Emergency department crowding: Factors influencing flow
van der Linden, Christien

Citation for published version (APA):

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Download date: 05 Jan 2019
Chapter 1 describes the background of this thesis. Crowding at emergency departments (EDs) is a widespread and complex problem. Consequences of ED crowding are listed. Furthermore, the conceptual model of Asplin which breaks down the problem of ED crowding into input, throughput and output factors is discussed. The aim of the studies in this thesis was to focus on different aspects of ED crowding and patient flow at the emergency department. Understanding ED processes that are related to ED crowding and comparing our findings regarding patient flow (input-, throughput- and output factors) with international evidence might support health care professionals and hospital management in the process of recognising and mitigating ED crowding in the Netherlands and improve patient flow at Dutch emergency departments. A summary of each chapter of this thesis follows below.

PART I CROWDING IN DUTCH EMERGENCY DEPARTMENTS

In the Netherlands, the state of ED crowding is unknown. Anecdotal evidence suggests that ED patients experience a longer length of stay compared to some years ago, which is indicative of crowding. However, no multi centre studies have been performed to quantify length of stay and assess crowding at Dutch emergency departments. In chapter 2, we present a study which describes the current state of emergency departments in the Netherlands regarding patients’ length of stay and ED managers’ experiences of crowding.

A survey was sent to all 94 ED managers in the Netherlands, with questions regarding type of facility, annual ED census, and patients’ length of stay. Additional questions included whether crowding was ever a problem at the particular emergency department, how often it occurred, which time periods had the worst episodes of crowding, and what measures the particular emergency department had undertaken to improve patient flow.

Surveys were collected from 63 emergency departments (67%). Mean annual ED visits were 24,936 (SD±9,840); mean length of stay for discharged patients was 119 (SD± 40) minutes and mean length of stay for admitted patients was 146 (SD± 49) minutes. Consultation delays, laboratory and radiology delays, and hospital bed shortage for patients needing admission were the most cited reasons for crowding. Admitted patients had a longer length of stay because of delays in obtaining inpatient beds. Thirty-nine of 57 respondents (68%) reported that crowding occurred several times a week or even daily, mostly between 12:00 and 20:00. Measures taken by hospitals to manage crowding included placing patients in hallways and using fast-track with treatment of patients by trained emergency nurse practitioners.

Despite a relatively short length of stay, frequent crowding appears to be a nationwide problem according to Dutch ED managers, with 68% of them reporting that crowding occurred several times a week or even daily.
PART II  INPUT OF THE EMERGENCY DEPARTMENT

Chapter 3 presents a description of the caseload at the emergency department of MCH Westeinde, focusing on ED use by self-referrals and their eligibility for primary care treatment. Main outcome measures in this study were the characteristics of self-referrals and non-self-referrals, their need for hospital emergency care and self-referrals’ motives for presenting at the emergency department.

Of the 5,003 consecutive ED patients registering within the 5-week observation period, 3,028 (60.5%) were self-referrals. Younger age; non-urgent triage level; chest pain, ear-nose- or throat problems; and injuries were independent predictors for self-referral. Thirty-nine percent of the self-referrals had urgent triage levels, as opposed to 65% of the non-self-referrals. Self-referrals presented during out-of-hours as well as during office hours as a heterogenic group. Most cited motives for self-referring were ‘accessibility and convenience’ and perceived ‘medical necessity’.

We concluded that about half of all self-referrals were eligible for primary care, during office hours as well as during out-of-hours. Therefore, other models of health care delivery than an out-of-hours ED - GP cooperative combination should be considered. For inner-city hospitals with many self-referrals presenting during office hours, an integrated emergency department and GP cooperative which functions 24 hours a day, 7 days a week, might work. Other options are GPs working in the emergency department, or the combination of emergency nurse practitioners with emergency physicians. Self-referrals with minor injuries and minor illnesses can be handled by emergency nurse practitioners via a separate fast-track stream. For more complex problems an emergency physician or a GP is available and for self-referrals with major trauma or needing specialist care, emergency physicians and other medical specialists are available. We recommend further research into different models of care, their clinical outcomes and cost-effectiveness and in ways to discriminate between patients needing hospital emergency care and patients who can be managed by primary care.

Chapter 4 characterises ED return visits with respect to incidence, risk factors, reasons and post-ED destination. We hypothesised that risk factors for unscheduled return and reasons for returning would differ from previous international studies, due to differences in health care systems. All unscheduled return visits occurring within one week and related to the initial ED visit were selected. Multivariable logistic regression was conducted to determine independent factors associated with unscheduled return, using patient-information available at the initial visit. Reasons for returning unscheduled were categorised into illness-, patient-, or physician-related. Post-ED destination was compared between patients with unscheduled return visits and patients who did not return.
Unscheduled within-week return accounted for 5% (2,492/49,341) of our ED visits, implying an unscheduled return rate of over 200 visits a month. Patients presenting during the night shift, with a wound or local infection, abdominal pain or urinary problems, and with an urgent triage level were more likely to return unscheduled. Short-term follow-up at the outpatient clinic or GP for these patients might prevent unscheduled return.

Reasons to revisit unscheduled were comparable with studies from other countries: mostly illness-related (49%) or patient-related (41%). Admission rates for returning patients were the same as for the patients who did not return. Apart from abdominal complaints, risk factors for unscheduled return differ from previous studies.

Chapter 5 presents a study on high ED utilisation. We assessed the proportions of frequent visitors (7 to 17 visits per year) and highly frequent visitors (greater than or equal to 18 visits per year); compared age, sex, and visit outcomes between patients with high ED utilisation and patients with single ED visits; and explored the factors associated with high ED utilisation. Two separate logistic regression models were developed, comparing frequent ED use with single ED use, and highly frequent ED use with single ED use. The variables included in the models were arrival time, arrival with ambulance, self-referral, chief complaint and triage level.

Frequent visitors and highly frequent visitors (together accounting for 0.5% of total ED patients) attended the emergency department 2,338 times (3.3% of the total number of ED visits). Frequent visitors and highly frequent visitors were equally likely to be male or female, were less likely to be self-referred, and they suffered from urgent complaints more often compared to patients with single visits. Frequent visitors were significantly older than patients with single visits and more often admitted than patients with single visits. Several chief complaints were indicative for frequent and highly frequent ED use, such as shortness of breath and a psychiatric disorder. Frequent visitors were more likely to be admitted than patients with single visits. Most patients with high ED utilisation visit the emergency department for significant medical problems.

Chapters 3, 4 and 5 assessed the caseload of the emergency department at MCH Westeinde. The results described in chapter 3 and 4 suggest that it is possible to reduce the input of patients at the emergency department: a part of the self-referrals are suitable for primary care and a part of the unscheduled returns may be prevented. Chapter 5 shows that the rate of frequent visits at our emergency departments is low compared to international standards. Moreover, the majority of these frequent visitors and highly frequent visitors visit the emergency department for significant medical problems. Efforts to improve ED flow that focus on this small group of patients will have minimal impact on ED crowding.
PART III THROUGHPUT OF THE EMERGENCY DEPARTMENT

The Medical Centre Haaglanden Westeinde introduced the Manchester Triage System in 2002. The objective of the Manchester Triage System is to prioritise patients according to the severity of their conditions, consisting of five triage levels: immediate (level 1), very urgent (level 2), urgent (level 3), standard (level 4) and non-urgent (level 5).

To improve patient flow for patients with non-life-threatening conditions, a fast-tracking system for patients with minor injuries and/or minor illnesses was introduced in 2007. Emergency nurses were retrained as emergency nurse practitioner to assess, treat, and discharge patients with minor injuries and/or minor illnesses autonomously.

Chapter 6 reports on the implementation of an adapted version of the Manchester Triage System in the Medical Centre Haaglanden Westeinde. The adaptation of the Manchester Triage System was needed to clarify emergency nurse practitioners’ role boundaries and manage patient streaming. Emergency nurse practitioners’ diagnoses are not linked directly to clinical priority (triage level). Therefore, it was not sufficient to simply assign all level 5 and level 4 patients to the emergency nurse practitioner. Emergency nurse practitioners are able to treat certain categories of patients with triage level 2 and 3 as well, while some patients with levels 4 and 5 should be treated by a physician. For example, our emergency nurse practitioners can treat patients with a dislocation of the shoulder that were triaged with level 2 because of the pain. However, they are not sufficiently trained to treat asthmatic children with level 4. The stream system helps to clarify the emergency nurse practitioners’ role while ensuring that the objective of triage, to organise patients according to clinical priority, remains the same. Working with the stream system has improved patient flow and decreased the mean length of stay for patients with minor illnesses and minor injuries.

In chapter 7, we validated the stream system of the Manchester Triage System against ED patients’ injury severity and resource utilisation. Electronic data on admission and death rates – indicating injury severity – and data on length of stay – indicating resource utilisation – were collected from 48,397 patients triaged in the Medical Centre Haaglanden Westeinde in 2009. A total of 24,294 (50.2%) patients were triaged as ‘suitable for treatment by an emergency nurse practitioner’ (ENP-stream). Remaining patients were triaged ‘medium care’ or ‘high care’. In the medium and high care groups, significantly more admissions took place (6100, 25.3%) and significantly more patients had died at the emergency department (31, 0.1%) compared to the patient group in the ENP-stream (admissions: 840, 3.5%, \( P < 0.001 \) and deaths 0, 0.0%, \( P < 0.001 \)).

We concluded that the ENP-streaming is an accurate predictor of not needing to be admitted (PPV=97%) and of ED survival (PPV=100%). Mean length of stay was significantly shorter for patients in the ENP-stream compared to the other patients (back transformed values:
Our study showed excellent correlation between the ENP-streaming and patients’ injury severity and resource utilisation, suggesting high validity of our triage streaming system. The stream system clarifies the emergency nurse practitioner role, minimising the subjectivity of patient allocation.

Chapter 8 presents a study on the incidence of missed injuries and inappropriately managed cases in patients with minor injuries and illnesses. We evaluated diagnostic accuracy of the ENPs compared with junior doctors/senior house officers. In addition, we evaluated waiting time and length of stay of the patients. In a descriptive cohort study, 741 patients treated by ENPs were compared with a random sample of 741 patients treated by junior doctors/senior house officers.

Within the total group, 29 of the 1,482 patients (1.9%) had a missed injury or were inappropriately managed. No statistically significant difference was found between the emergency nurse practitioner and physician groups in terms of missed injuries or inappropriate management, with 9 errors (1.2%) by junior doctors/senior house officers and 20 errors (2.7%) by emergency nurse practitioners. The most common reason for missed injuries was misinterpretation of radiographs (13 of 17 missed injuries). There was no significant difference in waiting time for treatment by junior doctors/senior house officers versus emergency nurse practitioners (20 minutes vs. 19 minutes). The length of stay of patients who were treated by junior doctors/senior house officers was significantly longer than for patients who were treated by emergency nurse practitioners (senior house officer mean length of stay: 85 minutes, 95% CI 81 to 89 minutes, versus emergency nurse practitioner mean length of stay: 65 minutes, 95% CI 62 to 68 minutes, $P < 0.001$).

The three studies in the throughput section of this thesis show that a stream system based on discriminators of an accepted triage system may be used to objectively identify patients suitable for treatment by emergency nurse practitioners (chapters 4 and 5). Since the emergency nurse practitioners showed high diagnostic accuracy, the emergency nurse practitioner model of care is an important strategy in the improvement of the throughput of ED patients and therefore, in preventing or handling ED crowding (chapter 6).

PART IV  OUTPUT OF THE EMERGENCY DEPARTMENT

Emergency department crowding is associated with long waiting times for patients before evaluation. This can lead to patients leaving the emergency department without being seen by a physician or emergency nurse practitioner. Patients who fail to wait for medical evaluation are referred to as ‘walkouts’. The percentage of walkouts is used as a measure for the severity of ED crowding. Little is known about ED walkouts in countries with well-established primary care systems such as the Netherlands.
In chapter 9 we present a study on walkout from two emergency departments: the Medical Centre Haaglanden Westeinde and the Medical Centre Haaglanden Antoniushove. The purpose of our population-based cohort study was to assess the walkout rate and to identify influencing patient- and visit characteristics, including crowding, on walkout. Furthermore, we assessed reasons for leaving and medical care needs after leaving, using a follow-up telephone interview.

A total of 169 (0.7%) of 23,780 registered patients left without treatment, of whom 62% left after triage. Of the triaged walkouts 26% had urgent or highly urgent medical complaints and target times to treatment had elapsed for more than half of the triaged walkouts. Independent predictors of leaving without treatment included being self-referred, arriving during the evening or night or during crowded conditions and relatively lower urgency triage allocation. Ninety walkouts (53%) were contacted afterwards by phone. Long waiting time (61%) was the most cited prime reason for leaving. Medical problems had resolved spontaneously in 19 of the 90 walkouts (21%) and 47 walkouts (52%) reported having sought medical care elsewhere. For 24 of the 90 walkouts (27%) with persisting complaints, medical care was advised during the follow-up phone call. We concluded that a small but significant proportion of ED patients lack required timely medical treatment. As a matter of risk management, it might be useful to follow-up on the walkouts to be able to refer them to appropriate care.

One of the major causes of ED crowding is the need for patients to wait at the emergency department until an inpatient bed is available. According to many researchers, ED crowding can be reduced most effectively by moving admitted patients to inpatient settings as rapidly as possible. To increase the throughput of acute patients, the Medical Centre Haaglanden Westeinde introduced a flexible acute admission unit in 2009. The flexible acute admission unit consists of 15 inpatient beds located in different wards that are set aside for patients from the emergency department when all of the beds in specialty wards are being used. In chapter 10 we present a qualitative evaluation of the flexible acute admission unit. This evaluation has revealed that the flexible acute admission unit has reduced emergency nurses’ workload and, in knowing that beds are always available for acute admissions, they are under less stress.

Chapter 11 is a quantitative evaluation of flexible acute admission unit. With the flexible acute admission unit, maximal bed flexibility was expected in the Medical Centre Haaglanden Westeinde. Beds that otherwise were ‘empty for admission the next day’ or ‘from another specialty’ but were equipped and staffed were assigned for acute admissions. On average, 10 ED patients a day need to be admitted at a regular floor (and thus were potential flexible
acute admission unit patients) during off-hours. A study was performed during four months in 2008 (control period) and four months in 2009 (intervention period), evaluating whether the flexible acute admission unit would result in fewer transfers to other hospitals and in a lower ED length of stay of patients needing hospital admission.

Of 1,619 regular admission patients, 768 were admitted in the control period and 851 in the intervention period. The flexible acute admission unit reduced the number of transfers of admitted patients to other hospitals from 80 (10.4%) to 54 (6.4%) ($P = 0.004$). The increase in length of stay for special care patients and non-admitted patients was not observed for regular, flexible acute admission unit-admissible patients. We concluded that flexible bed management might be useful in preventing or reducing ED crowding.

Chapters 10 and 11 in the output section of this thesis assessed the effects of flexible bed management. Access to hospital beds is deemed essential in reducing ED crowding. When emergency patients who have been admitted at the hospital are moved out of the emergency department to inpatient areas, the burden of boarding is more evenly spread across the hospital, thus freeing the emergency department to function effectively (chapters 9 and 10).

In chapter 12 we present the general discussion of this thesis, summarising the main findings and interpretations, discussing some methodological considerations, and reflecting on the implications for practice and future research.