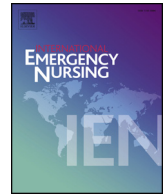




Contents lists available at ScienceDirect

## International Emergency Nursing

journal homepage: [www.elsevier.com/locate/aaen](http://www.elsevier.com/locate/aaen)

## Assessing bottlenecks in Emergency Department flow of patients with abdominal pain

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## ARTICLE INFO

## Keywords:

Abdominal pain  
Continuity of patient care  
Crowding  
Emergency service  
Hospital  
ED length of stay  
Patient journey

## ABSTRACT

**Introduction:** Abdominal pain has a wide range of possible causes, which may lead to difficulties in diagnosing and lengthy Emergency Department (ED) stays. In this study, bottlenecks in ED processes of patients with abdominal pain were identified.

**Methods:** Time-points of patients who presented to a Dutch ED with abdominal pain were observed and documented. The institutional review board approved the study.

**Results:** In total, 3015 min of patient time were observed in 54 patients. Median length of stay (LOS) was 218 min for admitted patients, and 168 min for discharged patients. For 65 patients (27.4%), LOS exceeded 4 h. Delays were found during the diagnostic process, when multiple physicians were needed in order to make a decision, and during departure.

**Conclusions:** Our study concerning individual patients' time-points provides important insight into delays in the patient journey of patients with abdominal pain. Flow improvement can be achieved by focusing on these bottlenecks, for example by minimizing diagnostic delays and by simultaneous specialists' consultations for patients who need more than one physician. The optimization of ED flow for patients with abdominal pain depends on coordinated efforts between ED staff, medical specialists, radiology and laboratory staff, staff from inpatient units, and hospital supporting services.

### 1. Introduction

#### 1.1. Background and importance

Crowding at Emergency Departments (EDs) is a major international problem [1]. It is associated with numerous adverse events, such as unsafe waiting times, elapsed target times to triage, delayed treatments, increased length of stay (LOS) and poor quality of care [2–4]. High attendance rates at EDs reduce patient flow as transfer or discharge cannot keep pace with new arrivals [5]. During crowding, queuing in the waiting room for an ED bed, waiting times for triage and for diagnostic and therapeutic procedures, and waiting times for specialty consultations increase [6–8], and patient satisfaction decreases [9–11].

Some countries have adopted the four-hour target to decrease ED LOS [12,13], others a six-hour target [14] in order to alleviate ED crowding. In the study setting, target set are: (1) to have an initial assessment and diagnostic plan for each patient within 30 min after the patients' arrival, (2) to ensure patients leave the ED within 30 min after

the call to the inpatient unit to collect the patient, and (3) to have a maximum ED LOS of 2 h per patient.

In this study we assessed whether these targets are feasible by examining the bottlenecks in ED flow for patients with abdominal complaints. Patients with abdominal pain comprise a substantial part of the ED patients (over 10% in the study setting). Abdominal pain has a wide range of possible causes, which may lead to difficulties in diagnosing [15] and lengthy ED stays. Understanding ED processes and identifying waypoints that act as bottlenecks in the patient journey of patients with abdominal pain may guide the implementation of interventions that are needed to fulfill the ambitious time targets.

### 2. Methods

#### 2.1. Setting

This study was performed at the ED of Haaglanden Medical Center Westeinde (HMC), an inner-city, 380-bed level 1 trauma center in The

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<https://doi.org/10.1016/j.ienj.2018.03.006>

Received 11 December 2017; Received in revised form 14 February 2018; Accepted 22 March 2018  
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Hague, The Netherlands. The ED has an annual census of 52,000 patient visits and a 20% admission rate. Both adult and pediatric patients are treated at the 26-bedded ED. All incoming patients are registered before they undergo triage. The Manchester Triage System (MTS), a five-level scale consisting of 52 flowchart diagrams [16] is used to triage patients, based on their presenting complaint and the severity of their signs and symptoms. At triage it is also decided whether patients need hospital emergency care or can be assessed by a general practitioner (GP) [17]. The latter (approximately one fifth of the patients presenting at the ED) are redirected to the GP cooperative (GPC), located in proximity of the ED. Critical patients are brought to an ED room. When no beds are available, patients with acuity levels 3–5 wait in the waiting room. The triage nurses are allowed to request X-rays and blood and urine analysis without a physicians' order. A clinical information system is used which automatically records patient registration time, triage time, and discharge time. Times of radiology requests and availability of results, laboratory requests and availability of results, and admission decision times are not automatically recorded.

## 2.2. Study design

A prospective, observational study using a prespecified convenience sample of patients with abdominal pain was undertaken during nine days in April 2017. Patients were included when they complained of abdominal pain and were triaged within one of the following flowcharts: 1. abdominal pain, 2. general discomfort, 3. vomiting/diarrhea, or 4. GI bleeding. One research assistant was present at the ED during 6 h per day. During these hours, she recorded real-time what was happening for each patient with abdominal pain from time of arrival until leaving the ED, defined as patient journey time. When multiple patients presented simultaneously, as many time-points as possible were recorded, focusing on admission decision time because departure delay (i.e. the delay in an admitted patient leaving the ED) is a known critical bottleneck [18].

Data from direct observation were linked to a dataset abstracted from the electronic health record system which included data of all patients who had presented at the ED during the study period and who, a. were triaged within one of the four flowcharts mentioned above and b. abdominal pain was documented in their patient files (Fig. 1). The dataset contained demographic details (age, sex), date and time of ED arrival, date and time of triage, triage level, date and time of entrance into a consultation room, date and time of ED discharge, and discharge

disposition.

No individual identifiers were collected to ensure anonymity of the patients. The regional medical ethics committee and the institutional review board approved the study (IRB Southwest Holland, nr. 17–121).

## 2.3. Data analysis

Statistical analysis was performed using SPSS (IBM Corp., IBM SPSS Statistics for Windows, version 22.0. Armonk, New York USA). To assess differences between the observed group and the non-observed group, Chi<sup>2</sup>-tests (gender, acuity level, and disposition) and Mann-Whitney *U*-tests (age and LOS) were calculated.

## 3. Results

During the 9-day study period, a total of 1264 patient visits (approximately 140 ED visits per day, min. 114, max. 163) were registered at the ED. In 223 of these visits (mean of 25 visits per day (min. 15, max. 36) the patients were redirected to the General Practitioner Cooperative (GPC), located next to the ED. There were 237 ED visits (18.8%) matching the inclusion criteria (triaged within one of the four flow charts and documented abdominal pain). The research assistant recorded time-points for 54 patients (22.8% of included patients) (Fig. 1). In total 3015 min (50 h and 25 min) of patient time were observed.

Patient characteristics of the total group ( $n = 237$ ) and the observed group ( $n = 54$ ) are detailed in Table 1. Most patients with abdominal complaints were assigned a yellow/urgent triage level ( $n = 121$ , 51.1%), and most ( $n = 136$ , 57.4%) were discharged home. Patients in the observed group were generally older (51 vs. 38 years,  $p = 0.02$ ) and more often admitted to the hospital (40.7% vs. 24.6%,  $p = 0.02$ ) compared to the non-observed group.

Time-points in the patients' journeys are listed in Table 2 and shown in Fig. 2. Median LOS for the patients with abdominal complaints (excluding the 34 patients who were redirected to the GPC) was 174 min (2 h, 54 min;  $n = 203$ ). For admitted patients, median LOS was 217 min (3 h, 37 min), and for discharged patients median LOS was 158 min (2 h, 38 min). For over one quarter of patients, LOS exceeded 4 h ( $n = 65$ , 27.4%). On average, it took 32 min for the first contact between patient and physician. For two of the 54 observed patients, a second consultation by a different specialism was performed. These patients were an 88-y old woman who was assessed by a gastroenterologist and a cardiologist, and a 14-y old girl who was assessed by both the pediatrician and a gynecologist. The second consultation took 49 min and 135 min respectively.

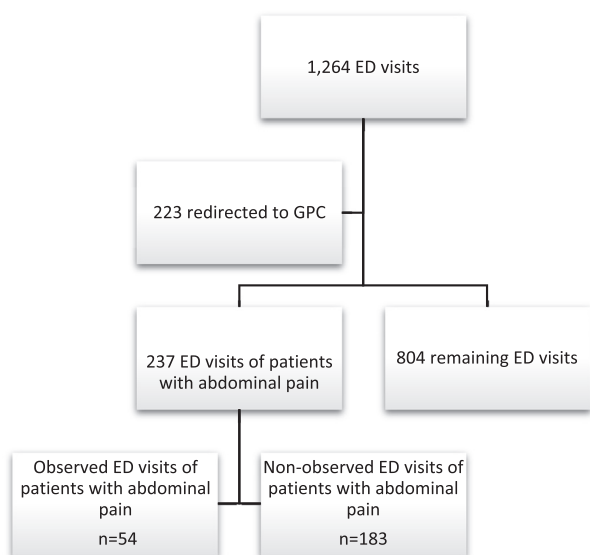
**Table 1**  
Patient and visit characteristics ( $N = 237$ ).

	Total ( $n = 237$ )	Observed ( $n = 54$ )	Non-observed ( $n = 183$ )	$p^{1,2}$
Gender, male, n (%)	103 (43.5)	19 (35.2)	84 (45.9)	0.16
Median age, y (IQR)	39 (34)	51 (42)	38 (34)	0.02
Acuity level, n (%)				
Orange, high urgent	42 (17.7)	14 (25.9)	28 (15.3)	0.08
Yellow, urgent	121 (51.1)	30 (55.6)	91 (49.7)	
Green, standard	74 (31.2)	10 (18.5)	64 (34.9)	
Disposition, n (%)				
Admitted to the hospital	67 (28.3)	22 (40.7)	45 (24.6)	0.02
Discharged home	136 (57.4)	27 (50.0)	109 (59.6)	0.21
GPC	34 (14.3)	5 (9.3)	29 (15.8)	0.23

Abbreviations: ED, emergency department; GPC, General Practitioner Cooperative; IQR, interquartile range; LOS, length of stay.

<sup>1</sup> Difference between Observed group and Non-observed group

<sup>2</sup> All  $p$ -values were calculated with Chi<sup>2</sup>-tests, except age and LOS, which were calculated with Mann-Whitney *U*-tests.



**Fig. 1.** Selection of study group.

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