Comparison of management and outcomes of ED patients with acute decompensated heart failure between the Canadian and United States' settings

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ABSTRACT

Introduction: The objective of this study was to compare the emergency department (ED) management and rate of admission of acute decompensated heart failure (ADHF) between two hospitals in Canada and the United States and to compare the outcomes of these patients.

Methods: This was a health records review of adults presenting with ADHF to two EDs in Canada and the United States between January 1 and April 30, 2010. Outcome measures were admission to the hospital, myocardial infarction (MI), and death or relapse rates to the ED. Data were analysed using descriptive, univariate and multivariate analyses.

Results: In total, 394 cases were reviewed and 73 were excluded. Comparing 156 Canadian to 165 U.S. patients, respectively, mean age was 76.0 and 75.8 years; male sex was 54.5% and 52.1%. Canadian and U.S. ED treatments were noninvasive ventilation 7.7% v. 12.8% ($p = 0.13$); IV diuretics 77.6% v. 36.0% ($p < 0.001$); IV nitrates 4.5% v. 6.7% ($p = 0.39$). There were significant differences in rate of admission (50.6% v. 95.2%, $p < 0.001$) and length of stay in ED (6.7 v. 3.0 hours, $p < 0.001$). Proportion of Canadian and U.S. patients who died within 30 days of the ED visit was 5.1% v. 9.7% ($p = 0.12$); relapsed to the ED within 30 days was 20.8% v. 17.5% ($p = 0.5$); and had MI within 30 days was 2.0% v. 1.9% ($p = 1.0$).

Conclusions: The U.S. and Canadian centres saw ADHF patients with similar characteristics. Although the U.S. site had almost double the admission rate, the outcomes were similar between the sites, which question the necessity of routine admission for patients with ADHF.

RÉSUMÉ

Introduction: L'étude visait à comparer la prise en charge de l'insuffisance cardiaque aiguë décompensée (ICAD) au service des urgences (SU) et le taux d'hospitalisation liée au trouble ainsi que les résultats cliniques, entre deux hôpitaux situés l'un au Canada et l'autre aux États-Unis (É.-U.).

Méthode: L'étude consistait en l'examen de dossiers médicaux d'adultes qui ont consulté dans deux SU au Canada et aux É.-U., pour de l'ICAD, entre le 1er janvier et le 30 avril 2010. Les critères d'évaluation comprenaient les taux d'hospitalisation, d'infarctus du myocarde (IM), de mortalité et de nouvelle consultation au SU. Les données ont été étudiées à l'aide d'analyses descriptive, unifactorielle et plurifactorielle.

Résultats: Au total, 394 cas ont été examinés et 73 ont été écartés. Il y avait 156 patients au Canada et 165 aux É.-U.; l'âge moyen s'élevait à 76,0 et à 75,8 ans; le taux de patients de sexe masculin était de 54,5 % et de 52,1 %. Les traitements administrés dans les SU au Canada et aux É.-U. se sont répartis comme suit: ventilation sans intubation: 7,7 % contre [c.] 12,8 % ($p = 0,13$); diurétiques intraveineux (i.v.): 77,6 % c. 36,0 % ($p < 0,001$); dérivés nitrés, i.v.: 4,5 % c. 6,7 % ($p = 0,39$). Des écarts significatifs ont été relevés en ce qui concerne le taux d'hospitalisation (50,6 % c. 95,2 %; $p < 0,001$) et la durée de séjour (6,7 c. 3,0 heures; $p < 0,001$). Enfin, la proportion de patients qui sont morts au Canada et aux É.-U. dans les 30 jours suivant la consultation au SU s'est établie à 5,1 % c. 9,7 % ($p = 0,12$); le taux de nouvelle consultation au SU au cours des 30 jours suivants s'élevait à 20,8 % c. 17,5 % ($p = 0,5$); enfin, le taux d'IM dans les 30 jours suivants était de 2,0 % c. 1,9 % ($p = 1,0$).

Conclusions: Les patients examinés dans les deux SU, au Canada et aux É.-U., pour de l'ICAD avaient des caractéristiques comparables. Bien que le taux d'hospitalisation fût pratiquement le double aux É.-U. comparativement à celui enregistré au Canada, les résultats cliniques étaient de même ordre, ce qui autorise à remettre en question la nécessité de l'hospitalisation quasi systématique des patients souffrant d'ICAD.

Keywords: emergency department, health records review, heart failure

INTRODUCTION

Acute decompensated heart failure (ADHF) is one of the most common presentations to the emergency

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department (ED). This clinical problem is growing rapidly and thought to be due to an aging population and a greater survival rate from acute myocardial infarction (MI).[1-3] The predicted lifetime risk of developing ADHF is 1 in 5 for adults in North America.[4,5]

ADHF accounts for over 1 million annual ED visits each year.[1] In Italy, Germany, Canada, and the United States, heart failure is the most common reason for admission among those greater than 65 years of age.[1,5-8] Moreover, the costs associated with the management of decompensated heart failure pose a large economic burden on the health care system.[5]

At the present time, limited data exist to guide the disposition of patients with ADHF presenting to the ED. Because of this, the decision to admit is based mostly on clinical judgment and local practice patterns.[9] The rate of hospital admission for ADHF in Canada is declining, with a 27.2% reduction of hospital admissions and a 23.5% decrease in mortality from 1994–2004.[10] Although the rate of hospital admission has been decreasing in Canada, the rate of hospital admission has been steadily increasing in the United States.[11]

There have been no previous studies comparing admission rates and management of patients with ADHF between Canada and the United States and correlating outcomes in these patients. We conducted a health records review to compare the rate of admission and outcomes of ADHF patients between a Canadian and a U.S. ED. We hypothesized that the admission rates in Canada would be lower than the admission rates in the United States, and that there would be no significant difference in outcomes between sites.

METHODS

Design and setting

We conducted a health records review of consecutive adults presenting to the ED with ADHF at the Civic Campus of The Ottawa Hospital in Ottawa and at Saint Mary's Hospital at Mayo Clinic in Rochester, MN, from January 1, 2010 to April 30, 2010. We estimated that we would enrol approximately 150 eligible patients at each site during the 4-month enrolment period. We wished to have greater than 90% power to detect an absolute difference of 10% between sites for hospital admission. The Ottawa Hospital and Mayo Clinic are large academic hospitals that are major referral centres with close medical school affiliation and emergency medicine residency training programs. The annual patient volume at the Civic Campus of The Ottawa Hospital is approximately 65,000 patients, and the annual patient volume at Saint Mary's Hospital ED is 73,000 patient visits.

Selection of participants

We included all patients who met the following criteria: 1) age 18 years or older; 2) presenting with acute dyspnea; 3) final ED or hospital primary diagnosis of ADHF; and 4) had clinical findings consistent with the diagnosis of heart failure. Patient cohorts were identified from the National Ambulatory Care Reporting System (NACRS) database at The Ottawa Hospital and by the International Classification of Disease (ICD)-9 code 428 at Mayo Clinic.

We excluded patients 1) whose primary presentation was for another condition (pneumonia, pulmonary embolism [PE], chronic obstructive pulmonary disease [COPD] exacerbation, lung cancer, ST-elevation MI); 2) who had chronic renal failure requiring dialysis; or 3) who had been previously enrolled during the study period. The study was approved by the research ethics boards of the respective study hospitals.

Data collection and processing

Potential cases were identified from the local site hospital patient database using key search terms (*heart failure*, *congestive heart failure*, *left ventricular failure*). The patients were consecutively recruited. The ED charts of these potential cases were reviewed for eligibility by an investigator at each site. Data elements and outcome measures were explicitly defined and collected with a common data abstraction form from hospital records and coroner's databases. The data abstractors were involved in creating the data abstraction forms and, after the creation of these forms, the data abstractors each reviewed 25 charts and then discussed problems encountered and variables requiring further defining.[12] Throughout the study, the investigators at each site regularly communicated by teleconference or email, as needed, to clarify questions that arose in the process of data abstraction. Interrater reliability was not formally assessed; however, 10% of the cases were reviewed by senior investigators (IGS, DN).

Outcome measures

Outcomes measured included hospital admission, death within 30 days of the index ED visit, relapse rate to the ED within 30 days, and length of stay of patients in the ED and in the hospital, if admitted.

Data analysis

Continuous variables were summarized with means and medians; categorical variables were summarized with percentages. Baseline characteristics, investigations, treatments, disposition, and outcome between sites were evaluated using a two-sample t-test or Wilcoxon rank-sum tests for continuous variables, as appropriate, for the distribution and chi-squared or Fisher's exact tests for categorical variables. Associations of site (Mayo Clinic versus The Ottawa Hospital) with hospital admission, acute coronary syndrome, relapse to the ED, and death were further evaluated using logistic regression models and summarized with odds ratios and 95% confidence intervals (CIs). We had very few missing values, and these are indicated in the tables. Because of this, we chose not to impute values for the multivariate analyses. All tests were two-sided and p values <0.05 were considered statistically significant. To control for case severity, we conducted one multivariate model using the Ottawa Heart Failure Risk Scale (OHFRS), which has been recently derived and validated, comprises 10 simple bedside variables, and estimates the probability of a serious adverse event within 14 days.[13,14]

RESULTS

In total, 394 cases were reviewed: 217 cases at The Ottawa Hospital and 177 cases at the Mayo Clinic (Figure 1). Seventy-three cases were excluded (61 from The Ottawa Hospital, 12 from Mayo Clinic) due to previous PE, COPD, lung cancer, dialysis, ST elevation MI, or previous enrolment in the study, resulting in the inclusion of 321 cases.

Baseline characteristics were similar between patients at each site (Table 1). Comparing the Canadian to U.S. cases, mean age was 76.0 and 75.8 years, male sex was 54.5% and 52.1%, mean vital signs on arrival to ED were heart rate, 87.8 and 83.9; respiratory rate, 21.1 and 21.2; and oxygen saturation was 94.9% and 95.1%. The duration of dyspnea prior to ED visit was longer in the

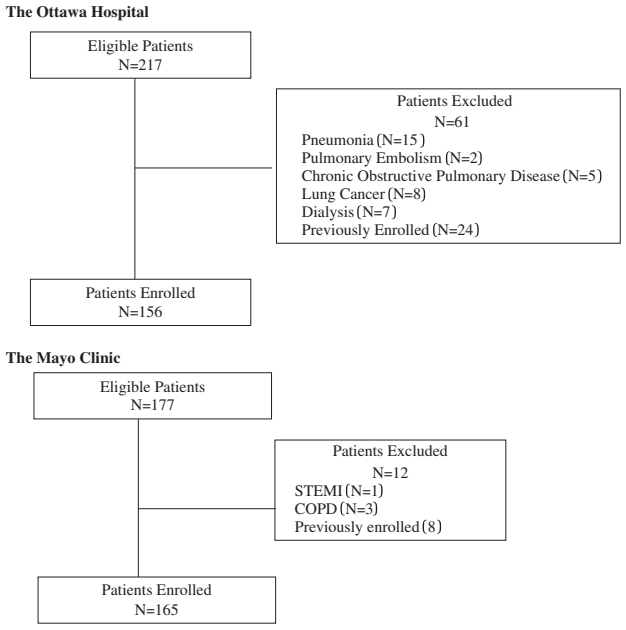

Figure 1. Study flow diagram.

Canadian compared to U.S. cases: 124.8 v. 106.4 hours. Similar, though, were the crackles on auscultation (73.7% and 64.9%) and peripheral edema (71.2% and 63.0%). A lower percentage of Canadian cases had cancer (1.3% v. 22.4%) and pacemaker (11.5% v. 23.0%). A smaller percentage of Canadian cases were using inhaled anticholinergic agent (2.6% v. 15.8%) and oral steroids (2.6% v. 7.9%) compared to that in U.S. cases.

Table 2 compares the investigations and treatments at the two hospital sites. Values for the urea, creatinine, and serum carbon dioxide were slightly higher at the U.S. site. The proportion of patients with troponin I levels greater than or equal to 0.1 ng/mL at The Ottawa Hospital and troponin T levels greater than or equal to 0.01 ng/mL at the Mayo Clinic were 17.3% and 14.4%. Treatment comparisons for the Canadian and U.S. sites showed noninvasive ventilation 7.7 v. 12.8 ($p = 0.13$); IV diuretics 77.6% v. 36.0% ($p < 0.001$); and IV nitrates 4.5% v. 6.7% ($p = 0.39$).

There was a significant difference between sites in the rate of hospital admission (50.6% v. 95.2%, $p < 0.001$) (see Table 1; Figure 2). There were also significant differences between the two sites for length of stay in the ED and length of stay in the hospital, if admitted: 6.7 v. 3.0 hours ($p < 0.001$) and 10.4 days v. 3.9 days ($p < 0.001$) for The Ottawa Hospital and Mayo Clinic, respectively.

Table 1. Baseline characteristics of the 321 patients at The Ottawa Hospital and at the Mayo Clinic

	The Ottawa Hospital (N = 156)	Mayo Clinic (N = 165)
Age (years)	76.0 (77.5)	75.8 (77)
Gender – Male (%)	54.5	52.1
Arrival by EMS (%)	42.3	41.2
Vitals on Arrival		
Heart rate (bpm; N = 154:165)	87.8 (84.5)	83.9 (81)
Systolic blood pressure (mm Hg; N = 156:163)	141.6 (140)	135.4 (133)
Respiration rate (resp/min; N = 150:163)	21.1 (20)	21.2 (20)
Oxygen saturation (%; N = 156:164)	94.9 (96)	95.1 (96)
Temperature (°C; N = 145:147)	36.2 (36.2)	36.7 (36.6)*
Duration Dyspnea (hours; N = 156:149)	124.8 (72)	106.4 (48)*
Past Medical History (%)		
Congestive heart failure (N = 155:165)	54.8	67.3*
Coronary artery disease	53.2	58.8
Percutaneous coronary intervention or coronary artery bypass surgery	32.7	38.8
Type II diabetes	44.9	46.7
Asthma	3.9	3.0
Atrial fibrillation	37.8	47.3
Chronic obstructive pulmonary disease	18.0	23.6
Pacemaker	11.5	23.0*
Dyslipidemia	41.0	58.2*
Valvular heart disease	23.7	26.7
Dementia	7.7	6.1
Lung cancer	0	1.2
Other cancer	1.3	22.4*
Renal failure	23.7	32.7
Hypertension	53.9	69.7*
Transient ischemic attack (N = 148:165)	12.2	12.7
Intubation for respiratory distress (N = 148:165)	0.7	3.6
Smoking status (N = 40:164)		
Current	25.0	7.3
Former	27.5	54.9
Never	47.5	37.8*
Medications (%)		
ACE inhibitors	44.2	37.6
Angiotensin receptor blocker	14.7	12.1
β Blockers	64.7	79.4*
Calcium channel blockers	25.0	28.5
Antiplatelet agent	19.2	16.4
Diuretics	73.1	77.0
Vasodilators	28.2	19.4
Acetylsalicylic acid (ASA)	53.9	59.4
Statin	59.6	61.2
Inhaled β agonist	22.4	24.9
Inhaled anticholinergic	2.6	15.8*
Oral steroids	2.6	7.9*
Inhaled steroid (N = 155:165)	11.0	15.2
Coumadin	34.0	39.4
Symptoms (%; N = 134:165)		
Chest pain	29.1	23.6
Paroxysmal nocturnal dyspnea	28.4	21.8
Palpitations	2.2	1.8

Table 1. (Continued)

	The Ottawa Hospital (N = 156)	Mayo Clinic (N = 165)
Physical exam (%)		
Crackles on auscultation of chest	73.7	64.9
Wheezes on auscultation of chest	12.2	17.6
Peripheral pitting edema	71.2	63.0
Predisposition Vitals		
Heart rate (bpm; N = 85:162)	84.8 (82)	77.9 (77)*
Systolic blood pressure (mm Hg; N = 81:161)	135.9 (137)	131.0 (128)
Respiration rate (resp/min; N = 76:161)	20.4 (20)	20.0 (20)
Oxygen saturation (%; N = 100:162)	96.1 (96.5)	95.9 (96)
Temperature (°C; N = 56:91)	36.1 (36.1)	36.6 (36.6)*
Modified RAD Score (N = 94:127)	1.8 (1)	2.3 (2)*

Baseline characteristics are summarized with means (medians) or percentages (%). Samples sizes for characteristics with missing data are indicated in parentheses. For example, N = 94:127 for modified RAD score indicates that 94 of the 156 Ottawa Hospital patients and 127 of the 165 Mayo Clinic patients had non-missing data for this feature.
*$p < 0.05$.

The proportion of patients at The Ottawa Hospital and Mayo Clinic who died during admission or within 30 days of the ED visit was 5.1% v. 9.7% ($p = 0.12$) (Figure 3). The proportion that relapsed to the ED within 30 days was 20.8% v. 17.5% ($p = 0.46$), and the proportion that had acute MI within 30 days was 2.0% v.1.9% ($p = 1.0$).

As shown in Table 3, the univariate odds ratio for the association of site (Mayo Clinic v. The Ottawa Hospital) with hospital admission was 19.12 (95% CI 8.80–41.57; $p < 0.001$). This significant association remained after adjusting for past medical history of congestive heart failure, pacemaker, dyslipidemia, other cancer, and hypertension (odds ratio 18.42; 95% CI 7.76–43.68; $p < 0.001$; N = 320), after adjusting for these variables in addition to temperature on arrival and duration of dyspnea (odds ratio 31.60; 95% CI 10.77–92.73; $p < 0.001$; N = 276) and after adjusting for the modified RAD score (odds ratio 19.78; 95% CI 6.70–58.37; $p < 0.001$; N = 221).

DISCUSSION

Summary

This is the first study to compare presenting characteristics, ED management, disposition, and outcomes for ADHF between the United States and Canada. We compared two similar EDs and found that patients presenting with ADHF had similar characteristics and severity of illness. We found a striking difference in the admission rates because it appeared that the Mayo Clinic admitted almost twice as many patients compared to The Ottawa Hospital (95.2% v. 50.6%), and yet the outcomes of relapse to the ED, MIs, and death within 30 days were not better. Given that this study involves only two large teaching hospitals in each country, it is unknown whether these findings are generalizable to the rest of the United States and Canada.

Comparison with previous studies

The rate of admission of 50.6% at The Ottawa Hospital was similar to the 38.1% admission rate reported by Stiell et al. in their prospective cohort study of six Canadian EDs in the development of a heart failure risk scale.[13] Supporting our findings of significantly higher admission rates in the United States, an observational cohort study performed by Graff et al. performed in 1999 reported an admission rate of 80% in the United States of patients presenting to 12 EDs with heart failure.[15]

Previous studies have shown that Canadians are discharging home heart failure patients with increased risk for serious adverse outcomes; however, in our study, The Ottawa Hospital had a lower 30-day mortality rate compared to the Mayo Clinic (5.1% v. 9.7%).[9,13,16]

STRENGTHS

To our knowledge, there have been no previous studies comparing management and disposition of ADHF patients in the ED between Canadian and U.S. sites.

Table 2. Investigations and treatments of patients presenting to The Ottawa Hospital and to Mayo Clinic Emergency Departments with acutely decompensated heart failure

	The Ottawa Hospital (N = 156)	Mayo Clinic (N = 165)
Investigations		
Hemoglobin (g/L; N = 156:157)	121.6 (120.5)	115.6 (116)*
White blood cell count (g/L; N = 156:157)	9.1 (8.3)	8.9 (7.9)
Serum urea (mmol/L; N = 156:161)	11.3 (8.6)	12.8 (10.6)*
Creatinine (μmol/L; N = 156:161)	136.0 (121)	140.0 (115)*
Sodium (mmol/L; N = 156:159)	137.6 (138)	136.8 (137)
Potassium (mmol/L; N = 151:159)	4.3 (4.2)	4.4 (4.3)
Glucose (mmol/L; N = 148:161)	7.8 (6.4)	7.7 (6.8)
CO_2 (mmol/L; N = 155:161)	26.2 (26)	27.8 (27)*
Elevated troponin (%; N = 150:125)†	17.3	14.4
Electrocardiogram QRS width (ms; N = 153:156)	117.3 (104)	118.5 (105)
Arterial blood gas (N = 11:14)		
Partial pressure carbon dioxide (mm Hg)	51.8 (49)	42.7 (39)
Partial pressure oxygen (mm Hg)	102.0 (85)	94.3 (84)
Bicarbonate level (mmol/L)	28.6 (29)	25.7 (25)
pH	7.4 (7.4)	7.4 (7.4)
Venous blood gas (N = 13:18)		
Partial pressure carbon dioxide (mm Hg)	56.4 (51)	52.9 (51.5)
Bicarbonate level (mmol/L)	29.5 (28)	27.6 (26.5)
pH	7.3 (7.3)	7.3 (7.4)
Chest x-ray (%; N = 156:159)		
Pulmonary congestion	67.3	69.8
Cardiomegaly	43.6	70.4*
Pleural effusion	59.0	54.1
Ejection fraction by echocardiography (%; N = 118:121)	44.0 (47.5)	47.8 (53)*
Treatment (%; N = 156:164)		
Endotracheal intubation	0	0
Noninvasive ventilation	7.7	12.8
Intravenous diuretics	77.6	36.0*
Oral diuretics	3.9	1.8
Intravenous nitrates	4.5	6.7
Acetylsalicylic acid	13.5	25.6*
β Blockers	7.1	1.8*
Calcium channel blockers	0	3.1
Angiotensin converting enzyme inhibitors	0	0
Anti-arrhythmic (N = 155:163)	0.7	0.6

Investigations and treatments are summarized with means (medians) or percentages (%). Samples sizes for investigations and treatments with missing data are indicated in parentheses.
*$p < 0.05$.
†Defined as troponin I ≥ 0.1 ng/mL at The Ottawa Hospital and as troponin T ≥ 0.01 ng/mL at Mayo Clinic.

We included all patients with presenting symptoms of ADHF at each institution and reviewed these cases consecutively. The strength in this study also comes from the similarity in the hospital sites being compared.

LIMITATIONS

We used Worster et al.'s suggested methods for medical record review studies in the development of our methods for this study.[12] We were able to follow abstractor training, case selection criteria, variable definition, use of abstraction forms, monitoring of performance of abstractors, identifying medical records, describing sampling methods and obtaining ethics board approval but could not adhere to abstractor blinding to hypothesis, measuring of interobserver reliability, and management of missing data. There was a small chance that patients were missed during follow-up in Ottawa. The follow-up data of patients discharged from the ED and the hospital were obtained

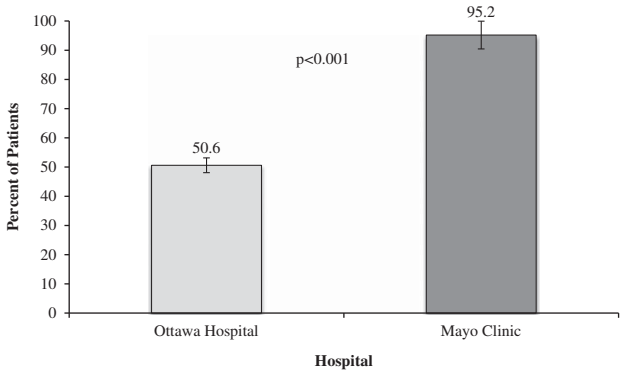

Figure 2. Percentage of patients with acute exacerbation congestive heart failure admitted to the hospital.

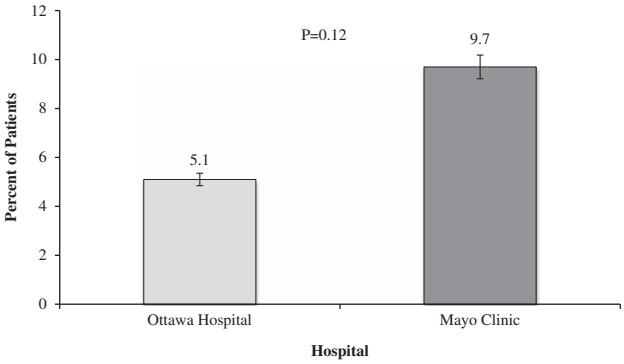

Figure 3. Death in hospital and 30 days post-emergency department visit.

from an electronic records system based in The Ottawa Hospital and also from the City of Ottawa Coroner's Database. The Ottawa Hospital has two-thirds of the acute care beds in the city and is also the home of the regional cardiac centre. There is a possibility that patients could have relapsed to the EDs of two community hospitals; however, we believe that this is unlikely because most patients would present themselves to the same hospital as their previous visit or at least to the other academic hospital. The Mayo Clinic is the primary and largest hospital in Rochester, MN, and provides the large majority of acute cardiac care in the Olmsted County community, so it is unlikely that outcome ascertainment was systematically biased by the health records review methodology employed in this investigation.

CLINICAL IMPLICATIONS

There has been a large emphasis on comparative effectiveness research recently to study the implications of variations in medical practice on patient outcomes.[15] This study adds to previous studies showing higher admission rates in U.S. hospitals with other common ED presentations. Ekanayake et al. compared the admission rates of elderly patients presenting with syncope and found that U.S. hospitals admitted greater than double the number of patients presenting with syncope than Canadian hospitals.[17] Similarly, for patients presenting with atrial fibrillation, the rate of admission varied amongst Canada and U.S. hospitals, with U.S. EDs admitting more patients to short-stay ED observational units.[18,19] This study urges policymakers to consider shifting resources from inpatient hospital services toward risk stratification and outpatient services. Differences in availability of timely outpatient follow-up may lead to differences in admission and mortality. Previous studies have shown decreased rates of hospitalization of ADHF patients with the use of multidisciplinary outpatient follow-up clinics.[20] Policymakers, managers, and physicians in the United States may need to consider reasons why their admission rates are so high and strategies to optimize admission rates. Perhaps this may be due to lower risk acceptance by U.S. physicians, physician billing practices, and/or privatized health care systems.

Although The Ottawa Hospital admitted much fewer patients with ADHF, the length of stay in the ED and in the hospital, if admitted, were significantly longer at The Ottawa Hospital compared to that of the Mayo Clinic, respectively (6.7 hours v. 3.0 hours; 10.4 days v. 3.9 days). This may mitigate any potential differences in costs between the health care systems.

Canadians seem to be practicing risk stratification based on physician judgment to limit rates of admission due to limited inpatient beds and hospital overcapacity. However, we know that patients are still discharged home with high-risk features and may have higher rates of death if discharged home.[9] In the United States, despite having a higher admission rate, the data did not show better outcomes. A previous U.S.-based study showed that, amongst those discharged from the hospital for heart failure, there was a 50% all-cause readmission rate, 20% ADHF readmission rate, and 31.4% of these patients died within 1 year.[21] Overall, it seems as though our disposition practices in both countries are not producing optimal management of patients with ADHF, and perhaps other strategies of management need to be considered.

Table 3. Disposition and outcomes of patients presenting to The Ottawa Hospital and to the Mayo Clinic with acute exacerbation of heart failure

	The Ottawa Hospital (N = 156)	Mayo Clinic (N = 165)	Odds ratio or difference (95% CI)*	P-value
Disposition				
Admitted (%)	50.6	95.2	19.12 (8.80-41.57)	<0.001
Admitting service (%; N = 79:156)				
ICU	0	8.3		
Internal medicine	59.5	18.0		
Cardiology	32.9	68.6		
ED observation unit	NA	1.3		
Other (e.g., family medicine, geriatrics, transfer to other hospital)	7.6	3.9		
Length of stay in ED (hours; N = 155:163)	6.7 (6.4)	3.0 (2.7)	3.7 (3.1-4.2)	<0.001
Hospital length of stay if admitted (days; N = 79:154)	10.4 (7)	3.9 (3)	6.5 (4.8-8.2)	<0.001
Outcomes (%)				
Acute coronary syndrome within 30 days post-discharge from ED (N = 154:159)	2.0	1.9	0.97 (0.19-4.87)	1.0
Relapse to ED within 30 days (N = 154:160)	20.8	17.5	0.81 (0.46-1.42)	0.46
Reason for relapse (%; N = 32:27)				
Worsening dyspnea	68.8	59.3		
Chest pain	6.3	7.4		
Not related	25.0	33.3		
Death in hospital or within 30 days post-discharge	5.1	9.7	1.99 (0.83-4.78)	0.12

Dispositions and outcomes are summarized with means (medians) or percentages (%). Sample sizes for dispositions and outcomes evaluated on patient subsets or with missing data are indicated in parentheses.
*Differences represent mean changes (95% CIs) for continuous variables and odds ratios (95% CIs) for categorical variables. For example, the odds ratio for the association of site (Mayo Clinic v. The Ottawa Hospital) with admission was 19.12.

Up until the last few years, there has been a lack of studies supporting guidelines for hospital admission of patients with ADHF presenting to the ED. To balance the need for patient safety and appropriateness of hospital admissions, there have been steps made toward assisting emergency physicians in guiding the management and disposition of ADHF. Lee et al. developed and validated a prediction model for patients with ADHF in the ED, called the Emergency Heart Failure Mortality Risk Grade. It uses age, presenting vitals, clinical and presentation features, and lab tests to predict risk of death in 7 days after ED presentation.[22] Recently, as well, Stiell et al. published the Ottawa Heart Failure Risk Scale to aid in deciding which patients are at high risk for serious adverse events such as death, intubation, admission to a monitored unit, or relapse requiring admission, which can help emergency physicians advocate for admission of these patients or at least early follow-up.[13] Both of these prediction tools help guide emergency physicians in deciding which ADHF patients should be admitted.[23,24]

RESEARCH IMPLICATIONS

To further understand the difference in rate of hospital admission of ADHF patients, future studies should focus on broadening this type of study to evaluate variation in ED and outpatient management throughout multiple institutions in both countries. In addition, qualitative research studies may be useful to ascertain reasons for admissions.

CONCLUSIONS

The Canadian and U.S. centres saw ADHF patients with similar characteristics but differed in the use of treatments. Although the U.S. centres had almost double the hospital admission rate of that of the Canadian sites, the outcomes of patients were similar. This study questions the necessity of routine hospital admission for ED patients with ADHF.

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