

The Tests and Time study: Achieving timely care in an Emergency Department

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Abstract

Aims

Emergency Departments suffer regularly from overcrowding and patient delays. This research was aimed at establishing the impact of the requirement for investigations on achieving timely care.

Methods

A retrospective cohort study of 58,323 patient attendances to an ED in a tertiary referral hospital was performed. The Emergency Department Information System (EDIS) was examined for the time stamp data on all patients. SPSS version 24 was used for the analysis.

Results

The standard was achieved for 23,461 (40.2%) patients. Those patients who needed blood tests (64.5%) spent an additional six hours and thirty minutes in the ED. The need for plain x-ray (47.8%) was associated with an increased stay of over 3 hours ($p < .001$). The requirement for a CT scan (13.9%) was associated with a mean prolongation in the time spent in the ED of just over 6 hours ($p < .001$). MRI (1.8%) was associated with a mean increase of an additional 5 hours 24 minutes ($p < .001$). Requiring any investigation reduced the likelihood of achieving the six hour time standard for completion of care (OR 0.40, (95%CI) 0.37 to 0.43).

Discussion

To deliver timely care in the ED necessitates reduction in the turnaround time from test performance to provision of results.

Introduction

The time a patient spends in the ED from arrival to hospital admission or discharge is described in the literature as the Emergency Department length of stay (EDLOS) or the patient experience time (PET)¹. Length of stay has been proposed as a quality indicator and as a valuable marker of overall ED efficiency and crowding². It can be described in terms of a dichotomous variable i.e. achieving or failing to achieve completion of care in a time period or as a continuous variable in hours and minutes. In 2004 in the United Kingdom, the rule that 98 % of ED patients should be seen and then admitted or discharged within 4 hours of presentation to the ED was introduced, it has been shown to be very effective in decreasing ED crowding, and it has led to the development of further acute care clinical indicators³.

The failure to achieve the 4 hour target for patients resulted in a one hundred and twenty pound fine for each patient for the hospital trust in the United Kingdom, there is no such fine in Ireland⁴. National monitoring clearly demonstrated a major impact on EDLOS, with the percentage of patients being seen within 4 hours increasing from 77% to 96 % between 2002 and 2004, despite a 37 % increase in ED presentations between 2002 and 2006³. In 2008, the Western Australian government announced that EDs would adopt a 4 hour rule, whereby firstly 85 % and eventually 98 % of patients would be either discharged home or admitted to a ward within 4 hours of presentation³.

In Ireland in 2012 the Emergency Medicine Programme set a six hour time standard for 95% of patients attending the ED to have their care completed⁵. It had been included in the Health Service Executive (HSE) service plan for a number of years, even prior to the publication of the Emergency Medicine programme in 2012, and yet it is not being achieved in most of Ireland's EDs on a consistent basis⁶. There is a need for a more detailed understanding of the determinants of prolonged ED length of stay⁷.

When patients build up in the waiting room, it may be because there are neither sufficient beds nor sufficient providers to provide adequate care at that time⁸. It may also be due to the delays patients are experiencing in undergoing investigations or procedures or pending the results of the investigations being made available. ED crowding is a serious and growing problem around the world and it has created significant worldwide public health challenges in terms of accessing timely and safe emergency care^{3,9}.

This research explores the hypothesis that requiring investigations will impact on the timeliness of care completion in the ED. It will further provide the specific implications in terms of the time added to the EDLOS for commonly performed tests.

Methods

The research was approved by the Hospital Research Ethics Committee. It was performed in the adult only Emergency Department of an urban area, 680 bed, teaching Hospital in Dublin, Ireland. The Emergency Department staff provide care to in excess of 50,000 patient attendances annually. The ED has 28 clinical care spaces. It has two x-ray machines but formal ultrasound, CT and MRI are performed in the main hospital radiology department.

A retrospective cohort study of prospectively gathered data on all patient attendances to the ED in the calendar year of 2019 was performed. All patients attending have their data entered into the A&E Oracle database, which is the Emergency Department Information System (EDIS), by the reception staff. All patients have the details of time of registration, time of triage, time of first medical assessment, time of blood test ordering, time of radiology ordering and time of discharge home recorded. For those patients referred for other specialty input, the time of referral to the on-take team, time of bed request and time of transfer to the ward are captured as time stamps on the patient's event record.

Patients having laboratory based blood tests will have the details of the requests captured on the laboratory information system and those having radiological investigations will have the details of these on the radiology ordering and recording system, the Picture Archiving and Communication system (PACS) and the National Imaging Management Information System (NIMIS). The data from these systems were merged using the Diver software solution which allows the merging of data from different databases. SPSS Version 24 was used for analysis.

Imputation of missing data was not employed for the research. The EDLOS was calculated by subtracting the date and time of registration from the date and time of leaving the Emergency

Department. To achieve the six hour target a patient attendance had to be six hours or less from registration to admission to a ward bed or discharge from the Emergency Department.

Categorical variables were created to allow the production of two by two tables and the calculation of Odds ratios with 95% Confidence Intervals. The data file was stratified by achieving or failing to achieve the six hour target and the split file function in SPSS was used to compare the distribution and central tendency in relation to specific variables and the likelihood or not of achieving the target.

Results

In 2019 there were 58,323 attendances to the Emergency Department (Table 1). Of these 14,517 (24.9%) were admitted. The six hour target was achieved for 23,461 (40.2%) patients.

Of the total attendances 27,874 (47.8%) underwent plain x-rays, 8,103 (13.9%) had computed tomography, 3,165 (5.4%) required radiology delivered ultrasonography and 1,067 (1.8%) had magnetic resonance imaging. Blood tests were performed on 37,614 (64.5%) patients.

Variable	All patient attendances	6 Hr standard achieved	6 Hr standard not achieved	OR**(95%CI) ^f	p value
Totals (%)	58,323	23,461 (40.2%)	34,862 (59.8%)		
Median EDLOS ^a (IQR ^b)	7hr 24 min (4:01 to 12:27)	3 Hr 20 mins (1:54 to 4:41)	11 hr 9 mins (8:12 to 16:11)		
Mean EDLOS (sd*)	9hr 12 mins (7 hrs 13 mins)	3 hr 16 mins (1 hr 38 mins)	13 hr 11 mins (6 hrs 45 mins)		
Radiology Performed (%)	33 452 (57.4%)	10,553 (31.5%)	22,899 (68.5%)	0.43 (0.41 to 0.44)	<0.001 ^g
Plain X-ray Performed (%)	27,876 (47.8%)	8,927 (32.0%)	18,947 (68.0%)	0.52 (0.50 to 0.53)	<0.001 ^g
CT ^c Performed (%)	8,103 (13.9%)	1,044 (12.9%)	7,059 (87.1%)	0.18 (0.17 to 0.20)	<0.001 ^g
US ^d Performed (%)	3,165 (5.4%)	1,147 (36.2%)	2,018 (63.8%)	0.84 (0.78 to 0.91)	<0.001 ^g
MRI ^e Performed (%)	1,067 (1.8%)	188 (17.6%)	879 (82.4%)	0.31 (0.27 to 0.37)	<0.001 ^g
Blood Testing Performed (%)	37,614 (64.5%)	9,046 (24.0%)	28,568 (76.0%)	0.14 (0.13 to 0.14)	<0.001 ^g

sd^{*}=standard deviation, OR^{**}= odds ratio, EDLOS^a= Emergency Department length of stay, IQR^b= Interquartile Range, CT^c= Computed Tomography scan, US^d= Ultrasound scan, MRI^e= Magnetic resonance imaging, CI^f= Confidence Interval, ^g= Chi square,

The necessity to perform investigations on patients added significantly to the length of stay in the Emergency Department (p value<.001). With a median ED length of stay for all attendances of 7 hours and 24 minutes (IQR 4:01-12:27) the prolongation of this with certain tests is apparent from table 2.

Table 2. The 6 Tests and Time Study and the impact of Investigations on ED length of stay (EDLOS).

Investigations	Number	Mean EDLOS ^c (SD)	Mean Difference	95% CI ^e	Median EDLOS (IQR ^f)	p value
Radiology required	33,449	10:55 (7:52)			8:58 (5:01 – 15:06)	
Radiology Not required	24,868	6:53 (5:26)	-4:01	(-4:08 to -3:55)		<.001 ^d
X-Ray performed	27,871	10:58 (7:59)			9:00 (4:56 – 15:14)	
X-Ray not performed	30,466	7:34 (5:58)	-3:24	(-3:30 to -3:17)		<.001 ^d
Ultrasound Performed	3,165	10:07 (7:30)			7:49 (4:45-13:46)	
Ultrasound not performed	55,152	9:09 (7:11)	-0:58	(-1:14 to -0:42)		<.001 ^d
CT ^a performed	8,103	14:27 (8:14)			13:04 (8:11-19:29)	
CT not performed	50,214	8:21 (6:39)	-6:06	(-6:17 to -5:54)		<.001 ^d
MRI ^b performed	1,067	14:31 (9:10)			12:34 (7:23-20:24)	
MRI not performed	51,250	9:06 (7:08)	-5:24	(-5:58 to -4:51)		<.001 ^d
Blood tests performed	37,612	11:30 (7:24)			9:40 (6:07-15:12)	
Blood tests not performed	20,705	5:00 (4:25)	-6:30	(-6:36 to -6:24)		<.001 ^d

CT^a = Computed tomography scan, MRI^b = Magnetic Resonance Imaging, EDLOS^c = Emergency Department Length of Stay,
^d= t-test, CI^e = Confidence Interval, IQR^f = Interquartile Range.

Patients requiring any form of radiological investigation had a mean EDLOS of four hours longer than those not requiring them. The requirement for a CT scan was associated with a mean prolongation in the time spent in the ED of just over 6 hours (P<.001) whilst the need for plain x-ray was associated with an increased stay of over 3 hours (p<.001). MRI (Table 2) was associated with a mean increase in stay of an additional 5 hours 24 minutes to those patients' length of stay. Those who needed blood tests spent an additional six hours and thirty minutes in the ED prior to admission or discharge. In terms of achieving the six hour standard on average those requiring any form of radiology exceeded it by 4 hours and 55 minutes (sd 1 hour 52 minutes). Patients having blood tests exceeded the 6 hour standard by an average of 5 hours and thirty minutes (sd 1 hour 24 minutes).

Discussion

The Australasian College for Emergency Medicine (ACEM) defines ED crowding as the situation where ED function is impeded primarily because the number of patients waiting to be seen, undergoing assessment and treatment, or waiting to leave exceed the physical and/or staffing capacity of the ED ¹⁰. As noted by Haydar et al, there is often a focus on throughput inefficiencies innate to busy EDs when attempting to address ED crowding but many of the operational inefficiencies ascribed to EDs are heavily influenced by hospital-wide processes downstream from ED flow ¹¹.

Each institution should analyse parameters and processes that potentially affect throughput times in their institution ¹². Others have noted that there is a clear trend toward more diagnostic testing and imaging occurring during ED visits, and the efficiency with which these services are integrated into ED-based care could potentially have a significant impact on EDLOS ¹³. In their analysis of data gathered between 2001 and 2005 on 138,569 adult ED visits from the National Hospital Ambulatory Medical Care Survey (NHAMCS), which is an annual survey of U.S. ED visits conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics (CDC/NCHS), Herring et al recognised that diagnostic tests in ED were one of the major contributors to ED crowding ¹⁴. Specifically they noted that, in multivariate analysis, ED visits where advanced imaging was ordered took 37.6% longer ¹⁴.

In the United States it has been noted that the addition of advanced diagnostic imaging, namely CT, ultrasound, and MRI, to the ED encounter work up is a predictor of longer length of stay ¹⁵. The decision by an ED provider to request advanced diagnostic imaging studies during an ED visit is a major contributor to increased ED LOS, and advanced diagnostic imaging use in the ED has been increasing for more than a decade as has ED crowding ¹⁵.

In a secondary analysis of ED data collected from the NHAMCS ED sub-file, a study of 139,150 ED patient visits in the United States from December 2008 to December 2014, Zhang et al, found that 21.9% of visits resulted in advanced diagnostic imaging use, including 16.8% who had CTs (this study found 13.9% of patients underwent CT), 3.6% with US (ultrasound was performed on 5.4% of the patients in this study), 0.4% with MRIs (1.8% of those studied underwent MRI in this study but the

Hospital provides a neuroscience, neurosurgical and stroke intervention service), and 1.2% who had multiple types of advanced diagnostic imaging.

Emergency Department crowding has been a patient care issue since the 1980s¹⁶. Increasingly there is a realisation that the crowding of EDs is a manifestation of the pressures that modern medical services are experiencing in trying to provide for the healthcare needs of the populations they serve. Efforts at providing alternate ways and locations to access care have not been associated with a reduction in ED attendances and many authors describe increasing patient attendances to EDs internationally¹⁷⁻¹⁹. Kawano et al, in a cross sectional single centre study of ED attendances in a Japanese Hospital, noted that an increase of one in the number of walk-in patients and ambulance arrivals prolonged patient stay in ED by only 1.8 and 2.6 minutes respectively; however, the execution of laboratory blood tests added another 74 minutes to the stay of discharged patients¹⁴. This study also noted that the requirement for blood tests contributed to a significant prolongation in the patient's length of stay. A positive correlation between laboratory turnaround times i.e. from receiving a sample to issuing a result, and ED LOS was observed in a broad patient population and across distinct acuity levels in a retrospective analysis of real-world patient data from 486 US hospitals. Their finding indicated a thirty second decrease in ED LOS with every one minute decrease in laboratory processing time²⁰.

Tests are now organised for patients in the ED that historically would have been done during a hospital admission. These tests are often done to establish if a hospital admission is absolutely necessary. The challenge is doing these tests with a view to hospital admission avoidance in what is often the most crowded part of the hospital. The ED cannot fulfil one of its roles in facilitating hospital avoidance whilst also boarding those patients who definitely need hospitalisation.

This research confirms that the likelihood of achieving the six hour target is significantly reduced by needing investigations. Limitations of this study include that it is a single centre study and as such the data may not be applicable to other EDs. The data was gathered from the EDIS and so the reliability of the time data is dependent on inputting by busy clinicians in real time. Data was not gathered on the total turnaround time (from ordering to reporting) of each test but rather on the impact of a test being performed on the patients' ED length of stay.

Conclusions

Being able to improve turnaround times for investigations to be performed and results made available would help in achieving timely care. Having more timely availability of laboratory tests and radiology would help to reduce EDLOS and ED crowding.

Declarations of Conflicts of Interest:

None declared.

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