Effect of early physician follow-up on mortality and subsequent hospital admissions after emergency care for heart failure: a retrospective cohort study

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ABSTRACT

BACKGROUND: The 1-year mortality rate in patients with heart failure who are discharged from an emergency department is 20%. We sought to determine whether early follow-up after discharge from the emergency department was associated with decreased mortality or subsequent admission to hospital.

METHODS: This retrospective cohort study conducted in Ontario, Canada, included adult patients who were discharged from 1 of 163 emergency departments between April 2007 and March 2014 with a primary diagnosis of heart failure. Using a propensity score–matched landmark analysis, we assessed follow-up in

relation to mortality and admissions to hospital for cardiovascular conditions.

RESULTS: Of 34 519 patients, 16 274 (47.1%) obtained follow-up care within 7 days and 28 846 (83.6%) within 30 days. Compared with follow-up between day 8 and 30, patients with follow-up care within 7 days had a lower rate of mortality over 1 year (hazard ratio [HR] 0.92; 95% confidence interval [CI] 0.87–0.97), and a reduced rate of admission to hospital over 90 days (HR 0.87, 95% CI 0.80–0.94) and 1 year (HR 0.92; 95% CI 0.87–0.97); the mortality rate over 90 days in this group trended to a lower rate (HR 0.90, 95% CI 0.10–1.00). Follow-up care within 30 days, compared

with patients without 30-day follow-up, was associated with a reduction in 1-year mortality (HR 0.89, 95% CI 0.82–0.97) but not admission to hospital (HR 1.02, 95% CI 0.94–1.10). In this group, there was a trend toward an increase in 90-day admission to hospital (HR 1.14, 95% CI 1.00–1.29).

INTERPRETATION: Follow-up care within 7 days of discharge from the emergency department was associated with lower rates of long-term mortality, as well as subsequent hospital admissions, and a trend to lower short-term mortality rates. Timely access to longitudinal care for patients with heart failure who are discharged from the emergency setting should be prioritized.

Patients with heart failure often experience exacerbations of their disease,[1,2] when they may seek care in an emergency department. There are over a million visits to the emergency department for heart failure annually in North America, accounting for 3% of all visits, and they are increasing.[3] Between 64% and 84% of these patients are admitted to hospital in Canada, Europe and the United States.[1,3–5] In Canada, the direct costs of heart failure are $2.8 billion per year. Admissions to hospital constitute most of the expenditures on heart failure[6,7] and in the current environment of accelerating health care costs,[8] there is growing preference to choose outpatient over inpatient management where possible.[9] However, there are limited data on the effect and timing of follow-up care on outcomes after discharge from an emergency department.[10,11] Physician follow-up within 7 days of discharge from the hospital has been

associated with lower 30-day readmissions in patients with heart failure.[12]

In the emergency department, acute symptoms of heart failure are usually treated with diuretics.[1,2] However, it is long-term disease management, including administration of guideline-directed medical therapy,[13,14] that likely decreases the risk of death and subsequent admissions to hospital.[2,15–18] Follow-up care is needed to ensure that guideline-directed medical therapy is instituted and dosages are optimized, and that early evidence of deterioration is addressed.[19] Emergency physicians recommend follow-up for cardiovascular ambulatory care sensitive conditions within 7 days,[20] but the optimal timing of physician follow-up is unclear. We sought to determine what the optimal timing of physician follow-up should be by examining the association between timing of follow-up care and subsequent admissions to hospital and death.

Methods

Sources of data

We identified patients using the Canadian Institutes of Health Information National Ambulatory Care Reporting System (CIHI-NACRS), an administrative database that contains information on all emergency department visits made in Ontario, Canada.[21]

We linked patients in CIHI-NACRS to other health data sets at our research institute (ICES) using the unique encoded health card number (Appendix 1, part a, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.180786/-/DC1). We used neighbourhood income data from Statistics Canada to assign patients to an income quintile based on residential postal code. We defined rural areas using the Statistics Canada definition of areas with less than 10 000 persons.[22]

Study population and design

We included patients aged 18 years and older who made a visit to the emergency department between Apr. 1, 2007, and Mar. 31, 2014, with a primary (first) diagnosis of heart failure. Only the first visit by each patient during the study period was included. We excluded specialty emergency departments (e.g., pediatric) and those not open 24 hours per day, because these are typically lower-acuity, clinic-style sites. We excluded patients with a low-acuity triage score of 4 or 5 on the 5-point emergency department Canadian Triage and Acuity Scale[23] (e.g., purpose of visit was prescription refill), because they were unlikely to require timely follow-up. We excluded those who were admitted to hospital or died in the emergency department, as well as patients who could not be assigned to a family physician, because they would have different access to follow-up care than patients who had a family physician.

We subsequently analyzed use of guideline-directed medical therapy 1 year after presentation, restricting the cohort to patients who were not already taking guideline-directed medical therapy for heart failure. We excluded patients who were younger than 66 years of age in this analysis because comprehensive medication data are not available in the Ontario Drug Database for this age group,[24] and we excluded patients who died during the follow-up period.

Outcome measures

The primary outcome was 1-year all-cause mortality. Secondary outcome measures included 90-day all-cause mortality, and 1-year and 90-day admission to hospital. To avoid counting unrelated admissions to hospital (e.g., renal colic), we limited admissions to hospital to those with a main diagnosis code that was cardiovascular (i.e., International Classification of Diseases and Related Health Problems, 10th revision codes in chapter IX [ICD-10]). We also examined subsequent diagnostic testing and interventions (i.e., echocardiograms, stress testing, catheterizations, revascularizations and implantable cardioverter-defibrillators) and use of guideline-directed medical therapy 1 year after discharge (a new prescription of a guideline-directed medication that was dispensed between day 320 and 410 after discharge). The latter included a medication from any of the following classes: angiotensin-converting-enzyme inhibitors, angiotensin II receptor blockers, β-blockers (with the exception of sotalol, pindolol and acebutolol) and aldosterone antagonists (spironolactone and eplerenone).[2]

Statistical analysis

We made the following comparisons: follow-up care within 7 days ("early" care) compared with days 8 through 30; and follow-up care within 1 to 30 days ("basic" care) compared with no 30-day follow-up care. Seven and 30 days were chosen based on follow-up recommendations from emergency physicians and to be consistent with previous work.[20,25] We decided a priori to define follow-up care as care by physicians who would be expected to assume responsibility for ongoing care of the heart failure (i.e., a family physician, a cardiologist or an internist).

Univariate comparisons were performed with 1-way analysis of variance for mean values, the Kruskal–Wallis test for medians and the χ^2 test for proportions.

To avoid immortal-time bias and reverse causality when defining time-based exposure groups, we used a landmark design.[25,26] In a landmark analysis, the exposure period is defined a priori: we set the landmark at 30 days. Patients who had the outcome (e.g., death) during the exposure period (i.e., before 30 d) are excluded. Outcomes are assessed starting at the end of the exposure period (i.e., 30 d after discharge from the emergency department). Although this avoids the aforementioned biases, it does result in a cohort that consists of healthier patients, as those who had the outcome within the landmark date are excluded.

To adjust for differences in illness severity between groups, we used propensity score methods.[27,28] We matched on 37 variables, chosen based on our previous work and review of the literature.[2,4,10,25,29–31] Validated ICD codes and algorithms were used where available.[32–38] These variables were included in a logistic regression model, and patients were matched 1:1 on the logit of the propensity score using a greedy nearest-neighbour matching algorithm, with a caliper width of 0.2 of the standard deviation of the logit of the propensity score.[39,40] We assessed the balance between matched groups using standardized differences.[41]

To assess differences in the rate of outcomes between matched groups, we used cause-specific hazards models with follow-up–care type as the sole covariate, treating death as a competing risk for the admission to hospital outcome, and using a robust variance estimator to account for clustering of patients within matched pairs.[42] Kaplan–Meier curves were fit on matched patients for the mortality outcomes. We repeated the analyses stratifying on patient sex and in patients with no history of heart failure.

To explore potential mediators of differences in outcomes, we compared subsequent diagnostic testing and interventions performed up to 1 year after discharge from the emergency department between the matched follow-up groups. Finally, we performed a logistic regression examining the adjusted association of early follow-up, and follow-up between days 8 and 30, compared with no 30-day follow-up (3-level exposure variable), on use of a new guideline-directed medical therapy medication 1 year after discharge among patients who were not already receiving guideline-directed medical therapy. All analyses were performed with SAS software (version 9.3).

Ethics approval

This retrospective cohort study was approved by the Research Ethics Board of the Sunnybrook Health Sciences Centre, Toronto, Ontario.

Results

Of the 34 519 eligible patients with heart failure who were discharged from the emergency department (Figure 1), 16 274

(47.1%) and 28 846 (83.6%) obtained follow-up care within 7 and 30 days of discharge, respectively. Patients without 30-day care, among other differences, were more likely to be in the lowest socioeconomic group and live in a rural area (Table 1). One-third
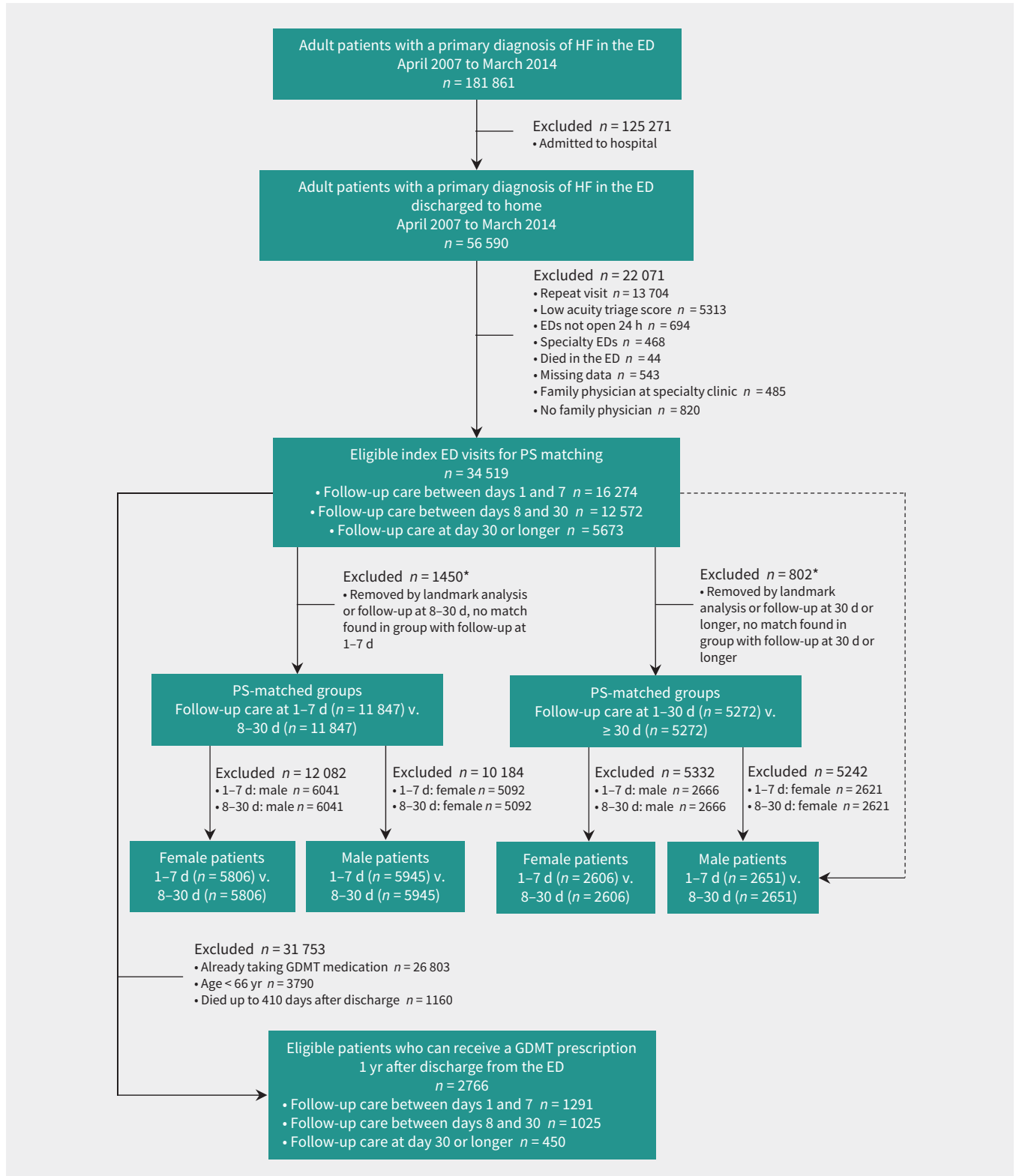

Figure 1: Flow chart for study participants. Note: ED = emergency department, GDMT = guideline-directed medical therapy, HF = heart failure, PS = propensity score. *Met outcome within 30 days (Appendix 1, part b, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.180786/-/DC1).

of the cohort had no history of heart failure. Almost one-quarter (24%) died within 1 year of the visit, with the lowest rate of mortality among those with early follow-up (Table 2).

Of the 12 253 patients with follow-up between days 8 and 30 who remained after application of the landmark (Appendix 1, part b), 96.7% were successfully propensity-score matched to a patient with early follow-up. For the 30-day care analysis, all 5272 patients without 30-day follow-up who remained after

application of the landmark were successfully matched to a patient with basic follow-up care. Absolute standardized differences were less than 10% in both comparator groups (Appendix 1, parts c and d).

Mortality
Compared with obtaining follow-up between days 8 and 30, matched patients with early follow-up had a lower rate of death

Table 1 (part 1 of 2): Patient characteristics at index emergency department visit for heart failure, by timing of follow-up care

Characteristic	Total no. of patients (%)* n = 34 519	No. (%) of patients with follow-up care*			p value
		At 1–7 d n = 16 274	At 8–30 d n = 12 572	No 30-d care n = 5673	
Demographic					
Age, yr					
Mean (95% CI)	76.4 (76.3–76.5)	76.5 (76.4–76.7)	76.6 (76.3–76.8)	75.6 (75.3–75.9)	< 0.001
Median (IQR)	78.0 (69.0–85.0)	78.0 (70.0–85.0)	79.0 (70.0–85.0)	78.0 (68.0–85.0)	0.003
Sex, female	16 888 (48.9)	7840 (48.2)	6251 (49.7)	2797 (49.3)	0.03
Income quintile (5 is the highest)					
1	8065 (23.4)	3572 (21.9)	3015 (24.0)	1478 (26.1)	< 0.001
2	7582 (22.0)	3586 (22.0)	2750 (21.9)	1246 (22.0)	
3	6804 (19.7)	3266 (20.1)	2446 (19.5)	1092 (19.2)	
4	6437 (18.6)	3069 (18.9)	2354 (18.7)	1014 (17.9)	
5	5631 (16.3)	2781 (17.1)	2007 (16.0)	843 (14.9)	
Rural residence	5496 (15.9)	2299 (14.1)	2111 (16.8)	1086 (19.1)	< 0.001
Living in a long-term care facility	2100 (6.1)	853 (5.2)	964 (7.7)	283 (5.0)	< 0.001
Medical history					
Heart failure	23 246 (67.3)	10 772 (66.2)	8607 (68.5)	3867 (68.2)	< 0.001
Hypertension	30 310 (87.8)	14 375 (88.3)	10 999 (87.5)	4936 (87.0)	0.01
Atrial fibrillation	17 618 (51.0)	8754 (53.8)	6452 (51.3)	2412 (42.5)	< 0.001
Acute myocardial infarction	17 804 (51.6)	8473 (52.1)	6560 (52.2)	2771 (48.8)	< 0.001
Coronary artery disease	15 320 (44.4)	7144 (43.9)	5687 (45.2)	2489 (43.9)	0.05
CABG	4098 (11.9)	1946 (12.0)	1573 (12.5)	579 (10.2)	< 0.001
ICD/PPM	2632 (7.6)	1284 (7.9)	979 (7.8)	369 (6.5)	0.002
Stroke	4066 (11.8)	1907 (11.7)	1475 (11.7)	684 (12.1)	0.78
Diabetes mellitus	16 983 (49.2)	7872 (48.4)	6184 (49.2)	2927 (51.6)	< 0.001
Dementia	4469 (12.9)	1966 (12.1)	1748 (13.9)	755 (13.3)	< 0.001
COPD	14 801 (42.9)	6627 (40.7)	5592 (44.5)	2582 (45.5)	< 0.001
Asthma	7374 (21.4)	3498 (21.5)	2732 (21.7)	1144 (20.2)	0.05
Renal disease	7573 (21.9)	3307 (20.3)	2708 (21.5)	1558 (27.5)	< 0.001
Liver disease	579 (1.7)	255 (1.6)	209 (1.7)	115 (2.0)	0.07
Cancer	6639 (19.2)	3160 (19.4)	2425 (19.3)	1054 (18.6)	0.38
Metastatic cancer	915 (2.7)	428 (2.6)	320 (2.5)	167 (2.9)	0.29
ADG score, median (IQR)	14 (11–16)	14 (11–16)	14 (11–16)	13 (11–16)	< 0.001
Frailty score (%)†	9172 (26.6)	3986 (24.5)	3471 (27.6)	1715 (30.2)	< 0.001
Specialist‡ visit in year before ED visit	19 767 (57.3)	9751 (59.9)	7196 (57.2)	2820 (49.7)	< 0.001
ED visit for same in year before ED visit	5436 (15.7)	2430 (14.9)	2054 (16.3)	952 (16.8)	< 0.001
Admission to hospital for same in 2 yr before ED visit	7464 (21.6)	3355 (20.6)	2799 (22.3)	1310 (23.1)	< 0.001

Table 1 (part 2 of 2): Patient characteristics at index emergency department visit for heart failure, by timing of follow-up care

Characteristic	Total no. of patients (%)* n = 34 519	No. (%) of patients with follow-up care*			p value
		At 1–7 d n = 16 274	At 8–30 d n = 12 572	No 30-d care n = 5673	
Hospital-level details					
Triage score at the ED (1 is highest acuity)					
1 or 2	13 951 (40.4)	6653 (40.9)	5112 (40.7)	2186 (38.5)	0.006
3	20 568 (59.6)	9621 (59.1)	7460 (59.3)	3487 (61.5)	
Arrived by ambulance	11 081 (32.1)	4892 (30.1)	4093 (32.6)	2096 (36.9)	< 0.001
Time patient presented to the ED					
00:00–07:59	5530 (16.0)	2580 (15.9)	2014 (16.0)	936 (16.5)	0.35
08:00–15:59	19 241 (55.7)	9068 (55.7)	7068 (56.2)	3105 (54.7)	
16:00–23:59	9748 (28.2)	4626 (28.4)	3490 (27.8)	1632 (28.8)	
Patient presented to the ED on the weekend	8530 (24.7)	4123 (25.3)	3038 (24.2)	1369 (24.1)	0.04
Hospital type					
Community	24 561 (71.2)	11 592 (71.2)	8945 (71.2)	4024 (70.9)	< 0.001
Small	2460 (7.1)	991 (6.1)	960 (7.6)	509 (9.0)	
Teaching	7498 (21.7)	3691 (22.7)	2667 (21.2)	1140 (20.1)	
Emergency department physician details					
Female	8093 (23.4)	3954 (24.3)	2873 (22.9)	1266 (22.3)	0.001
No. of years of practice					
0–5	8166 (23.7)	4066 (25.0)	2901 (23.1)	1199 (21.1)	< 0.001
6–10	7031 (20.4)	3324 (20.4)	2579 (20.5)	1128 (19.9)	
11–15	6235 (18.1)	2947 (18.1)	2254 (17.9)	1034 (18.2)	
> 15	13 087 (37.9)	5937 (36.5)	4838 (38.5)	2312 (40.8)	
Main specialty					
3-yr EM	14 575 (42.2)	6889 (42.3)	5323 (42.3)	2363 (41.7)	< 0.001
5-yr EM	4252 (12.3)	2181 (13.4)	1487 (11.8)	584 (10.3)	
FM	11 930 (34.6)	5409 (33.2)	4390 (34.9)	2131 (37.6)	
Other	3762 (10.9)	1795 (11.0)	1372 (10.9)	595 (10.5)	
Hospital type					
Community	24 561 (71.2)	11 592 (71.2)	8945 (71.2)	4024 (70.9)	< 0.001
Small	2460 (7.1)	991 (6.1)	960 (7.6)	509 (9.0)	
Teaching	7498 (21.7)	3691 (22.7)	2667 (21.2)	1140 (20.1)	
Family physician details					
Female	7907 (22.9)	3825 (23.5)	2827 (22.5)	1255 (22.1)	0.04
No. of years of practice					
0–5	1330 (3.9)	590 (3.6)	474 (3.8)	266 (4.7)	0.008
6–10	1915 (5.5)	866 (5.3)	722 (5.7)	327 (5.8)	
11–15	2997 (8.7)	1407 (8.6)	1087 (8.6)	503 (8.9)	
> 15	28 277 (81.9)	13 411 (82.4)	10 289 (81.8)	4577 (80.7)	
Main specialty					
FM	34 135 (98.9)	16 197 (99.5)	12 475 (99.2)	5463 (96.3)	< 0.001
EM	384 (1.1)	77 (0.5)	97 (0.8)	210 (3.7)	
Remuneration model					
CCM/FHG	14 622 (42.4)	7385 (45.4)	5141 (40.9)	2096 (36.9)	< 0.001
FHN	2445 (7.1)	975 (6.0)	981 (7.8)	489 (8.6)	
FHO/FHT	7075 (20.5)	3184 (19.6)	2588 (20.6)	1303 (23.0)	
FHO/no FHT	7259 (21.0)	3298 (20.3)	2747 (21.9)	1214 (21.4)	
FFS	3118 (9.0)	1432 (8.8)	1115 (8.9)	571 (10.1)	

Note: ADG = adjusted diagnosis group, CCM = comprehensive care model, CI = confidence interval, CABG = coronary artery bypass graft, COPD = chronic obstructive pulmonary disease, ED = emergency department, EM = emergency medicine, FFS = fee for service, FHG = Family Health Group, FHN = Family Health Network, FHO = Family Health Organization, FHT = family health team, FM = family medicine, ICD = implantable cardioverter defibrillator, IQR = interquartile range, PPM = permanent pacemaker.
*Unless specified otherwise.
†Sixty-seven (0.2%) patients were missing a frailty score.
‡Specialist is defined as cardiologist or internist.

over 1 year (hazard ratio [HR] 0.92, 95% confidence interval [CI] 0.87–0.97) and showed a trend to a lower rate of death over 90 days (HR 0.90, 95% CI 0.10–1.00) (Table 2). Kaplan–Meier curves for these comparisons are presented in Figures 2 and 3. Compared with matched patients without 30-day follow-up, patients with basic follow-up also had a reduction in the rate of death over 1 year (HR 0.89, 95% CI 0.82–0.97) but not over 90 days (HR 0.91, 95% CI 0.78–1.06) (Table 2). Kaplan–Meier curves for these comparisons are presented in Appendix 1 (supplementary Figures 1 and 2).

Among matched female patients, there was no difference in mortality by timing of follow-up care. Among male patients, early follow-up versus days 8 to 30 reduced the rate of death by 11% at 1 year, and both 1-year and 90-day mortality were reduced (by 11% and 23%, respectively) with 30-day follow-up versus none (Appendix 1, part e). Among patients without a history of heart failure, early follow-up was associated with an 18% reduction in the rate of 1-year mortality compared with between days 8 and 30 (Appendix 1, part f). We found no association between basic care and mortality.

Admissions to hospital

Matched patients with early follow-up had a reduction in the rate of admission to hospital over 1 year (HR 0.92, 95% CI 0.87–0.97) and over 90 days (HR 0.87, 95% CI, 0.80–0.94) compared with those seen between days 8 and 30. Among patients with basic follow-up, there was no difference in the rate of admission to hospital over 1 year (HR 1.02, 95% CI 0.94–1.10) compared with patients without 30-day follow-up care and a trend to an increase in the rate of 90-day admission to hospital (HR 1.14, 95% CI 1.00–1.29) (Table 2).

Admissions to hospital over 1 year were reduced by 9% among female patients who had early follow-up, whereas, among male patients, there was a trend toward increased admissions to hospital with 30-day follow-up care versus none (HR 1.18, 95% CI 0.99–1.41), but this finding was not statistically significant (Appendix 1,

part e). Among patients with no history of heart failure, early follow-up was associated with a 17% and 12% reduction in 90-day and 1 year admission to hospital, respectively, versus 8 to 30 day care (Appendix 1, part f). We found no association between basic care and admission to hospital outcomes.

Diagnostic testing, interventions and guideline-directed medical therapy

The frequency of subsequent testing and interventions was similar between the matched early versus 8 to 30-day follow-up groups (Appendix 1, part g), whereas there were more echocardiograms, placements of implantable cardioverter-defibrillators and stress testing among patients seen within 30 days compared with matched patients without 30-day follow-up. Compared with patients without 30-day follow-up, patients seen within 7 days had higher adjusted odds (adjusted odds ratio [OR] 1.42, 95% CI 1.12–1.79) of filling a prescription for guideline-directed therapy 1 year later, as did patients with follow-up between days 8 and 30 (adjusted OR 1.52, 95% CI 1.19–1.94) (Appendix 1, supplementary Figure 3).

Interpretation

In this population-based study involving patients with heart failure who received emergency care and were discharged, we found that less than half obtained physician follow-up within 1 week of leaving an emergency department. Follow-up within a week was associated with a reduction in subsequent death in the long term and trended to a lower rate of mortality in the short term for cardiovascular outcomes; admissions to hospital for cardiovascular outcomes were reduced for both the short and long term, compared with later care as much as 30 days after discharge. Follow-up within 30 days was associated with 11% lower rates of 1-year mortality compared with no 30-day follow-up and potentially associated with a 14% increase in the

Table 2: Unadjusted and adjusted outcomes, by timing of follow-up care

| | | No. (%) of patients (unadjusted outcome) | | | | Adjusted outcome* | | | | | | | |
| | | | | | | Follow-up care within 7 d v. 8–30 d | | | | Follow-up care within 30 d v. no 30-d follow-up | | | |
Outcome	Total no. (%) of patients $n = 34\,519$	Within 7 d $n = 16\,274$	At 8–30 d $n = 12\,572$	None $n = 5673$	p value†	AER (%)	HR (95% CI)	ARR, %	NNT	AER (%)	HR (95% CI)	ARR, %	NNT
Mortality, 1-yr	8129 (23.5)	3533 (21.7)	2982 (23.7)	1614 (28.5)	< 0.001	19.6 (21.2)	0.92 (0.87–0.97)	1.6	63	20.7 (22.9)	0.89 (0.82–0.97)	2.2	45
Mortality, 90-d	3213 (9.3)	1418 (8.7)	1049 (8.3)	746 (13.2)	< 0.001	5.1 (5.7)	0.90 (0.81–1.00)	0.6	167	5.9 (6.5)	0.91 (0.78–1.06)	NS	NS
Admitted to hospital within 1 yr	11 180 (32.4)	5324 (32.7)	3893 (31.0)	1963 (34.6)	< 0.001	26.6 (28.1)	0.92 (0.87–0.97)	1.5	67	27.3 (26.9)	1.02 (0.94–1.10)	NS	NS
Admitted to hospital within 90 d	6139 (17.8)	3043 (18.7)	1949 (15.5)	1147 (20.2)	< 0.001	10.1 (11.4)	0.87 (0.80–0.94)	1.3	77	10.7 (9.5)	1.14 (1.00–1.29)	–	–

Note: AER = absolute event rate, ARR = absolute risk reduction, CI = confidence interval, HR = hazard ratio, NNT = number needed to treat, NS = not significant.
*Outcomes were adjusted for 37 variables (see Statistical analysis in the Methods section).
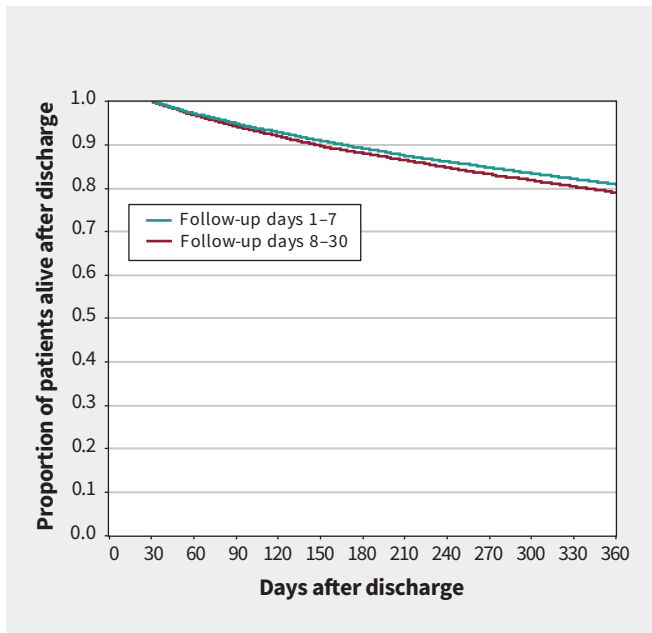†One-way analysis of variance was used to obtain p values.

Figure 2: Kaplan–Meier curve for mortality after discharge from the emergency department (1 yr) in matched patients with heart failure who had follow-up care between days 1 and 7 versus 8 and 30 using propensity score–matched groups. Landmark at 30 days.
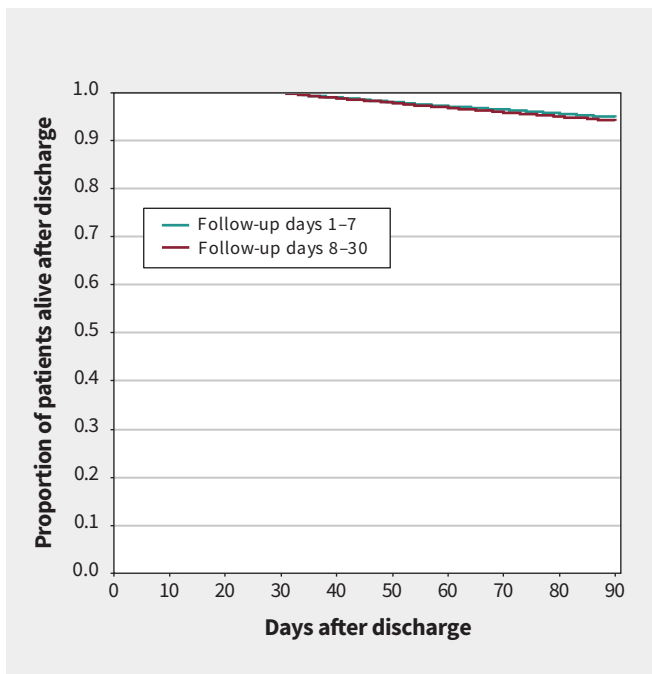

Figure 3: Kaplan–Meier curve for mortality after discharge from the emergency department (90 d) in matched patients with heart failure who had follow-up care between days 1 and 7 versus 8 and 30, using propensity score–matched groups. Landmark at 30 days.

risk of subsequent admission to hospital within 90 days. These results suggest that follow-up within 7 days is optimal to keep more patients alive and out of hospital. If 7-day follow-up is viewed as a medication, the number needed to treat (NNT) is 63,

which is an acceptable value. In patients with incident heart failure, the NNT was 40. For comparison, the NNT with daily β-blocker therapy to prevent 1 death at 7 months is 38.[43]

At present, the optimal time for follow-up after discharge from an emergency department following an exacerbation of heart failure is unknown. Guidelines based on expert opinion suggest follow-up with a specialist within 14 days.[13,31] A prospective study involving 410 patients from 8 emergency departments in Quebec did not find a statistically significant difference in the composite outcome of death, admission to hospital or return emergency visit between 14-day follow-up and no such follow-up; however, a reduction was found with 4- and 6-week follow-up.[10] The reason for the difference in findings compared with our study is likely sample size. A larger retrospective study at 93 emergency departments in Alberta found a reduction in the adjusted hazards of death and admission to hospital at 6 months if patients were seen within 30 days.[11] A study in the United States involving patients with heart failure who were 65 years or older and admitted to hospital found that patients discharged from hospitals who were in the highest quartile of 7-day follow-up rates had lower 30-day readmission rates.[12] Our findings show further evidence of 7-day follow-up in a different health care system, where there are no penalties for higher 30-day readmissions, and at the patient level.

Unlike patients admitted to hospital, patients discharged from the emergency department do not receive daily assessment and investigations by physicians and nurses. These patients are left to arrange their own subsequent care. Although many are safe to discharge from the emergency department,[29,44] our findings show that provision of physician follow-up within 1 week occurs in less than half of such discharges in Ontario. The rate may be even lower in other regions, such as Quebec (about 20%).[10]

Potential systems-level solutions include care by nurse practitioners, physician assistants and transitional care clinics.[45] Telemedicine is an option of increasing interest for follow-up of patients in remote areas. Health insurance is one of the most important predictors of obtaining follow-up care;[46,47] therefore, in the US, outcomes will likely be affected by the future of the *Affordable Care Act*.[48]

Based on observational data from patients with heart failure who were admitted to hospital,[12] the American College of Cardiology Foundation/American Heart Association Task Force recommended that all patients with heart failure who have been admitted to hospital should have a follow-up appointment scheduled before discharge.[2] A study involving patients who were admitted to hospital and who received scheduled follow-up appointments between 2009 and 2012 found an improvement: 51% to 65%.[49] Given our findings, we argue that scheduled follow-up appointments for patients with heart failure in the emergency department should be prioritized in the same manner. Providing such an appointment before the patient leaves the emergency department is one of the most efficient ways to ensure timely follow-up.[50] The major barrier is that most patients in the emergency department are seen when outpatient offices are not available for real-time communication;

however, managed care consortiums with linked hospital and outpatient office electronic health records (e.g., Veterans Health Administration, Kaiser–Permanente in the US) have the capability to provide scheduled follow-up appointments outside of business hours.[51]

We found a potential increased risk of 90-day admission to hospital associated with basic follow-up versus no 30-day care. Although of borderline statistical significance, this finding could be secondary to early identification of disease instability, which may lead to referral for hospital admission. In turn, admission to hospital could lower subsequent mortality, resulting in a lower rate of 1-year mortality in the basic follow-up group compared with the no 30-day follow-up group. For patients seen more than a month after discharge, there may be some provider and patient inertia around starting investigations, given that the emergency visit was over a month earlier and other management priorities may have arisen to supersede the heart failure.

We found that more tests and interventions were performed in patients seen within 30 days, which may contribute to lower mortality and admissions to hospital. In older patients who were not taking guideline-directed medical therapy, those with early follow-up were 42% more likely to be taking this therapy 1 year later. This result suggests another route to improved mortality. Because the risk reduction conferred by these medications is cumulative over time, the widening of the Kaplan–Meier curves over time is consistent with this hypothesis. Increased access to providers (whether a physician or specialized nursing care) could also support educational efforts on important self-care interventions by patients with heart failure, including nonpharmacologic modalities.

Limitations

We used propensity score methods to match groups on multiple factors; however, propensity scores cannot account for unmeasured covariates. The ethical issues surrounding random assignment to early versus later follow-up may preclude a randomized trial on this topic. Our study was conducted in Ontario, which has universal health care coverage, and our findings may not be generalizable to patients without health insurance, nor to those without a family physician; however, timely access to care has been shown to be worse in Canada than in other developed countries.[52] We did not include admissions to hospital for other reasons, where heart failure may have been a secondary diagnosis. This may have resulted in an underestimation of the number of subsequent admissions to hospital where heart failure played a role. We did not have access to ejection fraction, and strong evidence for the reduction in mortality and admissions to hospital by guideline-directed medical therapy exists only for patients with reduced ejection fraction.[2] Our findings may be an underestimation of the association between timely follow-up and outcomes in patients with reduced ejection fraction.

The effect of early follow-up might be expected to be greatest in the initial period after discharge. However, the Kaplan–Meier curves in our study did not separate early, which may be due to the landmark analysis starting at day 30; we may have underestimated the early effect. In addition to systems factors, patient adherence to follow-up may play a role in outcomes. However, because more than 90% of patients discharged from the emergency department with a cardiovascular ambulatory sensitive–care condition have documented follow-up instructions,[53] and follow-up rates vary little between diseases of varying severity,[54,55] we believe patient adherence played a smaller role.

Conclusion

We found that among patients who received emergency care for heart failure, obtaining follow-up within 1 week of discharge from the emergency department may be associated with a reduced rate of subsequent admission to hospital and death. This study provides evidence to support the timing of follow-up care for an expanding population of patients. Obtaining early follow-up for all of these patients will require a transition in systematic care between emergency and longitudinal care, via collaboration between administrators, researchers, clinicians and information technology specialists.

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