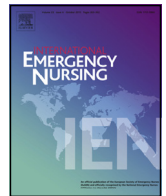




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## Emergency department crowding affects triage processes

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## ABSTRACT

**Introduction:** During emergency department (ED) crowding there is an imbalance between the need for emergency care and available resources. We assessed the impact of crowding on the triage process.

**Methods:** A 1-year health records review of 49,539 patient visits was performed. Data extracted included: occupancy ratio, ED occupancy, demographics, length of stay (LOS), time to triage, triage score, years working as a triage nurse, and triage destination. Data were analyzed using descriptive statistics and regression analyses.

**Results:** During crowding, target times to triage elapsed more often than during non-crowding (49.7% vs. 24.9%,  $P < 0.001$ ), and more patients were not triaged (2.2% vs. 1.6%,  $P < 0.001$ ). A higher ED occupancy was associated with longer waiting times for triage and longer LOS ( $P < 0.001$ ). There were 12,627 (25.5%) patients redirected to the general practitioner cooperative (GPC). No association between level of crowdedness and number of patients who were redirected to the GPC was found ( $P = 0.122$ ). Redirection to the GPC occurred significantly more often when the triage nurse had more years working as a triage nurse ( $P < 0.001$ ).

**Conclusion:** At this hospital, crowding affects the triage process, leading to longer waiting times to triage and longer ED LOS. Crowding did not influence triage destination.

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## 1. Introduction

Emergency Department (ED) crowding is a global problem associated with poor quality of care and negative patient outcomes (Carter et al., 2013). Crowding is associated with delays in ED care (Ackroyd-Stolarz et al., 2011; Bernstein et al., 2009; Hong et al., 2013; Hwang et al., 2006; McCarthy et al., 2008; Moskop et al., 2009; Pines et al., 2007; Pines et al., 2009; Pines et al., 2010; Schull et al., 2004; United States Government Accountability Office, 2009).

In The Netherlands, a recent survey showed that 68% of the ED managers indicated that periods of crowding were common at their ED (van der Linden et al., 2013b). Some of these EDs try to reduce crowding by implementing General Practitioner Cooperatives (GPC), and referring eligible self-referred patients to the GPC (RIVM, 2014). In the study setting, approximately half of the self-referred patients are referred to the GPC. Since self-referred patients are not

the root cause of ED crowding (Forero et al., 2011; Hoot and Aronsky, 2008), other interventions to improve throughput and output of EDs have been introduced in the study setting (van der Linden et al., 2012, 2013a). One of the most recent interventions to reduce patients' ED length of stay (LOS) and ED crowding was the 4-hour rule: ED patients are to be treated and either discharged or admitted to a ward within 4 hours. The 4-hour rule was introduced in the United Kingdom in 2000 and intended to improve the quality and the timeliness of ED care (Jones and Schimanski, 2010; Mason et al., 2012; Mayhew and Smith, 2008).

During ED crowding there is an imbalance between the need for emergency care and available resources, which enhances the need for accurate triage (Fitzgerald et al., 2010). During triage, a triage score is assigned to the patient. This triage score indicates the urgency of the patients' problem. In EDs with integrated GPCs, the triage score is also used to identify the patients' eligibility of being treated at the GPC. Ensuring that the most acute patients are prioritized for assessment is key when the waiting room is filled up with new patients. Although the triage process is an important part of a patient's visit to an ED, no studies have been conducted in Europe to examine the relationship between ED crowding and triage practices. A recent Canadian study found that during overcrowded conditions, high acuity patients presenting with chest pain or shortness of breath had a higher rate of triage to the non-monitored area

**Conflicts of interest:** None.

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of the ED (O'Connor et al., 2014), which could be considered as underclassification of severity. Underclassification of severity may lead to potentially dangerous situations.

The aim of this study was to assess the impact of ED crowding on triage processes and destination. We hypothesized that during ED crowding more patients would have elapsed target times to triage. Furthermore, we hypothesized that triage nurses may redirect more patients to the GPC while they actually need hospital emergency care, in order to relieve pressure on a crowded ED.

## 2. Methods

### 2.1. Design and setting

We performed a health records review of all patient visits at the ED of Medical Center Haaglanden (MCH) Westeinde between March 1, 2014 and February 28, 2015. The MCH Westeinde is an urban, 380-bed teaching hospital and trauma center in The Netherlands. The annual volume in the mixed adult and pediatric ED is approximately 50,000 ED visits. After registration, patients are assigned a Manchester Triage System (MTS) score based on their presenting complaint and the severity of their signs and symptoms. The MTS is a five level scale and consists of 52 flowchart diagrams (Mackway-Jones et al., 2005). Each of the flowcharts uses key discriminators to determine the triage score, prioritizing the patients into subgroups with its associated waiting time limits: emergent (requires immediate attention), very urgent (attention within 10 minutes), urgent (attention within 60 minutes), standard (attention within 120 minutes), and non-urgent (attention within 240 minutes). Eligibility for treatment at the GPC is based on a streaming element attached to each discriminator, which was developed in 2012 based on consensus between GPs, emergency physicians and emergency nurses (van der Linden et al., 2012). The triage nurse selects one of the computerized MTS-flowcharts. Once the triage nurse assigns the triage score based on the discriminator, the electronic system adds a mark indicating eligibility for treatment at the GPC. The triage nurse is allowed to overrule this GPC-mark and to assign the patient to the ED instead of to the GPC. Approximately one fifth of the patients presenting at the ED (half of the self-referred patients) are redirected to the GPC.

### 2.2. Data collection and processing

Patient and visit characteristics were extracted from the hospitals' database. Age was categorized into three categories (0–17 years, 18–64 years, 65 years and older). Medical specialism was categorized into twelve categories (Redirection to GPC; Surgery; Internal medicine; Cardiology; Neurology and Neurosurgery; Orthopedics; Respiratory; Gynecology; Pediatrics; Urology; Otorhinolaryngology; and Other). 'Other' included specialisms with less than 600 ED visits registered per year (dermatology, microbiology, ophthalmology, oral and maxillofacial surgery, plastic surgery, psychiatry, rheumatology, and sleeping disorders). Time of arrival was categorized into day shift (7:30 am to 3:29 pm), evening shift (15:30 pm to 11:29 pm), and night shift (11:30 pm to 7:29 am). Target times to triage are based on the Dutch Triage Guideline (Dutch Association of Emergency Nurses, 2008): patients should be assigned with a triage decision within 10 minutes after arrival.

### 2.3. ED crowding indicators

The occupancy ratio (McCarthy et al., 2008) (total number of patients in the ED divided by the total number of ED beds) was used as indicator of ED crowding and was measured at the time of patient triage. The higher the occupancy ratio, the more crowded the ED. An occupancy ratio of >1 is considered to indicate ED crowding. Other

crowding indicators used in this study were ED occupancy (number of simultaneously present patients at triage), LOS (i.e. the time from the patients' arrival until leaving the ED), and the percentage of patients staying more than 4 hours in the ED. Medical Ethics Committee exemption was granted under nr.14-091.

### 2.4. Analyses

Data were analyzed using predictive analytics software (SPSS, version 23; SPSS Inc., Chicago, Illinois, USA). Differences in patient and visit characteristics between crowding and non-crowding based on the occupancy ratio were tested using  $\chi^2$  tests, Mann-Whitney U-tests, and t-tests. The association between the occupancy ratio and triage process indicators was assessed using  $\chi^2$  tests. The association of waiting time to triage, ED LOS, and redirection to the GPC with ED occupancy and years of experience of the triage nurse were analyzed with linear and logistic regression analyses. Included in the models were patient age, gender, triage score, triage nurses' experience, and ED occupancy. ED occupancy and waiting times to triage, per triage category, were further examined by plotting a scatter graph that included locally weighted regression scatterplot smoothing for a moving fitted-average line ("loess line").

## 3. Results

Throughout the study period, 49,874 patient visits were registered at the ED, of which 335 records were excluded (double records). Thus, 49,539 patient visits were included in the study.

The mean number of patients occupying the ED was 17 (SD 10), ranging from 0 patient to 49 patients.

### 3.1. Effects of crowding measured using the ED occupancy ratio

Of the patients, 39.3% ( $n = 19,480$ ) arrived during crowding (ED occupancy ratio >1) and 60.7% of the patients ( $n = 30,059$ ) arrived during non-crowding (ED occupancy ratio  $\leq 1$ ).

During crowding, more patients stayed more than 4 hours in the ED compared to during non-crowding (19.3% vs. 16%,  $P < 0.001$ ). Base-line data and differences in patient and visit characteristics between crowding and non-crowding are presented in Table 1.

Patients who arrived during crowding more often had delayed target times to triage compared to patients who arrived during non-crowding (49.7% vs. 24.9%,  $P < 0.001$ ). During crowding 2.2% of the patients was not assigned a triage score, versus 1.6% of the patients who arrived during non-crowding ( $P < 0.001$ ) (Table 2).

### 3.2. Effects of crowding measured using ED occupancy

A higher ED occupancy was significantly associated with longer waiting times to triage ( $P < 0.001$ ), also when corrected for years working as a triage nurse and triage category. The more years of experience the triage nurse had, the longer the waiting time for triage ( $P < 0.001$ ) (Table 3). Fig. 1 shows a scatter graph of ED occupancy and waiting times to triage, per triage category, including locally weighted regression scatterplot smoothing for moving fitted-average lines ("loess lines"). The loess lines indicate the positive association between ED occupancy and waiting times is stronger for less urgent patients. Higher ED occupancy was also significantly associated with longer LOS ( $P < 0.001$ ) (Table 4). During the study period, 12,627 (25.5%) patients were redirected to the GPC. Referral to the GPC was associated with years of experience of the triage nurse ( $P < 0.001$ ) (Table 5).

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