World J Surg (2019) 43:2186–2193
https://doi.org/10.1007/s00268-019-05026-7

ORIGINAL SCIENTIFIC REPORT

Has Symptom-Based Admission Replaced Diagnosis in the Emergency Department? An 18-Year Review of Emergency General Surgical Admissions at Royal Perth Hospital

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Published online: 14 May 2019

Abstract

Background Classical medical teaching has made a clear distinction between signs and symptoms, and diagnosis. However, at the time of ward admission, a diagnosis may remain unclear. We propose administrative pressures during the admission process may have reduced the ability for pathological diagnosis. This may result in increased hospitalisation for investigation of signs and symptoms, rather than for treatment of clear diagnoses. We sought to further clarify this hypothesis and investigate changes in the nature of admissions during the last two decades in an adult emergency general surgery service.

Methods A retrospective analysis of emergency general surgical admissions during four six-month time periods, between 2000 and 2018, was conducted. The six-month periods were spaced evenly during the 18-year study. Demographic information, emergency department length of stay, incidence of a pathological diagnosis on ward admission and accuracy of admission diagnosis were analysed.

Results 2763 patients were admitted in the four six-month time periods. A significant reduction in number of patients admitted with a pathological diagnosis was noted between the 2012 and 2018 study periods ($p < 0.05$), with 21.2% of patients admitted in 2018 for investigation of signs and symptoms. The incidence of an accurate admission diagnosis (as assessed by the discharge diagnosis) ranged from 62.3 to 63.6% and did not differ significantly by year.

Conclusion Between 2012 and 2018, there was a significant increase in the number of emergency general surgical patients admitted for investigation of signs and symptoms. However, accuracy of admission diagnosis was unchanged during the study period.

Introduction

Clinical medicine continues to evolve; changes in medical practice are multifactorial and are influenced by a multitude of factors, including population changes, demographic variations such as an aging population, changing patterns and burdens of disease, new insights into pathology and therapeutics, development and increasing uptake of advanced medical imaging technologies, medical and surgical subspecialisation, medico-legal concerns, health economics, political factors and change in hospital structures [1–3].

In Western Australia, two specific recent health policy and hospital structural alterations may have contributed to a change in the management of emergency general surgical patients over the last decade. The first was the introduction of the 4-hour rule program by the Western Australian government in 2008, aimed at reducing emergency department (ED) overcrowding and inpatient bed access block [4, 5]. The program target was for 98% of patients to be discharged home or admitted to a ward within 4 h of

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presentation to the ED. The 4-hour rule was initially developed in the UK National Health Service in 2000. It recognises that many processes in the hospital contribute to ED overcrowding and addressing it required a hospital-wide approach. Hospitals are given targets, but not directed how to achieve them; hence, a wide variety of measures have been implemented at different hospitals. The second major change was the adoption of the Acute Surgical Unit (ASU) model, a stand-alone surgical ward, for the provision of emergency general surgical services. The ASU model was first described in Australian hospitals in 2005 and has been extensively described in recent literature. [6–10].

The previous research has described temporal changes in emergency general surgical admissions. However, these admissions rely on principle diagnosis at discharge and do not consider diagnosis at ward admission [11]. Akoh et al. investigated inappropriate general surgical emergency admissions, but also relied on discharge diagnoses. Further, the study was unable to account for temporal changes and was limited to patients over 75 years of age [12]. To the best of our knowledge, we are unaware of recent publications that have specifically addressed the accuracy of ward admission diagnoses.

We postulate that the drive to reduce emergency department overcrowding and bed access block such as the 4-hour rule program has led to an increase in the number of patients admitted under general surgery for investigation of undifferentiated signs and symptoms, rather than treatment of a pathological diagnosis.

Methods

Study setting

Royal Perth Hospital (RPH) is a major metropolitan tertiary teaching hospital, located within the central business district of Perth, Western Australia. It is the tertiary referral hospital for the East Metropolitan Area Health Service, which services 708,000 Western Australians. The ED sees 70–78,000 presentations per annum. In 2018, 54.8% of the 71,596 patients who presented to the ED were male. The age distribution is depicted in Fig. 1.

The 4-hour rule was instituted at RPH concurrent with the other two Perth tertiary hospitals in October 2009 [13]. RPH introduced an ASU in June 2014. The ASU consists of an independent general surgical ward dedicated to multidisciplinary assessment and management of non-elective, undifferentiated acute general surgery admissions for up to 48 h [14]. One of the objectives of the ASU is to expedite general surgical admissions from ED. A key performance indicator is the percentage of patients admitted to the ward within 4 h of ED presentation.

Study design

A retrospective analysis of general surgical admissions from ED was performed over an 18-year period from the year 2000. Six-month consecutive patient cohorts were taken every 6 years (2000, 2006, 2012 and 2018). No age restriction was placed though RPH does not provide a paediatric service and generally does not admit patients under 16 years of age. Patients were excluded if they were a multitrauma presentation or admitted under the trauma service. To minimise the influence of prior investigation on ward admission diagnosis, patients also were excluded if they were an inter-hospital transfer or referred from an outpatient clinic. Patients admitted under a medical or alternative surgical speciality with later transfer of care to general surgery were also excluded.

The digital Patient Administration System (PAS) was used to generate a list of patients meeting the selection criteria. Patient demographic data, PAS ward admission diagnosis (as manually entered by ED medical staff member at time of inpatient bed booking) and times of presentation to ED, transfer to ward and discharge were also retrieved from the PAS. Clinical coding data including principle discharge diagnosis and principle procedure were also retrieved from this digital record. Emergency Department Information System (EDIS), a stand-alone digital record used by the ED, was interrogated to retrieve Australasian triage scale category, triage note and an alternative record of ward admission diagnosis as selected by the treating ED doctor from a finite list. Hence, two records of the ward admission diagnosis were available. Triage scale category was included as a surrogate for disease acuity [15]. ED length of stay was calculated using information drawn from the PAS, however, is also recorded using EDIS.

Extracted data from the two digital records were reconciled using a Microsoft Excel spreadsheet allowing processing of data for later analysis. Following data reconciliation, the ED triage notes of all patients were interrogated to ensure appropriate exclusion of patients not meeting the selection criteria. Both the PAS and EDIS ward admission diagnoses were reviewed for each patient and categorised as a sign or symptom, or pathological diagnosis. Where discrepancies occurred, the more specific diagnosis was utilised. The ward admission diagnosis was then compared to discharge diagnosis to determine its accuracy. Where these differed, the patient discharge summary was reviewed to determine if the ward admission diagnosis instead reflected a significant comorbidity

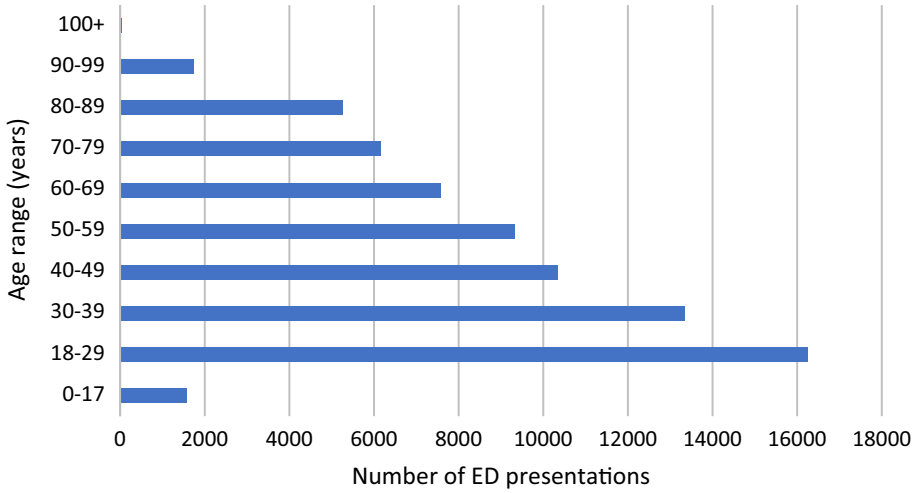


Fig. 1 Age distribution of emergency department presentations (2018)

relevant to the hospital stay. For the purpose of the analysis, this was considered an accurate diagnosis.

Discharge diagnosis was also used to categorise patients into diagnostic groups similar to those described by Becher et al. in 2012, in order to allow comparisons of the surgical case mix [16]. Where the discharge diagnosis was not a general surgical pathology, the discharge summary was interrogated to determine if a surgical pathology was a significant comorbid condition. For the purpose of analysis, these were categorised as having a general surgical diagnosis.

The study was approved as an institutional quality improvement project. An ethics approval–waiver for publication was granted based on the use of de-identified grouped data. Data analysis was performed using multiple proportions Chi-square tests for binary data. ANOVA and Welch's t test were used for comparison of means as variances, and sample sizes were unequal. Statistical significance was set at a p value of 0.05.

Results

Demographics

2763 patients were included in the study. General surgical admissions represented between 4.1 and 5.7% of all patients admitted from ED across the studied years. Study participants ranged from 14 to 96 years of age and mean age did not vary significantly between years. There was no significant change in disease acuity as measured by Australasian triage scale. Table 1 compares the demographics of general surgical admissions from ED by year.

Nature and accuracy of ward admission diagnosis

2281 patients received a pathological diagnosis, and 482 were admitted based on a sign or symptom. During the four study periods, 78.9–84.5% of patients received a pathological diagnosis on ward admission (Fig. 2). The 5.5% decrease between the 2012 and 2018 study periods is statistically significant ($p = 0.011$). A similar trend was present when comparing 2018 to earlier time intervals, but these did not reach statistical significance using the Marascuilo procedure.

Approximately, three-quarters of pathological diagnoses received at the time of ward admission were accurate, as reflected by either their primary discharge diagnosis or significant comorbid pathology on discharge. This translated to an overall accuracy at ward admission of 62.3–63.6%, regarding a pathological diagnosis (Fig. 3). No significant variation was demonstrated between the study periods ($p = 0.963$).

Discharge diagnosis

Appendicitis and gallbladder pathology were the most common clinical events treated during the study periods. A breakdown of diagnoses is presented in Table 2. The rate of non-general surgical pathologies remained steady at just over 7% throughout the 18-year study. These pathologies are further described in Table 3. Patients with a discharge diagnosis of undifferentiated abdominal pain were not included in this group. Rates of undifferentiated abdominal pain ranged from 3.5 to 8.9% with a trend towards reduced frequency in 2012 and 2018.

Table 1 Demographics of emergency general surgical admissions over 6-month period by year

Year	2000	2006	2012	2018
Annual ED presentations	54,125	57,216	79,736	72,892
Total ED admissions (study period)	11,562	11,176	18,923	14,161
ED ward admission rate (%)	42.7%	39.1%	47.5%	38.9%
General surgery admissions (study period)	599	584	775	805
Mean age in years (SD)	50.7 (21.9)	48.1 (20.7)	48.9 (22.1)	50.9 (21.4)
Males	48.1%	49.5%	55.0%	47.2%
Aboriginal or Torres Strait Islanders	5.5%	6.3%	6.8%	6.5%
Triage category 1	0.7%	0.7%	0.7%	0.3%
Triage category 2	7.9%	6.7%	5.9%	11.3%
Triage category 3	58.0%	57.9%	56.4%	62.4%
Triage category 4	33.4%	34.4%	36.1%	25.5%
Triage category 5	0%	0.3%	0.9%	0.6%

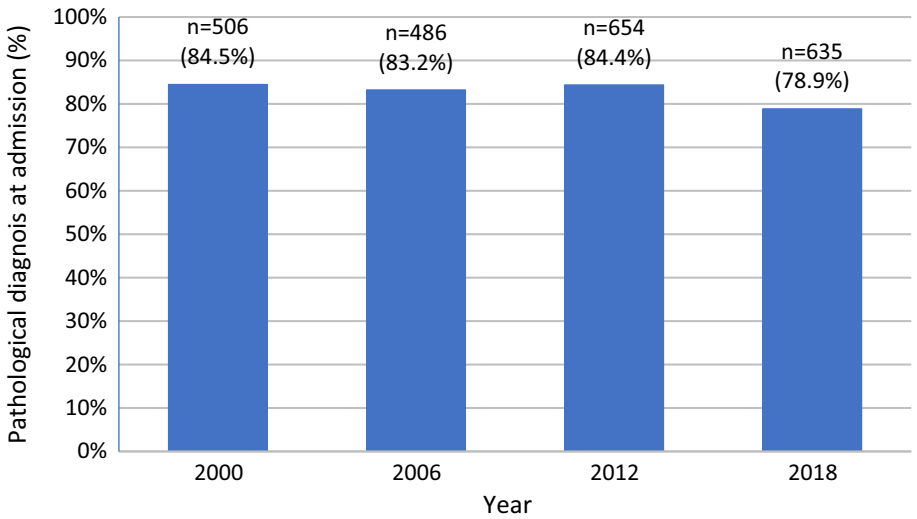


Fig. 2 Percentage of patients with a pathological diagnosis on admission by year

Emergency department length of stay

The median ED length of stay ranged from 119 to 217 min and was at its highest in 2018 (Fig. 4). Outliers exist for each of the time periods with emergency departments stay up to 18 h. The resultant slight positive skew is further demonstrated in Fig. 5. In the studied cohort, compliance with the 4-hour rule was 87.0% in 2000, 72.9% in 2006, 94.6% in 2012 and 62.6% in 2018. Those patients who met the 4-hour rule had significantly higher rates of an accurate ward admission diagnosis ($p = 0.000001$).

Inpatient length of stay

Mean inpatient stay ranged between 4.2 and 6.8 days (Fig. 6). ANOVA revealed a significant difference between study periods, and Welch's t test demonstrated that inpatient length of stay was significantly less in 2018 than all the previous study periods ($p < 0.0001$). No significant difference was shown between 2000, 2006 and 2012.

Discussion

The practice of clinical medicine continues to evolve and is affected by changes to government policy and hospital structures. We hypothesised that these pressures may have resulted in an increase in general surgical patients admitted from the emergency department for investigation of signs and symptoms. The results of this study support this thought, with a statistically significant reduction in pathological diagnoses between 2012 and 2018, and a similar

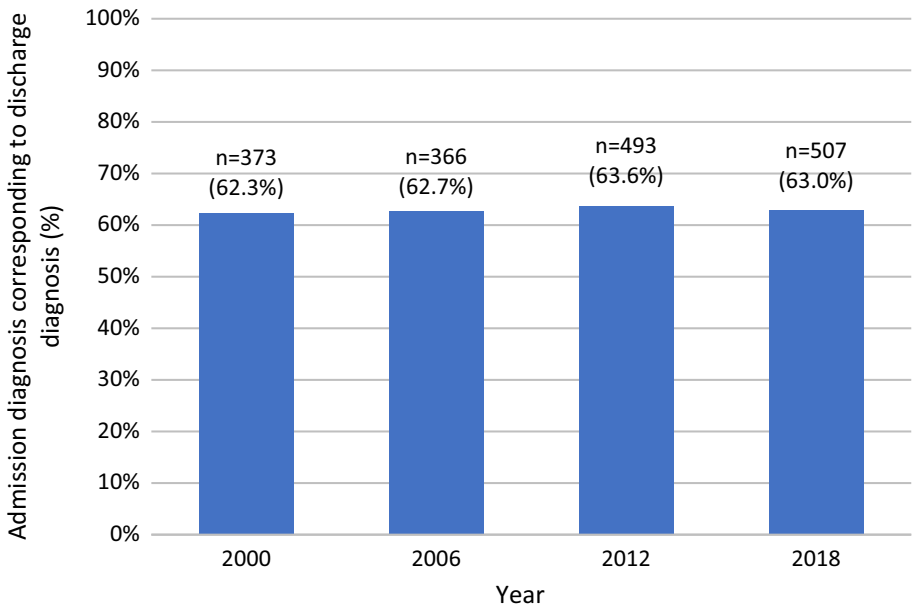


Fig. 3 Percentage of patients where admission diagnosis corresponded to discharge diagnosis

Table 2 Breakdown of discharge diagnosis by year

Year	2000	2006	2012	2018
Abdominal pain (undifferentiated)	37 (6.2%)	52 (8.9%)	33 (4.3%)	28 (3.5%)
Appendicitis	105 (17.5%)	87 (14.9%)	167 (21.5%)	145 (18.0%)
Biliary/gallbladder pathology	80 (13.7%)	61 (10.4%)	99 (12.8%)	94 (11.7%)
Diverticular disease	20 (3.3%)	31 (5.3%)	40 (5.2%)	53 (6.6%)
Hernia	30 (5.0%)	23 (3.9%)	31 (4.0%)	37 (4.6%)
Intestinal obstruction	56 (9.3%)	47 (8.0%)	42 (5.4%)	56 (7.0%)
Lower GI bleed (undifferentiated)	16 (2.7%)	7 (1.2%)	19 (2.4%)	13 (1.6%)
Neoplasm	20 (3.3%)	16 (2.7%)	14 (1.8%)	25 (3.1%)
Pancreatic pathology	25 (4.2%)	27 (4.6%)	45 (5.8%)	56 (7.0%)
Perianal disease	41 (6.8%)	45 (7.7%)	48 (6.2%)	47 (5.8%)
Peritonitis	16 (2.7%)	7 (1.2%)	16 (2.1%)	22 (2.7%)
Post-procedural complication	27 (4.5%)	39 (6.7%)	28 (3.6%)	30 (3.7%)
Skin/subcutaneous abscess	40 (6.7%)	70 (12.0%)	96 (12.4%)	105 (13.0%)
Vascular insufficiency of intestine	9 (1.5%)	10 (1.7%)	14 (1.8%)	7 (0.9%)
Other	33 (5.5%)	21 (3.6%)	27 (3.5%)	29 (3.6%)
Non-general surgical	44 (7.3%)	41 (7.0%)	56 (7.2%)	58 (7.2%)

trend in the previous years. However, approximately four in five patients continue to receive a pathological diagnosis at ward admission, with a reasonable degree of accuracy. Whilst surgical admissions prior to diagnosis are not necessarily inappropriate, they may reflect an increasing role of surgeons as diagnosticians, rather than primarily proceduralists. This may have implications related to surgical workload, health economics and patient outcomes.

The proportion of patients given a diagnosis in the emergency department that either reflects the primary discharge diagnosis or a clinically significant comorbidity did not change significantly over the 18-year study. This was unexpected given the trend towards increased utilisation of laboratory testing and sophisticated medical imaging in the emergency department [2]. For example, current practice at our centre is that patients over the age of 45 years with clinical suspicion of appendicitis undergo

Table 3 Breakdown of patients discharged without a general surgical diagnosis

Year	2000	2006	2012	2018
Gastroenterology				
Inflammatory bowel disease	2	2	1	1
Other	2	4	4	5
Total gastroenterological	4	6	5	6
General medical				
Chronic pancreatitis	6	1	3	3
Colitis/ enteritis/gastroenteritis	4	6	10	12
Constipation	7	4	10	5
Gastritis	2	2	0	6
Nephritis	2	1	0	0
Urinary tract infection	0	0	1	2
Other	6	4	4	5
Total general medical	27	18	28	33
Gynaecological				
Neoplasm	1	3	0	1
Ovarian cyst	3	4	12	8
Pelvic inflammatory disease	3	4	5	4
Other	1	1	1	3
Total gynaecological	8	12	18	16
Urological				
Ureterolithiasis	2	3	2	1
Urinary retention	2	1	0	0
Other	1	0	2	0
Total urological	5	4	4	1
Other	0	1	1	2

CT imaging. Patients with positive CT findings are then admitted with the specific diagnosis of appendicitis rather than "right lower quadrant pain" or "abdominal pain for

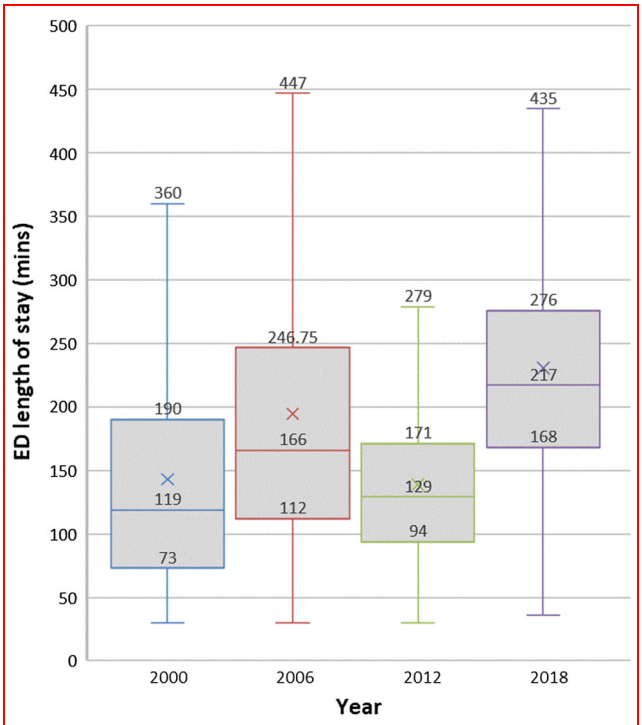
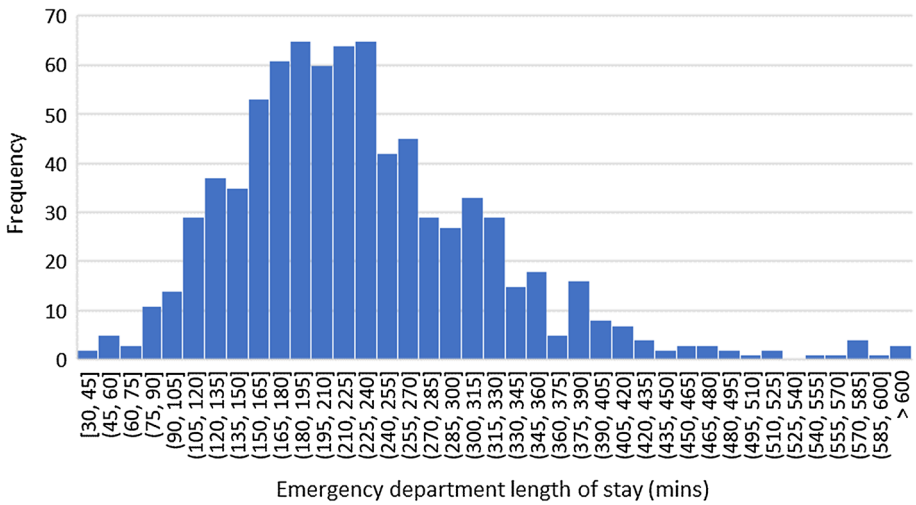


Fig. 4 Box and whisker plot of emergency department length of stay for general surgical admissions by year

investigation". However, a clinical decision has already been made that admission to hospital is required and ward admission diagnosis entered into the PAS and EDIS records at the time of submission of an inpatient bed request. It is unlikely that the recorded ward admission diagnosis is necessarily updated in these cases which limit the utility of the PAS and EDIS records. Bed requests are also often submitted concurrent with general surgical referral, and again the PAS and EDIS record may not be updated after review by the surgical registrar.

Fig. 5 Histogram of ED length of stay for emergency general surgical admissions in 2018



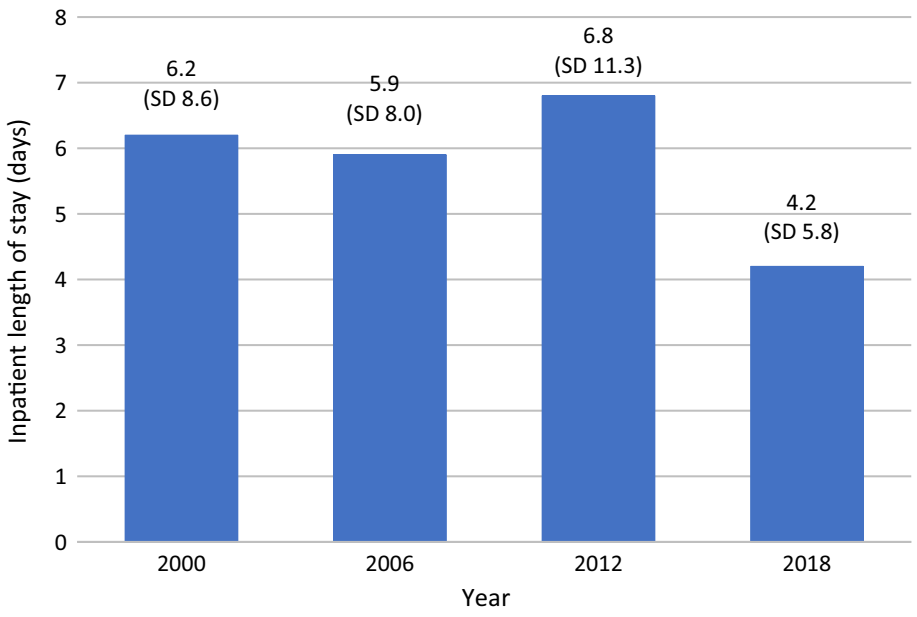


Fig. 6 Mean inpatient stay in days for emergency general surgical admissions by year

The rate of admission of patients with non-general surgical pathologies did not improve over the study period, remaining steady at around 7%. The majority of these patients had conditions best managed by general medical physicians; however, gynaecological pathology was also a significant group. This is not unexpected as RPH does not have a gynaecology service and patients with suspected ovarian cyst accidents are often admitted under the surgical team whilst awaiting ultrasound. There were relatively low rates of inappropriate admission of patients with urological pathologies.

This study represents a quantitative presentation of the emergency general surgical case mix at RPH over the last 18 years. The results indicate a 20% increase in emergency admissions. This is significantly less than the 48% population growth experienced in the greater Perth area between June 2000 and June 2017, highlighting that this audit does not represent an epidemiological population survey as population features, patient behaviours and multiple other factors affect patient behaviours and referral patterns [17, 18].

A presupposition of this study was that efforts to reduce emergency department overcrowding and bed access block have led to reduction in time spent by patients in the ED. This study correlates the introduction of the 4-hour rule with a decrease in median time spent in ED in 2012. These data suggest that the improvement was not sustained in 2018 despite the introduction of the ASU model of care, as the median time spent in ED rose further in the first half of 2018. However, this figure may be misleading due to a number of variables intrinsic to ED care and the limited scope of the study. Time spent in ED may be influenced by ambulance ramping, emergency department staffing constraints, delays to surgical referral and review, waiting time for pathology results and medical imaging, time spent stabilising patients prior to ward transfer and inpatient bed availability. Significantly lower rates of an accurate diagnosis at ward admission in patients with longer ED stays suggest that the clinical complexity of patients also plays a role in ED length of stay. Further limitations of the study in this regard are the exclusion of patients referred from outpatient clinics, transferred from another hospital or subsequently discharged from the emergency department though these patients are included in the 4-hour rule targets. For these reasons, we feel that no conclusions can be drawn from the increase in ED length of stay in 2018.

This study has demonstrated a trend to a recent decrease in the proportion of emergency general surgical patients receiving a pathological diagnosis on ward admission. The failure to demonstrate a statistically significant reduction in pathological diagnoses on ward admission between 2018 and 2000 or 2006 is likely a type 2 error relating to lower patient numbers in these years. Further research is required to identify the reasons for this trend and its implications on overall quality of patient care and health economics. This study is limited by the constraints of a retrospective observational study and is reliant on the accuracy of data abstracted from the various administrative databases used. This may result in misclassification or information bias.

Acknowledgements The authors acknowledge the assistance of the RPH Business Unit and RPH Emergency Department Research Team for their assistance in extracting data from the digital records.

Compliance with ethical standards

Conflict of interest The authors do not report any conflict of interest.

Ethics approval The study was approved as an institutional quality improvement project. An ethics approval–waiver for publication was granted based on the use of de-identified grouped data.

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