Can patient flow be effectively controlled?

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Background Emergency department (ED) overcrowding may affect the ability to provide quality care and maximize patient flow.

Study objectives To analyse the impact of the control of the patient flow during a conflict on ED overcrowding.

Methods During a recent military conflict in Israel the Ministry of Health issued a directive aimed at redirecting the patient flow to EDs in a metropolitan area. The admissions were monitored to identify trends and determine if any changes occurred after the policy change.

Results Medical admissions in the only level I trauma centre decreased by 6.5% after the notification, while rising in two other level II hospitals by 3.7% and 4.3%, respectively. Pre- and post-conflict trauma admissions in the level I trauma centre dropped by 2.2% and increased by 6.4% and 1.8%, respectively, in the other hospitals.

Conclusions It is possible to direct the flow of patients to EDs and rationalize the use of resources, making it possible for patients to be admitted to EDs best able to care for them. These findings are especially relevant to emergency situations, but also to non-emergent situations in which control of patient flow may be required. Direct communication with the public is recommended to minimize the implementation time of directives regarding patient flow.

Keywords Emergency medicine, health resources, health care rationing

KEY MESSAGES

- It is possible to direct patient flow to Emergency Departments in order to ensure that patients most in need of critical care will receive it.
- Control of patient flow may be achieved through central collaboration and co-ordination between medical organizations.
- Control of patient flow requires a mechanism for direct communication with the public that will facilitate a more rapid implementation of directives that are issued.

Introduction

Emergency department (ED) overcrowding affects the ability to provide quality care and maximize patient flow (Adams and Biros 2001; Derlet et al., 2001; Taylor 2001). The functioning of EDs beyond their operating capacity is a phenomenon that many hospitals are confronted with. Overcrowding results in longer waiting times, and lengths of stay in the ED (AMA 2002; McCaig and Ly 2002). The ability to provide efficient and
Effective care in the ED is dependent on ED input, throughput and output (Asplin et al. 2006). The delays in providing care to patients stem from issues related to the flow of patients (Haraden and Resar 2004).

EDs are in a unique and challenging position with regard to controlling patient flow due to the fact that they are required to provide services on a 24-hour basis, and the demand for patient care is, for all practical purposes, limitless (Gilboy et al. 2005). The alleviation of overcrowding can be achieved by optimizing the flow of patients to the EDs by controlling the number of patients who present for care (McGaig and Ly 2002; Greene 2007).

Some hospitals have adopted a policy of redacting ambulance traffic for a period of time, known as ‘diverting patients’. This approach, however, only presents a partial solution to the problem, as it has been shown that approximately 75% of patients who seek care in the ED tend to arrive by means other than ambulances (McGaig and Ly 2002). ED overcrowding and ambulance diversion have been identified as a growing problem for hospitals in the United States over the past decade. Surveys of hospital directors have reported overcrowding of EDs in almost every state in the United States, and 91% of hospital ED directors reported that overcrowding was a problem that they had to contend with (Olshaker and Rathlev 2006).

Emergency medical services (EMS) which operate on the basis of a private or volunteer basis have been shown to be problematic, especially in times of disaster, during which the flow of casualties to the ED requires co-ordination to prevent overcrowding from occurring (Derlet and Richards 2000; Institute of Medicine 2006). In order to assist hospitals in preparing to treat patients efficiently in EDs during routine times and in emergencies, ongoing surveillance measures of hospital patient flow should be implemented (DeLia 2006).

Overcrowding in the ED has been shown to negatively impact on patient safety and the quality of care provided to patients (JCAHO 2006). Regionalization of services has been found to improve health outcomes, mitigate overcrowding and reduce costs (Committee on the Future of Emergency Care in the U.S. Health System 2006).

In a recent military conflict in Israel, a large urban area was subjected to recurring missile attacks. All hospitals in the area were required to continue admitting routine medical, trauma and other patients seen on a day-to-day basis during non-conflict times. A total of 1228 military and civilian casualties were evacuated to hospitals in the metropolitan area under attack during the period of hostilities. Approximately 2 weeks after the outbreak of hostilities, a decision was made by the Ministry of Health (MOH) to issue a directive instructing all medical organizations in the specific metropolitan area to refer all non-conflict-related casualties and other patients to the two level II trauma centres. The aim was to free-up the level I trauma centre to provide care to the more severely injured casualties, both military and civilian, caused by the conflict.

The aim of this article is to evaluate the impact of the control of patient flow to the EDs in the metropolitan area during the conflict.

**Medical system in the metropolitan area**

The city that was under attack has a population of approximately 267,000. There are three public general hospitals in the city: (1) Hospital A, owned and operated by the MOH, is a level I trauma centre, has 902 hospital beds and 34 ED beds (this hospital is the only level I trauma centre in the region); (2) Hospital B, which is owned and operated by one of the Health Maintenance Organizations (HMO) has 442 hospital bed and 36 ED beds; and (3) Hospital C, also owned and operated by the MOH, has 414 hospital beds and 34 ED beds. The specialties available in the three hospitals differ in relation to trauma capacity, for example only hospital A has a burns unit and neurosurgical facilities. All three hospitals have intensive care and neonatal units and are authorized to provide care to both civilian and military patients and casualties.

EMS are provided by the national EMS service (Magen David Adom). The MOH has overall responsibility for ensuring supply of medical services to the public, and as such regulates and supervises the operations of the various medical organizations.

The evacuation destinations of the casualties were directed according to the policy which was determined by the MOH and disseminated to all medical organizations including the Medical Corps, the hospitals, the EMS and the HMOs.

**Control of patient flow in the metropolitan area**

During the period of the conflict which lasted approximately 30 days different sections of the metropolitan area were hit by close to 80 missiles. While under attack the three general hospitals continued to admit all patients seeking care, both the medically ill and conflict casualties. The flow of patients to the three hospitals was monitored and evaluated on a daily basis by the MOH in order to prevent overloading of the EDs. Based on this process, on 27 July 2006 the MOH issued a directive aimed at directing the patient flow to the three metropolitan area hospitals. The directive designated hospital A as the primary evacuation destination for severe and moderate conflict-related casualties from the battle front, and for civilian casualties who required treatment in a level I trauma centre; hospitals B and C were directed to serve as the primary evacuation destinations for all other patients seeking medical attention for various reasons (births and illness). The directive was disseminated directly to all medical organizations including the Medical Corps, the hospitals, the EMS and the HMOs.

**Methods**

The number of ED patients admitted on a daily basis to the three general hospitals in the metropolitan area during the conflict was obtained from the MOH and entered into an SPSS data file for analysis (SPSS version 17). Admissions were categorized into the following groups: (1) medical admissions; (2) births; (3) non-conflict-related trauma; and (4) conflict-related trauma. The percentage of patients admitted to the three EDs as a proportion of the overall number of patients admitted was calculated for each hospital. Descriptive statistics for the number of admissions for the pre- and post-notification period were calculated.

The numbers of admissions for each category were plotted on a graph in order to identify trends in admissions and determine if any changes in admission rates occurred after the
notification of the MOH directive on 27 July 2006. In order to increase stability and smooth the data, moving averages were calculated based on 3-day periods, which represent overlapping sequences (HRSA 2008). A reference line was inserted on the x axis of the graphs, representing the date that the MOH directive was issued, and is referred to as ‘notification’. The period prior to the MOH directive and that post directive are referred to as the pre-notification and the post-notification period, respectively.

The Mann–Whitney U Test (2-tailed, \( P \leq 0.05 \)) was used to test for significant differences in the pre-notification and post-notification admission rates to the EDs of the three hospitals for all categories of admissions. All statistical tests were carried out prior to the smoothing of the data.

**Results**

Details of the number of inhabitants who left the city due to the conflict are not available. However, we were able to compare ED utilization in different periods prior to and following the conflict, as presented in Figure 1. As can be seen, utilization decreased in all hospitals during the conflict compared with all other periods.

Figures 2 to 5 present the graphs based on the moving averages for the four types of admissions for the four hospitals. Table 1 presents the mean percentage and standard deviation by hospital and type of admission for the pre- and post-notification periods and Table 2 presents the results of the Mann–Whitney U Test of significance for the pre- and post-notification rates of admissions to the three hospitals.

![Figure 1](image1.png)
**Figure 1** Emergency department utilization in different periods: prior to, during and following conflict.

![Figure 2](image2.png)
**Figure 2** Mean number of medical admissions to metropolitan area hospitals during a conflict; moving average.
Medical admissions

Figure 2 presents the 3-day moving average graph for medically related admissions to the EDs. The trend for admissions to hospital A shows a drop from the first day of the conflict till the notification date. Medical admissions to hospital A increased slightly for approximately 3–4 days after the notification and then decreased until the end of the conflict. Medical admissions to the ED of hospital B increased during the first 4 days, and then remained fairly constant till the notification date. During the post-notification period there was a trend for medical admissions to hospital B to increase. Hospital C admissions remained fairly constant from the start of the conflict till the notification date, thereafter they tended to increase till the end of the conflict. Pre-notification admissions for hospital A decreased by 6.5% after the notification, while the percentage of admissions for hospitals B and C increased by 3.7% and 4.3%, respectively. The Mann–Whitney test showed that the differences between the pre- and post-notification admissions for the three hospitals were significant ($P < 0.05$, 2-tailed).

Births

Figure 3 presents the 3-day moving average graph for the percentage of women giving birth at the three metropolitan area hospitals. During the first few days of the conflict there was a slight trend for the percentage of births at hospitals A and C to increase, while hospital B births tended to decrease. Most notable is the trend for the percentage of births at hospital A to drop, while those in hospitals B and C increased as the conflict continued, mainly for hospital B. This trend continued after the notification date. The percentage of births at hospital A dropped by 6.1% after the notification date, while those at hospitals B and C increased by 4.2% and 2.6%, respectively. Mann–Whitney test was significant for the pre- and post-notification percentages of births carried out at hospital A ($P < 0.05$, 2-tailed). The differences in admissions pre- and post-notification for hospitals B and C were not significant.

Non-conflict trauma

Figure 4 presents the 3-day moving average graph for non-conflict-related trauma admissions to the three hospitals. Hospital A admitted proportionally more non-conflict trauma patients than the other two hospitals. There was a notable trend for the percentage of non-conflict trauma admissions to hospital A to decrease during the initial phase of the conflict, while hospital B admissions increased. No clear trend was obvious for hospital C, with the exception of a slight increase in the percentage of admissions towards the closing phase of the conflict. The mean percentage of non-conflict trauma admissions to hospital A decreased by 5.2% post-notification, while for hospitals B and C there was an increase (5.7% and 2.7%, respectively). The Mann–Whitney test for pre- and post-notification non-conflict-related trauma admissions for the three hospitals was significantly different ($P < 0.05$, 2-tailed).

Conflict-related trauma

Figure 5 presents the percentage of conflict-related trauma admissions to the three hospitals. As was the case with...
non-conflict-related trauma, it can be seen that hospital A admitted a higher volume of conflict-related trauma cases than the other two hospitals during the conflict. In the pre-notification period there was a trend for the percentage of conflict trauma admissions to hospital C to increase, but the trend changed with fewer conflict trauma victims being admitted in the post-notification period. In hospital B the percentage of conflict-related trauma admissions remained fairly constant up until the notification date and increased somewhat after the notification date. Pre- and post-conflict
trauma admissions to hospital A dropped by 2.2%. For hospitals B and C the number of conflict-related trauma victims post-notification increased by 6.4% and 1.8%, respectively. The Mann–Whitney test showed that the pre- and post-notification percentages of conflict-related trauma were significantly different only for hospital B ($P < 0.05$, 2-tailed).

Stress and worried well patients
Approximately 30% of the patients who sought care in the EDs during the conflict period did so as a result of stress-related symptoms (i.e. had no physical injuries but rather psychological symptoms). Analysis of the rate of stress-related patients admitted to each of the three hospitals in the pre- and post-notification periods showed a reduction in admissions in hospital A (68% vs 46%, respectively), a significant increase in hospital B (7% vs 25%, respectively), and a slight increase in hospital C (25% vs 29%, respectively).

Discussion
Avoiding overcrowding of EDs and decreasing patient volumes are important factors in improving quality care and maximizing patient flow (Adams and Biros 2001; Taylor 2001). Improving the patient flow to the EDs has been found to be a significant factor in improving the quality of care for patients seeking care in this setting (Asplin et al. 2006). Minimizing hospital delay in treating patients is now recognized as a patient flow issue (McCaig and Ly 2002; Haraden and Resar 2004). Co-ordination among emergency medical response teams, hospitals and a compatible system which facilitates effective and real-time communication can improve patient flow and minimize overcrowding and the need for ambulance diversions (Derlet and Richards 2000).

Requests for medical care in EDs during the period of conflict decreased in all three hospitals in comparison to similar time periods prior to and following the end of the conflict. This reduction may be attributed to the fact that some inhabitants chose to leave the area and others may have delayed the decision to seek care for their medical conditions. Analysis of ED utilization in hospitals located in surrounding areas outside the conflict zone did not show an increase during the conflict period.

The attempt to intervene in the flow of patients in the metropolitan area hospitals during the conflict showed that it is possible to effectively direct the flow of patients to the ED. The directive of the MOH and the process of communication, co-ordination and collaboration between the various medical agencies involved (EMS, military evacuation forces, HMO-based primary physicians and hospitals) contributed to this outcome. The MOH directive was implemented to maximize the use of the level I trauma centre (hospital A) by ensuring that military casualties originating at the battle front and severely injured civilians received their care in the most appropriate setting. This was achieved by redirecting patients seeking care for medical problems, births and non-conflict-related trauma to the two other municipal hospitals. People living in the metropolitan area who felt they needed the services provided by an ED and conflict-related casualties who did not need to be treated in a level 1 trauma centre were directed to the other two hospitals in an organized manner. Evidence of this can be seen in the increase of conflict casualties who were referred to hospital B and the decrease in hospital C, following the MOH notification. An important factor which enabled the MOH to achieve its goal

![Figure 5](image_url)
of controlling the patient flow to the hospitals during the conflict was the computer-based monitoring and analysis of ED admissions.

With regard to individuals suffering from stress-related symptoms, the MOH undertook the following actions, the aim of which was to reduce the number of people seeking care in EDs for this problem: (1) community facilities for helping to deal with acute stress reactions and worried well were established in the city and the public was informed of their locations; (2) written and electronic materials concerning coping with stress were made available to the public.

The findings of this study show that with the exception of conflict-related casualties, there was to some degree a lag time until the MOH directive took effect. In the case of casualties from the battle front the effect was immediate, mainly due to the fact that casualties were evacuated by air directly to hospital A. The directive of the MOH was disseminated by the Surgeon General of the Medical Corps and immediately implemented at all military levels that control the aerial evacuation. EMS is responsible for the evacuation of non-conflict trauma casualties; however, as has been shown in studies, many civilian casualties are frequently evacuated by means other than the EMS (McCaig and Ly 2002). This fact contributed to a delay in the application of the MOH directive as the degree of direct control of the MOH over the public at large was limited.

The redirection of medical and other types of admissions was not as immediate, as might be expected, due to the fact that these admissions tend to originate from the HMO clinics or the public at large. The dissemination of the MOH policy to the HMO-based primary care physicians is a more lengthy process as it requires the distribution of the directive through the director-general of each HMO. More so, although self-referral to EDs entails a significant co-payment, it is not uncommon for patients seeking care in the ED to self-refer, especially in the event of acute conditions.

Women are free to select the hospital they wish to give birth in without seeking a referral from their primary care physician. While there was no direct dissemination of the MOH directive to the public at large, hospital admissions for births changed, with a significant decrease in admissions for births at hospital A. This change occurred without the public being informed directly through the media. It would appear that the information not to go to hospital A was communicated by word of mouth and to some degree by official channels such as the hospitals themselves, the HMO primary care physicians and the EMS.

The need for more effective communication with populations living in areas in which emergencies occur is an important component of a response plan. It is essential that members of the public be kept informed regarding the services that are available. In order to enable more rapid and effective control of the flow of patients to the ED, it is recommended that policies and directives concerning evacuation destinations and various hospital designations be publicized in real-time not only to the medical institutions but also to the public itself. This would speed up the implementation of decisions taken to direct patient flow and improve compliance of both institutions that provide care and the public at large.

Two important factors contributed to the ability of the health authorities to direct the patient flow: (1) the ongoing monitoring and interventions which were made by the MOH, and (2) a centralized EMS system. This situation may not be common in all countries; however, the process by which the decisions with regard to patient flow were taken and implemented could be applicable to other types of health care systems.

Limitations
The study did not differentiate between conflict-related trauma that occurred at the battle front and that of civilians who were injured as a result of missile attacks on the city.

Conclusions
This study showed that it is possible to direct the flow of patients to the EDs in a large metropolitan area, so as to ensure that the patients most in need of critical care will receive it. While this paper dealt with the issue of patient flow to EDs during a period of conflict, the findings are relevant to all situations in which control of patient flow is needed. The control of the patient flow may have been made substantially easier due to the manner in which the Israeli healthcare system is organized, i.e. the co-ordination of all medical organizations by the MOH, the operation of one national EMS, the medical coverage of all residents by public HMOs and the close collaboration between the military and the civilian medical systems in relation to utilization of hospital resources. One of the major lessons learned from this experience was the need for the response plan of the MOH to include a mechanism for communicating directly with the public so that its directives can be implemented more quickly.

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References


