EM Advances

Understanding hospital and emergency department congestion: an examination of inpatient admission trends and bed resources

Hannah J. Wong;[*†‡] Dante Morra, MD, MBA;[§¶] Michael Caesar, MBA;[†] Michael W. Carter, PhD;[*†] Howard Abrams, MD[§¶**]

ABSTRACT

Objective: Patients in the emergency department (ED) who have been admitted to hospital (inpatient "boarders") are associated with ED overcrowding. They are also a symptom of a hospital-wide imbalance between demand and supply of resources. We analyzed the trends of inpatient admissions, ED boarding volumes, lengths of stay and bed resources of 3 major admitting services at our teaching institution.

Methods: We used hospital databases from Jan. 1, 2004, to Dec. 31, 2007, to analyze ED visits that resulted in admission to hospital.

Results: During the study period, 21 986 ED patients were admitted to hospital. The percentage of cancer-related admissions to the oncology admitting service decreased from 48% in 2004 to 24% in 2007, and admissions to general internal medicine (GIM) increased nearly 2-fold, from 28% in 2004 to 54% in 2007. In addition, GIM admitted about 10% more myocardial infarction and heart failure patients than did cardiology. General internal medicine constituted the majority of ED boarders and had a median boarding length of stay of approximately 15 hours. Inpatient beds on oncology and cardiology services remained static.

Conclusion: Without bed capacity to admit more patients, our specialty services relied on GIM to serve as a safety net. At the same time, GIM was cited as a main source of ED congestion as their patients occupied more ED beds for longer periods than any other admitting service. The data presented in this study has helped effect positive change within our institution. Other hospitals running at or near capacity and faced with similar ED congestion may apply the methods we used in this study to analyze the cause and nature of their situation.

Keywords: emergency department overcrowding, inpatient care, internal medicine, performance measurement

RÉSUMÉ

Objectif : On associe les patients ayant été admis à l'hôpital après une consultation à l'urgence (« pensionnaires ») à l'engorgement des urgences. Ils sont également un symptôme d'un déséquilibre important entre l'offre et la demande des ressources dans tout l'hôpital. Nous avons analysé les tendances relativement aux admissions, aux volumes de « pensionnaires » (patients admis occupant une civière à l'urgence), aux durées de séjour et au nombre de lits de 3 grands départements d'hospitalisation à notre établissement hospitalier universitaire.

Méthodes : Nous avons utilisé les données de l'hôpital, entre le 1er janvier 2004 et le 31 décembre 2007, pour analyser les visites à l'urgence qui ont mené à l'admission à l'hôpital.

Résultats : Au cours de la période de l'étude, 21 986 patients à l'urgence ont été admis à l'hôpital. Le pourcentage d'hospitalisations liées au cancer au département d'oncologie a diminué entre 2004 et 2007, passant de 48 % à 24 %, et les hospitalisations en médecine interne générale (MIG) ont presque doublé, passant de 28 % en 2004 à 54 % en 2007. En outre, le service de MIG a admis environ 10 % de plus de cas d'infarctus du myocarde et d'insuffisance cardiaque que la cardiologie. La médecine interne générale représentait la majorité des « pensionnaires », qui occupaient une civière à l'urgence pendant une durée médiane d'environ 15 heures. Le nombre de lits en oncologie et en cardiologie est demeuré stable.

Conclusion : Sans la capacité en lits pour admettre plus de patients, nos départements spécialisés considéraient la MIG comme un filet de sécurité. Parallèlement, la GIM était citée

From the *Department of Mechanical and Industrial Engineering, University of Toronto, Toronto, Ont., the †Centre for Research in Health Care Engineering, University of Toronto, Toronto, Ont., ‡Shared Information Management Services, University Health Network, Toronto, Ont., the §Division of General Internal Medicine, Department of Medicine, University Health Network, University of Toronto, Toronto, Ont., the ¶Centre for Innovation in Complex Care, University Health Network, Toronto, Ont., and the **Department of Health Policy, Management, and Evaluation, University of Toronto, Toronto, Ont.

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comme une des principales sources de congestion dans les urgences, ses patients occupant plus de lits et plus longtemps que tout autre département d'hospitalisation. Les données présentées dans cette étude ont permis d'apporter des changements positifs au sein de notre établissement. D'autres hôpitaux qui fonctionnent à pleine capacité ou presque et dont les services d'urgence font face à une congestion similaire peuvent appliquer les méthodes que nous avons utilisées dans cette étude pour analyser leur situation et en déterminer la cause.

INTRODUCTION

Emergency department (ED) overcrowding and excessive wait times for ED treatment are persistent problems for hospitals in many countries. Studies typically report the key indicator of ED overcrowding to be the number of admitted patients occupying beds in the ED while they wait for an inpatient bed to become available, otherwise known as inpatient "boarders."[1–6] It is also widely acknowledged that for most hospitals, inpatient boarding is a symptom of an underlying hospital-wide problem: an imbalance between the demand and supply of hospital resources.[7,8] Accordingly, studies have focused on inpatient supply-related issues, including staffing levels, bed capacity and bed use by patients who no longer require acute care.[9–11] In terms of emergent inpatient demand, investigations have focused on predictors of admission and the role elderly patients play in the challenges faced by EDs.[12–16] There is general consensus that the most significant contributing factor to ED congestion is inpatient boarders, thus solutions to reduce volumes of boarders and time spent boarding are likely to have the greatest impact on the ED congestion crisis.[17–19]

In recent years at our centre, it has been common for more than half of our ED stretchers to be occupied by inpatient boarders. There was broad agreement between clinicians and hospital management that this posed a threat to patient safety, quality of care, and patient and staff satisfaction. We undertook this study to characterize the ED boarding population at our institution and to understand the reasons for the increasing volume of inpatient boarders. We hypothesized that in terms of inpatient boarding volumes and boarding lengths of stay (LOS), one admitting service, general internal medicine (GIM), was the main cause of ED congestion at our institution. We further hypothesized that changes in emergent admitting patterns of specialty services, in response to an imbalance of supply and demand for bed resources, influenced GIM admission volumes. We evaluated these hypotheses by examining 1) inpatient admission volumes via the ED, 2) inpatient boarding volumes and LOS, 3) the service of admission and 4) inpatient bed resources.

METHODS

Study design

This was a retrospective review of consecutive ED visits that resulted in inpatient admission at Toronto General Hospital (TGH), during a 4-year period from Jan. 1, 2004, to Dec. 31, 2007. The University Health Network Research Ethics Board approved this study.

Setting

This study was conducted at TGH, 1 of 3 hospitals of the University Health Network (UHN), a research and teaching institute located in downtown Toronto, Ont. The UHN is also composed of Toronto Western Hospital (TWH) and Princess Margaret Hospital (PMH). Each hospital has unique specialties of care: TGH specializes in heart disease and transplantation; TWH specializes in neuroscience and musculoskeletal science; and PMH is a comprehensive cancer treatment and research centre. Although TGH and TWH each have their own ED, PMH does not, and its patients are referred to the TGH ED (adjacent to PMH) for emergent care.

Selection of participants

We analyzed data for 21 986 consecutive ED visits at TGH that resulted in admission to hospital. This study focused on TGH ED inpatient admissions to GIM and the major specialty programs of cardiac care (cardiology and cardiovascular surgery) at TGH and cancer care (oncology) at PMH. The TGH ED was chosen for analysis, as it is the primary emergent admitting site for all specialty programs within TGH and PMH.

Data collection and methods of measurement

We obtained patient-level data from UHN's primary

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patient care system electronic patient record (EPR) for ED visits and the administrative information system WinRecs (Med2020 Health Care Software Inc.) for discharged inpatients. The EPR contains information pertaining to socio-demographics, the date and time of patient admission to hospital, the date and time of discharge, the LOS (defined as the interval from inpatient admission to discharge), diagnosis and patient disposition. In addition, we obtained the number of beds staffed and midnight bed occupancy levels from the financial information system SmartStream (SmartStream Technologies Ltd.). We linked patient records from EPR and WinRecs databases using unique patient and visit identifiers.

Outcome measures and primary data analyses

Demographic and visit characteristics

We examined demographic and visit characteristics of patients admitted to the 3 services of interest. We included age, sex, LOS and whether an encounter was classified as a "repeat" admission (i.e., the associated unique patient identifier accompanying the encounter was found to be associated with other admissions to the same inpatient service in the calendar year of study).

Inpatient admissions via the ED, boarding volumes and time spent boarding

For each calendar year, we report the total number of ED visits, the total number (and proportion of ED visits) resulting in admission to hospital and the total number (and proportion of inpatient admissions) admitted to the 3 services of interest.

Ideally, following the decision to admit, inpatients are transferred out of the ED to a ward bed of the service involved. The reality for most visits at our institution is that inpatients board in the ED waiting for a ward bed to become available. To investigate the extent of boarding, we analyzed boarding volumes (measured at midnight) and boarding LOS. We defined boarding volume as the number of inpatients occupying ED beds at midnight. The unit of analysis for boarding volume was one calendar day. We defined boarding LOS as the interval from the time of the decision to admit to the time the patient was transferred out of the ED (including transfers to ward beds and ED discharges or deaths).

Shifts in service of inpatient admission

We hypothesized that changes in admitting patterns to cardiac and cancer services would impact GIM admission volumes. To investigate secular changes in the service of inpatient admission, we performed an analysis on ED admissions for cardiac- and cancer-related conditions using the International Classification of Diseases, 10th revision (ICD-10).[20] Applicable cardiac- and cancer-related case-mix group (CMG) codes and descriptions are listed in the legend of Table 1.

In addition to investigating cardiac- and cancer-related visits, we further compared admission rates for patients who had received previous care at PMH (specializing in cancer care) and patients diagnosed with acute myocardial infarction (AMI) or congestive heart failure (CHF).

Inpatient bed resources

We also hypothesized that changes in inpatient bed resources would impact GIM inpatient boarding volumes and boarding LOS. We examined the number of beds staffed and midnight bed occupancy levels on the GIM, oncology (PMH), and cardiology and cardiovascular surgery inpatient units.

Statistical analyses

Median and interquartile ranges are reported for continuous variables and proportions are reported for categorical variables. To determine whether significant differences existed across the 4-year study period, we used Kruskal–Wallis one-way analysis of variance by ranks for continuous variables, and χ^2 analysis for proportions. We performed analyses using SPSS (SPSS Inc.) and we deemed an α level of < 0.05 statistically significant.

RESULTS

Demographic and visit characteristics

We first examined demographic and visit characteristics of GIM, oncology, and cardiology and cardiovascular surgery admissions from 2004 to 2007 (Table 2). During this period, demographics of the 3 services (i.e., percentage female and median age) remained stable with the most elderly patient admissions occurring in GIM, followed by cardiology and cardiovascular surgery and finally oncology. Median LOS also remained unchanged for each service, with GIM admissions having the shortest LOS, followed closely by cardiology and cardiovascular surgery, and finally oncology admissions, which had nearly twice the LOS of GIM. The proportion of repeat admissions for oncology, and

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cardiology and cardiovascular surgery remained stable at 16.0% and 24.8%, respectively, during the entire study period. In contrast, during the study period there were significant increases in the number of GIM repeat admissions (21.9% in 2004 and 30.0% in 2007).

Inpatient admissions via the ED, boarding volumes and time spent boarding

Table 3 summarizes ED visits, inpatient admissions via the ED, and inpatient admissions to GIM, oncology, and cardiology and cardiovascular surgery. During the study period, there were a total of 112 268 consecutive ED visits at TGH, of which 21 986 resulted in admission to hospital. The proportion of inpatient admissions to GIM, oncology, and cardiology and cardiovascular surgery grew, declined and remained stable, respectively across the study period. The proportion of ED visits admitted to GIM increased 7.6% in 2007 compared with 2004, whereas those admitted to oncology decreased 2.2%.

Figure 1 presents mean ED inpatient boarding volumes measured at midnight for total inpatient admissions, the 3 services of interest, and all remaining inpatient services. Overall, the fluctuating pattern of total admitting services' boarders is primarily driven by GIM boarders. In contrast, oncology, and cardiology and cardiovascular surgery boarders account for about 10% of total inpatient boarders. Figure 1 also indicates the period when TGH experienced inpatient bed reductions and when a "bed-spacing" policy was put into effect (at our institution, inpatient services are allocated a certain number of physical beds; instituting the bed-spacing policy allowed inpatients to be transferred or "bed-spaced" to empty beds in other services). Figure 1 clearly illustrates that the period of inpatient bed reductions resulted in a significant increase in ED boarders. The effect of the bed-spacing policy (intended to relieve ED congestion) is less apparent. In addition to boarding volumes, we analyzed

Table 1. Admitting service of emergency department inpatient admission visits with cancer-related* and heart-related† case-mix groups at Toronto General Hospital, from 2004 to 2007

	No. (%) of inpatient admission visits				
Admitting service	2004	2005	2006	2007	*p* value
Cancer related	*n* = 419	*n* = 422	*n* = 416	*n* = 380	
Oncology	153 (36.5)	141 (33.4)	109 (26.2)	75 (19.7)	< 0.001
General internal medicine	153 (36.5)	179 (42.4)	216 (51.9)	219 (57.6)	< 0.001
Other inpatient service	113 (27.0)	102 (24.2)	91 (21.9)	86 (22.6)	0.45
Modifying factor: patient of PMH	*n* = 296	*n* = 310	*n* = 302	*n* = 269	
Oncology	141 (47.6)	130 (41.9)	97 (32.1)	65 (24.2)	< 0.001
General internal medicine	84 (28.4)	107 (34.5)	142 (47.0)	146 (54.3)	< 0.001
Other inpatient service	71 (24.0)	73 (23.5)	63 (20.9)	58 (21.6)	0.82
Heart related	*n* = 739	*n* = 735	*n* = 783	*n* = 914	
Cardiology/cardiovascular surgery	277 (37.5)	274 (37.3)	278 (35.5)	327 (35.8)	0.88
General internal medicine	397 (53.7)	401 (54.6)	441 (56.3)	504 (55.1)	0.92
Other	65 (8.8)	60 (8.2)	64 (8.2)	83 (9.1)	0.89
Isolation for CMG of AMI or CHF	*n* = 324	*n* = 271	*n* = 339	*n* = 303	
Cardiology/cardiovascular surgery	139 (42.9)	136 (50.2)	129 (38.1)	109 (36.0)	0.04
General internal medicine	147 (45.4)	112 (41.3)	177 (52.2)	166 (54.8)	0.07
Other inpatient service	38 (11.7)	23 (8.5)	33 (9.7)	28 (9.2)	0.62

AMI = acute myocardial infarction; CHF = congestive heart failure; CMG = case-mix group; ENT = ear, nose and throat; LOS = length of stay; MNRH = may not require hospitalization; PMH = Princess Margaret Hospital.
*Includes CMGs: Neoplasm of nervous system (10), ENT malignancy (100), respiratory neoplasms (138), digestive system malignancy (279), hepatobiliary/pancreatic malignancy (284), pancreatic cancer/other hepatobiliary system malignancy (324), musculoskeletal malignant neoplasm (357), musculoskeletal biopsy for malignancy (361), secondary neoplasm/pathologic fracture (391), major gynecological procedure ovarian/adnexal malignancy (401), malignant breast disorders (443), urinary neoplasms (522), other musculoskeletal malignancy (577), radioimplant for malignancy (583), malignancy female reproductive organ (592), bone marrow transplant (700), major leukemia/lymphoma procedure (725), acute leukemia no major procedure (726), lymphoma/chronic leukemia with other procedure (728), lymphoma & chronic leukemia (730), major ill-defined neoplasm procedure (733), ill-defined neoplasm with other procedure (734), radiation therapy (735), chemotherapy (736), other poorly differentiated neoplastic diagnosis (737), lymphoma with HIV (865).
†Includes CMGs: AMI, angina, catheter with shock/pulmonary embolism (200), AMI with cardiac catheter with CHF (201), AMI with cardiac catheter with ventricular tachycardia (202), AMI with cardiac catheter with angina (203), AMI with cardiac catheter no specific condition (204), AMI no cardiac catheter with CHF (205), AMI no cardiac catheter with ventricular tachycardia (206), AMI no cardiac catheter with angina (207), AMI no cardiac catheter no specific condition (208), other/miscellaneous cardiac disorder (209), unstable angina with catheter with specific condition (210), unstable angina with catheter no specific condition (211), unstable angina no catheter with specific condition (212), unstable angina no catheter/specific condition (213), cardiac catheter with CHF (215), cardiac catheter with ventricular tachycardia (216), cardiac catheter with unstable angina (217), cardiac catheter no condition or LOS < 4 (218), endocarditis (219), pulmonary embolism (220), heart failure (222), hypertensive heart disease (225), other circulatory diagnoses (226), atherosclerosis (MNRH) (229), acquired valve disorder (MNRH) (232), hypertension (MNRH) (233), congenital cardiac disorder (MNRH) (234), angina pectoris (235), arrhythmia (237), syncope and collapse (240), chest pain (242).

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boarding LOS for GIM, oncology, and cardiology and cardiovascular surgery (Fig. 2). The median boarding LOS for GIM inpatients was 12.3 hours in 2004, 16.5 hours in 2005, 14.9 hours in 2006 and 14.0 hours in 2007. Overall, GIM boarding LOS was nearly double that of either oncology, or cardiology and cardiovascular surgery.

Shifts in service of inpatient admission

It is evident that the proportion of inpatient visits admitted to GIM increased during the study period. To further investigate the shift to greater GIM admissions, we performed an analysis that was confined to inpatient admissions discharged with CMGs of cancer- or cardiac-related conditions (Table 1). Table 1 reveals that each year, cancer-related visits were proportionately less likely to be admitted to oncology and more likely admitted to GIM ($p < 0.001$). In fact, the proportion of cancer-related visits resulting in admission to oncology decreased 16.8% in 2007 when compared with 2004, whereas the proportion admitted to GIM increased 21.1%. We further limited the analysis to patients who had already received care at PMH, our cancer care hospital. In this way, we ensured that analyses were restricted to ED visits resulting in admission with already diagnosed cancer (as opposed to cancers newly diagnosed after the admission decision). In this analysis, we found even more pronounced shifts away from oncology and toward GIM.

For cardiac-related conditions, we found no signifi-

Table 2. Emergency department visits resulting in admission to general internal medicine, oncology, and cardiology and cardiovascular surgery inpatient services at Toronto General Hospital, from 2004 to 2007

Visit characteristics	2004	2005	2006	2007	*p* value
GIM inpatient admissions	*n* = 2103	*n* = 2309	*n* = 2727	*n* = 3120	
Median (IQR) age, yr	69 (54–80)	70 (55–80)	69 (55–80)	69 (54–80)	0.39
Female sex, no. (%)	970 (46.1)	1117 (48.4)	1307 (47.9)	1435 (46.0)	0.49
Median (IQR) length of stay, d	5.4 (2.7–10.2)	5.1 (2.7–9.9)	5.2 (2.6–9.6)	4.8 (2.5–9.5)	0.07
Repeat admission,* no. (%)	461 (21.9)	556 (24.1)	771 (28.3)	937 (30.0)	< 0.001
Oncology inpatient admissions	*n* = 272	*n* = 226	*n* = 211	*n* = 204	
Median (IQR) age, yr	58 (48–69)	60 (50–68)	60 (51–69)	59 (48–67)	0.66
Female sex, no. (%)	127 (46.7)	128 (56.6)	108 (51.2)	104 (51.0)	0.50
Median (IQR) length of stay, d	12.3 (6.5–23.6)	14.3 (7.1–25.5)	11.6 (6.3–22.7)	14.7 (7.5–26.1)	0.24
Repeat admission,* no. (%)	47 (17.3)	35 (15.5)	28 (13.3)	36 (17.6)	0.65
Cardiology and cardiovascular surgery inpatient admissions	*n* = 576	*n* = 582	*n* = 616	*n* = 698	
Median (IQR) age, yr	63 (51–74)	63 (51–74)	64 (53–75)	64 (53–74)	0.43
Female sex, no. (%)	191 (33.2)	182 (31.3)	201 (32.6)	231 (33.1)	0.94
Median (IQR) length of stay, d	5.7 (2.9–10.9)	5.9 (3.0–11.3)	5.7 (2.6–11.1)	5.0 (2.6–10.7)	0.23
Repeat admission,* no. (%)	133 (23.1)	158 (27.1)	143 (23.2)	178 (25.5)	0.43

GIM = general internal medicine; IQR = interquartile range.
*To the same inpatient service, via the emergency department, within calendar year of study.

Table 3. Emergency department visit volumes at Toronto General Hospital, from 2004 to 2007

	No. (%) of visits				
ED volume	2004	2005	2006	2007	*p* value
ED visits	25 729	26 950	29 233	30 356	
Total inpatient admissions*	5 003 (19.4)	5 046 (18.7)	5 641 (19.3)	6 296 (20.7)	< 0.001
General internal medicine†	2 103 (42.0)	2 309 (45.8)	2 727 (48.3)	3 120 (49.6)	< 0.001
Oncology†	272 (5.4)	226 (4.5)	211 (3.7)	204 (3.2)	< 0.001
Cardiology and cardiovascular surgery†	576 (11.5)	582 (11.5)	616 (10.9)	698 (11.1)	0.71

ED = emergency department.
*Percent of ED visits.
†Percent of inpatient admissions.

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cant secular trends in the service under which patients were admitted. Cardiology and cardiovascular surgery, and GIM admitted consistently about 36% and 55% of patients with cardiac-related conditions, respectively. However, when the analysis was further restricted to visits with CMGs of either AMI or CHF, GIM admitted approximately 10% more AMI or CHF patients in 2007 than in 2004 ($p = 0.07$).

Inpatient bed resources

We also analyzed bed staffing levels and midnight bed occupancy levels on GIM, oncology (at PMH), and cardiology and cardiovascular surgery inpatient units. Oncology staffed beds significantly decreased from about 116 in 2004 to about 113 in 2005–2007, while midnight bed occupancy remained stable at about 93% over the 4 years. Neither staffed beds nor bed occupancy levels changed significantly for cardiology (26 beds at ~93% occupancy during the study period). Cardiovascular surgery staffed beds significantly decreased in 2005 compared with 2004 (a reduction of ~6 beds), but returned to 2004 levels by 2007. Midnight bed occupancy levels were the lowest of the 4 services analyzed, ranging from 85%–90% occupancy. Similar to cardiovascular surgery, GIM staffed beds decreased in 2005 when compared with 2004 (a reduction of ~4 beds). By 2007, GIM staffed beds had increased (from ~71 in 2006 to ~82 in 2007). Overall, GIM midnight bed occupancy consistently increased during the study period, from 94% in 2004 to more than 96% use in 2007, maintaining the highest occupancy levels of the 4 services analyzed.

Figure 3 presents average ED inpatient boarding volumes and median boarding LOS for GIM and total inpatient admissions for calendar years 2007 and 2008.

DISCUSSION

We set out to analyze inpatient admissions via the ED at our organization. Our goal was to provide insightful data to hospital management on the nature of our ED congestion crisis. Specifically, we wanted to understand where the increasing volume of inpatients who were boarded in the ED was coming from. Our results indicate that the shifting admission pattern from specialty to GIM services created the appearance of a GIM problem, when in reality an institutional problem existed. We found that in each progressive year, the GIM service admitted a greater proportion of total inpatients and their patients occupied more ED beds for longer periods than any other inpatient admitting service. Allowing patients to be transferred or "bed-spaced" to empty ward beds in other inpatient services did not significantly change the number of ED boarders. In our analyses of inpatient volumes, we observed

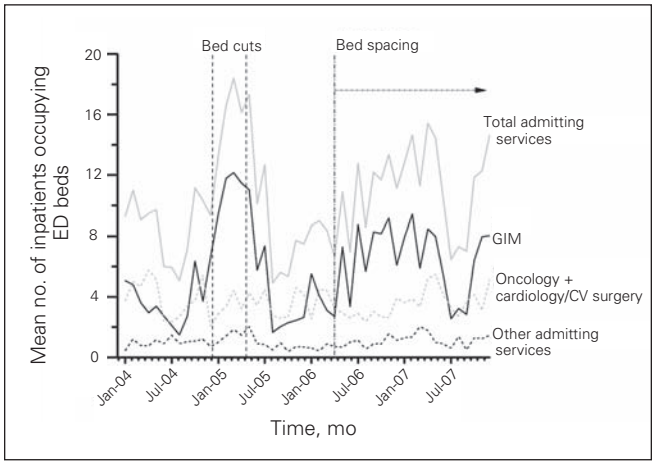

Fig. 1. Mean number of emergency department (ED) beds occupied at midnight by inpatients at Toronto General Hospital, from 2004 to 2007. Also indicated is the period (December 2004–May 2005) when there were reductions or "bed cuts" in the number of general internal medicine (GIM) and cardiovascular (CV) surgery inpatient staffed beds, and the time at which a bed-spacing policy was put into effect (May 2006 onwards), which allowed inpatients to be transferred or "bed-spaced" to empty beds in other services.

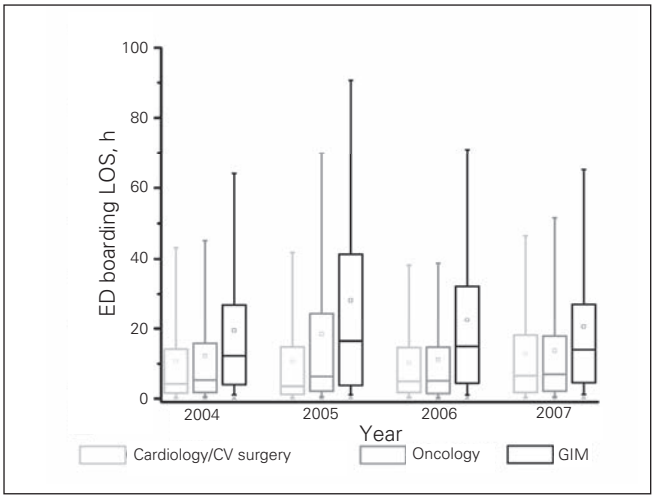

Fig. 2. Box plot showing median value and distribution of boarding lengths of stay of cardiology and cardiovascular (CV) surgery, oncology, and general internal medicine (GIM) inpatient admissions at Toronto General Hospital, from 2004 to 2007. Boarding length of stay is defined as the interval from emergency department (ED) inpatient admission decision to transfer out of the ED. Boxes show interquartile range, ▫ represent median value, and I bars represent highest and lowest values not considered as outliers.

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significant increases in total inpatient admissions (Table 3) and bed occupancies (Table 4), suggesting that even with a bed-spacing policy in place, movement of inpatients out of the ED was severely limited because of the lack of beds. This may be indicative of a larger hospital-wide capacity issue beyond the ED, or reflect a flaw in the design or implementation of the policy.[21] A dedicated unit for immediate transfer of admitted medical patients has been previously found to reduce ED boarding volumes.[22]

There is evidence to suggest that the shift away from admission to specialty services and toward GIM may be for reasons other than clinical. We found reductions in the proportion of admissions to cardiology and cardiovascular surgery for myocardial infarction and congestive heart failure, while the proportions admitted to GIM increased. Even more striking was the 2-fold proportionate reduction in admissions to oncology for cancer-related diagnoses even when these visits had received previous care at PMH. General internal medicine on the other hand, experienced a nearly 2-fold proportionate increase in admission of these cancer-related visits. As demand continues to increase for specialty services, such as ambulatory cancer care,[23] monitoring the ambulatory–emergent–inpatient feedback relationships will be essential when making decisions about hospital

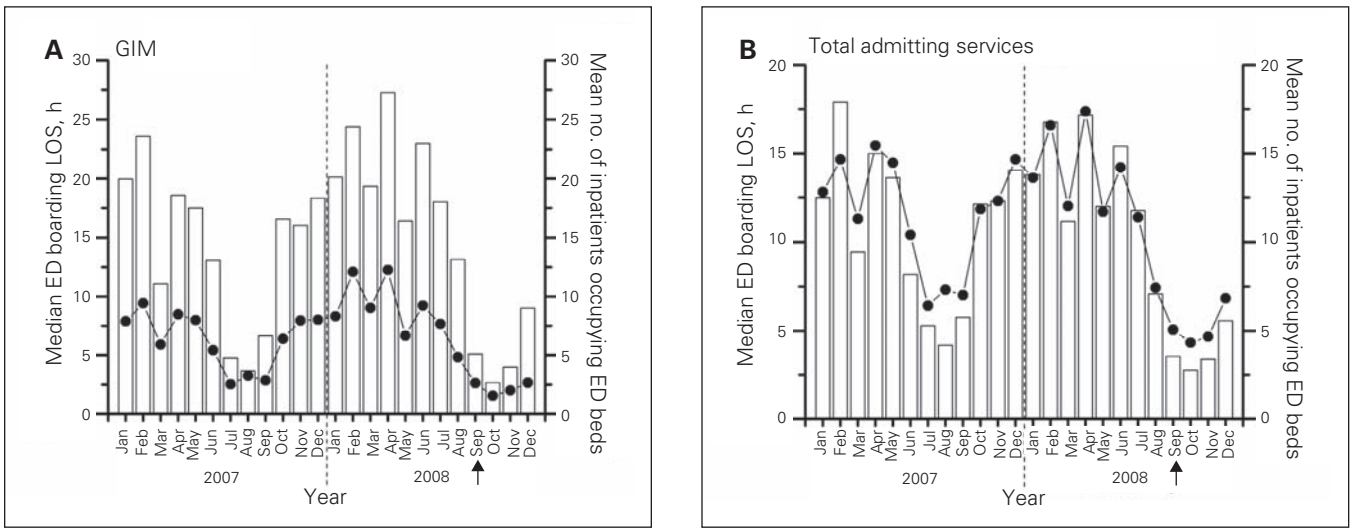

Fig. 3. Mean emergency department (ED) beds occupied at midnight by inpatients (line) and median boarding length of stay (LOS) (bars) for general internal medicine (GIM) **(A)** and total admitting services **(B)** at Toronto General Hospital for 2007 and 2008. Boarding LOS is defined as the interval from ED inpatient admission to transfer out of the ED. Arrow denotes when ED admitting and escalation policy reforms took effect.

Table 4. Inpatient staffed beds and midnight bed census at Toronto General Hospital and Princess Margaret Hospital, from 2004 to 2007

Admitting service	2004	2005	2006	2007	*p* value
Oncology					
Median (IQR) no. of staffed beds	116.3 (114.5–116.8)	113.1 (111.9–113.3)	113.3(112.2–113.7)	113.6 (111.9–113.8)	0.002
Bed occupancy, %	92.2	93.6	92.7	92.5	0.21
Cardiology					
Median (IQR) no. of staffed beds	26.0 (25.5–26.0)	25.8 (25.5–26.0)	26.0 (25.1–26.0)	26.0 (26.0–26.0)	0.27
Bed occupancy, %	91.1	92.6	93.3	94.1	0.18
Cardiovascular surgery					
Median (IQR) no. of staffed beds	52.0 (51.2–52.1)	46.9 (46.0–47.7)	49.5 (46.0–50.9)	51.8 (51.1–52.0)	< 0.001
Bed occupancy, %	85.3	86.0	89.4	88.0	< 0.001
General internal medicine					
Median (IQR) no. of staffed beds	70.0 (69.8–70.0)	66.2 (59.4–66.5)	70.7 (69.7–71.1)	82.7 (80.7–84.8)	< 0.001
Bed occupancy, %	93.6	94.0	95.8	96.4	0.001

IQR = interquartile range.

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resource allocation.[24] We also observed that the proportion of GIM admissions that were repeat visits grew significantly during the study period. This may reflect overly aggressive discharge planning, lack of outpatient care coordination or deficits in the quality of care. Alternatively, this may be due to a changing patient population, for example, an increase in late-stage oncology patients with predictable subsequent admissions requiring inpatient care.

Finally, we observed that the number of staffed beds on cardiology and oncology remained relatively unchanged during the study period. When considered with our findings regarding repeat visits, this suggests that bed resources influenced admission decisions. In lieu of increased bed capacity, it appears that specialty services strictly regulate their emergent inpatient admissions. A study by Kroneman and Siegers[25] that investigated the manner in which bed reductions affect the use of remaining beds, supports this conclusion. The results of this study indicated that the number of admissions and the share of beds kept empty for emergency cases were reduced when hospital beds were cut.[25] Without the capacity to admit more patients, our specialty services relied on GIM to serve as a safety net. We also found that inpatient bed reductions increased the number of inpatient boarders in the ED. Reports have shown that the lack of inpatient beds and high hospital occupancy are important determinants of inpatient boarders in the ED.[26–28]

Our investigation highlights the need for a comprehensive approach to improving ED congestion. In particular, it illustrates how ED congestion is exacerbated when hospitals expand their specialty services and procedures, while allowing these services to "opt out" of the more complex, long-term and recurring inpatient care, especially if such patients are redirected to an already busy GIM inpatient service. The data presented in this study have had a positive effect on senior management within our institution. Clinicians and medical directors have worked together to realign patient volumes and redistribute care across the organization. This work has included revisions to the escalation policy and ED consultation guidelines that provide guidance on what conditions are appropriate for admission for each inpatient service. Significant progress has been made at our institution in reducing boarding volumes and LOS since implementation of the reformed policies in September 2008. For 2007, the typical seasonal pattern of high boarding volumes during the fall, winter and spring months followed by a lull in the summer months is illustrated (Fig. 3). A similar pattern can be seen at the beginning of 2008; however, the reduction of inpatient boarders during the summer months is sustained through the fall and early winter, suggesting that the reforms that took place in September 2008 were helpful in improving the number of inpatient boarders and time spent boarding in our ED.

Limitations

Our study has several limitations. First, we chose to study cardiology and cardiovascular surgery, and oncology admitting services primarily because they are the premier specializations of care at TGH and PMH, respectively. However, we readily acknowledge that there are diagnoses in which expertise may overlap between the 2 services and GIM. Second, we analyzed CMGs instead of ED presenting complaint, as we felt it would be most informative for a retrospective analysis of the most appropriate service for admission. However, the list of CMGs considered as cancer- and cardiac-related is not exhaustive, nor has it been validated. As a result, there is potential that we may have underestimated the total number of ED admissions attributable to cancer and cardiac conditions. In spite of this, our analysis still reveals important data on an apparent shift in service of inpatient admission away from cardiology and cardiovascular surgery and oncology, and toward GIM. Finally, this study took place in one large teaching institution, and as a consequence, may be less generalizable to other community hospitals.

CONCLUSION

Our study found that during a 4-year period GIM increasingly became the service to which patients were admitted, even though historically some had been cared for by cardiology and oncology specialty services. General internal medicine patients also occupied more ED beds for longer periods than they did for any other service. Moreover, of the 3 services analyzed, GIM maintained the highest bed occupancy levels and had the shortest LOS. The data presented in this study were of interest to senior management within our institution and contributed to the progress achieved in reducing the number of inpatients boarding in the ED. Further research is required to better understand how organizations should balance supply with demand in order to provide optimal care to their patient populations. Other hospitals running at or near capacity and

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faced with similar ED congestion may apply the methods we used in this study to analyze the cause and nature of their situation.

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Correspondence to: Dr. Howard Abrams, Toronto General Hospital, 200 Elizabeth St., EN 14-216, Toronto ON M5G 2C4; howard.abrams@uhn.on.ca