Does the “July effect” of new trainees at teaching hospitals impact outcomes for patients hospitalized with heart failure? Real-world analyses of more than half a million US admissions

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Introduction: The “July effect” refers to the potential of adverse clinical outcomes related to the annual turnover of trainees. We investigated whether this impacts inpatient heart failure (HF) outcomes.

Methods: Data from all adults (≥18 years) admitted with a primary diagnosis of HF at US teaching hospitals from the 2012–2014 National Inpatient Sample were analyzed. Non-teaching hospital admissions were excluded. The primary outcome was in-hospital mortality. Secondary metrics included hospital length of stay (LOS) and total cost adjusted for inflation. Logistic and linear regression models were used to adjust for confounders. Admissions were classified into 4 quarters (Q1–Q4), based on the academic calendar. Q1 and Q4 were designated to assess the effect of novice (July effect) versus experienced trainees, respectively.

Results: There were 699,675 HF admissions during Q1 and Q4 in the study period. Mean age was 71 ± 15 years and 48% were females. There were 20,270 in-hospital deaths, with no difference between Q1 and Q4; crude odds ratio (OR) 1.00, 95% confidence interval (CI) 0.94–1.07, p = 0.95. After risk adjustment, there was no in-hospital mortality difference between Q1 and Q4 admissions; adjusted OR 0.96, 95% CI 0.89–1.03, p = 0.23. There was no difference in hospital LOS or total cost; 5.8 versus 5.8 days, p = 0.66 and $13,755 versus $13,586, p = 0.46, in Q1 and Q4, respectively.

Conclusions: In this nationally representative sample, there was no evidence of a “July effect” on inpatient HF outcomes in the US. This suggests that HF patients should not delay seeking care during trainee transitions at teaching hospitals.

1. Introduction

The “July effect” is a term used in academic medicine to describe the potential for adverse patient outcomes that may be consequential to clinical inexperience related to the annual turnover of trainees that occurs in the United States (US) on July 1st. The validity of this prevalent concern has been previously investigated [1]. For instance, major general and vascular surgical procedures early in the academic year are associated with higher morbidity and mortality, which may in part be attributable to the limited experience of new trainees [2]. To the

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contrary, this concern has been largely debunked in the cardiac surgery literature based on published results from analyses of over 470,000 cardiac procedures, where risk-adjusted in-hospital mortality for these procedures did not differ across academic year quartiles [3]. Other studies have investigated whether the “July effect” notion applies to medical and overall hospital admissions in the US, with conflicting results [4-6]. Hence, we sought to assess the relationship between academic year quarter and patient outcomes at US teaching hospitals in patients admitted for heart failure (HF).

2. Methods

To address this question, we used the National Inpatient Sample (NIS) database, the largest publicly available, all-payer, administrative database in the US. The NIS database comprises de-identified data from over 7 million inpatient admissions annually. Data are derived from a 20% stratified sample of US hospitals, with sampling weights that translate into representative national estimates for over 95% of the US population [7].

For the present analyses, data from all adults (>18 years) admitted with a primary diagnosis of HF from 2012 to 2014 were included, with primary diagnosis identified by ICD-9 codes. Since the consideration of the “July effect” is unique to academic medical centers, non-teaching hospitals were excluded. The primary outcome of interest was inhospital mortality. Secondary metrics of interest included hospital length of stay (LOS) and total hospitalization cost, adjusted for inflation. Logistic and linear regression were used for analyses of associations and to adjust for potential confounders. Candidate variables were first tested adjusted hospital LOS or cost; 5.8 ± 0.89 vs. 7.2 ± 0.6 days, p = 0.46, for Q1 versus Q4, respectively.

3. Results

There were 699,675 HF hospitalizations during Q1 and Q4 over the study period. Baseline patient and hospital characteristics are provided in Table 1. Overall, the mean age was 71 ± 15 years, and 48% were women. There were 20,270 in-hospital deaths, 95% confidence interval (CI) 19,442-21,097 (Q1 9,695, 95% CI 9,216-10,174 versus Q4 10,575, 95% CI 10,024-11,126), with no difference between Q1 and Q4; crude odds ratio (OR) 1.00, 95% CI 0.94-1.07, p = 0.95. After adjusting for age, sex, race, estimated household income, Charlson Comorbidity Index, hospital region, hospital size, and insurance type, there remained no mortality difference between Q1 and Q4; adjusted OR 0.96, 95% CI 0.89-1.03, p = 0.23 (Fig. 1). Similarly, there was no difference in adjusted hospital LOS or cost; 5.8 ± 7.2 versus 5.8 ± 7.0 days, p = 0.66; and $13,755 ± 27,182 versus $13,586 ± 27,517, p = 0.46, for Q1 versus Q4, respectively.

4. Discussion

In these analyses of a large, nationally representative sample of HF admissions in the US, and after risk adjustment, there was no difference in in-hospital mortality, hospital LOS, or total costs, when comparing admissions in the first versus last quarter of the academic year. The “July effect” theory has been put to the test in analyses of data from several cohorts and across different disciplines, with varying results. Among the key messages across investigations of the “July effect” is that adequate control for baseline risk factors is crucial, and evidence of a “July effect” seems only to be observed when adequate controls are not performed [1-3].

It is plausible that the “July effect” may be more relevant to surgical specialties, where new/junior trainees rely heavily on direct “hands-on” training for operative procedures that may have steep learning curves for improvement of skills and outcomes, with potential for adverse results despite this training having direct supervision. Whether the same situation applies to medical specialties is controversial. In 2017, Mims, et al. sought to assess the outcomes of July medical admissions; namely, myocardial infarction (MI), HF, and pneumonia [5]. They observed longer hospital LOS and higher costs associated with July HF admissions — findings that were not observed in the present results. There are several reasons why these two analyses may have yielded different findings. One major reason is that the present analyses using data from 2012 to 2014 comprises over 3 times more patients than the sample of HF patients from the 2011 NIS dataset included in the prior analyses. The larger sample size in the present cohort likely translates into more reliable estimates [5]. Additionally, the prior study included comparisons between teaching and non-teaching hospitals as well as Q1 versus all other quarters (Q2 through Q4). In the present analyses, only participants admitted in Q1 and Q4 (excluding Q2 and Q3), and admitted at teaching hospitals (excluding non-teaching hospitals) were included, so that the focus of comparison is the “novice trainee effect” and to minimize the effects of and associations with other factors, such as seasonal variations in HF admissions as well as inherent differences between teaching and non-teaching hospitals, that may have confounded the results [9,10]. It is also worth highlighting that the reported differences in hospital LOS and costs observed in the prior analyses were generally modest with marginal real-world significance [5].

In analyses of another large dataset of over 18 million admissions from the University Health System Consortium, which includes admission data from 120 academic medical centers and 333 affiliated hospitals, there was no mortality difference between Q1 and Q4; adjusted OR 0.96, 95% CI 0.94-1.00, p = 0.11. Additionally, the prior study included comparisons between teaching and non-teaching hospitals as well as Q1 versus all other quarters (Q2 through Q4). In the present analyses, only participants admitted in Q1 and Q4 (excluding Q2 and Q3), and admitted at teaching hospitals (excluding non-teaching hospitals) were included, so that the focus of comparison is the “novice trainee effect” and to minimize the effects of and associations with other factors, such as seasonal variations in HF admissions as well as inherent differences between teaching and non-teaching hospitals, that may have confounded the results [9,10]. It is also worth highlighting that the reported differences in hospital LOS and costs observed in the prior analyses were generally modest with marginal real-world significance [5].

Table 1

|                      | Q1 (N = 334,965) | Q4 (N = 364,710) | p-value  |
|----------------------|-----------------|-----------------|----------|
| Age – years, mean    | 70.4 (70.2–70.6)| 70.7 (70.5–71.0)| ≤ 0.001  |
| Females, n (%)       | 160,785 (48)    | 174,325 (48)    | ≤ 0.45   |
| Race                 |                 |                 | 0.003    |
| White, n (%)         | 190,105 (60)    | 210,445 (61)    |          |
| Black, n (%)         | 85,425 (27)     | 89,760 (26)     |          |
| Hispanic, n (%)      | 25,650 (8)      | 28,170 (8)      |          |
| Other/unknown, n (%) | 16,850 (5)      | 18,435 (5)      |          |
| CCI, mean (95% CI)   | 3.4 (3.4–3.4)   | 3.4 (3.4–3.4)   | ≤ 0.003  |
| Quartile 1, n (%)    | 110,215 (34)    | 118,270 (33)    |          |
| Quartile 2, n (%)    | 78,550 (24)     | 87,030 (24)     |          |
| Quartile 3, n (%)    | 76,035 (23)     | 83,335 (23)     |          |
| Quartile 4, n (%)    | 63,485 (19)     | 66,940 (19)     |          |
| Insurance status     |                 |                 | 0.11     |
| Public, n (%)        | 115,620 (35)    | 120,215 (33)    |          |
| Private, n (%)       | 140,415 (42)    | 143,105 (40)    |          |
| Self-pay, n (%)      | 7,165 (2)       | 7,515 (2)       |          |
| Hospital bed size    |                 |                 | 0.38     |
| Small, n (%)         | 60,980 (18)     | 66,315 (18)     |          |
| Medium, n (%)        | 97,630 (29)     | 105,540 (29)    |          |
| Large, n (%)         | 176,355 (53)    | 192,855 (53)    |          |
| Hospital region      |                 |                 | 0.001    |
| Northeast, n (%)     | 84,570 (25)     | 93,465 (26)     |          |
| Midwest, n (%)       | 81,665 (24)     | 88,565 (24)     |          |
| South, n (%)         | 127,084 (38)    | 136,319 (37)    |          |
| West, n (%)          | 41,645 (12)     | 46,360 (13)     |          |

CCI = Charlson Comorbidity Index; CI = Confidence Interval.

* Median household income and insurance status have missing values
- All percentages rounded to nearest whole number
- Significant p-values rounded to 3 decimal places
- Non-significant p-values rounded to 2 decimal places
- All counts (n) are weighted estimates of number of admissions
In conclusion, there was no evidence of a “July effect” on inpatient HF outcomes or other important metrics of care. In-hospital mortality, hospital readmission rates, and diagnostic accuracy were not higher for July/August admissions. Taken together, these observations provide reassurance of consistent outcomes and suggest that patients should not delay seeking medical care in July (or first quarter the academic year) for concerns about the quality of care delivered by new trainees. For HF specifically, these findings may be reassuring to patients and may help to allay concerns about the quality of care delivered by new trainees in July.