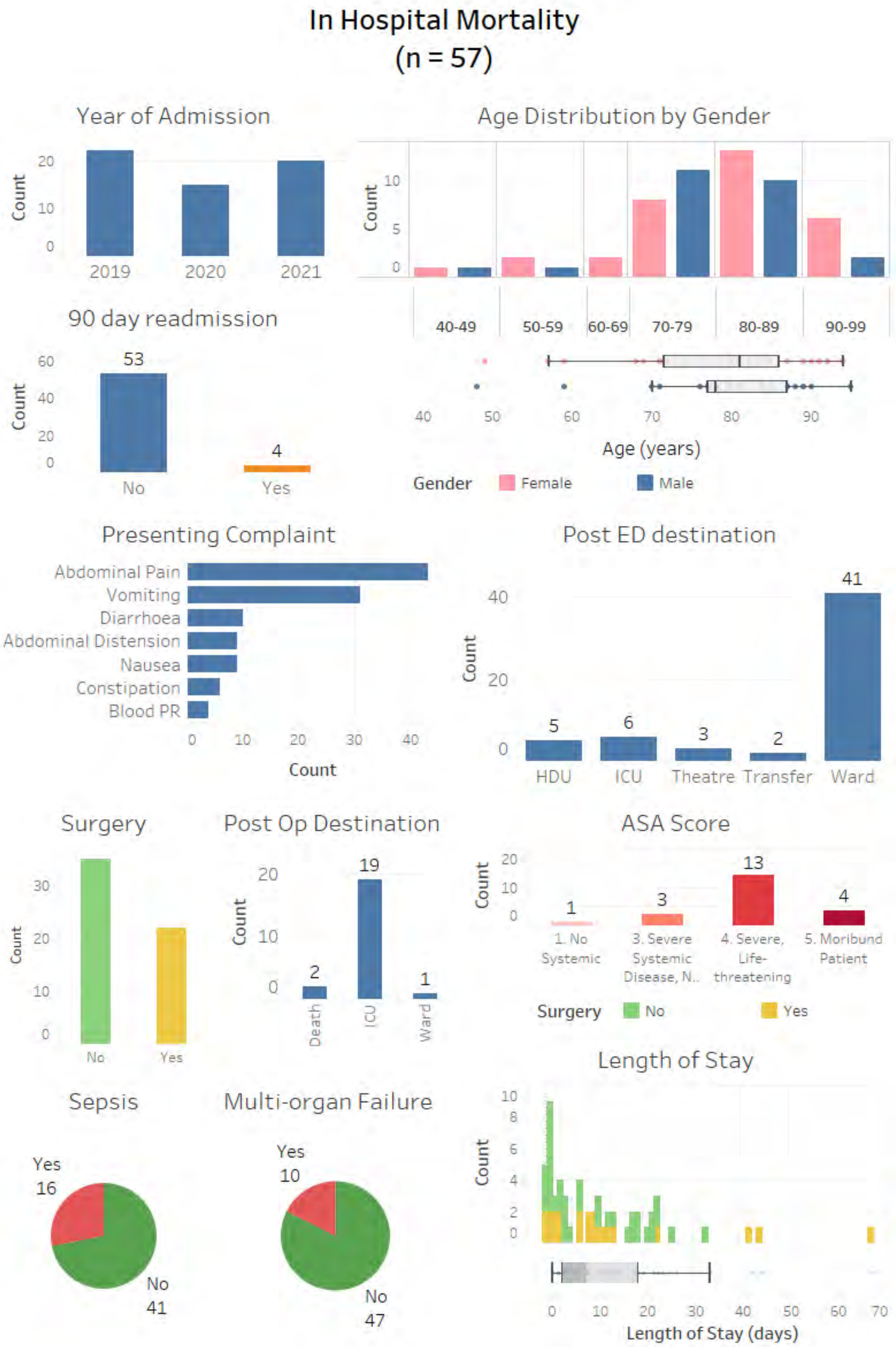
Mortality

(NB Does not include Trauma, Vascular, Cellulitis or Urology)



Large bowel obstruction improving EGS Care

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Large bowel obstruction (LBO) is a regular feature of the emergency surgical week. It is associated with a variety of pathologies of which bowel cancer is foremost in the diagnosing clinician's mind. Up to 30% of colorectal cancer patients are admitted as a surgical emergency, some already with evidence of metastatic spread. The majority of obstructing cancers occur below the splenic flexure. Worldwide, colonic volvulus is the next most frequent aetiology followed by the benign 'strictures' encompassing inflammatory bowel disease, complicated diverticulitis, and ischaemia. There are also the more scarce presentations, such as abdominal wall or internal hernias and carcinomatosis, which can keep the clinical team thinking1.

LBO is a good test of the Emergency Surgical care-system as care of the obstructed patient will involve many healthcare disciplines. The patient will journey through emergency medicine, radiology (+/- intervention), urgent theatre, critical care, enhanced recovery and will be looked after by nearly all the healthcare professions. Recognition and resuscitation of patients with LBO requires a significant investment in workforce education. Complications are common in this patient group and the salvage of people who have had an adverse outcome is a further test of the wider hospital team. Achieving good, and consistently good, outcomes in this patient group is challenging. Measuring and benchmarking team performance is a key outcome of the ESOP programme.

Improving surgical outcomes in EGS in general and LBO, in particular, is all about marginal gains. The 90 day mortality of colorectal patients after emergency surgery is 6 times that of the elective patient. There is not a 'silver bullet' which will singularly and dramatically change the fortunes of these patients. To achieve sustainably good results healthcare organisations need to 'measure and reflect'. Reflection with a view to implementing productive change requires investment in the long term. The best technical surgeon will fall down if there are no critical care beds, the high-functioning EGS team will fail without timely access to intervention radiology, more patients will die unless healthcare staff are adequately trained to recognise the deteriorating septic patient on the post-operative ward.

Investment in time, as well as money, will allow organisations to do just that: organise. The LBO patient can therefore expect to be rapidly resuscitated, scanned, diagnosed and looked after in a dedicated and appropriately staffed emergency surgery environment overseen by the most senior decision makers. Quick access to intervention radiology for metallic stenting (aiming for a 90% success rate), or to a dedicated emergency operating theatre will save lives as well as stomas. In addition, where possible, access to sub-specialty expertise, will further improves outcomes. Critical care bed provision is crucial and appropriate step down facilities with good rehabilitation will facilitate earlier discharge of this patient group2.

There is a great deal of work to be done and Professor Sugrue and his team should be congratulated for shining the light and leading the way forward in Emergency General Surgery.

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The subspeciality surgeon and provision of EGS care

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Altnagelvin Area Hospital Derry
Western HSCT

As a General Surgeon with subspecialty interest in Oncoplastic Breast Surgery, I find this contemporaneous review of evidence and outcomes pertaining to EGS highlights current areas of strength and others domains requiring targeted improvement. Our teams continue to strive for best management of our patients. Reflecting insightfully on our past outcomes, this report provides a benchmark for all clinicians to refer to for future performance optimisation.

Laparotomy Outcomes making a difference

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Over the past two years, both our personal and work lives have been consumed with the COVID-19 pandemic. It has taken up the headlines, our headspaces and even the majority of peer reviewed publications. While the death toll from COVID-19 globally is being predicted and presented in real-time, the collateral damage from the pandemic may never be fully understood.

As this current report from the Emergency Surgery Outcomes Advancement Project (eSOAP) shows, emergency surgery provision is a vital part of all health care systems. However, the COVID-19 pandemic has had a major impact on surgical provision as ventilators, hospital space and personnel were redeployed [1]. In addition, there has been reduced capacity for acute care [2], limited availability of critical care [3], the cancellation of elective surgery [4], and national guidance for clinicians to reassess thresholds for emergency surgery, while considering non-surgical approaches for common surgical conditions [5, 6]. Furthermore, emergency surgical patients who were COVID-19 positive have had higher than expected mortality [7-9].

While the eSOAP data also provides professional bodies for surgery, anaesthesia and perioperative care to benchmark services to reduce variation in care, it can aid policy-makers. eSOAP provides healthcare systems data to ensure that treatment pathways for acute surgical conditions are monitored and maintained. It also provides examples of best practices such as reducing length of stay.

The focus for all those involved in the care of emergency surgical patients should be systems with the potential to rapidly scale during surges in demand, such as seasonal variations and the next pandemic. eSOAP provides a framework to make this happen.

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Data Dictionary

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Data Dictionary

Emergency general surgery is an expanding discipline accounting for over ten percent of hospital admissions worldwide (Lyu 2018). It is estimated that one million people die annually related to emergency surgery primary pathology and complications. It accounts for one of the highest morbidities and mortalities currently seen in medicine (Havens et al 2015).

Emergency general surgery metrics provide a mechanism to understand the natural history, current presentations, investigations, management and a potential pathway to improve outcomes (Parlour et al. 2019). The quality of data entry and its accuracy is essential to any functioning registry.

A data dictionary will ensure consistency of terminology and increase accuracy of data entry (Garcia-Doval et al. (2018)). Data dictionaries are important tools in data analysis, clinical service delivery and research but must be reproducible and accurate.

The Emergency Outcome Performance Summit held in Donegal in 2017 defined the minimum standards required for a functioning emergency general surgery registry (Sugrue et al. (2017)). The emergency general surgery registry's minimum dataset (MDS) was developed by the Emergency Surgery Outcomes Advancement Project (eSOAP) team over a ten month period from March to December 2018. A multi-disciplinary input was obtained from surgeons, emergency physicians, nurses, health economists, health informatics experts and epidemiologists. A consensus methodology was used to develop each data element. This was achieved via email and discussions with the relevant stakeholders. Following the identification of the key core components of the emergency general surgery registry's MDS, the data dictionary was developed to identify, define and give data abstraction instructions for each data element. The data dictionary followed the patient flow reflecting the registry enrolment which includes; patient identifiers and demographics, emergency department variables, comorbidities, imaging, disposition, surgery and post-operative outcome.

The MDS has a total of 60 data entry variables which are outlined in the data dictionary. Clear definitions and data entry instructions were identified to ensure consistency and that the data integrity is maintained. The data dictionary comprises of a) Relevance of Data points, b) Definitions, c) Criteria, d) Options and e) Notes. A list of the dropdown menu for each relevant variable is given in the options menu. Within the data dictionary all presenting complaints and procedures are coded with the International Classification of Disease (ICD) 10 codes (World Health Organization (2004)). This is an international recognised method of coding disease and procedures by the World Health Organisation (WHO). A total of 275 ICD-10 codes have been utilised for coding of presenting complaints, diagnoses and procedure codes.

The Clavien Dindo International Classification of Surgical Complications are also utilised to code complications (Clavien et al. (2009)).

Following the development of an emergency general surgery registry a data dictionary was successfully defined.

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The Patient

Involving the patient in EGS; The Benefit of Patient Advocacy Groups

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Background:
Emergency general surgery (EGS) is carried out for urgent, in some cases life threatening medical conditions such as serious surgical patient presentations. These incidences are, in many cases life changing for patients and impact on their physical, psychological, social and emotional wellbeing. The quality and safety of care and patient outcomes should always be a central tenet within the patient pathway. The establishment of focused advocacy groups to support patients who have undergone emergency general surgery are vital for the delivery of patient-centred outcomes. This process has the potential to influence and support nursing and medical teams to evaluate care delivery and enhance the emergency surgery patient pathway.

An International Patient Advocacy Group for patients who have undergone emergency general surgery (EGS) was established in September 2021. The group was supported by the Association of Surgeons of Great Britain and Ireland (ASGBI). Members include Clinical Nurse Specialists, Advanced Nurse Practitioners, Consultant Surgeons and patients who have undergone emergency general surgery.

The average age of patients was 45-50 years old. The inaugural meeting of the group was held via a virtual platform. There was a total of ten patients that contributed, seven attended and three shared their thoughts via email prior to the meeting. Permission from the patients who contributed to the group meeting was obtained successfully prior to their involvement. Subsequently, their thoughts and their perspectives were included as influencing factors to the patient pathway in EGS.

Outcomes from the International Patient Advocacy Group
The advocacy group provides an avenue to host an open discussion and provides space and time for patients who have undergone EGS to share both positive and challenging experiences. A broad discussion ensued at the virtual advocacy group around the potential issues and values that the group could develop to enhance patient involvement in contributing to EGS systems. The discussion focused on immediate patient care delivery and also on the wider research, audit and patient reported outcome measures for the future.

From the inaugural meeting emerging themes from the patients' perspective was the lack of consistency in communication between disciplines to the patient, pre and post emergency general surgery which in-turn impacted on their care pathway. The patients articulated that because they were ill, the sudden onset and in most cases a traumatic experience of having to undergo surgery with little preparation. They expressed the need for constant reassurance and explanation around their care and what to expect, particularly around the many complexities and complications that did occur from their emergency surgery. They reported that this was not always apparent. Further improvement and information around consistent advice would augment the patient-centred care pathway and improve patient satisfaction (Jones et al 2017). Patients shared how emergency surgery was a life changing event and whilst they appreciated that their life was saved they also had to deal with the post-traumatic stress of the EGS.

Patients also felt that when discharged from the hospital they would have benefited from increased multidisciplinary and specialised support. They specifically spoke about the potential value of ease of access to multidisciplinary team members upon discharge within an appropriate time frame. Furthermore they expressed it would be beneficial to have planned connection with appropriate voluntary support groups

Patients spoke of their feelings of fear and of the unknown, these could have been lessened with appropriate supports and information. One of the experiences shared was in the area of colorectal surgery where individuals had to adapt and adjust to significant changes in altered bowel function, manage their stoma, become accustomed to a changed body image and cope with the emotional effect on their personal relationships.

Overall, the patients who contributed to the inaugural Advocacy Group expressed that it was a positive experience to have their voice heard, become involved proactively, enabling patients to influence and contribute to patient care in EGS.

Discussion

The overall focus of establishing the International Advocacy Group for EGS is to include and empower patients in their care. In addition, this approach will influence the wider care agenda from an EGS clinical perspective and improve patient care outcomes.

Highlighted, was the importance of recognising the patient journey, the need for support particularly relating to appropriate psychological and clinical supports both as an inpatient and when discharged home. A reduction in discordance and discontinuity between multidisciplinary team members would improve patient experience. At the group meeting, it was discussed that a Charity be established to support the development of a patient advocacy group in EGS.

Conclusion

Contributions from the patients, nursing and Consultant Surgeons agreed that this was a very useful and important group and should be continued and supported by the (ASGBI).
The significance of incorporating the patient's voice alongside the surgical nursing and medical team in EGS has the potential to influence positively patient reported outcomes, patient's overall health and well-being and improve patient satisfaction.

Whilst this group is at the embryonic stage the potential for growth should not be underestimated for making a significant positive changes to patient outcomes in EGS

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Education
Education in EGS

Andrei Mihailescu
Consultant General/Emergency Surgery,
MD, MSC, PhD, AdE FRCSE, RCS Tutor
EGS of ESTES Panel Member

Dear ESTES Members and Colleagues,
My name is Andrei Mihailescu.

I am working as a Consultant in general and emergency surgery in UK, after I qualified from medical school back in 2006, in Romania and started my surgical training there in 2007. After my early residency years in my home country, I joined the NHS in UK from 2010 and continued my training there.

Since April 2016 I am a full time consultant in my current hospital, Tameside and Glossop Integrated Care NHS Foundation Trust, a lovely district general Hospital on the Pennine side of Greater Manchester area. In 2019 I was appointed as the "Royal College Tutor" in my Trust and I have a passionate interest in medical/surgical education of the surgical residents as well as 4th and 5th year medical students that come to our hospital on regular basis.

I am a member of ESTES since 2017 and joined the panel of the Emergency General Surgery section of ESTES from 2019.

I am writing to all of you today with my vision in regards to "Education in emergency general surgery" and how I think ESTES and it's committees could help disseminate this throughout Europe to all its members.

It is well known that training in the sub-specialty of emergency surgery, particularly for the medical students, is very challenging, as emergency surgical care is delivered 24/7, 365 days/year. Sometimes, the emergency surgical cases happen at night or outside the normal working hours, at week-ends. It is then when only the "on-call" team is involved in delivering care to these patients, unlike elective scheduled care which attracts during working hours most of the surgical residents and students, due to obvious reasons. Moreover, the prompt response that is required for emergency surgical cases often means early involvement of the seniors doctors, consultant level, as to be able to expedite patient's episode of care by early senior input and decision making. High risk cases, unstable, co-morbid patients, elderly population, all in combination with acute surgical pathology make most of the cases that are being dealt with by the emergency surgeons, to be best suited by consultant delivered care in theatre or in other challenging scenarios.

This sometimes means that the young surgical resident or medical students does not get first option to be directly involved in patient's care and it is not often when senior residents in surgical training are feeling unsecure to deal with these type of emergencies on their own, at night or in the A&E resuscitation area.

Emergency surgery is all about prompt resuscitation of the patient, establishing quick diagnosis, often with help of advanced imaging modalities and progressing to definitive surgical care in theatre, in most cases.

Training in these scenarios is often forgotten, but we should not forget that the surgical residents today are the emergency surgeons of tomorrow and the better they are trained in these difficult scenarios, the better their outcomes will be and their ability and confidence to deal with the emergencies will increase.

I think that the training process in emergency surgery should be a modular one, with the junior surgical trainees (year 1 and 2) involved in minor surgical procedures on regular basis, scheduled on their weekly timetable, to attend the emergency surgical theatre and perform these (abscess drainage, EUA ano-rectum, removal of benign superficial/skin lesions, lymph node/s biopsy etc.); The procedures performed by the trainees should be logbook recorded. In the mid-years of training (3rd and 4th year) they should master surgeries as open and laparoscopic appendectomies, open/laparoscopic hernia repairs, acute/elective gall bladder surgery, remaining for the higher training years (5th to 6th/7th year) to get exposure and increased confidence in emergency laparotomies for acute intra-abdominal pathologies of any kind.
I believe one of the major discrepancies currently within Europe is the variability of the surgical training from country to country that we observe. Whilst in some countries a trainee is more exposed to GI procedures, in others they will be equally exposed to trauma surgeries as well as general surgical procedures, during their training. In certain European countries, the higher trainees orientate towards a sub-specialty of their choice (UGI, LGI, HPB or more recently emergency surgery) whilst in other they can perform various surgical procedures across general surgery after they finish the training. In some countries general surgeons will become "cancer surgeons" whilst other will deal with benign pathology and/or trauma. In other countries though, their practice encompasses both benign and malignant pathology.

As a first approach, I think ESTES could propose a standardised training model in emergency surgery, across the European member countries, by developing and standardising the model above. This could be piloted in some of the University Hospitals where ESTES members work and provide training to surgical residents. A joint effort between the education section of ESTES and the EGS section could be a first step forward to try and implement a strategy in this direction. I look forward to your ideas re-the above proposals.

Medical Students EGS Education

Melanie Roy
Final Year Medical Student NUI, Galway

Acute abdomen is frequently described as a sudden onset of severe abdominal pain, which demands urgent assessment and potential surgical interventions. Considering its prevalence amongst Emergency Department (ED) attendance, with one cross-sectional study reporting it being 15% of all presentations (1), it is no wonder that "Approach to the Acute abdomen" remains a core topic in the surgical module of any medical school globally. Medical academies no doubt recognise the significance of this presentation and its implication on mortality and morbidity, secondary to its affiliated diagnosis. It is therefore their responsibility to ensure that their programme is proficient in its training of the new generation of Physicians, who are safe and competent in their management of the acutely unwell patient.

Despite the academic emphasis on this topic, the acute abdomen remains daunting to many medical trainees, primarily due to the seemingly inexhaustible list of differentials and life threatening emergencies to consider, with patient demographics (age profiles, gender) and the concept of referred pain further complicating the algorithm. Furthermore, students are often bombarded with the multitude of guidelines available that differ in their recommendations depending on their local guidelines, which inevitably causes more confusion. The pressure to promptly diagnose the patient in order for timely surgical intervention, and the implications for failing to do so, further serves as a deterrence to many students, who feel inadequately equipped to manage this acute presentation . With this overwhelming conundrum, it is unsurprising that surgery is not a popular speciality that most students would consider, with a national review reporting a mere 18% interest rate in surgery as a potential career pathway amongst final year Irish medical students (2).

The solution appears to be simple then. Medical schools may need to adjust their curriculum further to provide even more support to this generation of medical trainees. Not only are the schools responsible for our learning, but students should also take the initiative to seek out surgical teaching opportunities to complement their syllabus. Surgical workshops for students have long been around and have proven to be an extremely valuable adjunct to our learning. In particular, the Emergency Abdominal Surgery Course (EASC) that was founded by the Donegal Clinical Research Academy in 2012 is a highly recommended module by medical students across Ireland.

The EASC course is designed for different levels of medical professionals: Medical students, Surgical Trainees, Consultants/Fellows and Nurses. Through this differentiation, the course ensures that the material delivered is individualised and thus most relevant to the audience. In the medical student programme, this focuses on the common causes of the acute abdomen and goes through a systematic approach including a focused history and examination of patients presenting to the ED. The programme is divided into multiple sections, ensuring that information is delivered in a concise and digestible manner that provides an organised structure that facilitates learning and engages the learner. The inclusion of videos of patients with real clinical findings further enriches the programme as it highlights how to perform specific clinical manoeuvres (eg. Rovsing's Sign) and what a positive clinical finding looks like, all of which is highly relevant to the medical student.

Each case is then concluded with a panel discussion hosted by members of the multi-disciplinary team, comprising Surgeons, Radiologists, Oncologists and Nurses. The discussions that take place are arguably the most stimulating and insightful for medical students. In these meetings, each member explains their interpretation of the case and their management approach, which invariably varies across the panel. Conservative approaches versus surgical interventions were often a topic for debate which frequently precipitated exciting discussions with salient points. This allowed the audience to review the case through the lens of each expert, thus shedding new insight on aspects of the case that was previously missed.

Evidently, the EASC course is an excellent learning platform that complements the surgical module of any medical school. The experience not only gives medical students a wealth of knowledge on the common surgical conditions and how to manage them, but also provides a basic approach that resolves much apprehension towards Surgery. Considering its multitude of benefits, it is of highest recommendation that more of such programmes are made available to medical trainees to facilitate their surgical training.

References:

1. Thakur J, Kumar R. Epidemiology of acute abdominal pain: a cross-sectional study in a tertiary care hospital of Eastern India. International Surgery Journal [Internet]. 2019 [cited 3 December 2021];6(2):345. Available from: https://www.ijsurgery.com/index.php/isj/article/view/3754
2. Boyle E, Healy D, Hill A, O'Connell P, Kerin M, McHugh S et al. Career choices of today's medical students: where does surgery rank?. Irish Journal of Medical Science [Internet]. 2012 [cited 3 December 2021];182(3):337-343. Available from: https://pubmed.ncbi.nlm.nih.gov/23242574/

Nursing Education in EGS

Louise Flanagan R.G.N. BSc Hons Nursing
EU INTERREG Emergency Surgery Outcomes Advancement Project (eSOAP),
Letterkenny University Hospital, Letterkenny, Co. Donegal

The team approach to advancing outcomes in Emergency General Surgery should include all the key players both surgical, emergency and nursing care combined with Allied Health and a process within the hospital system. To achieve this optimal care education linked to performance is crucial. Understanding the key goals of delivery of optimal process and ability to evaluate outcomes in Emergency General Surgery can only be delivery through appropriate targeted education. Nursing education in Emergency General Surgery should commence at an undergraduate level highlighting the importance of emergency general surgery in terms of its admission numbers, impact on patients and expense to the system. The nurse plays a key role within emergency general surgery. This may relate to the delivery of primary care as part of a family practice, through to triage in the emergency department followed by delivery of ward emergency general surgery care through the operating theatre to recovery and finally back to the public health nurse.

At all times understanding the goals in outcomes in emergency general surgery is crucial particularly relating to targets, communication, pathways, optimum care, reducing variation, consideration of communication, transfer of information and patient related outcome evaluation.

Current nursing education modules have dealt inadequately with the emergency general surgery sphere and it is with pride and pleasure that the eSOAP programme has developed a new and to our knowledge the only world nursing emergency surgery course linked to Donegal Clinical Research Academy. This course targeting post graduate nurses predominantly but also inclusive of nurses at an undergraduate level and facilitating nurses in low and middle income countries, looks at the key aspects of delivery of care particularly in the common conditions of abdominal pain, appendicitis, cholecystitis, bowel obstruction. In addition nurses are educated on wound care, optimal outcomes and radiology. This exciting development is something that as a co-ordinator of the nursing emergency abdominal surgery course I am pleased to have had many of my colleagues both nationally and internationally join this faculty, which we believe will exert an international change increasing the recognition of the importance of nursing education and provide a greater targeted performance. Specifically the nurses can be involved in early triage, promotion of key outcome indicators, increased safety and communication, reduction in unnecessary tests and incorporating links between different disciplines to ensure clear discharge is facilitated for our patients. Knowledge is power and education creates that knowledge, nurses are fundamental to the advancement of emergency general surgery care; this has been outlined in a number of international reports including the Nutfield report[1]

It has been a pleasure to have contributed along with my nursing colleagues to the development of the eSOAP programme; it is something that we hope will stand to the time and have the key recommendations in the executive summary implemented to the fullest level both in Ireland and internationally.

nEASC Feedback:

This course has furthered my learning and enabled me to make suggestions to managers to improve patient care both pre-operative and post-op. It has helped me develop my knowledge in surgical nursing and helped bridge the knowledge gap between doctors decision making and nursing care to achieve better patient care. 10/12/2021 4:54 PM

References:

1. Watson, R., Crump, H., Imison, C., Currie, C., & Gaskins, M. (2016). Emergency general surgery: challenges and opportunities. London: Nuffield Trust. DOI 978-1-910953-09-9

EGS and the Nursing Team Contribution

Cathy Clarke

RANP Emergency, RAT

The Nursing contribution to the care of the EGS patient cannot be understated or undervalued. Nursing, through the decades has evolved, to place nurses at the centre of patient care delivery. Advanced Nurse Practitioner (ANP) and Clinical Nurse Specialist roles (CNS) are increasing within many services in the acute hospital, providing expert knowledge and undertaking more responsibility and accountability for patient care delivery. Nurses possess, now more than ever, critical thinking ability which they utilise in order to recognise and act independently at the bedside, therefore contributing to the prompt and often lifesaving interventions patients require. Commonly, within the Irish Healthcare System, Emergency Departments (ED's) are the gateway to the presentation of the acutely unwell or potentially unwell patient, including the EGS patient. In some instances and locations, Acute Surgical Assessment Units (ASAU) also play a vital role in the EGS patient journey, but they have yet to be situated in all acute hospitals nationally.

Within ED's, the triage system is the research based tool which Emergency Nurses access in order to categorise or prioritise patient's needs. This system is underpinned by identification of cardinal signs and symptoms of common ED presentations, translating to a more prompt medical assessment of one patient over the next. Emergency protocols for life threatening conditions such as STEMI, Stroke and Major Trauma etc are embedded within ED's recognition of time critical conditions. With regard to the EGS patient there are no national strategies currently in use to alert staff to time critical situations for the acute surgical patient. Triage is and remains so, the only method by which these patients are potentially flagged.

It is vital that the needs and treatment of the EGS patient are recognised within a time critical period, to maximise the potential for prompt diagnostics and seamless transfer to the OT for those who will warrant emergent intervention. This publication is an important means by which we can learn from data, both nationally and internationally, about how we can improve pathways for these patents presenting to Surgical centres within Healthcare Systems.

One such answer, as aforementioned, is the wider use of ASAU's. Ideally, attached to ED's or located within the acute floor plan of each hospital, these units can allow the process of streaming to occur, patients could potentially be directly referred by GP's, streamed from ED triage following discussion with the ASAU team or post-operative patients with complications can directly contact the unit to re-attend with a myriad of post-operative issues. This helps the patient bypass the ED and directly access the Surgical specialities, allowing prompt assessment. This pathway is in keeping with the Slaintecare mantra – that all patients should access "the right care, in the right place, at the right time".

CNS and Advanced Practice roles may also hold the key to expediting the patient journey with regard to EGS. ANP and CNS roles can be pivotal in helping KPI's to be achieved, especially when such nursing extended roles allow that practitioner, to independently complete an episode of care, including ordering of diagnostics and prescription of medication.

What is clear, is that continuing education and training of all nurses, at all levels is imperative, allowing them to identify the emergent needs of the EGS patient, at all points during the patient journey. Prompt intervention can only enhance that journey. It is also pivotal that nurses are central to the conversation at senior decision making level with a view to shaping future services.

Welcome to the *virtual* Emergency Abdominal Surgery Course. The first EASC course was held in Letterkenny Donegal Ireland in May 2012 and has since expanded around the World and been held in 12 countries. This new course builds on previous success and is further enhanced by a large international faculty who are at the coal face of Emergency General Surgery (EGS). Covid-19 has necessitated a change to a virtual platform.

EASC curriculum focuses on the acute abdomen, in a multidisciplinary shared learning approach. It brings a level of discussion you may not have heard before and will enhance your ability as an on-call resident/consultant surgeon, or radiologist. EASC is about decision making and surgical techniques in patients with common surgical emergencies.

The course is supported by many societies and is mandatory for training with RCSI. It is the endorsed course of WSES and is constantly updated with the latest advances in EGS care.

Course Goals

Comprehensive understanding of the commonest Acute Abdominal problems in EGS delivered through 8 short lectures (<15 min) combined with real interactive cases and extensive literature review. Performance testing will occur through MCQs. A range of additional lectures are also available online.

Who should register?
If you treat or manage a patient with an acute abdomen this course is a must for you!

Michael Sugrue EASC Coordinator

www.easccourse.com

ν Emergency Abdominal Surgery Course

Wednesday and Thursday
February 16th and 17th 2022

18.00-21.10 **(2 x 3hour blocks)**

Virtual Zoom Platform

CME 6 credits

Provisional Faculty

vEASC

Kevin Barry Ireland
Gary Bass USA
Ferdia Bolster Ireland
Fausto Catena Italy
Marco Ceresoli Italy
John Chau Canada
Federico Coccolini Italy
Simon Cross Ireland
Marc de Moya USA
Dulantha de Silva Sri Lanka
Louise Flanagan Ireland
Gwendolyn Hollaar Canada
Li Hsee New Zealand
Sean Johnson Ireland
John Kortbeek Canada
Rita Marren Ireland
Isidro Martinez Spain
Carlos Mesquita Portugal
Rajashekar Mohan India
Bruno Pereira Brazil
Chris Steele Ireland
Gavin Sugrue Canada
Pantelis Vassiliu Greece
Ronan Waldron Ireland
Carol-Ann Walker Ireland
Saqib Zeeshan Ireland

Day 1 Wednesday 18.00 - 21.10

18.00 Welcome

18.05 **Appendicitis**

18.15 **Case Scenarios with Faculty**

Waldron Walker GSugrue

Real Patients Real Problems
Dealing with;

Appendicitis Scoring
Pathways
Role of CT v US
NOTA
Surgical Techniques
Complications
Appendicular Mass

19.00 **Diverticulitis; The controversies**

19.15 **Case Scenarios with Faculty**
Zeeshan Hsee Marren
Johnson Hollaar

Differentiating Simple versus Complicated Diverticulitis

When to admit-send home
Role of inflammatory markers
Traps
Differential Diagnosis
Surgical Approaches
Resection ± anastomisis
Wound Bundle

Laparotomy closure techniques

20.00 **Management of Cholecystitis**

20.15 **Case Scenarios with Faculty**
Pereira Catena Flanagan Bass Steele
Mesquita Mohan Bolster de Silva Coccolini

When to operate
When to abort
Technical tips for difficult GB

21.00 **Short update from industry**

21.10 **Close**

Certification for the course will be given once MCQ's have been completed and following your participation in the course.

Day 2 Thursday 18.00 - 21.10

18.00 Welcome

18.05 **Small Bowel Obstruction**

18.15 **Case Scenarios with Faculty**

Vassiliu Marren Martinez Cross Barry Chau

SBO Bundle in action
When to laparoscope
The equipment/approach
Traps -Open Surgery

18.50 **Large Bowel Obstruction**

Hsee Zeeshan Flanagan Waldron G Sugrue Marren

19.00 **Case Scenarios with Faculty**

Path to diagnosis
Approach
Problems with Ostomies
When to reverse
Anastomotic leaks

19.45 **Acute Mesenteric Ischaemia**

20.00 **Open Abdomen**; **When/How to open/close**

20.15 Testing Case Scenarios with Faculty
Zeeshan Hsee Walker Mesquita de Silva
deMoya Kortbeek Ceresoli

Scenario session will test the ability of the faculty to get it all together for the patient.

20.50 **Key learning points to transform your EGS care**

21.10 Close

Register online Fee 150 €

LMIC registration fee 20€

Places limited- Delivered through Zoom Platform

www.easccourse.com

Contact easccourse@gmail.com

@DCRA2012TM

Welcome to the 2nd Nursing Emergency Abdominal Surgery Course. This course is based on the EASC multidisciplinary course, predominantly a surgeon's course. The parent EASC course has always embraced nursing concepts and now in recognition of the integral part of nursing care, DCRA has designed a unique course in the delivery of Emergency Surgery Care specifically for nurses

The first EASC was held in Letterkenny, Donegal in May 2012. That popular course is now taught around the world. This is the inaugural nEASC course and builds on previous successes of the other EASC courses. It will be enhanced by a faculty who are at the coal face in Emergency Surgery and Nursing.

nEASC curriculum focuses on the acute abdomen, in a multidisciplinary shared learning approach. It will bring you a level of discussion you have not heard before and enhance your ability on-duty in emergency care. This course is about decision making in patients with common surgical emergencies.

Course Goals

Understanding the natural history of key emergency surgery presentations, with emphasis on decision making and how nursing can interact with other disciplines. nEASC will identify tips and traps to optimize outcome. This coupled with an emanual containing lectures and the latest literature references will ensure your patients are getting optimal outcomes.

Who should attend? -
If you treat or manage a patient with an acute abdomen in Emergency, Surgical Ward, Theatre or ICU environment this course is a must for you!

Take this opportunity to be at the cutting edge of Emergency Abdominal Surgery delivery.

Michael Sugrue
Louise Flanagan
Carol-Ann Walker

Co-Conveners

www.dcra.ie
www.easccourse.com

Nursing Emergency Abdominal Surgery Course

nEASC

Thursday February 24th 2022
17:00-21:00

Virtual Zoom Platform
Approved by Nursing +Midwifery Board of Ireland for 4 Continuing Education Units (CEUs)

Provisional Faculty

Gary Bass Philadelphia USA
Ferdia Bolster Dublin
Sacha Cowell New Zealand
Aileen Crawford Letterkenny
Louise Flanagan Letterkenny
Morad Hameed Canada
Aine Keating Letterkenny
Rita Marren Letterkenny
Rajashekar Mohan India
Rebecca Shellnutt Canada
Gavin Sugrue Canada
Treasa Toye Letterkenny
Colleen Trevino USA
Manvydas Varzgalis Letterkenny
Cheryl Waldron Mass USA
Ronan Waldron Castlebar
Carol-Ann Walker Letterkenny
Annekartin Wussow Letterkenny
Saqib Zeeshan Letterkenny

Donegal Clinical and Research Academy

Nursing Emergency Abdominal Surgery Course

17.00 Welcome M Sugrue

17.05 **Challenges in EGS**

17.10 **EGS The Challenge and the Team approach**

17.25 **Appendicitis - Nursing Care**

17.35 **Case Scenario with Panel**

Walker Crawford Keating Varzgalis
Waldron Cowell

18.00 **Cholecystitis - Peri-op Nursing care**

18.15 Case Scenario
Flanagan G Sugrue
Zeeshan Trevino Shellnutt

18.35 Emergency 10 min Coffee

18.45 **Diverticulitis Nursing Challenges**

18.55 Case Scenario Panel
Walker Crawford
Varzgalis Bass Marren

19.20 **Small Bowel Obstruction making a difference**

19.40 Case Scenario Panel
Marren Zeeshan Toye Crawford
Wussow

Nursing Emergency Abdominal Surgery Course

20.10 **The Wound Bundle and the Nurse**

20.20 Case scenarios

Bolster Flanagan C Waldron Bass
Mohan Hameed Shellnutt

20.45 **Nurse led Improvement in EGS outcomes**

21.00 **Close of meeting and Certification**

www.easccourse.com

Contact
easccourse@gmail.com

MCQs via website for pre-course test

Registration Fee €30

Student Nurses registration fee €10

Welcome to the new *virtual* **Medical Student** Emergency Abdominal Surgery Course (**s**EASC). This course is based on the award winning EASC for registrars and consultants. The first EASC course was held in Letterkenny, Donegal Ireland in May 2012 and has now been run in 10 countries. 16 sEASC courses have now been held in Ireland, Brazil and Greece. We have gone virtual and the feedback is just fantastic.

This award-winning student course is tailored to curriculum of medical students. It is an ideal preparation for those who wish to excel at their exams. Since the first sEASC course in 2015 it is rated by final meds as one of the best educational events in their student curriculum.

sEASC curriculum focuses on the acute abdomen, in a multidisciplinary shared learning approach. It brings a level of discussion you have not heard before and will enhance your knowledge of presentations, symptoms, signs and management. This course is about the patient and common emergencies. It will help, not only with your exams but as a young doctor. It combines theory with practical cases. Over half of the course involves discussion between consultants and residents. You can relax and take the two 3 hour sessions in your stride.

Course Goals

Understanding the natural history of key emergency abdominal surgery presentations. This course will take your knowledge to the next level.

Who should attend?
Final Meds and those in earlier years who want to do Surgery

Thanks to our faculty who make all the difference.

Mr Michael Sugrue
Course Director

ν Student Emergency Abdominal Surgery Course

Virtual on line

Wed March30th + Thurs March 31st 2022

18.00-21.00 (**2 x 3hour blocks**)

Global Course

Please do MCQ on line

www.easccourse.com

Great Refresher for Final Med Exams
Taking the Mystique out of Emergency Abdominal Conditions!

Provisional Faculty (may vary on the day)

Mr Emmet Andrews	Surgeon University Cork Ireland
Dr Mark Bolger	Radiology Fellow Mater Dublin Ireland
Dr Claire Donohoe	Surgeon St James Ireland
Professor Larry Egan	Gastroenterology NUI Galway
Dr Olga Fagan	Gastroenterology Ireland
Ms Louise Flanagan	Emergency Nursing LUH Ireland
Prof Gustavo Fraga	University Campinas Brazil
Ms Emmeline Nugent	Surgeon Galway Ireland
Mr Colin Peirce	Surgeon University Limerick
Dr Ian Stephens	Surgery Dublin Ireland
Prof Maurice Stokes	Surgeon Mater Dublin
Dr Gavin Sugrue	Radiologist Vancouver Canada
Mr Michael Sugrue	Surgeon Letterkenny Ireland
Mr Manvydas Varzgalis	Surgeon Letterkenny
Dr Pantelis Vassiliu	Surgeon Athens Greece
Mr Ronan Waldron	Surgeon Mayo Ireland
Ms Carol-Ann Walker	Emergency Surgery Nurse LUH
Dr Robert Whiriskey	Radiology GUH Ireland

Student Emergency Abdominal Surgery Course

Block 1 Wed March 30th 2022

18.00 Welcome

18.05 **Appendicitis**

18.20 Real Case Discussion
Andrews Nugent Donohoe Stephens
Waldron Walker Bolger

18.50 **Diverticulitis**

19.05 Real Case Discussion
Fraga Waldron Vassiliu Whiriskey
Flanagan

19.30 **Large Bowel Obstruction**

19.40 Real Case Discussion

Peirce G Sugrue Walker

20.00 Quick Coffee

20.05 **Pancreatitis**

20.15 **Cholecystitis**

20.35 Real Case Discussion
Nugent Donohoe Egan
Bolger Stokes

21.00 Finish Day 1

Student Emergency Abdominal Surgery Course

Block 2 Thur March 31st 2022

18.00 Welcome

18.05 **Upper GI Bleed**

18:15 Real Case Discussion
Egan Walker Fraga Fagan
Varzgalis

18.45 **Lower GI Bleed**

19.00 Real Case Discussion
Waldron Varzgalis

19.20 **Mesenteric Ischaemia**

19.30 **Quick Coffee**

19.35 Small Bowel Obstruction

19.50 Real Case Discussion

Flanagan Waldron Fraga

Varzgalis

20.25 **10 steps to managing patients for Final Med Exam + Internship**
21.00 Finish Day 2

Register online fee €30

LMIC students studying in their home country receive a discounted rate via www.iasss.org

Places limited-
Delivered through Zoom Platform
www.easccourse.com
Contact eascourse@gmail.com
(proceeds to DCRA A Non-Profit Charity
(None of the faculty receive any payment for participation)

Welcome to the fourth *virtual* advanced EASC course (AEASC). This course builds on the award winning EASC course which was first held in Donegal Ireland in 2012. EASC Courses have expanded around the World, and are now run in 11 countries and have been attended by over 1000 surgeons and residents. EASC is regarded by the majority of participants as one of the best courses they ever attended.

Advanced EASC curriculum focuses entirely on the acute abdomen, in a multidisciplinary shared learning approach. The course is endorsed by many societies. It is constantly updated with the latest advances in Emergency Surgery Care. The first aEASC was held in Mangalore in 2020 and because of Covid we have moved to a virtual platform.

Course Goals

- **Complex emergency surgery cases**
- **Identify mistakes that can be made**
- **Discuss advanced surgical techniques**
- **Changes you need in your practice**

Who should attend ?- Consultants and Fellows who want to be more confident in their care of emergency surgery patients

Donegal Clinical Research Academy would like to thank RCSI, WSACS and WSES and in particular the many faculty over the years for their support. Also, the SEUPB through the Centre for Personalised Medicine and Emergency Surgery Cluster are supporting and advancing Emergency Surgery Care.

Michael Sugrue

Convenor
www.dcra.ie
www.easccourse.com

4th Advanced

Emergency Abdominal Surgery Course

Wednesday + Thursday
October 26th 27th 2022

18.00 - 21.10

A Global Virtual Course

CME 6 credits

Provisional Faculty

Ferdia Bolster Ireland
Fausto Catena Italy
Fiachra Cooke Ireland
Aileen Crawford Ireland
Aisling Hogan Ireland
Morad Hameed Canada
Louise Flanagan Ireland
Barry Kelleher Ireland
Andrew Kirkpatrick Canada
Ewen Griffiths UK
Rita Marren Ireland
Rajashekar Mohan India
Shahin Mohseni Sweden
Bruno Pereira Brazil
Gavin Sugrue Canada
Matti Tolonen Finland
George Velmahos USA
Carol-Ann Walker Ireland
Dieter Weber Australia
Des Winter Ireland
Saqib Zeeshan Ireland

Advanced Emergency Abdominal Surgery Course
Day 1
Wednesday October 26th 2022

18.00 Welcome

18.05 **Complex Appendicitis Surgical Approaches**

18.20 **Case Scenario**

Tolonen Catena Velmahos Walker
The New Pathway approach
Appendicular Mass
Difficult Stump

18.50 **Surgical Approach to Hinchey ¾**

19.05 **Case Scenario**
Winter Weber Marren Zeeshan
Avoiding complications
When to abort laparoscopy
Wound bundle

19.40 Coffee Time with Trade Video 8 min

19.50 **Large Bowel Obstruction with Primary Anastomosis: when and how!**

20.00 **Case Scenario**
Hogan Crawford Winter Cooke Bolster
On table techniques
Laparotomy closure bundle
Incision Hernia Prevention

20.30 **Open abdomen advanced techniques in closure**

20.40 **Case Scenario**
Kirkpatrick Pereira Tolonen Velmahos Hameed

Direct Peritoneal Resuscitation
Mesh Mediated Traction
NPWT Max

21.10 Close of meeting

Advanced Emergency Abdominal Surgery Course
Day 2
Thursday October 27th 2022

18.00 **The Impossible Gallbladder**
18.15 **Case Scenario**
Kelleher Pereira
Griffiths Flanagan G Sugrue Mohseni

The new pathway
When to abort
Techniques in subtotal chole

19.00 How to deal with CBD Stone

19.15 **Case Scenario**
Griffiths Kelleher
Mohseni Mohan

Laparoscopic approach
Rendevous ERCP
Post-Op ERCP

19.40 Coffee Time with Trade Video 8 min

19.50 **Strangulated necrotic Umbilical Hernia**

20.00 **Case Scenario**

Conlon Hogan Catena

Tolenen Walker

20.20 **Case Scenario**

Conlon Hogan Catena

Tolonen Walker

20.45 **Changing your consultant practice.**

21.10 Close of meeting

Register online Fee 200 €

Places limited-

Delivered through Zoom Platform

www.easccourse.com

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Contact easccourse@gmail.com
MCQ's via website

The Radiologist the Gatekeeper to EGS

Dr Gavin Sugrue MB BCh BAO, FFR RCSI, FRCPC
Vancouver General Hospital, Canada
Division of Abdominal and ER/Trauma Radiology

The emergency department (ED) is a major access point for acutely sick and traumatized patients, as outlined in the Emergency Surgery Outcomes Advancement Project. The increasing requirement for cross-sectional imaging performed around-the-clock has given rise to the Emergency Radiology and Trauma subspecialty, now an established cornerstone of the multidisciplinary treatment of patients undergoing emergency and general surgery. A well-established Emergency Radiology and Trauma subspecialty, typically housed within the ED of many large academic centres, provides 24/7 emergency radiology coverage.[i] [1]

Upon presentation or transfer to the ED, Radiologists are required to make a timely and accurate diagnosis of acute and potentially life-threatening injuries, in an effort to facilitate the clinical decision-making process for appropriate surgical, interventional or conservative management. Once admitted to hospital, follow up imaging allows for interval assessment for complicating features or improvement of a patient's clinical condition.

The roles of the Radiologist with respect to emergency and general surgery can be broadly divided into 2 broad categories—image interpretation/Intervention Radiology and noninterpretative tasks. While many Radiologists are formally trained with the belief that their duty is solely of image interpretation and/or interventional procedures, noninterpretative tasks (predominately communication, but also includes quality and safety, ethics and leadership) contribute to a substantial and vital component of a radiologist's workload. Both of these roles are carried out synergistically in the delivery of best patient centred care.

Communication, especially in the acute or emergency setting, is of utmost value and forms the framework for Radiology practice. For example, appropriate clinical information from the referring doctor, access to a patient's prior radiology investigations, medical history and laboratory results are essential for the delivery of the highest quality radiology reports. Often, pertinent clinical information may not be relayed to the Radiologist, especially in the acute setting. Lack of appropriate clinical history is a known detriment to image interpretation[2], and thus stresses the importance of reciprocal real time communication between the referring doctor and Radiologists in the delivery of patient care.

In particular, Computed tomography (CT) is the key imaging modality in the assessment of acutely ill patients. Advances in CT technology allows for high quality and rapid imaging to be achieved with a higher sensitivity in diagnosing potentially life-threatening injuries compared to x-rays or ultrasound/point of care ultrasound. Thus, many institutions have CT scanners based within the emergency department to expedite the imaging process to improve the speed of delivery of care.

Imaging studies are requested by a spectrum of healthcare providers with varying levels of understanding of radiology imaging protocols. Many institution have well-established protocols for a spectrum of clinical presentation in order to reduce incorrect CT protocols, which directly result in reduced diagnostic accuracy, delay in diagnosis, excessive radiation, prolonged scanner time and increased cost. By utilizing the correct imaging protocol, the most appropriate radiological study can be tailored to address a specific concern or question by the referring team. For example, a patient with suspected mesenteric ischemia, a multiphase CT abdomen (for example a non contrast, arterial and portal venous CT abdomen and pelvis) is required to provide a detailed assessment[i] [i] . Failure to undertake biphasic or triphasic abdominal CT reduces the sensitivity in the detection of mesenteric ischemia. Clear communication between the Radiologist and provider in conjunction with institutional established CT/MRI/US protocols has helped to overcome this avoidable error

Overall, Radiologists play an important role in the diagnosis, management and follow up of patients undergoing emergency and general surgery. Accurate and precise image interpretation by Radiologists, in conjunction with reciprocal real time communication between the Radiologist and referring doctor, allows for the delivery of the highest quality of patient centered care.

References:

1. Sellers A, Hillman BJ, Wintermark M. Survey of after-hours coverage of emergency department imaging studies by US academic radiology departments. Journal of the American College of Radiology. 2014 Jul 1;11(7):725-30

[2] "Accuracy of information on imaging requisitions: does it matter?," J Am Coll Radiol vol. 4, no. 9, pp. 617–21, Sep. 2007

"Furukawa A, Kanasaki S, Kono N, Wakamiya M, Tanaka T, Takahashi M, Murata K. CT diagnosis of acute mesenteric ischemia from various causes. American Journal of Roentgenology. 2009 Feb;192(2):408-16.

Research

Research Priorities in EGS

Ms Olga Rutka

MD

From the times of arrival of Andreas Vesalius to Padua in sixteenth century and starting his new approach in learning and practicing medicine by subjecting all previously gained knowledge to scrutiny, examination, dissection, and comparison. He was one of the first known doctors who practiced what now we call an evidence-based medicine. He was the first one who chose not to blindly accept common practice or the knowledge just because it was told by a teacher or colleague, but to question it.

Modern medicine and health care in whole is based on practices, procedures, pathways, and guidelines that are based on evidence – what we have learned or studied or researched over decades and centuries. Many advancements have been made and many improvements.
The modern doctor is much more capable and knowledgeful than his ancestors, thanks to experience, careful observations and records, doubts, mistakes and mainly desire to do better than yesterday.

Variety of health care structures and systems had been practiced over many centuries. We progressed from general doctors and barbers with fairly sharp knife and pair of players who did all sort of treatments in one small dark room to a superspecialists with loads of shiny equipment and in dept knowledge of their field of interest.

However over last few decades, once again thanks to hard work of data collectors and analysists, we know that many diseases are as common as they used to be in those days. The diseases like appendicitis, cholecystitis, perforation, and bowel obstruction still do make at least a 50% of all surgical workload. These diseases typically have an acute presentation and do require immediate actions and surgery. Unfortunately, even though these pathologies are well known they still make up for one of the highest numbers of surgical mortality and morbidity.

Emergency surgery is a niche speciality that deals with one of the sickest, comorbid and complex patients that do require the best and the most prompt help.

Best care however relies on best and most up to date evidence. From the time of creation of the universe data collection takes time, analysis takes time and distribution of this results does take time that our patients often do not have.

Would it not be great to have an opportunity to have a tool that would allow us to collect a real time data of real time situation in our emergency surgical department? Collecting the largest set of information starting from date and time of the patients' arrival to the hospital and gathering information throughout their journey till discharge date. What could we do if we would have near to real time data of our performance and outcomes available from few weeks ago without performing lengthy and time-consuming data collection and analysis that likely to look only at one specific area of service or specific outcome? What if we could have a tool that would allow us to have data that is directly comparable on every parameter with our near and far hospitals? Data that would be on the same parameters in many hospitals in different countries and parts of the world. I feel it be almost like going to pre-Babylon time when all of us spoke the same language and easily did understand each other.

I am glad to say that such a tool of the – Emergency General Surgery Registry as part of emergency Surgery Outcome Advancement Project- has been developed and already has been adopted in a few hospitals in Northern Ireland and Scotland. The group of scientists and surgeons has developed a computerised system that allows near real time data entry on every step of the patients' journey: arrival time and date, transport, complains, localisation of symptoms, blood tests, vital parameters, preformed investigations, and procedures, used medication, outcomes of treatment, complications, readmission and many more.

All this information is vital to build expert knowledge and to be able to change the ways we operate and perform, to facilitate better outcomes, save lives, and improve patients' experience. This group of enthusiasts has used this Registry since 2016. During five years of data has created one of the biggest emergency surgical patient cohort that has largest collection of data on each of them.

This system allowed them to see within a few months of work what are the areas that do require improvement, how the resources can be better utilised based on knowledge of the busiest time of the year and days of the week; what are the most common complaint at the presentation, what are the usuals blood test that will mean worst outcome, which patients will require longer stay and are more likely to have complications etc.

Information gathered during eSAOP project did allow involved hospitals as well universities to establish were the extra work and efforts are required.

They used this data for reconfiguration of service, for education, for patient's involvement in their own treatment and decision making, as well as provided invaluable data for further research. And now this group of authors is ready to present some of their results.

Highlights of eSOAP research

Alison Johnston
Research Assistant
Letterkenny University Hospital

The research output from eSOAP has grown steadily throughout the 3-year lifespan of the project. Multiple research papers, chapters, books and abstracts have been published, with one paper partially published in Arabic, French and Chinese / Mandarin. The specific areas of research have included:

Emergency general surgery (EGS) conditions of appendicitis, cholecystitis, hernia and colorectal cancer as well as key issues such as surgical site infection prevention and clinical pathways.

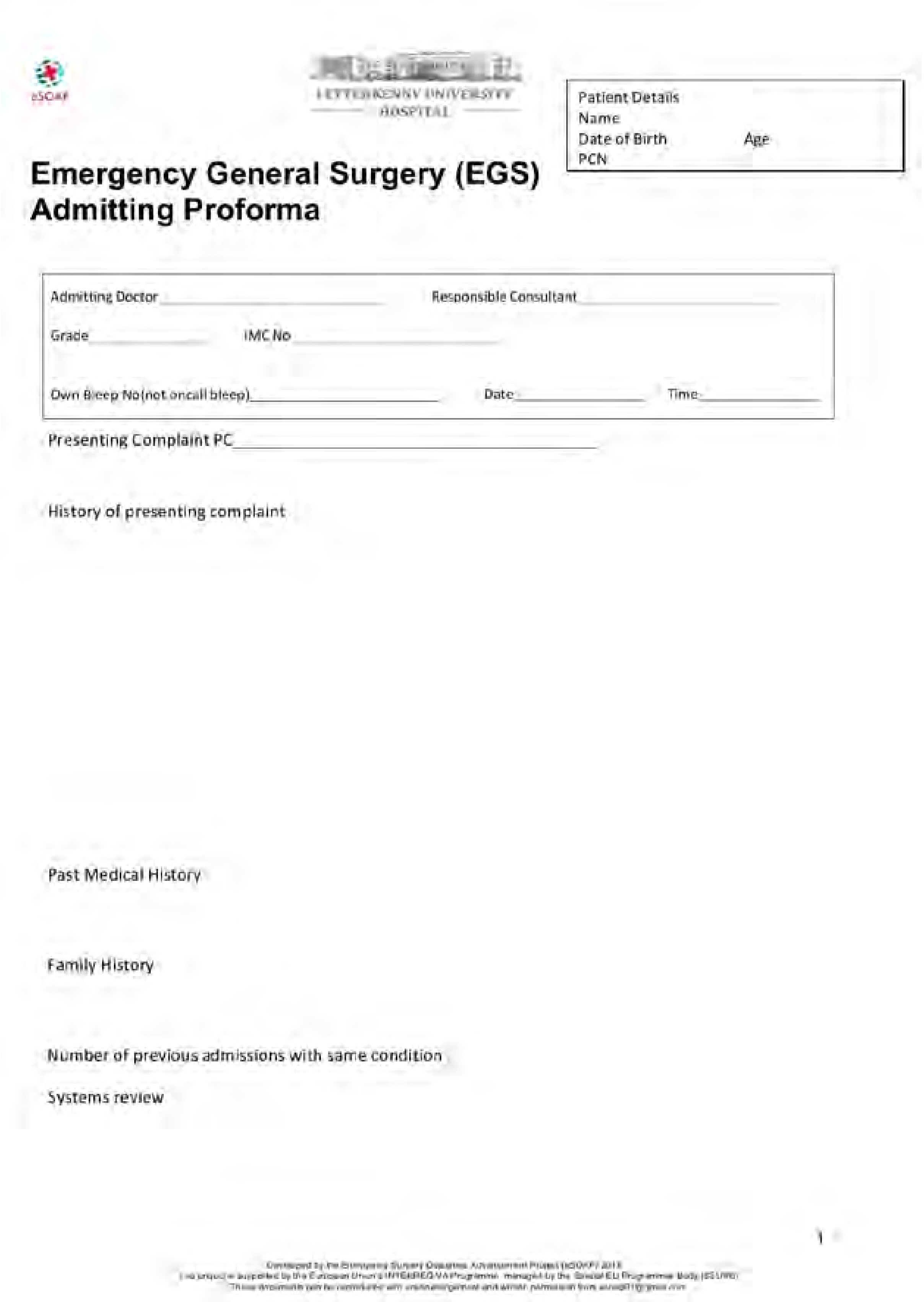
EGS data
EGS registry

Close multi-disciplinary collaboration across multiple regions nationally, internationally and indeed globally has been crucial for this research output. The partnership has been made up of researchers from the fields of medicine, nursing, and data analytics and within the medical field it has been inclusive of all grades-medical students, non-consultant hospital doctors and consultants.

Dissemination of the results of the research relevant to important concepts in the care of EGS patients has been presented to relevant stakeholders locally, nationally and internationally. Presentations have been both in-person and, due to the recent global Covid-19 pandemic, virtual. The congresses and conferences at which the presentations were delivered internationally were located in Brazil, Poland, The Netherlands, USA and the UK and included:

World Society of Emergency Surgery Congress
World Congress of Surgery
European Society of Emergency Surgery Congress
American College of Surgeons Clinical Congress
Abdominal Wall Reconstruction EUROPE conference

Emergency General Surgery (EGS) Admission Proforma



eSOAP

LETTERKENNY UNIVERSITY
HOSPITAL

Emergency General Surgery (EGS) Admitting Proforma

Patient Details
Name
Date of Birth Age
PCN

Admitting Doctor __________ Responsible Consultant __________

Grade __________ IMC No __________

Own Bleep No(not oncall bleep)__________ Date __________ Time __________

Presenting Complaint PC __________

History of presenting complaint

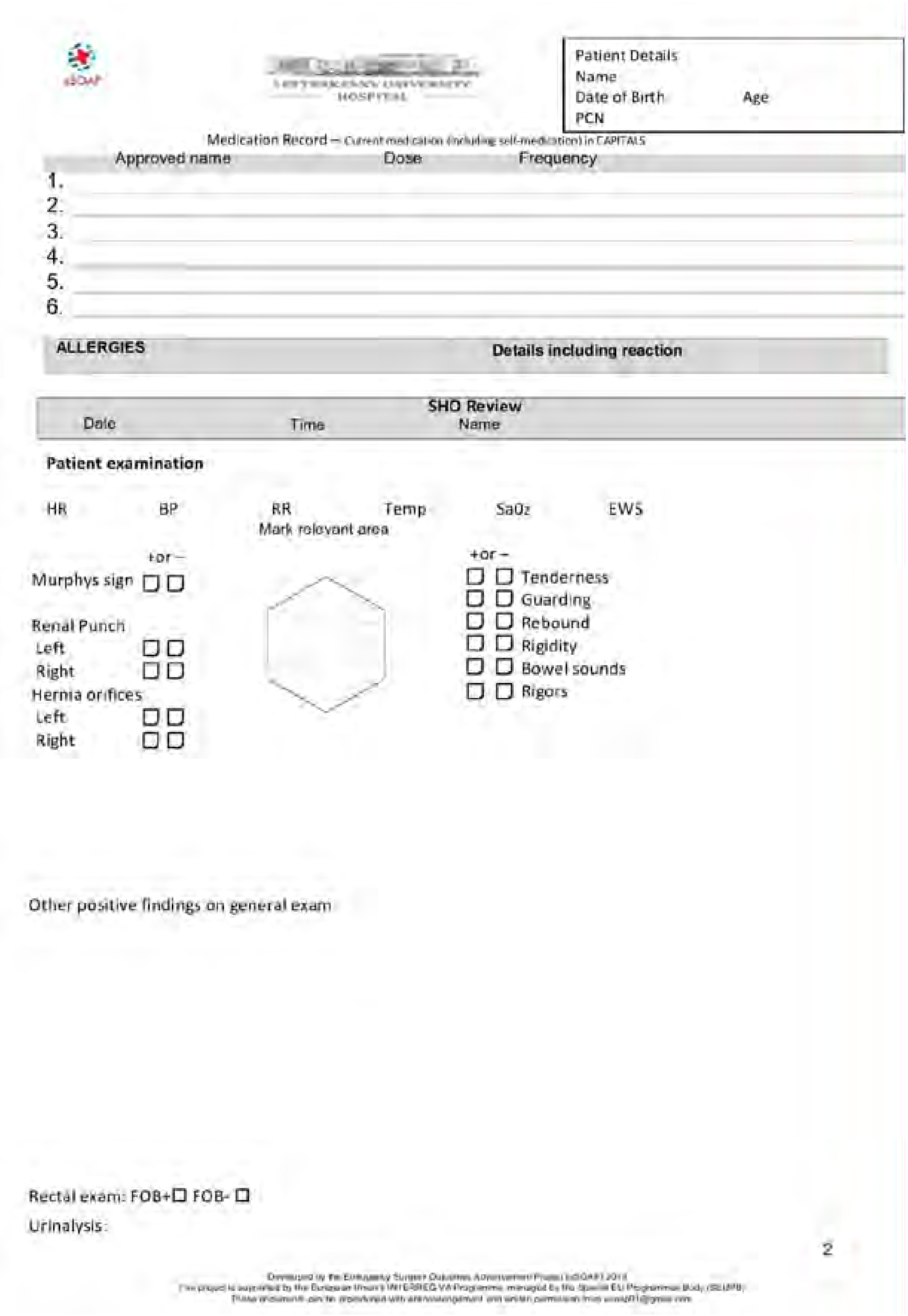
Past Medical History

Family History

Number of previous admissions with same condition

Systems review

1



eSOAP

LETTERKENNY UNIVERSITY HOSPITAL

Patient Details
Name
Date of Birth Age
PCN

Medication Record – Current medication (including self-medication) in CAPITALS

	Approved name	Dose	Frequency
1.			
2.			
3.			
4.			
5.			
6.			

ALLERGIES	**Details including reaction**

SHO Review

Date	Time	Name

Patient examination

HR BP RR Temp Sa02 EWS

Mark relevant area

+or –
Murphys sign ☐ ☐

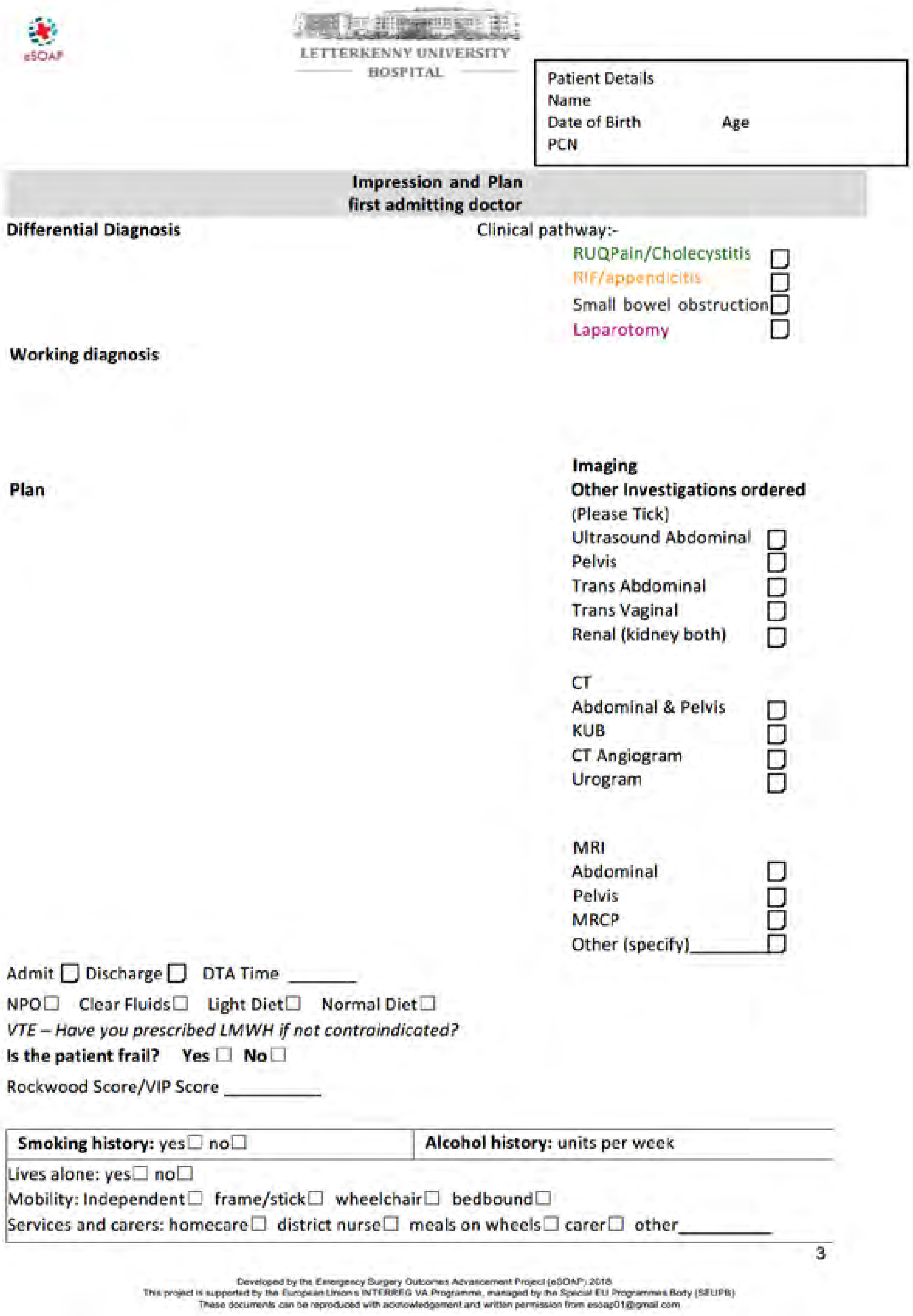
Renal Punch
Left ☐ ☐
Right ☐ ☐
Hernia orifices
Left ☐ ☐
Right ☐ ☐

+or –
☐ ☐ Tenderness
☐ ☐ Guarding
☐ ☐ Rebound
☐ ☐ Rigidity
☐ ☐ Bowel sounds
☐ ☐ Rigors

Other positive findings on general exam

Rectal exam: FOB+☐ FOB- ☐
Urinalysis:

2



eSOAP

LETTERKENNY UNIVERSITY HOSPITAL

Patient Details
Name
Date of Birth Age
PCN

Impression and Plan
first admitting doctor

Differential Diagnosis

Clinical pathway:-
RUQPain/Cholecystitis ☐
RIF/appendicitis ☐
Small bowel obstruction ☐
Laparotomy ☐

Working diagnosis

Plan

Imaging
Other Investigations ordered
(Please Tick)
Ultrasound Abdominal ☐
Pelvis ☐
Trans Abdominal ☐
Trans Vaginal ☐
Renal (kidney both) ☐

CT
Abdominal & Pelvis ☐
KUB ☐
CT Angiogram ☐
Urogram ☐

MRI
Abdominal ☐
Pelvis ☐
MRCP ☐
Other (specify)_________ ☐

Admit ☐ Discharge ☐ DTA Time _______

NPO☐ Clear Fluids☐ Light Diet☐ Normal Diet☐

VTE – Have you prescribed LMWH if not contraindicated?

Is the patient frail? **Yes** ☐ **No** ☐

Rockwood Score/VIP Score __________

Smoking history: yes☐ no☐ | **Alcohol history:** units per week

Lives alone: yes☐ no☐
Mobility: Independent☐ frame/stick☐ wheelchair☐ bedbound☐
Services and carers: homecare☐ district nurse☐ meals on wheels☐ carer☐ other__________

3

Developed by the Emergency Surgery Outcomes Advancement Project (eSOAP) 2018
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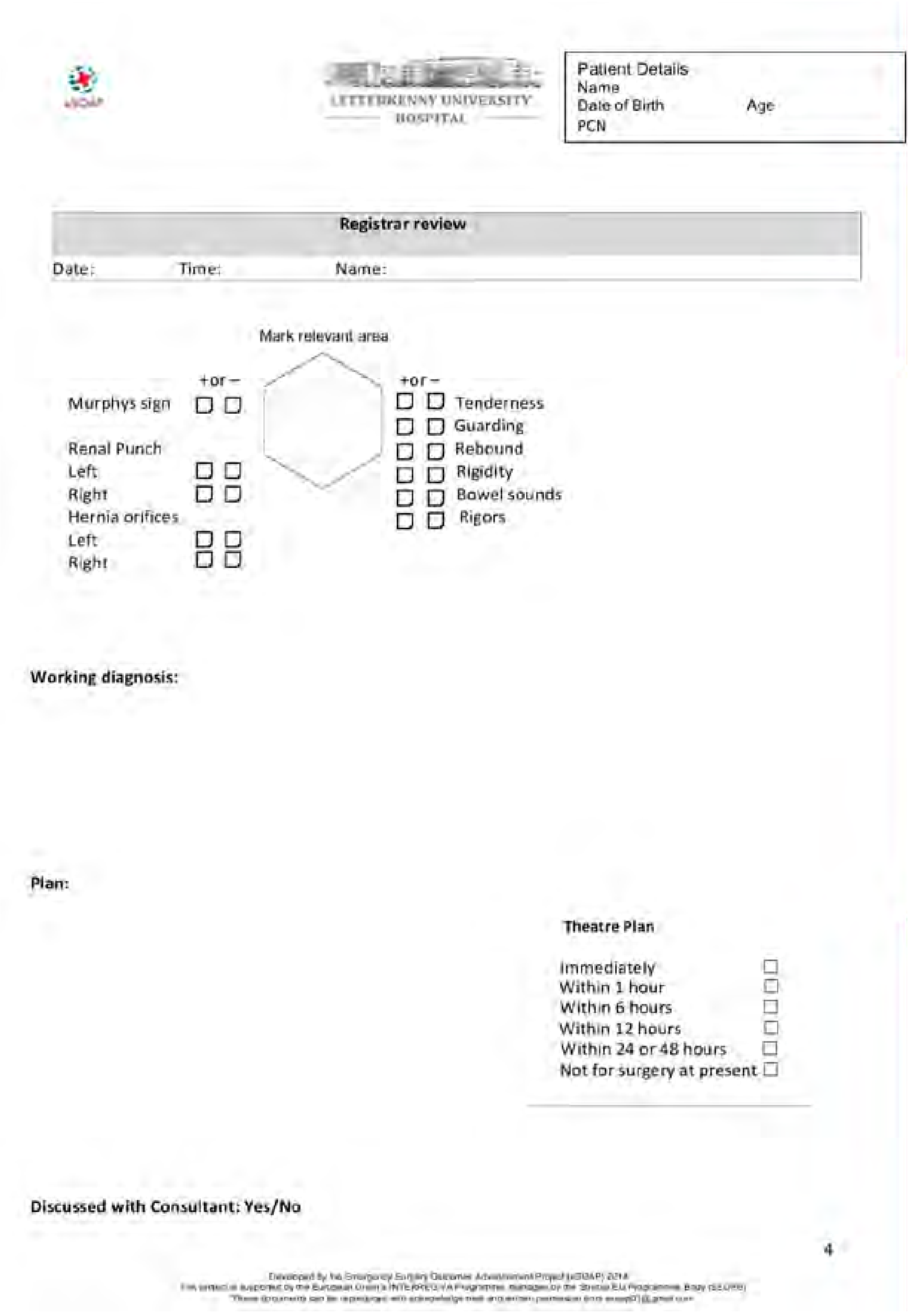


LETTERKENNY UNIVERSITY HOSPITAL

Patient Details
Name
Date of Birth Age
PCN

Registrar review

Date: Time: Name:

Mark relevant area

	+or −	
Murphys sign	☐ ☐	
Renal Punch		
Left	☐ ☐	
Right	☐ ☐	
Hernia orifices		
Left	☐ ☐	
Right	☐ ☐	

+or −	
☐ ☐	Tenderness
☐ ☐	Guarding
☐ ☐	Rebound
☐ ☐	Rigidity
☐ ☐	Bowel sounds
☐ ☐	Rigors

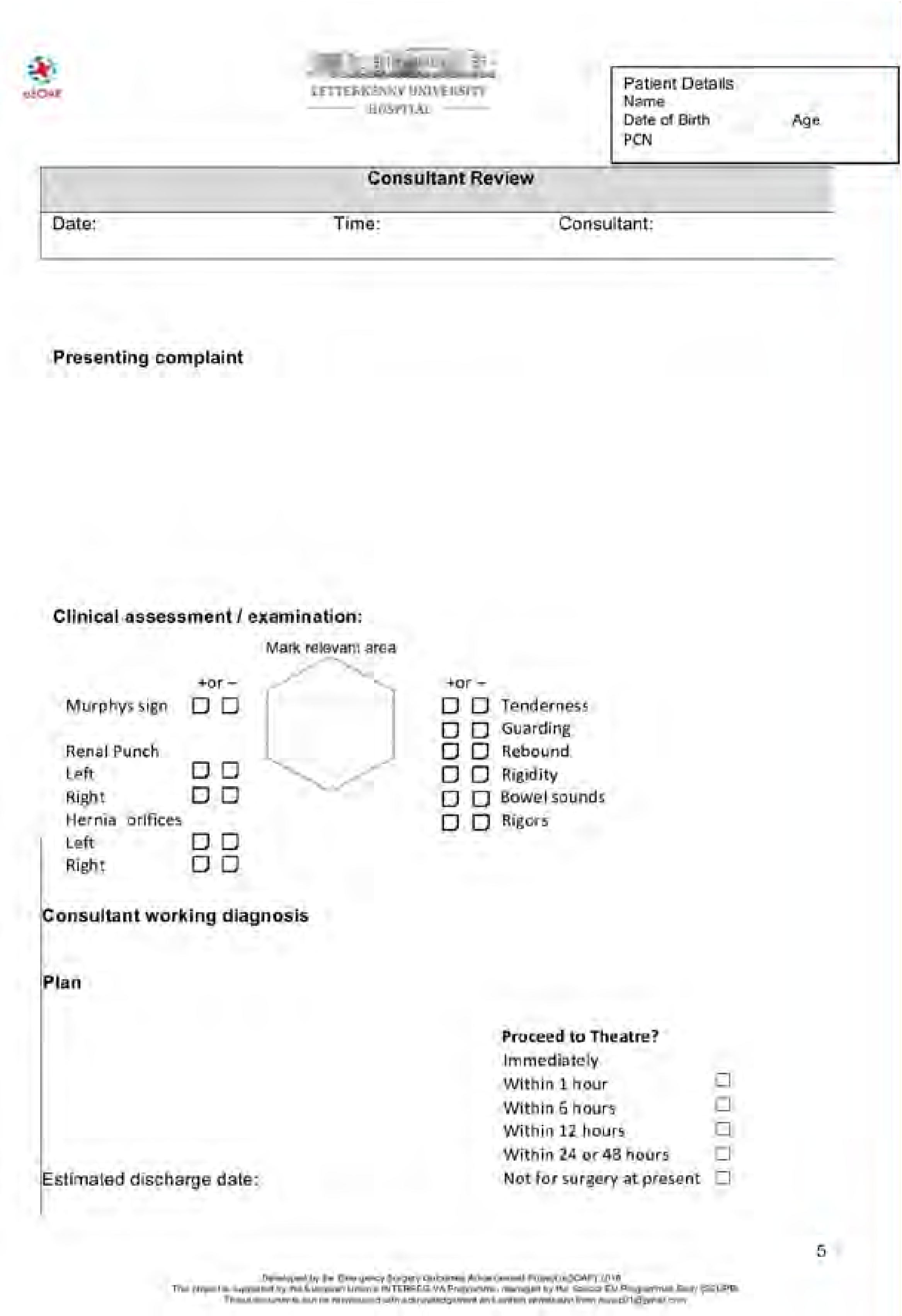
Working diagnosis:

Plan:

Theatre Plan

- Immediately ☐
- Within 1 hour ☐
- Within 6 hours ☐
- Within 12 hours ☐
- Within 24 or 48 hours ☐
- Not for surgery at present ☐

Discussed with Consultant: Yes/No



LETTERKENNY UNIVERSITY HOSPITAL

Patient Details
Name
Date of Birth Age
PCN

Consultant Review

Date: Time: Consultant:

Presenting complaint

Clinical assessment / examination:

Mark relevant area

	+or –			+or –		
Murphys sign	☐	☐		☐	☐	Tenderness
				☐	☐	Guarding
Renal Punch				☐	☐	Rebound
Left	☐	☐		☐	☐	Rigidity
Right	☐	☐		☐	☐	Bowel sounds
Hernia orifices				☐	☐	Rigors
Left	☐	☐				
Right	☐	☐				

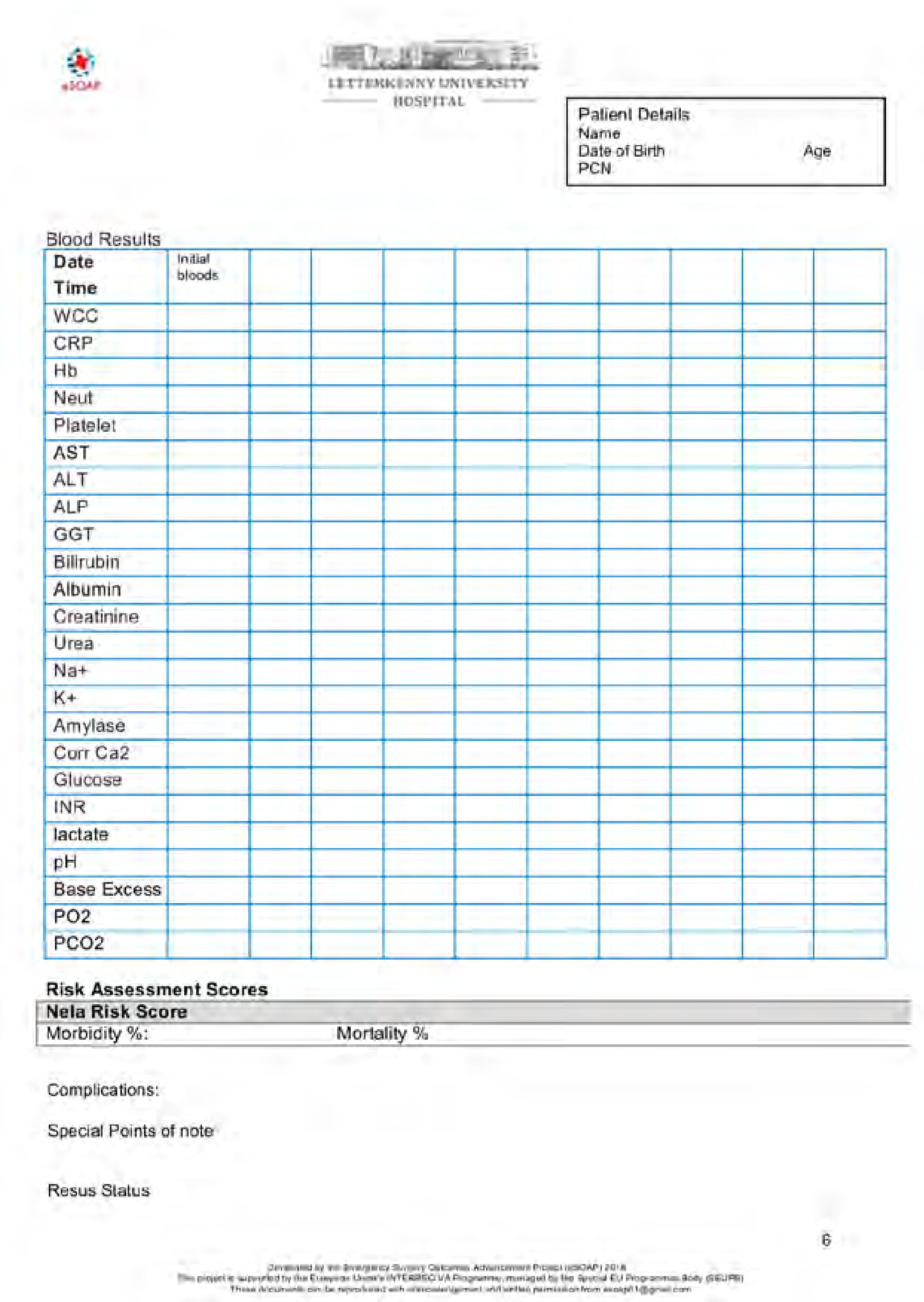
Consultant working diagnosis

Plan

Proceed to Theatre?
Immediately
Within 1 hour ☐
Within 6 hours ☐
Within 12 hours ☐
Within 24 or 48 hours ☐
Not for surgery at present ☐

Estimated discharge date:

5



eSOAP

LETTERKENNY UNIVERSITY HOSPITAL

Patient Details
Name
Date of Birth Age
PCN

Blood Results

Date **Time**	Initial bloods									
WCC										
CRP										
Hb										
Neut										
Platelet										
AST										
ALT										
ALP										
GGT										
Bilirubin										
Albumin										
Creatinine										
Urea										
Na+										
K+										
Amylase										
Corr Ca2										
Glucose										
INR										
lactate										
pH										
Base Excess										
PO2										
PCO2										

Risk Assessment Scores

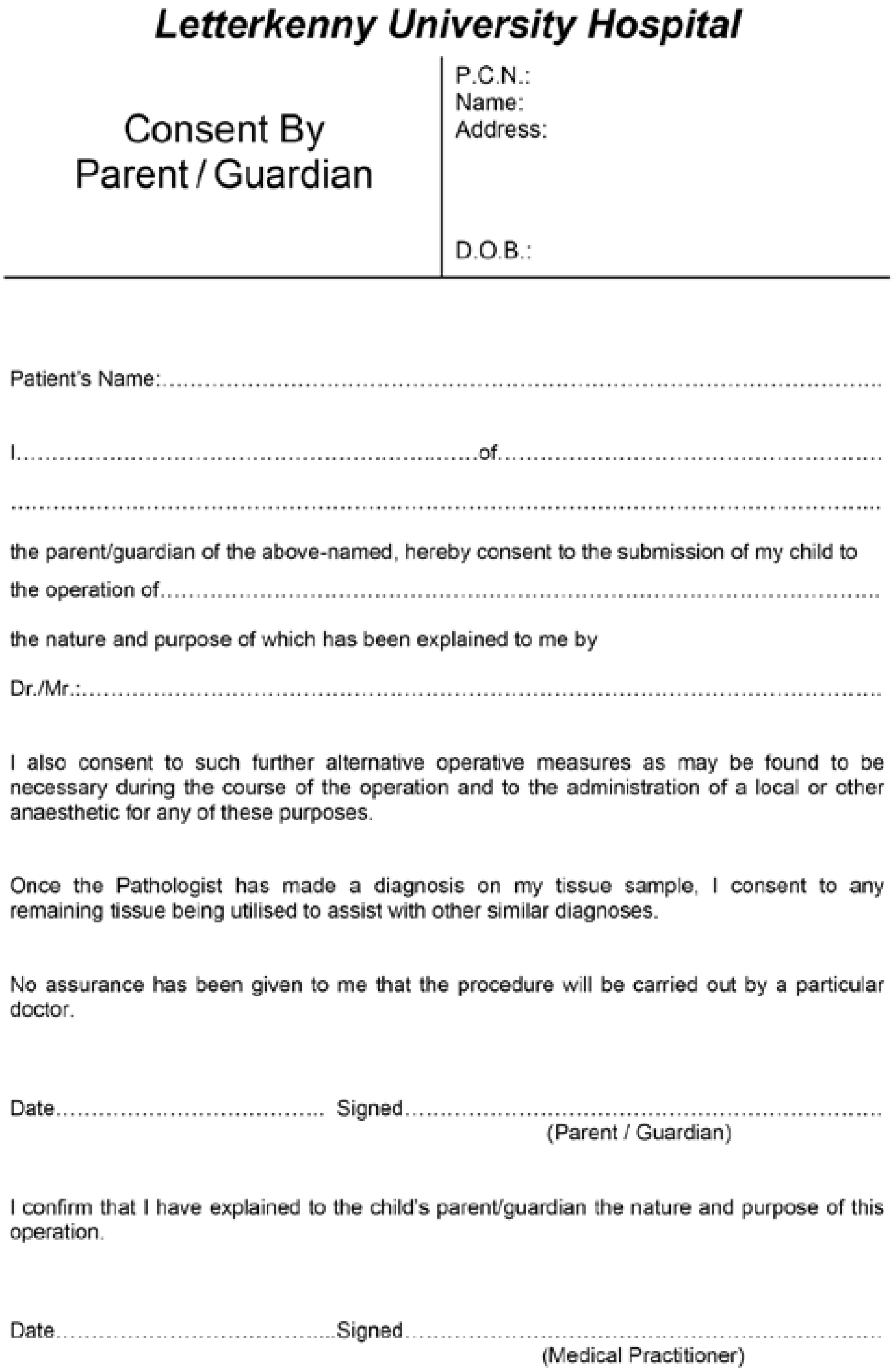
Nela Risk Score
Morbidity %: Mortality %

Complications:

Special Points of note

Resus Status

6



Letterkenny University Hospital

Consent By Parent / Guardian

P.C.N.:
Name:
Address:

D.O.B.:

Patient's Name:……………………………………………………………………………………………

I.…………………………………………………………………of…………………………………………………

……

the parent/guardian of the above-named, hereby consent to the submission of my child to

the operation of…………………………………………………………………………………………

the nature and purpose of which has been explained to me by

Dr./Mr.:……………………………………………………………………………………………………

I also consent to such further alternative operative measures as may be found to be necessary during the course of the operation and to the administration of a local or other anaesthetic for any of these purposes.

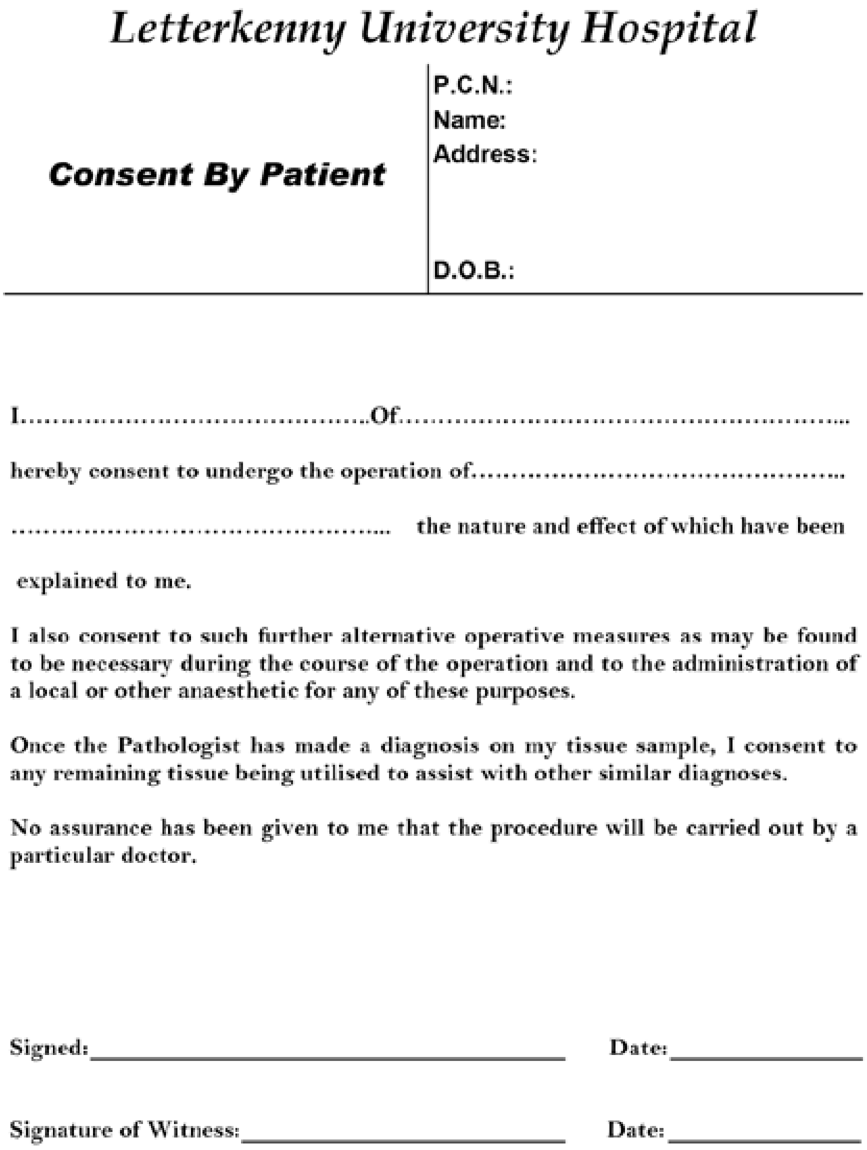
Once the Pathologist has made a diagnosis on my tissue sample, I consent to any remaining tissue being utilised to assist with other similar diagnoses.

No assurance has been given to me that the procedure will be carried out by a particular doctor.

Date………………………………… Signed……………………………………………………………
(Parent / Guardian)

I confirm that I have explained to the child's parent/guardian the nature and purpose of this operation.

Date…………………………………..Signed……………………………………………………………
(Medical Practitioner)



Letterkenny University Hospital

Consent By Patient

P.C.N.:
Name:
Address:

D.O.B.:

I……………………………………….Of…………………………………………………...

hereby consent to undergo the operation of………………………………………...

…………………………………………...   the nature and effect of which have been

explained to me.

I also consent to such further alternative operative measures as may be found to be necessary during the course of the operation and to the administration of a local or other anaesthetic for any of these purposes.

Once the Pathologist has made a diagnosis on my tissue sample, I consent to any remaining tissue being utilised to assist with other similar diagnoses.

No assurance has been given to me that the procedure will be carried out by a particular doctor.

Signed:____________________________________ Date:_______________

Signature of Witness:_________________________ Date:_______________

Emergency General Surgery Minimum Data Set Data Dictionary

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Introduction

Emergency General Surgery (EGS) data analysis will help mould future care for 10% of all hospital admissions that present as an emergency admission to acute hospitals around the world. Data entry, collection and analysis are the keys to optimising future care. The accuracy and reproducibility of registry data are vital and this dictionary forms the basis for this. At the Centre for Personalised Medicine we are grateful to the EU Interregional Funds for the research grant to facilitate this project. Along with our research partners in Altnagelvin Hospital, University of the Highlands and Islands, NHS Highland, Letterkenny Institute of Technology, Ulster University and The Clinical Translational Research and Innovation Centre (C-TRIC), we are happy to share this document. To-date there has been very significant collaboration with other societies and leaders in emergency surgery care. The World Society of Emergency Surgery (WSES) have been strong supporters of this project and it was discussed in detail at the 5th WSES Congress in Bertinoro in May of 2018. In addition the American Association of the Surgery of Trauma (AAST) has generously shared their EGS data dictionary and we are grateful to them and to Dr Raul Coimbra.

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The Team

Locally the team comprises of Clinical Lead Mr. Michael Sugrue, the Director of Research Dr. Randal Parlour, Clinical Research Nurses Louise Flanagan, Carol-Ann Walker, Alison Johnston and Administrative Co-ordinator Donna Sweeney.

Notes on Null Values:
Not Documented (ND): To be applied if it was expected that a piece of information would have been collected, but the information was not documented in the medical notes of the patient.

Not Requested (NR): To be applied if a blood test or imaging test has not been requested by the surgical team.

1 Patient Identifiers and Demographics

1.1

Data Entry Variable Name	**User I.D.**
Relevance of Data Entry Point:	**To identify the person who has entered the data**
Definition:	Each data collector has a unique identifier.
Notes:	*A user ID is created by the research team*

1.2

Data Entry Variable Name	**Database Number**
Relevance of Data Entry Point:	**The number, which is generated by the REDCap app.**
Definition:	A chronological number generated within the REDCap app for each entry.
Notes:	*This number is automatically inputted by the database.*

1.3

Data Entry Variable Name	**Unique ID**
Relevance of Data Entry Point:	**To allow the team to capture a unique ID relevant to a patient.**
Definition:	The Unique ID is a distinct number representing the patient and is assigned by the team, can be used to find the patient in the Emergency Surgery Database.
Options:	• **Enter Value**
Notes:	*A unique ID will be created by the research team.*

1.4

Data Entry Variable Name:	**Admission Date**
Relevance of Data Entry Point:	**To capture the date the patient presented to the Emergency Department.**
Definition:	The date the patient presented to the Emergency Department.
Criteria:	**Enter the date as dd/mm/yyyy**
Options:	• **Enter date (dd/mm/yyyy)**
Notes:	*Found page 1 ED clinical notes and Integrated Patient Management System (IPMS)*

1.5

Data Entry Variable Name:	**Age**
Relevance of Data Entry Point:	**To be able to calculate patient's age at the time of data entry.**
Definition:	The length of time that a person has lived
Criteria:	**Report the patient's age as per the medical record.**
Options:	• **Enter age in numerals in text box**
Notes:	*Found in patient's clinical record or Integrated Patient Management System (IPMS)*

1.6

Data Entry Variable Name:	**Gender**
Relevance of Data Entry Point:	**To capture gender for purpose of analysis. Gender can confer differential risk.**
Definition:	Distinguish between males and females. For transgender people, their sex assigned at birth and their gender identity are not necessarily the same.
Criteria:	**Report the patient's gender as per the medical record.**
Options:	• **Male** • **Female** • **Transgender**
Notes:	*Found in patients clinical records and IPMS*

1.7

Data Entry Variable Name:	**Consultant Surgeon**
Relevance of Data Entry Point:	**For sites to have the ability to track each surgeon's admissions.**
Definition:	A consultant surgeon with admitting rights who has overall responsibility for the care of patients in hospital.
Criteria:	**Consultant Surgeons in Letterkenny University Hospital**
Options:	**Select the appropriate surgeon from the dropdown menu located in the database.** **1.** **2.** **3.** **4.** **5.** **6.** **7.** **8.** **9.** **10.**
Notes:	*Found in clinical records and IPMS* *Locum (Add Locum surgeon's name to text box)*

1.8

Data Entry Variable Name:	**Residence Pre Admission**
Relevance of Data Entry Point:	**To capture patients admitted from home or transferred from another facility.**
Definition:	The place where the patient has lived within the last month prior to admission.
Criteria:	**The patient must meet criteria of one of the following:** • Admitted directly from home • Admitted from Sheltered Accommodation (accommodation consisting of private independent units with some shared facilities and a warden.) • Admitted from Nursing home (a private or public institution providing residential accommodation with health care, especially for elderly people.) • Residential care (kids under the care of child protection services) • Homeless (no fixed abode) • Unknown, if transferred from unknown location or facility
Options:	**Select from the dropdown menu located in the database.** • **Homeless** • **Nursing home** • **Own home** • **Residential care** • **Sheltered accommodation** • **Unknown** • **ND**
Notes:	*Residential care- kids that are under the care of Tusla (child protection agency in Ireland). Found on pg. 1 and or 2 Emergency Department (ED) clinical notes.*

1.9

Data Entry Variable Name: **Presenting Complaint**

Relevance of Data Entry Point: **To capture the complaint or complaints which the patient has presented to hospital with.**

Definition: The primary complaint or complaints that a patient states as the reason for seeking medical care.

Criteria:

The patient will present with one or more of the following complaints:

- Abdominal Pain R10.4 (unspecified) (See diagram in Notes identifying sub categories)

1. *Epigastric*
2. *Left Upper Quadrant*
3. *Left Para-umbilical*
4. *Left Iliac Fossa*
5. *Suprapubic*
6. *Right Iliac Fossa*
7. *Right para-umbilical*
8. *Right Upper Quadrant*
9. *Para-umbilical*
10. *Upper Abdominal Pain*
11. *Central*
12. *Lower*
13. *Upper Half*
14. *Lower Half*
15. *Entire Abdomen*
16. *Right Flank/ Renal*
17. *Left Flank/Renal*

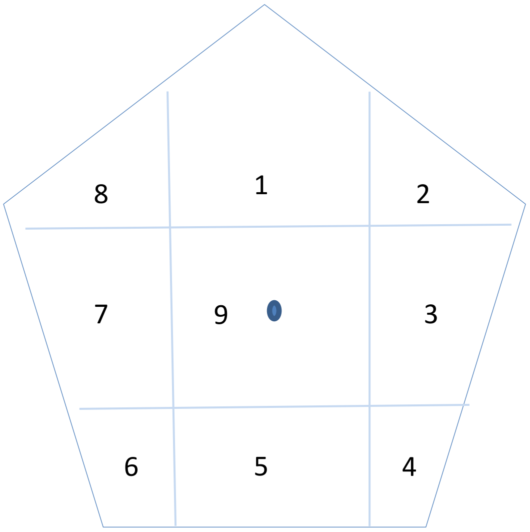
- Abdominal Distension R14
- Abscess
  - *Breast abscess N61*
  - *Perianal abscess K61.0*
  - *Skin abscess L02.9*
- Blood PR K92.2
- Cellulitis L03.9 cellulitis (diffuse) (with Lymphangitis)
- Constipation K59.0
- Diarrhoea R19.7 *(unspecified)*
- Dysphagia R13
- Fever R50.9
- Haematuria R31
- Hematemesis K92.0
- Hernia K46.9
- Jaundice R17 (unspecified)
- Left groin pain R10.3
- Nausea R11
- Obstipation K59.0
- Right groin pain R10.3
- Rigors R68.8
- Testicular pain N49.8
- Trauma T14.9
- Urology
  - *Urology Haematuria R31*
  - *Urology other N23*
  - *Retention of urine R33*
  - *Urology Stones N20*
- Vascular
- Vomiting R11
- Other (text box)

Options: **Select from the dropdown menu located in the database**

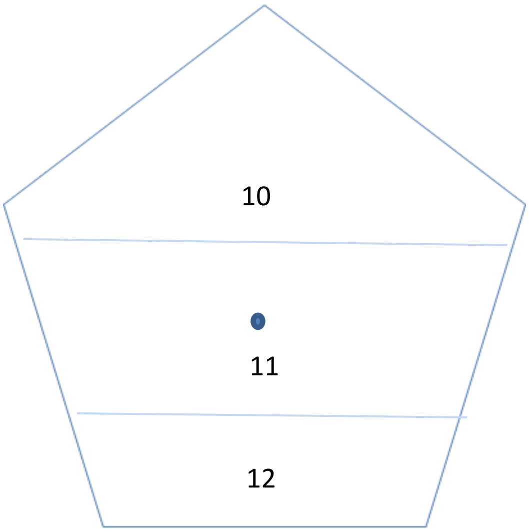
Notes: *Found in surgical proforma admission notes.*

Abdominal Pain Coding

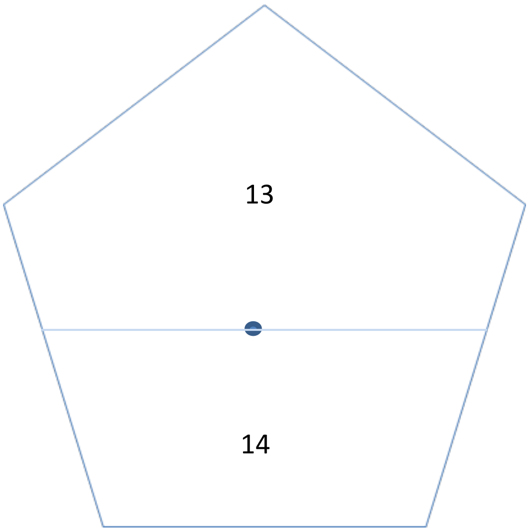
1	Epigastric
2	LUQ
3	Left Para-umblicial
4	LIF
5	Suprapubic
6	RIF
7	Right Para-umblicial
8	RUQ
9	Para-umblicial



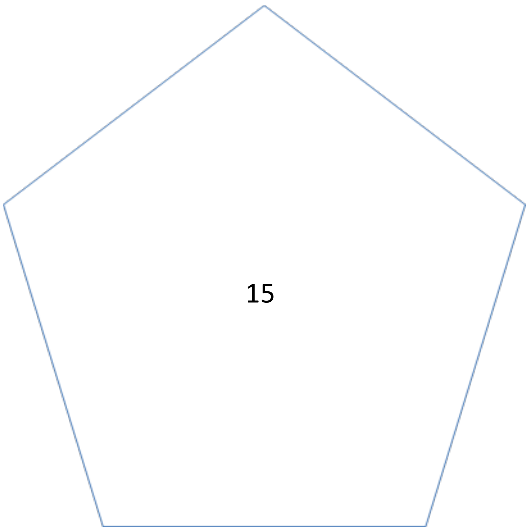
10	Upper abdominal pain
11	Central
12	Lower



13	Upper Half
14	Lower Half

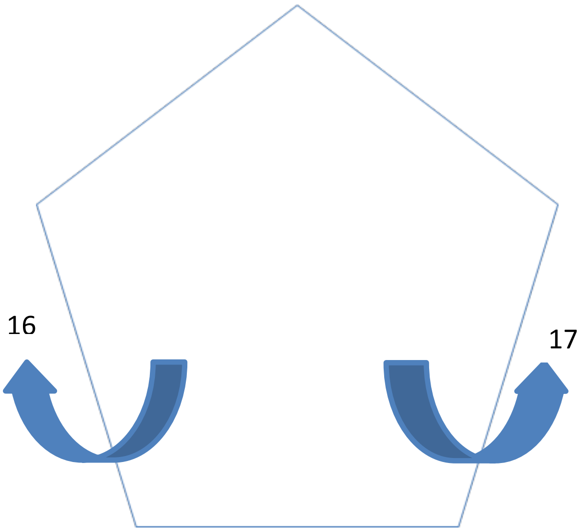


15 Entire Abdomen



16 R Flank/Renal

17 L Flank/Renal



1.10

Data Entry Variable Name: **Provisional Diagnosis**

Relevance of Data Entry Point: **To capture the initial impression of the presentation.**

Definition: A provisional diagnosis or working diagnosis is the most likely diagnosis based on presenting complaint/complaints (may be prior to confirmation by laboratory diagnosis and/or other test results) documented by the highest grade within surgical team, before they leave the emergency department.

Criteria: **The diagnosis is ICD-10 coded**

Options:

Select from the dropdown menu located in the database.

- Abscess
  - *Breast abscess N61*
  - *Perianal abscess K61.0*
  - *Skin abscess L02.9*
- Appendicitis K35
- Biliary Colic K80.5
- Cellulitis L03
- Cholangitis K83.0
- Cholecystitis K81
- Choledocholithiasis K80.5
- Cholelithiasis K80
- Colitis K52
- Crohn's K50
- Diverticulitis K57
- Diverticulosis K57.2
- Faecal impaction K56.4
- GI Bleed K92.2
- Haematemesis K92.0
- Melena K92.1
- Hernia-
  - *Diaphragm*
  - *Diaphragmatic K44.9*
  - *Diaphramatic K44*
  - *Epigastric K43.9*
  - *Femoral K41.9*
  - *Incisional K43.2*
  - *Inguinal K40*
  - *Other Abdominal hernia K45*
  - *Parastomal K43.5*
  - *Paraumbilical K42.9*
  - *Spigelian K43.9*
  - *Supraumbilicus K43.9*
  - *Umbilical K42.9*
  - *Unspecific Abdominal hernia K46*
  - *With gangrene K46.1*
  - *With obstruction K46.0*
- Large bowel obstruction K56.6
- Volvulus K56.2
- Mesenteric Ischaemia K55.0
- Mesenteric Adenitis I88.0
- Non-specific abdominal pain R10
- Obstructive Jaundice K83.1
- Pancreatitis K85
- Pelvic pathology R10.2
- Peptic Ulcer K27
- Gastric Ulcer K25
- Duodenal Ulcer K26
- Peritonitis K65
- Septic shock R57.2
- Small bowel obstruction
  - *Paralytic ileus K56.0*
  - *Gallstone ileus K56.3*
  - *Peritoneal adhesions K66.0*
  - *Intestinal adhesions [bands] with obstruction K56.5*
  - *Other and unspecified intestinal obstruction K56.6*
- Trauma T14.9
- Upper GI Bleed
  - *Gastrointestinal haemorrhage, unspecified K92.2*
  - *Haematemesis K92.0*
  - *Melaena K92.1*
  - *Oesophageal varices I85*
  - *Gastro-oesophageal laceration-haemorrhage syndrome K22.6*
  - *Mallory-Weiss syndrome*

Options:	- *Urology*
	  - *Urology Haematuria R31*
	  - *Urology other N23*
	  - *Retention of urine R33*
	  - *Urology Stones N20*
	- *Vascular*
	- *Other (allow for text box)*

Notes:	*Found in surgical proforma admission notes.* *Diagnosis will be coded using ICD-10 codes.*

1.11

Data Entry Variable Name:	**Include in Registry**
Relevance of Data Entry Point:	**This eSOAP Registry aims to capture all Emergency Surgical Admissions, however, due to rational workload some will not be included past this point as our area of interest for the purpose of this study is emergency general surgery admissions. This can be tailored to each hospital and/or healthcare needs.**
Definition:	The patient will only be included if they are being admitted on a provisional diagnosis of an emergency general surgical condition
Criteria:	**Emergency general surgical admissions. Cellulitis, Trauma, Urology or Vascular admissions will not be included past this point.**
Inclusion criteria	Patients who are admitted direct to the emergency surgery service (via ED) OR • Patients who are referred to the emergency surgery service and care transferred from another speciality (e.g. medicine) AND • With a provisional diagnosis of –

Inclusion criteria	• Abscess
	  • *Breast abscess N61*
	  • *Perianal abscess K61.0*
	  • *Skin abscess L02.9*
	• Appendicitis K35
	• Biliary Colic K80.5
	• Cellulitis L03
	• Cholangitis K83.0
	• Cholecystitis K81
	• Choledocholithiasis K80.5
	• Cholelithiasis K80
	• Colitis K52
	• Crohn's K50
	• Diverticulitis K57
	• Diverticulosis K57.2
	• Faecal impaction K56.4
	• GI Bleed K92.2
	• Haematemesis K92.0
	• Melena K92.1
	• Hernia-
	  • *Diaphragm*
	  • *Diaphragmatic K44.9*
	  • *Diaphramatic K44*
	  • *Epigastric K43.9*
	  • *Femoral K41.9*
	  • *Incisional K43.2*
	  • *Inguinal K40*
	  • *Other Abdominal hernia K45*
	  • *Parastomal K43.5*
	  • *Paraumbilical K42.9*
	  • *Spigelian K43.9*
	  • *Supraumbilicus K43.9*
	  • *Umbilical K42.9*
	  • *Unspecific Abdominal hernia K46*
	  • *With gangrene K46.1*
	  • *With obstruction K46.0*
	• Large bowel obstruction K56.6
	• Volvulus K56.2
	• Mesenteric Ischaemia K55.0
	• Mesenteric Adenitis I88.0
	• Non-specific abdominal pain R10
	• Obstructive Jaundice K83.1
	• Pancreatitis K85
	• Pelvic pathology R10.2
	• Peptic Ulcer K27
	• Gastric Ulcer K25
	• Duodenal Ulcer K26
	• Peritonitis K65
	• Septic shock R57.2
	• Small bowel obstruction
	  • *Paralytic ileus K56.0*
	  • *Gallstone ileus K56.3*
	  • *Peritoneal adhesions K66.0*
	  • *Intestinal adhesions [bands] with obstruction K56.5*
	  • *Other and unspecified intestinal obstruction K56.6*
	• Trauma T14.9
	• Upper GI Bleed
	  • *Gastrointestinal haemorrhage, unspecified K92.2*
	  • *Haematemesis K92.0*
	  • *Melaena K92.1*
	  • *Oesophageal varices I85*
	  • *Gastro-oesophageal laceration-haemorrhage syndrome K22.6*
	  • *Mallory-Weiss syndrome*

Exclusion criteria	• *Cellulitis* • *Trauma* • *Urology* • *Vascular*
Options:	**Select from the dropdown menu located in the database.** • **Yes** • **No**
Notes:	*Found in surgical proforma admission notes.*

1.12

Data Entry Variable Name	**Consent Signed**
Relevance of Data Entry Point:	**To capture if the patient has signed a consent form for the inclusion of their data in the registry.**
Definition:	The patient has consented to have their data included in the registry and can withdraw at any time by contacting the Director of Research.
Options:	**Select from the dropdown menu in the database** • **Yes** • **No**
Notes:	*Found in clinical notes*

1.13

Data Entry Variable Name:	**Module**
Relevance of Data Entry Point:	**To capture what module the patient's data to be entered under.**
Definition:	There are four modules which have been developed by the team which contain specific data points for emergency general surgery conditions.
Criteria:	**Select the appropriate module according to the patient's provisional diagnosis and presenting complaint/complaints.**
Options:	**Select from the dropdown menu in the database** • **Laparotomy** • **RIF pain and Appendicitis** • **RUQ pain and Cholecystitis** • **Small Bowel Obstruction** • **None of the Above**
Notes:	*Found in surgical proforma admission notes.*

2 Emergency Department

2.1

Data Entry Variable Name:	**Specialty First Admitted Under**
Relevance of Data Entry Point:	**To capture what speciality the patient was first admitted under.**
Definition:	The area of speciality the patient was first admitted under.
Criteria:	**What speciality the patient was first admitted under?**
Options:	**Select from the dropdown menu in the database** • **Care of the Elderly** • **Gastroenterology** • **General Medicine** • **General Surgery** • **Gynaecology/Obstetrics** • **Other** • **ND**
Notes:	*Found in page 1 ED clinical notes or in clinical notes if patient has been initially admitted under a different speciality or IPMS.*

2.2

Data Entry Variable Name:	**Referred By**
Relevance of Data Entry Point:	**To capture who has referred the patient to the Emergency Department or the emergency surgery service.**
Definition:	A process of referring a patient to another practitioner or a self-presentation to the emergency department or emergency surgery service.
Criteria:	**Who has referred the patient?**
Options:	**Select from the dropdown menu in the database** • **Self** • **GP** • **Another Consultant**
Notes:	*Found in ED clinical notes page 1 or in clinical notes if patient has been initially admitted under a different speciality. If not specified on ED clinical notes record as a self-presentation.*

2.3

Data Entry Variable Name:	**Transport**
Relevance of Data Entry Point:	**To capture how the patient arrived to the Emergency Department, that is by ambulance, helicopter or another means.**
Definition:	The means or vehicle how the patient was transported to the Emergency Department.
Criteria:	**How did the patient arrive to the Emergency Department?**
Options:	**Select from the dropdown menu in the database** • **Ambulance** • **Helicopter** • **Other**
Notes:	*Found in ED clinical notes page 1*

2.4

Data Entry Variable Name:	**Registered Time**
Relevance of Data Entry Point:	**To capture the date and time the person was registered in the Emergency Department.**
Definition:	Time of registration in the Emergency Department
Criteria:	**Enter date (dd/mm/yyyy)** **Enter time in 24 hour format.**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not documented (ND)**
Notes:	*Found in ED clinical notes page 1 and IPMS*

2.5

Data Entry Variable Name:	**Triage Time**
Relevance of Data Entry Point:	**To capture the date and time the patient was first seen by the triage nurse.**
Definition:	The time the patient was seen by the triage nurse.
Criteria:	**Enter date (dd/mm/yyyy)** **Enter time in 24 hour format.**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not documented (ND)**
Notes:	*Found in ED clinical notes page 1 and IPMS*

2.6

Data Entry Variable Name:	**Time Referred**
Relevance of Data Entry Point:	**To capture the time the patient was referred to surgical team on call.**
Definition:	The time the surgical team on call is first contacted to review the patient.
Criteria:	**Enter date (dd/mm/yyyy)** **Enter time in 24 hour format.**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not documented (ND)**
Notes:	*Found in page 8 ED clinical notes Refer Time.*

2.7

Data Entry Variable Name:	**Time Seen**
Relevance of Data Entry Point:	**To capture the time the surgical team reviewed the patient.**
Definition:	The time of first review by the surgical team.
Criteria:	**Enter date (dd/mm/yyyy)** **Enter time in 24 hour format.**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not documented (ND)**
Notes:	*Found in surgical proforma admission notes.*

3 Emergency Department Observations

3.1

Data Entry Variable Name:	**Blood Pressure (BP)**
Relevance of Data Entry Point:	**To capture what the patient's Blood pressure (BP) was at the time of triage in the Emergency department**
Definition:	The blood pressure is the pressure of the blood within the arteries. It is produced primarily by the contraction of the heart muscle
Criteria:	**Record the first or initial documented BP value. Systolic/Diastolic will be recorded in millimetre of mercury (mmHg)**
Options:	• **Enter numerals mmHg.** • **Not Documented (ND)**
Notes:	*Found page 1 ED Clinical notes*

3.2

Data Entry Variable Name:	**Temperature (Temp)**
Relevance of Data Entry Point:	**To capture what the patient's Temperature (Temp) was at the time of triage in the Emergency department**
Definition:	The temperature is the specific degree of hotness or coldness of the body
Criteria:	**Record the first or initial documented temperature value. Will be recorded in Degrees Celsius (˚C)**
Options:	• **Enter numerals ˚C** • **Not Documented ND**
Notes:	*Found page 1 ED Clinical notes*

3.3

Data Entry Variable Name:	**Pulse**
Relevance of Data Entry Point:	**To capture what the patient's pulse/heart rate is at time of triage in the Emergency Department.**
Definition:	The pulse rate is a measurement of the heart rate, or the number of times the heart beats per minute.
Criteria:	**Record the first or initial documented pulse rate. Will be recorded in beats per minute (/m)**
Options:	• **Enter numerals /min** • **Not Documented (ND)**
Notes:	*Found page 1 ED Clinical notes*

3.4

Data Entry Variable Name:	**Respiratory Rate (RR)**
Relevance of Data Entry Point:	**To capture what the patient's Respiratory Rate (RR) was at the time of triage in the Emergency department**
Definition:	The number of movements indicative of inspiration and expiration per minute.
Criteria:	**Record the first or initial documented RR value. Will be recorded in breaths per minute (/m)**
Options:	• **Enter numerals /min** • **Not Documented (ND)**
Notes:	*Found page 1 ED Clinical notes*

3.4

Data Entry Variable Name:	**Peripheral Capillary Oxygen Saturations (SpO2)**
Relevance of Data Entry Point:	**To capture what the patient's peripheral capillary oxygen saturations (Spo2) were at the time of triage in the Emergency department.**
Definition:	SpO2 is an estimate of arterial oxygen saturation, which refers to the amount of oxygenated haemoglobin in the blood.
Criteria:	**Record the first or initial documented SpO2 value. Will be recorded in percentage (%).**
Options:	• **Enter numerals /min** • **Not Documented (ND)**
Notes:	*Found page 1 ED Clinical notes*

4 Co-Morbidities

4.1

Data Entry Variable Name:	**Anti-Coagulants (Anti-Coags)**
Relevance of Data Entry Point:	**To capture patients with an increased risk for bleeding due to chronic anticoagulation. This may indicate a greater need for intra/postop transfusion, and might also affect wound healing and other complications**
Definition:	Agents that prevent or reduce blood coagulation; prescribed to prolong clotting time or prevent intravascular clot formation.
Criteria:	**Documented diagnosis in the medical record of the administration of medication (anticoagulants, antiplatelet agents other than aspirin, thrombin inhibitors, and thrombolytic agents) that interferes with blood clotting thereby predisposing the patient to excessive bleeding.**
Options:	**Select from the dropdown menu in the database** • **Yes** • **No**
Notes:	*Yes or No Page 1 ED Clinical notes and medications kardex*

5 Admission Lab Value Information

5.1

Data Entry Variable Name:	**Admission Lab Value Information**
Relevance of Data Entry Point:	**To capture patients with admission lab variances. Altered lab values may indicate an underlying disease process/state that may affect surgical outcomes. These are the initial bloods drawn. In the instance when the patient is admitted under a different speciality please take the bloods drawn closest to the time of surgical review.**
Definition:	Diagnostic blood tests performed to evaluate a patient's physical status prior to the surgical visit or surgical procedure.
Criteria:	**All of the following preoperative lab values are to be reported if they are drawn on the day of admission or drawn closest to the time of surgical review if initially admitted under a different speciality.** **White Cell Count (WCC)** (10 ^{9}/l) (cannot be >40) **Haemoglobin (Hb)** (g/dl) (cannot be <3 or >20) **C-Reactive Protein (CRP)** (mg/l) (cannot be >1000) **Amylase** (u/l) (cannot be >5000) **Gamma-Glutamyl Transferase (GGT)** (u/l) (cannot be >3000) **Serum Creatinine (Creat)** (mg/dl) (cannot be >900) **International Normalized Ratio (INR)** (unit less ratio) (cannot be >20) **Base Excess** (mmol/l) (cannot be>20) **Base Deficit** (mmol/l) (cannot be>20) **Lactate** (mmol/l) (cannot be >10)
Options:	**Select from the dropdown menu in the database** • **Enter Value** • **Not Requested (NR) (NR)** • **Haemolysed**
Notes:	*Decimals can be recorded*

6 Imaging

6.1

Data Entry Variable Name:	**Chest X-Ray (CXR)**
Relevance of Data Entry Point:	**To capture if a patient had a Chest X-Ray performed on this admission.**
Definition:	Diagnostic x-ray of thoracic cavity performed to evaluate a patient's physical status on admission.
Criteria:	**Only record imaging that was booked and performed within this admission.** **Enter date (dd/mm/yyyy)** **Enter time in 24 hour format.**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Requested (NR)**
Notes:	*Found in the results section of ICM or National Integrated Medical Imaging System (NIMIS).*

6.2

Data Entry Variable Name:	**Plain Film Abdomen (PFA)**
Relevance of Data Entry Point:	**To capture if a patient had a PFA on this admission.**
Definition:	Diagnostic plain x-ray of the abdomen.
Criteria:	**Only record imaging that was booked and performed within this admission.** **Enter date (dd/mm/yyyy)** **Enter time in 24 hour format.**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Requested (NR)**
Notes:	*Found in the results section of ICM or NIMIS.*

6.3

Data Entry Variable Name:	**Ultrasound (US)**
Relevance of Data Entry Point:	**To capture if a patient had an US on this admission and the type of US.**
Definition:	An ultrasound scan is an imaging test that uses high-frequency sound waves, also known as sonography
Criteria:	**Only record imaging that was booked and performed within this admission.** **All of the following are included in the database, select from list.** **Abdomen** **Abdomen and Pelvis-Trans Abdominal /Trans Vaginal** **Breast** **Pelvic -** Trans Abdominal /Trans Vaginal **Renal** (kidney both) **Not Requested** • **Booked** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Performed** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Reported** Enter date (dd/mm/yyyy) Enter time in 24 hour format
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Requested (NR)**
Notes:	*Found in the results section of ICM or NIMIS.*

6.4

Data Entry Variable Name:	**Computed Topography (CT)**
Relevance of Data Entry Point:	**To capture if a patient had a CT and type of CT on this admission.**
Definition:	CT is a radiologic imaging modality that uses computer processing to generate an image of the tissue density in a "slice" as thin as 1 to 10 mm in thickness through the patient's body. These images are spaced at intervals of 0.5 to 1 cm. Cross-sectional anatomy can be reconstructed in several planes without exposing the patient to additional radiation.
Criteria:	**Only record imaging that was booked and performed within this admission.** **All of the following are included in the database, select from list.** **Abdomen** **Abdomen &Pelvis** **Kidneys, Ureters and Bladder (KUB)** **Thoracic, Abdomen and Pelvis (TAP)** **CT Angiogram (ANGIO)** **Thorax** **Urogram** **Not Requested** • **Booked** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Performed** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Reported** Enter date (dd/mm/yyyy) Enter time in 24 hour format
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Requested (NR)**
Notes:	*Found in the results section of ICM or NIMIS.*

6.5

Data Entry Variable Name:	**Magnetic Resonance Imaging (MRI)**
Relevance of Data Entry Point:	**To capture if a patient had a MRI and the type of MRI on this admission.**
Definition:	Magnetic Resonance Imaging is a diagnostic technique that uses magnetic fields and radio waves to produce a detailed image of the body's soft tissue and bones.
Criteria:	**Only record imaging that was booked and performed within this admission. All of the following are included in the database, select from list.** **Abdomen** **Pelvis** **Magnetic Resonance Cholangiopancreatography (MRCP)** • **Booked** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Performed** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Reported** Enter date (dd/mm/yyyy) Enter time in 24 hour format
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Requested (NR)**
Notes:	*Found in the results section of ICM or NIMIS.*

6.5

Data Entry Variable Name:	**Other Image**
Relevance of Data Entry Point:	**To capture if another image has been performed during the admission which has not been included in another variable dropdown menu.**
Definition:	Any additional imaging which is not an option in another variable.
Criteria:	**Only record imaging that was booked and performed within this admission.** **Yes** **No** **ND** If yes selected enter image into text box • **Booked** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Performed** Enter date (dd/mm/yyyy) Enter time in 24 hour format • **Reported** Enter date (dd/mm/yyyy) Enter time in 24 hour format
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Requested (NR)**
Notes:	

7 Disposition

7.1

Data Entry Variable Name:	**Moved To**
Relevance of Data Entry Point:	**To capture what happened after the patient was seen by the surgical team (i.e.) was the patient admitted to a ward, stayed in the emergency department or transferred to another hospital and the date and time of movement.**
Definition:	Where and when the patient was moved to after being seen by the surgical team.
Criteria:	**The patient was moved to one of the following:** **Intensive Care Unit (ICU):** a designated area that is dedicated to the care of patients who are seriously ill who need more intensive observation, treatment and nursing care **High Dependency Unit (HDU):** a designated intermediate care unit, a step-down from the ICU **Ward:** a unit for the routine care of patients **Corridor:** a bed/trolley on a ward corridor when beds are unavailable **Theatre:** patient taken straight to theatre after review by surgical team in ED **Emergency department trolley:** A patient who has been admitted by the surgical team and remains in the Emergency Department on a trolley due to no available inpatient beds. **Overflow area:** A designated area within the hospital where patients are admitted to when no available inpatient beds are available. In Letterkenny University Hospital these areas are the Acute Medical Assessment Unit (AMAU) and the Day Services Unit. **Enter date (dd/mm/yyyy)** **Enter time in 24 hour format.**
Options:	**Please select one from the dropdown menu in the database.** • **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)**
Notes:	*Found in ED clinical notes page 8 or IPMS-In patient history system*

7.2

Data Entry Variable Name:	**Antibiotics**
Relevance of Data Entry Point:	**To capture if patients received antibiotic therapy on this admission.**
Definition:	A drug used to treat bacterial infections.
Criteria:	**Was an antibiotic given. Select Yes/No** **Enter date (dd/mm/yyyy)**
Options:	**Please select one from the dropdown menu in the database.** • **Yes** • **No** • **Enter date (dd/mm/yyyy)**
Notes:	*Page 2 ED Clinical notes Drug therapy and/or medications kardex.*

7.3

Data Entry Variable Name:	**Surgery**
Relevance of Data Entry Point:	**To capture if the patient has had a surgical procedure.**
Definition:	A medical procedure involving an incision with instruments, performed to repair damage or disease. Surgery can involve cutting, abrading, suturing, or otherwise physically changing body tissues and organs.
Criteria:	**Please select Yes/No.**
Options:	**Please select one from the dropdown menu in the database.** • **Yes** • **No**
Notes:	*Found in surgical notes*

8 Surgery

8.1

Data Entry Variable Name:	**Date & Time Surgery Booked**
Relevance of Data Entry Point:	**To capture date and time surgery is booked, as recorded in the operating theatre's entry system.**
Definition:	Date and time surgery booked.
Criteria:	**Enter date (dd/mm/yyyy)** **Enter time in 24 hour format**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Documented ND**
Notes:	*Found in clinical notes and booking documentation in theatre.*

8.2

Data Entry Variable Name:	**Date and Time of Induction**
Relevance of Data Entry Point:	**To capture the date and time of induction.**
Definition:	The date and time the anaesthetic agent is given.
Criteria:	**Enter date (dd/mm/yyyy)** **Enter time in 24 hour format**
Options:	• **Enter date (dd/mm/yyyy)** • **Enter time (hh:mm)** • **Not Documented ND**
Notes:	*Found on IPMS (Theatre screen-In theatre) or Operation Sheet in Clinical notes.*

8.3

Data Entry Variable Name:	**American Association of Anaesthesiologists (ASA) Score**
Relevance of Data Entry Point:	**To capture the patients ASA score.**
Definition:	A system for assessing the fitness of patients before surgery.
Criteria:	**Report the ASA category, 1 – 5, assigned to the patient as it appears on the anaesthesia record.** **1 No systemic disease** **2 Mild systemic disease** **3 Severe systemic disease, not life threatening** **4 Severe, life-threatening** **5 Moribund patient**
Options:	**Select from dropdown menu in the database**
Notes:	*Green Anaesthetic sheet at the back of the clinical notes and IPMS theatre screen.*

8.4

Data Entry Variable Name:	**Surgeon**
Relevance of Data Entry Point:	**For sites to have the ability to track each surgeon's surgical cases.**
Definition:	A doctor who perform surgical operations.
Criteria:	**01-** **02-** **03-** **04-** **05-** **06-** **07-** **08-** **09-**
Options:	**Select from dropdown menu in the database**
Notes:	*Found on operation chart in clinical notes*

8.5

Data Entry Variable Name:	**Procedure**
Relevance of Data Entry Point:	**To capture the surgical procedure.**
Definition:	The surgical procedure performed.
Criteria:	**The surgery performed** **Appendectomy 926** • Laparoscopic 30572-00 • Open 30571-00 **Abscesses** • Drainage of intra-anal abscess 32174-00 • Incision of pilonidal sinus, cyst or abscess 30676-00 • Drainage of perianal abscess 32174-01 • Drainage of ischiorectal abscess 32174-02 • Incision and drainage of pancreatic abscess 30575-00 • Laparoscopic drainage of intra-abdominal abscess, haematoma or cyst 30394-01 • Other closed drainage of intra-abdominal abscess, haematoma or cyst 30394-02 • Drainage of intra-abdominal abscess, haematoma or cyst 30394-00 • Drainage of retroperitoneal abscess, haematoma or cyst 30402-00 • Incision and drainage of abscess of skin and subcutaneous tissue 30223-01 **Cholecystectomy 965** • Laparoscopic cholecystectomy 30445-00 • Laparoscopic cholecystectomy with exploration of C.B.D. via cystic duct 30448-00 • Laparoscopic cholecystectomy with exploration of C.B.D. via Choledochotomy 30449-00 • Open Cholecystectomy 30443-00 • Cholecystectomy with choledochotomy 30454-01 • Cholecystectomy with choledochotomy and biliary intestinal anastomosis 30455-00 • Cholecystostomy 30375-05 • Intraoperative cholangiography 30439-00 • Choledochojejunostomy 30460-04 • Choledochoduodenostomy 30460-03 • Surgical repair of post-operative biliary stricture 917 • Open 30469-00 • Closed 30494-00 • Hepaticojejunostomy 30460-07(969)

Criteria

Hernia

Incisional

- Repair of incisional hernia 30403-00
- Repair of incisional hernia with muscle transposition 30405-00
- Repair of incisional hernia with mesh 30405-01
- Repair of incisional hernia with resection of strangulated intestine 30405-02

Inguinal

- Repair of inguinal hernia, unilateral laparoscopic 30609-02
- Unilateral laparoscopic with mesh 30609-02 [990]
- Incarcerated (obstructed) (strangulated) 30615-00 [997]
- Repair of inguinal hernia, unilateral open 30614-02
- Unilateral open with mesh 30614-02 [990]
- Incarcerated (obstructed) (strangulated) 30615-00 [997]
- Repair of inguinal hernia, bilateral laparoscopic 30609-03 [990]
- Repair of inguinal hernia, bilateral laparoscopic with mesh 30614-03 [990]
- Incarcerated (obstructed) (strangulated) 30615-00 [997]
- Repair of inguinal hernia, bilateral open 30614-03
- Repair of inguinal hernia, bilateral open with mesh 30614-03 [990]
- Incarcerated (obstructed) (strangulated) 30615-00 [997]

Umblicial

- Repair of umbilical hernia 30617-00 [992]
- Incarcerated (obstructed) (strangulated) hernia 30615-00 [997]

Diaphragmatic

- Repair of diaphragmatic hernia, abdominal approach 30601-00
- Repair of diaphragmatic hernia, thoracic approach 30601-01
- Repair of diaphragmatic hernia with use of body wall flap or insertion of mesh 43837-02

Epigastric

- Repair of epigastric hernia 30617-01

Criteria

Femoral

- Unilateral open with mesh 30614-00 [991]
- Unilateral laparoscopic repair of femoral hernia 30609-00
- Bilateral open repair of femoral hernia30614-01
- Bilateral open with mesh 30614-01[991]
- Bilateral laparoscopic repair of femoral hernia 30609-01
- Incarcerated (obstructed)(strangulated) 30615-00 [997]
- Via laparoscopy 30609-01 [991]

Criteria

Parastomal

- Repair of parastomal hernia 30563-02
- Repair of parastomal hernia with re-siting of stoma 30563-03

Spigelian

Other Abdominal hernia

Paraumbilical

Peptic/Duodenal ulcer

- Partial gastrectomy with gastroduodenal anastomosis following previous procedure for peptic ulcer disease 30503-00
- Partial gastrectomy with gastrojejunal anastomosis following previous procedure for peptic ulcer disease 30503-01
- Partial gastrectomy with Roux-en-Y reconstruction following previous procedure for peptic ulcer disease 30503-02
- Control of bleeding peptic ulcer by gastric resection 30509-00
- Endoscopic control of peptic ulcer or bleeding (non-operative) 90296-00
- Suture of perforated ulcer 30375-10
- Control of bleeding peptic ulcer 30505-00
- Selective vagotomy with partial gastrectomy and gastroduodenal anastomosis 30498-00
- Selective vagotomy with partial gastrectomy and gastrojejunal anastomosis 30497-01
- Selective vagotomy with partial gastrectomy and Roux-en-Y reconstructive 30497-02
- Gastroenterostomy 30515-00
- Total gastrectomy 30521-00

Criteria

Colorectal procedures

- Colostomy 30375-04(915)
- With rectosigmoidectomy (Hartman's procedure) 32030-00(934)
- Via laparoscopy 32030-01(934)
- Loop 30375-28(915)
- Permanent 30375-04(915)
- Revision 30563-01((18)
- Temporary (covering) (defunctioning) 30375-28(915)
- Low anterior resection of rectum 32025-00
- Ultra low anterior resection of rectum 32026-00
- High anterior resection of rectum 32024-00
- Incision of rectum or anus 90338-00
- Caecostomy 30375-00
- Temporary ileostomy 30375-29

Criteria	• Resection of small intestine with anastomosis 30566-00 • Resection of small intestines with formation of stoma 30565-00 • Strictureplasty of small intestine 30564-00 • Enterotomy of small intestine 30375-03 • Endoscopic examination of small intestine via intraoperative enterotomy 30568-00 • Division of adhesions abdominal (open) 30378-00 [986] • Division of adhesions via laparoscopy 30393-00 [986] • Excision of Meckel’s diverticulum 30375-09 • Reclosure of postoperative disruption of abdominal wall 30403-03 • Laparotomy exploratory (with biopsy) 30373-00 [985] • Laparoscopy (diagnostic) (exploratory) 30390-00 [984] • +/- Release of Adhesions • Right Hemicolectomy • Open right hemicolectomy with anastomosis 32003-01 (Resection of ascending colon, hepatic flexure and part of the transverse colon (mid transverse colon) with anastomosis) • Laparoscopic right hemicolectomy with anastomosis 32003-03 (Resection of ascending colon, hepatic flexure and part of the transverse colon (mid transverse colon) with anastomosis, via laparoscopy) • Open right hemicolectomy with formation of stoma 32000-01 (Resection of ascending colon, hepatic flexure and part of the transverse colon (mid transverse colon) with formation of stoma • Laparoscopic right hemicolectomy with formation of stoma 32000-03 (Resection of ascending colon, hepatic flexure and part of the transverse colon (mid transverse colon) with formation of stoma, via laparoscopy) • Open extended right hemicolectomy with anastomosis 32005-01 (Resection of ascending colon, hepatic flexure and transverse colon to the splenic flexure with anastomosis)
Criteria	• Laparoscopic extended right hemicolectomy with anastomosis 32005-03 (Resection of ascending colon, hepatic flexure and transverse colon to the splenic flexure with anastomosis, via laparoscopy) • Open extended right hemicolectomy with formation of stoma 32004-01 (Resection of ascending colon, hepatic flexure and transverse colon to the splenic flexure with formation of stoma)

Criteria	• Laparoscopic extended right hemicolectomy with formation of stoma 32004-03 (Resection of ascending colon, hepatic flexure and transverse colon to the splenic flexure with formation of stoma, via laparoscopy) **Left Hemicolectomy** • Open left hemicolectomy with anastomosis 32006-00 (Includes: resection of descending colon, sigmoid colon and splenic flexure) • Laparoscopic left hemicolectomy with anastomosis 32006-02 (Includes: resection of descending colon, sigmoid colon and splenic flexure) • Open left hemicolectomy with formation of stoma 32006-01 (Includes: resection of descending colon, sigmoid colon and splenic flexure) • Laparoscopic left hemicolectomy with formation of stoma 32006-03 (Includes: resection of descending colon, sigmoid colon and splenic flexure) **Subtotal/Partial Colectomy** • Open subtotal colectomy with anastomosis 32005-00 (Includes: resection of ascending colon, descending colon, transverse colon, hepatic flexure and splenic flexure.) • Laparoscopic subtotal colectomy with anastomosis 32005-02 (Includes: resection of ascending colon, descending colon, transverse colon, hepatic flexure and splenic flexure.) • Open subtotal colectomy with formation of stoma 32004-00 (Includes: Formation of mucous fistula and resection of ascending colon, descending colon, transverse colon, hepatic flexure and splenic flexure.) • Laparoscopic subtotal colectomy with formation of stoma 32004-02 (Includes: Formation of mucous fistula and resection of ascending colon, descending colon, transverse colon, hepatic flexure and splenic flexure.)
Criteria	**Total Colectomy** • Open total colectomy with ileorectal anastomosis 32012-00 (Leaving rectum) • Laparoscopic total colectomy with ileorectal anastomosis 32012-01 (Leaving rectum) • Open total colectomy with ileostomy 32009-00 (Includes: formation of mucous fistula) • Laparoscopic total colectomy with ileostomy 32009-01 (Includes: formation of mucous fistula)

Criteria	**Sigmoidectomy** • Open limited excision of large intestine with anastomosis 32003-00 • Caecectomy, local excision of colon, sigmoidcolectomy, sigmoidectomy with anastomosis (Includes: resection of splenic flexure) • Laparoscopic limited excision of large intestine with anastomosis 32003-02 • Laparoscopic: Caecectomy, local excision of colon, sigmoidcolectomy, sigmoidectomy with anastomosis (Includes: resection of splenic flexure) • Open limited excision of large intestine with formation of stoma 32000-00 • Caecectomy, local excision of colon, sigmoidcolectomy, sigmoidectomy with formation of stoma (Includes: resection of splenic flexure) • Laparoscopic limited excision of large intestine with formation of stoma 32000-02 • Laparoscopic caecectomy, local excision of colon, sigmoidcolectomy, sigmoidectomy with formation of stoma (Includes: resection of splenic flexure)
Criteria	**Anterior Resection/Proctosigmoidectomy/ Proctocolectomy** • Ultra low anterior resection of rectum 32026-00 • Proctosigmoidectomy with stapled coloanal anastomosis (Note: Anastomosis is performed ≤ 6 cm from anal verge) • Excludes: hand sutured anastomosis (32028-00 [935]) • Ultra low anterior resection of rectum with hand sutured coloanal anastomosis 32028-00 • Col-endo-anal sutured anastomosis • Proctosigmoidectomy with hand sutured coloanal anastomosis Note: Anastomosis is performed ≤ 6 cm from anal verge
Criteria	**Proctocolectomy** • Total proctocolectomy 936 • Total proctocolectomy with ileostomy 32015-00 (Excludes: that with anastomosis (32051 [936]) • Total proctocolectomy with ileo-anal anastomosis 32051-00 • Restorative proctocolectomy (Includes: formation of ileal reservoir (loop ileostomy)) • Total proctocolectomy with ileo-anal anastomosis and formation of temporary ileostomy 32051-01 • Restorative proctocolectomy with formation of temporary ileostomy (Includes: formation of ileal reservoir (loop ileostomy))

Criteria	**Open Abdomen** (Temporary abdomen closure) **Repair of Fistula**
Options:	**Select from dropdown menu in the database**
Notes:	*Procedures will be ICD-10 coded*

8.6

Data Entry Variable Name:	**Findings**
Relevance of Data Entry Point:	**To capture the surgeon’s intra operative findings.**
Definition:	What was found by the surgeon intra operatively.
Notes:	*Text box for main points*

9 Post-Operative

9.1

Data Entry Variable Name:	**Destination**
Relevance of Data Entry Point:	**To capture where the patient went following surgery.**
Definition:	Where the patient went in the initial post-operative period.
Criteria:	**ICU** **HDU** **Ward** **Transferred to another hospital** **Recovery > 2 hours or when intensive observation is required and there is no available bed in ICU.** **Death**
Options:	**Select from dropdown menu in the database**
Notes:	

9.2

Data Entry Variable Name:	**Complications**
Relevance of Data Entry Point:	**To capture complications which may have an impact on the morbidity or mortality of the patient.**
Definition:	Complications are any deviation from the normal course
Criteria:	

Surgical Site Occurrence (SSO)

Wound Superficial: An infection that occurs within 30 days after the principal operative procedure and the infection involves only skin or subcutaneous tissue of the incision and at least one of the following:

A. Purulent drainage, with or without laboratory confirmation, from the superficial incision

B. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision

C. Superficial incision is deliberately opened by the surgeon (see note below)

And

At least one of the following signs or symptoms of infection:

- pain or tenderness
- localized swelling
- redness
- heat

Wound Deep: An infection that occurs at the surgical site within 30 days after the principal operative procedure and involves deep soft tissues and at least one of the following:

A. Purulent drainage from the deep incision but not from the organ/space component of the surgical site

B. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (> 38^0 C), localized pain, or tenderness, unless the site is culture-negative

C. Other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination

D. Diagnosis of a deep incision SSI by a surgeon or attending physician

Deep Abscess: An abscess that occurs within 30 days after the principal operative procedure.

Organ/Space: An infection that occurs within 30 days after the principal operative procedure and involves any of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during the operation and at least one of the following:

A. Purulent drainage from a drain that is placed through a stab wound into the organ/space.

B. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space

C. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.

D. Diagnosis of an organ/space SSI by a surgeon or attending physician

Wound Dehiscence: A spontaneous reopening of a surgically closed wound that occurs within 30 days after the principal operative procedure

Wound Haematoma: Wound hematoma, a collection of blood and clot in the wound that occurs within 30 days after the principal operative procedure

Organ Failure

Sepsis: Sepsis takes a variety of forms and spans from relatively mild physiologic abnormalities to septic shock. Sepsis is the systemic response to infection.
Septic Shock: Sepsis is considered severe when it is associated with organ and/or circulatory dysfunction.
Report the most significant level using the criteria below: Septic shock is more severe than sepsis. Criteria must be noted within 30 days after the principal operative procedure

Heart Failure: "Heart failure is defined as a clinical syndrome characterised by symptoms such as shortness of breath, persistent coughing or wheezing, ankle swelling and fatigue, that may be accompanied by the following signs: jugular venous pressure, pulmonary crackles, increased heart rate and peripheral oedema." 2016 ESC heart failure guidelines.

Myocardial Infarction (MI): The clinical definition of MI denotes the presence of acute myocardial injury detected by abnormal cardiac biomarkers in the setting of evidence of acute myocardial ischaemia. Must be noted within 30 days after the principal operative procedure.

Cerebral Vascular Accident (CVA): CVA is defined as a sudden neurological deficit (e.g. weakness, loss of sensation or other) due to a vascular cause. The deficit must last for longer than 24 hours and is of sudden onset. A CVA must be noted within 30 days after the principal operative procedure.
Deep Vein Thrombosis (DVT): New diagnosis of blood clot or thrombus within the venous system (superficial or deep) which may be coupled with inflammation and requires treatment. Must be noted within 30 days after the principal operative procedure

Pulmonary Embolism (PE): Lodging of a blood clot in the pulmonary artery with subsequent obstruction of blood supply to the lung parenchyma. A pulmonary embolism must be noted within 30 days after the principal operative procedure.

Pneumonia: Pneumonia is an infection of one or both lungs caused by bacteria, viruses, fungi, or aspiration. Pneumonia can be community acquired or acquired in a healthcare setting, diagnosed within the 30 days after the principal operative procedure.

Renal Failure: A significant decline of kidney function in comparison to the preoperative state to occur within the 30 days after the principal operative procedure.

Urinary tract infection (UTI): An infection in the urinary tract (kidneys, ureters, bladder, and urethra). Must be noted within 30 days after the principal operative procedure

Ileus: A deceleration or arrest in intestinal motility. Must be noted within 30 days after the principal operative procedure

Unplanned Events

Haemorrhage: Bleeding after a surgical procedure which requires return to theatre. The haemorrhage may occur immediately after the surgery or be delayed. It need not be restricted to the surgical wound.

Re Operation: A surgery that was not planned at the time of the principal operative procedure. Must be within 30 days after the principal operative procedure

Return to Intensive Care Unit (ICU): An unplanned return to ICU for escalation of management. . Must be within 30 days after the principal operative procedure

Readmission: Patients, who were discharged from their index hospital stay after their principal operative procedure, and within 30 days of the principal operative procedure, are subsequently formally readmitted to hospital.

Death: Any death, regardless of cause, noted during the intraoperative period or within 30 days after the principal operative procedure.

Central line infection: An infection which has developed due to a central line being placed.

Failure to take over care: A consultant from another speciality not accepting transfer of patient care.

9.3

Data Entry Variable Name:	**Complication Classification/Clavien-Dindo ***
Relevance of Data Entry Point:	**An international recognised grading system for the classification of complications.**
Definition:	A morbidity scale based on the therapeutic consequences of complications.
Criteria:	**Grades Definition** **Grade I** *Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions Allowed therapeutic regimens are: drugs as antiemetic, antipyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.* **Grade II** *Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.* **Grade III** *Requiring surgical, endoscopic or radiological intervention* **IIIa** *Intervention not under general anaesthesia* **IIIb** *Intervention under general anaesthesia* **Grade IV** *Life-threatening complication (including CNS complications)* requiring IC/ICU-management* **IVa** *Single organ dysfunction (including dialysis)* **IVb** *Multi organ dysfunction* **Grade V** *Death of a patient* *(Dindo, Demartines et al. 2004)*
Options:	**Select from dropdown menu in the database**
Notes:	*DINDO, D., DEMARTINES, N. and CLAVIEN, P., 2004. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Annals of Surgery, 240(2), pp. 205.*

9.4

Data Entry Variable Name:	**Final Diagnosis**
Relevance of Data Entry Point:	**To capture the final diagnosis.**
Definition:	A final diagnosis that is made after getting the results of tests, such as blood tests and biopsies that are done to find out if a certain disease or condition is present.
Criteria:	**Diagnosis will be ICD-10 coded** • Abscess Breast abscess N61 Perianal abscess K61.0 Skin abscess L02.9 • Appendicitis K35 • Biliary Colic K80.5 • Cellulitis L03 • Cholangitis K83.0 • Cholecystitis K81 • Choledocholithiasis K80.5 • Cholelithiasis K80 • Colitis K52 • Crohns K50 • Diverticulitis K57 • Divertulosis K57.2 • Faecal impaction K56.4 • GI Bleed K92.2 • Haematemesis K92.0 • Melena K92.1 • Hernia- Diaphragm, Diaphragmatic K44.9 Diaphramatic K44 Epigastric K43.9 Femoral K41.9 Incisional K43.2 Inguinal K40 Other Abdominal hernia K45 Parastomal K43.5 Paraumbilical K42.9 Spigelian K43.9 Supraumbilicus K43.9 Umbilical K42.9 Unspecific Abdominal hernia K46 With gangrene K46.1 With obstruction K46.0
	• Large bowel obstruction K56.6 • Volvulus K56.2 • Mesenteric ischaemia K55.0 • Mesenteric Adenitis I88.0 • Non-specific abdominal pain R10

Criteria:	• Obstructive Jaundice K83.1 • Pancreatitis K85 • Pelvic pathology R10.2 • Peptic Ulcer K27 • Gastric Ulcer K25 • Duodenal Ulcer K26 • Peritonitis K65 • Septic shock R57.2 • Small bowel obstruction Paralytic ileus K56.0 Gallstone ileus K56.3 Peritoneal adhesions K66.0 Intestinal adhesions [bands] with obstruction K56.5 Other and unspecified intestinal obstruction K56.6 • Trauma T14.9 • Upper GI Bleed Gastrointestinal haemorrhage, unspecified K92.2 Haematemesis K92.0 Melaena K92.1 Oesophageal varices I85 Gastro-oesophageal laceration-haemorrhage syndrome K22.6 Mallory-Weiss syndrome • Urology Urology Haematuria R31 Urology other N23 Retention of urine R33 Urology Stones N20 • Vascular • Other (allow for text box)
Options:	**Select from dropdown menu in the database**
Notes:	*Other if Diagnosis is not in dropdown menu use other and put diagnosis in text box.*

9.5

Data Entry Variable Name:	**Discharge Date**
Relevance of Data Entry Point:	**To capture the date on which the patient is discharged.**
Definition:	The date the patient is discharged from the surgical service, to include transfer of care to another speciality within the hospital, or to another hospital and discharge from the hospital.
Criteria:	**Enter date (dd/mm/yyyy)**
Options:	**Enter date (dd/mm/yyyy)**

Publications and Presentations from eSOAP

eSOAP publications, presentations 2018 onwards

Publications

Emergency Surgery Outcomes Advancement Project (2022). Emergency General Surgery Report Improving Outcomes and Saving Lives. Sugrue M, Skelly B, Watson A, Parlour R. Broderick M (Eds.). DerryLondonderry Ireland: Donegal Clinical Research Academy.

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Oral Presentations

Sugrue M (2021) Can patients cure surgeons? Guest lecture at ASGBI virtual conference May 2021

Sugrue M (2021) How to decide to close the abdomen in a septic patient. Guest lecture at ESTES virtual week 2021, April 2021

Sugrue M (2021) Emergency surgery – Improving laparotomy outcomes. Guest lecture at ESTES virtual week 2021, April 2021

Sugrue M (2021) Introduction of the sEASC. Guest lecture at ESTES virtual week 2021, April 2021

Sugrue M (2020) Quality indicators in emergency general surgery and trauma-Key performance indicators. Guest lecture at 7th WSES Congress World Society of Emergency Surgery (virtual edition) November 2020.

Stephens I, Flanagan L, Scally B, Sugrue M (2020) Streamlining emergency biliary care: Development of a Right Upper Quadrant Pathway. Free paper at 7th WSES Congress World Society of Emergency Surgery (virtual edition) November 2020.

Gearóid Mc Geehan, Itoro. M Edelduok, Magda Bucholc, Angus Watson, Zsolt Bodnar, Alison Johnston, Michael Sugrue (2020) Systematic review and Meta-analysis identifies deficits in literature evaluating wound bundles effect on Infections following Emergency Midline Laparotomy incisions; Time for action! Free paper at 7th WSES Congress World Society of Emergency Surgery (virtual edition) November 2020.

Kabir U, Walker C, Johnston A, Sugrue M, Bulochl M (2020) The development of an appendicular right iliac fossa pathway. Free paper at 7th WSES Congress World Society of Emergency Surgery (virtual edition) November 2020.

Sugrue M. Managing the open abdomen-Abdominal compartment syndrome. Abdominal Wall Reconstruction EUROPE conference- Reconstructive and aesthetic management of complex abdominal wall defects and hernia. Royal College of Physicians, London, 2020.

Sugrue M. Is it time to change practice in getting the open abdomen closed? Guest Lecture at: 48th World Congress of Surgery. Krakow, Poland. August 2019

Deirdre Foley, Madga Bucholc, Randal Parlour, Caroline McIntyre, Alison Johnston, Michael Sugrue. Should Surgical Site Infection Wound Bundles become Mandatory in Colorectal Surgery? A Meta-analysis. Oral presentation at World Congress of Surgery. Krakow, Poland. August 2019

Cherian Mathew, Eoin Donnellan, Caroline McIntyre, Alison Johnston, Magda Bucholc, Louise Flanagan, Michael Sugrue. Understanding the natural history of common bile duct stones- a meta-analysis and systematic review. Oral presentation at World Congress of Surgery. Krakow, Poland. August 2019

E Donnellan, J Coulter, C Matthews, M Choynowski, L. Flanagan, M Bucholc, A Johnston, M Sugrue. A meta-analysis of the use of intraoperative cholangiography; time to revisit our approach to cholecystectomy. Oral presentation at World Congress of Surgery. Krakow, Poland. August 2019

Jack Lawler, Caroline McIntyre, Magda Bucholc, Alison Johnston, Michael Sugrue. A meta-analysis of re-admission following Emergency general surgery - Time to take action. 6th WSES Congress, Nijmegen, the Netherland. June 2019

Sugrue. M. Management of surgical emergencies in immunocompromised patients- The role for guidelines. Guest speaker at 6th WSES Congress, Nijmegen, the Netherland. June 2019

Sugrue. M. Prophylactic onlay MESH-A New Surgical Approach. 6th WSES Congress, Nijmegen, the Netherland. June 2019

Sugrue M. Pancreatitis and IAH- the Surgeon perspective. Guest speaker at 9th WCACS- the Abdominal Compartment Society Congress. Campinas, Brazil- May 2019

Sugrue M. The septic open abdomen. Guest speaker at 9th WCACS- the Abdominal Compartment Society Congress. Campinas, Brazil- May 2019

Sugrue M. Emergency surgery and fluids- Case scenario. Guest speaker at 9th WCACS- the Abdominal Compartment Society Congress. Campinas, Brazil- May 2019

Leppaniemi A, Sugrue M. The Challenging Abdominal Wall: Is there a role of prophylactic mesh in emergency surgery? Guest speaker at ESTES Congress 2019 Prague May 2019

E Donnellan, J Coulter, C Matthews, M Bucholc, L Flanagan, A Johnston, M Sugrue. A meta-analysis of the use of intraoperative cholangiography; time to revisit our approach to cholecystectomy. Oral presentation at Sylvester O'Halloran National meeting Limerick March 2019

Caroline McIntyre, Alison Johnston, Deirdre Foley, Magda Bucholc, Michael Sugrue. Readmission to Hospital Following Laparoscopic Cholecystectomy; A Meta-analysis. Oral presentation at Sylvester O'Halloran National meeting Limerick March 2019

Foley D, Bucholc M, Parlour R, McIntyre C, Johnston A, Sugrue M. Should Surgical Site Infection Wound Bundles become Mandatory in Colorectal Surgery? A Meta-analysis. Oral presentation at Sylvester O'Halloran National meeting Limerick March 2019

Sugrue M. A new incorporating on-lay mesh technique to prevent incisional hernia post emergency laparotomy. Free paper at Abdominal Wall Reconstruction Europe Conference -2019: Reconstructive and aesthetic management of complex abdominal wall defects and hernias. Royal College of Physicians, London February 2019

Foley D, Bucholc M, Parlour R, McIntyre C, Johnston A, Sugrue M. (2018) Should Surgical Site Infection Wound Bundles become Mandatory in Colorectal Surgery? A Meta-analysis. Oral presentation at UCD Surgical Symposium, Dublin Ireland.

Lawler Jack, Choynowski Michelle, Bucholc Magda, Johnston Alison, Sugrue Michael (2018). Colorectal post-operative infective complications worsen oncological outcomes - a meta-analysis. Oral presentation at UCD Surgical Symposium, Dublin Ireland.

Lawler Jack, MacIntyre Caroline, Bucholc Magda, Johnston Alison, Sugrue Michael (2018). A meta-analysis of re-admission following Emergency general surgery - Time to take action. Oral presentation at UCD Surgical Conference Dublin Ireland.

Coulter Jonathan, Moore Michael, O'Driscoll Liam, Flanagan Louise, Bucholc Magada, Sugrue Michael (2018). Direct Peritoneal Resuscitation in Peritonitis: Time To Take Note – Technical Options. Oral presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland.

Lawler Jack, MacIntyre Caroline, Bucholc Magda, Johnston Alison, Sugrue Michael (2018). A meta-analysis of re-admission following Emergency general surgery - Time to take action. Oral presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland.

Mathew Cherian, Mcintyre Caroline, Donnellan Eoin, Johnston Alison, Bucholc Magda, Flanagan Louise, Sugrue Michael (2018). Understanding the natural history of common bile duct stones: A meta-analysis and systematic review. Oral presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland.

Lawler Jack, Mcintyre Caroline, Randal Parlour, Bucholc Magda, Johnston Alison, Sugrue Michael (2018). A meta-analysis of re-admission following Emergency General Surgery - time to take action. Oral presentation in the William O'Keeffe Prize General Surgery Session at XXVIII Waterford Surgical October Meeting 2018. Waterford, Ireland.

Lawler Jack, Choynowski Michelle, Bucholc Magda, Johnston Alison, Sugrue Michael (2018). Colorectal post-operative infective complications worsen oncological outcomes - a meta-analysis. Oral presentation at American College of Surgeons Clinical Congress October 2018. Boston, MA, USA.

Poster Presentations

Mannion J, Hamed M, Johnston A, Sugrue M. Umbilical hernia repair: The fenestrated linea alba-time for surgeons to take note. Abdominal Wall Reconstruction EUROPE conference- Reconstructive and aesthetic management of complex abdominal wall defects and hernia. Royal College of Physicians, London, 2020.

Carol-Ann Walker, Louise Flanagan, Randal Parlour, Brendan Skelly , Angus Watson, Kevin Blake, Michael Sugrue (2019). The Design and development of an emergency surgery data dictionary: the core of an emergency surgery registry. Poster presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland. Nov 2019

Louise Flanagan, Carol-Ann Walker, Randal Parlour, Manvydas Varzgalis, Brendan Skelly, Sinead O Gorman, Maureen Harkin, Angus Watson MD, Michael Sugrue. (2019). Developing a novel emergency general surgery admission preform. Poster presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland. Nov 2019

Carol-Ann Walker, Louise Flanagan, Randal Parlour, Brendan Skelly , Angus Watson, Kevin Blake, Michael Sugrue (2019). The Design and development of an emergency surgery data dictionary: the core of an emergency surgery registry. Poster presentation at TMED 10 'Disruptive Innovation in Healthcare' Conference 2019. Derry/Londonderry, Northern Ireland. Sept 2019

Louise Flanagan, Carol-Ann Walker, Randal Parlour, Paula Loughlin, Angus Watson, Michael Sugrue. (2019). The design and development of an emergency general surgery admission proforma. Poster presentation at TMED 10 'Disruptive Innovation in Healthcare' Conference 2019. Derry/Londonderry, Northern Ireland. Sept 2019

Randal Parlour, Alison Johnston, Paula Loughlin, Angus Watson, Michael Sugrue (2019).Time for metrics in emergency surgical care-the role of an emergency surgery registry. Poster presentation at TMED 10 'Disruptive Innovation in Healthcare' Conference 2019. Derry, Northern Ireland. Sept 2019

Caroline McIntyre1, Alison Johnston2, Deirdre Foley1, Jack Lawler1, Magda Bucholc3, Michael Sugrue. Readmission to Hospital Following Laparoscopic Cholecystectomy; A meta-analysis. 6th WSES Congress, Nijmegen, the Netherland. June 2019

Moore Michael, Coulter Jonathan, Bucholc Magda, Walker Carol-Ann, Sugrue Michael. PR127 Prevention of incisional hernia post emergency laparotomy : a time to change? A case series. Poster presentation at ESTES Congress 2019 Prague May 2019

Coulter Jonathan, Moore Michael, O'Driscoll Liam, Flanagan Louise, Bucholc Magada, Sugrue Michael (2018). PR126 Direct Peritoneal Resuscitation in Peritonitis: Time To Take Note – Technical Options. Poster presentation at ESTES Congress 2019 Prague May 2019

Lawler Jack, Choynowski Michelle, Bucholc Magda, Johnston Alison, Sugrue Michael (2019). Colorectal post-operative infective complications worsen oncological outcomes - a meta-analysis. Poster presentation at Student medical Summit, Dublin Ireland.

Mathew Cherian, Mcintyre Caroline, Donnellan Eoin, Johnston Alison, Bucholc Magda, Flanagan Louise, Sugrue Michael (2019). Understanding the natural history of common bile duct stones: A meta-analysis and systematic review. Poster presentation at Student medical Summit, Dublin Ireland.

Randal Parlour, Kevin Blake, Mick McCann, Paula Loughlin, Angus Watson, Carol Ann Walker, Louise Flanagan, Michael Sugrue (2018). The Development of an Emergency Surgery Registry: Improving Emergency Surgery Outcomes. Poster presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland.

Moore Michael, Coulter Jonathan, Bucholc Magda , Walker Carol-Anne, Sugrue Michael (2018). Prevention of incisional hernia post emergency laparotomy: A time to change? A case Series. Poster presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland.

Carol-Ann Walker, Louise Flanagan, Randal Parlour, Kevin Blake, Magda Bucholc, Paula Loughlin, Michael Sugrue (2018) Developing an emergency surgery right iliac fossa pain and appendicitis module. Poster presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland.

Randal Parlour, Kevin Blake, Mick McCann, Paula Loughlin, Angus Watson, Carol Ann Walker, Louise Flanagan, Michael Sugrue (2018). Developing an emergency surgery right iliac fossa pain and appendicitis module. Poster presentation at Letterkenny University Hospital Multi-disciplinary Research Conference, Donegal Ireland.

McIntyre C, Johnston A, Foley D, Bucholc M, Sugrue M (2018), Readmission to Hospital Following Laparoscopic Cholecystectomy; A meta-analysis. Winner of best poster presentation at UCD Surgical Symposium, Dublin Ireland.

Mathew Cherian, Mcintyre Caroline, Donnellan Eoin, Johnston Alison, Bucholc Magda, Flanagan Louise, Sugrue Michael (2018). Understanding the Natural History of Common Bile Duct Stones: A Meta-Analysis and Systematic Review. Poster presentation at School of Medicine-Undergraduate Research Day, National University of Ireland Galway, Ireland.

Carol-Ann Walker, Louise Flanagan, Randal Parlour, Kevin Blake, Magda Bucholc, Paula Loughlin, Michael Sugrue (2018). Developing an emergency surgery right iliac pain and appendicitis module. Poster presentation at TMED9 ''Innovating to Live Well for Longer'' Conference 2018. Derry/Londonderry, Northern Ireland.

Michael Sugrue, Carol Ann Walker , Louise Flanagan, Randal Parlour, Paula Loughlin, Angus Watson (2018). Improving Emergency Surgical Outcomes-The Development of Key Performance Indicators in Emergency General Surgery. Poster presentation at TMED9 ''Innovating to Live Well for Longer'' Conference 2018. Derry/Londonderry, Northern Ireland.

Randal Parlour, Kevin Blake, Mick McCann, Paula Loughlin, Angus Watson , Carol Ann Walker, Louise Flanagan ,Michael Sugrue (2018). The Development of an Emergency Surgery Registry: Improving Emergency Surgery Outcomes. Poster presentation at TMED9 ''Innovating to Live Well for Longer'' Conference 2018. Derry/Londonderry, Northern Ireland.

Moore Michael, Coulter Jonathan, Bucholc Magda, Walker Carol-Ann, Sugrue Michael (2018). Prevention of incisional hernia post emergency laparotomy : a time to change? A case series. Poster presentation at XXVIII Waterford Surgical October Meeting 2018. Waterford, Ireland.

Coulter Jonathan, Carol-Ann Walker, Bucholc Magada, Michael Moore, Sugrue Michael (2018). Direct peritoneal resuscitation in peritonitis: time to take note - technical options. Poster presentation at XXVIII Waterford Surgical October Meeting 2018. Waterford, Ireland.

Mathew Cherian, Mcintyre Caroline, Donnellan Eoin, Johnston Alison, Bucholc Magda, Flanagan Louise, Sugrue Michael (2018). Understanding the natural history of common bile duct stones: a meta-analysis and systematic review. Poster presentation at XXVIII Waterford Surgical October Meeting 2018. Waterford, Ireland.

Publications [abstracts]

E Donnellan, J Coulter, C Matthews, M Choynowski, L. Flanagan, M Bucholc, A Johnston, M Sugrue. A meta-analysis of the use of intraoperative cholangiography; time to revisit our approach to cholecystectomy. 48th World Congress of Surgery Abstract Book, Abstract ID 36.10. Available online at: https://docs.wixstatic.com/ugd/a79198_181ced7c0b6544d591c726ed6e8de4ea.pdf August 2019

Deirdre Foley, Madga Bucholc, Randal Parlour, Caroline McIntyre, Alison Johnston, Michael Sugrue. Should Surgical Site Infection Wound Bundles become Mandatory in Colorectal Surgery? A Meta-analysis. 48th World Congress of Surgery Abstract Book, Abstract ID 43.08. Available online at: https://docs.wixstatic.com/ugd/a79198_181ced7c0b6544d591c726ed6e8de4ea.pdf August 2019

Cherian Mathew, Eoin Donnellan, Caroline McIntyre, Alison Johnston, Magda Bucholc, Louise Flanagan, Michael Sugrue. Understanding the natural history of common bile duct stones- a meta-analysis and systematic review. 48th World Congress of Surgery Abstract Book, Abstract ID 163.04. Available online at: https://docs.wixstatic.com/ugd/a79198_181ced7c0b6544d591c726ed6e8de4ea.pdf August 2019

McIntyre C, Johnston A, Foley D, Bucholc M, Sugrue M (2018), Readmission to Hospital Following Laparoscopic Cholecystectomy; A meta-analysis. Cited in Quirke NP, Cooney S, Lynch S, Downes E, Yussuf TB. Conference Abstract Booklet: 2nd Student Medical Summit 2019. Undergraduate Research in Natural and Clinical Science and Technology Journal. 2019 Mar 8:A1-50. Available online at : https://urncst.com/index.php/urncst/article/view/134/27

Foley D, Bucholc M, Parlour R, McIntyre C, Johnston A, Sugrue M. Should Surgical Site Infection Wound Bundles become Mandatory in Colorectal Surgery? A Meta-analysis. Cited in Quirke NP, Cooney S, Lynch S, Downes E, Yussuf TB. Conference Abstract Booklet: 2nd Student Medical Summit 2019. Undergraduate Research in Natural and Clinical Science and Technology Journal. 2019 Mar 8:A1-50. Available online at : https://urncst.com/index.php/urncst/article/view/134/27

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Lawler Jack, MacIntyre Caroline, Bucholc Magda, Johnston Alison, Sugrue Michael (2018). A meta-analysis of re-admission following Emergency general surgery - Time to take action. Cited in Quirke NP, Cooney S, Lynch S, Downes E, Yussuf TB. Conference Abstract Booklet: 2nd Student Medical Summit 2019. Undergraduate Research in Natural and Clinical Science and Technology Journal. 2019 Mar 8:A1-50. Available online at : https://urncst.com/index.php/urncst/article/view/134/27

Mathew Cherian, Mcintyre Caroline, Donnellan Eoin, Johnston Alison, Bucholc Magda, Flanagan Louise, Sugrue Michael (2019). Understanding the natural history of common bile duct stones: A meta-analysis and systematic review [Abstract only]. Journal of Medical Students, Galway. April-May 2019

Foley D, Sugrue M, Bucholc M, Parlour R, McIntyre C, Johnston A. Should surgical site infection wound bundles become mandatory in colorectal surgery?—a meta-analysis. Mesentery Peritoneum 2019;3:AB046. doi: 10.21037/map.2019.AB046

McIntyre C, Johnston A, Foley D, Bucholc M, Sugrue M. Readmission to hospital following laparoscopic cholecystectomy—a meta-analysis. Mesentery Peritoneum 2019;3:AB105. doi: 10.21037/map.2019.AB105

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From left to right

BACK ROW: Mr Sean Murphy, Mr Michael Sugrue , Dr Maurice O Kane , Mr Peter Devine, Professor Tony Bjourson , Mr Eddie Friel, Mr Brendan Crossey, Prof Liam Maguire, Mr Paul Hannigan

MIDDLE ROW: Professor Carol Curran, Dr Geraldine Horigan, Dr Aaron Peace, Professor Paddy Nixon

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From left to right

Mr Michael Sugrue, Mr Ken Mulpeter, Ms Teresa Lennon, Mr Eddie Friel, Dr Maurice O'Kane, Mr Sean McCaul, Ms Angela Revey, Professor Tony Bjourson

Generating and utilising knowledge to improve performance and patient outcomes

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