American Journal of Emergency Medicine 55 (2022) 45–50

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Implementation of a geriatric emergency medicine assessment team decreases hospital length of stay

Sarah E. Keene, MD, PhD [a], Lauren Cameron-Comasco, MD [a,b,*]

[a] Department of Emergency Medicine, Beaumont Health System, 3601 W. 13 Mile Rd, Royal Oak, MI 48073, USA
[b] Oakland University William Beaumont School of Medicine, 586 Pioneer Dr, Rochester, MI 48309, USA

ARTICLE INFO

Article history:
Received 2 September 2021
Received in revised form 31 January 2022
Accepted 17 February 2022

Keywords:
Geriatrics
Geriatric Assessment
Quality Improvement
Cost Savings

ABSTRACT

Background: Patients over the age of 65 who present to the Emergency Department (ED) are more likely to be admitted to the hospital and, if admitted, often have a longer length of stay (LOS) in the hospital than younger patients.
Objectives: To determine if assessment and intervention by a Geriatric Emergency Medicine Assessment (GEMA) team would decrease the admission rate and reduce the hospital LOS for admitted geriatric patients.
Methods: We conducted a case-control study of the impact of a GEMA team in a large ED. The team screened patients ≥65 years of age for functional decline to determine the need for targeted interventions. Potential interventions included: occupational therapy consultation in the ED, rehabilitation placement, geriatric clinic referral, and delirium management. Our control population was unassessed geriatric ED patients seen in the six months before and after GEMA team implementation.
Results: A total of 815 patients were assessed between June and November 2019. Assessed patients were more likely to be discharged from the ED (54% vs 29%, OR 2.06). Mean ED LOS was nineteen minutes longer in assessed patients (4.94 vs 4.62 h, $p < 0.01$). The mean hospital LOS was 25 h less in assessed patients (4.50 vs 5.54 days, $p < 0.01$). Assessed and unassessed patients who were admitted to the hospital had the same baseline health status as measured by the Charlson Comorbidity Index (median score 2, $p = 0.087$). The reduction in hospital LOS resulted in an estimated savings of $1.7 million per year using the national average cost for 24 h of inpatient care.
Conclusion: Patients who were assessed by the GEMA team were more likely to be discharged directly from the ED, and if admitted, hospital LOS was reduced by over 24 h. This indicates that a targeted intervention in the ED can help reduce hospital LOS in geriatric patients and therefore provide cost savings.

1. Background

The population of geriatric individuals, that is, persons 65 years of age and older, continues to increase in the United States and throughout much of the world. In 2018, the Administration on Aging (AoA), within the United States Department of Health and Human Services, estimated that there were over 54 million geriatric individuals in the US, or 16% of the total population, an increase of 8 million since 2013. AoA estimates that over 20% of the population will be geriatric by 2040 [1].

This aging of the population puts an increasing burden on the health care system, especially the Emergency Department (ED). Older adults are known to present in higher numbers to the ED than patients below the age of 65, have more severe illness on presentation, have a higher number of comorbidities, are more likely to have polypharmacy, and are more likely to be admitted than younger patients [1-7]. Geriatric patients have a longer ED length of stay than younger patients and undergo more tests [3]. Once admitted, geriatric patients have a longer average hospital length of stay and are more likely to be discharged to an extended care facility [8,9]. Moreover, ED visits and, especially hospitalizations are more likely to result in functional decline in older adults and are associated with increased mortality [10,11]. Geriatric patients are far more likely to develop delirium while hospitalized than younger patients, which carries with it increased in-hospital, 30-day, and six-month mortality, as well as loss of independent functioning and increased cognitive decline [12-15]. In addition to the personal and social cost of such morbidity, the medical care of geriatric patients is expected to cost up to 14% of gross domestic production by 2050 [16].

Sitting as it does in the interface between the community and the hospital, the ED is uniquely situated to decrease the morbidity and mortality associated with health care encounters. An ED visit provides an opportunity for a comprehensive assessment of the older adult. By

* Corresponding author at: Department of Emergency Medicine, Beaumont Health, Royal Oak, MI 48073, 3601 W. 13 Mile Rd, USA.
E-mail addresses: Sarah.Keene@beaumont.org (S.E. Keene), Lauren.Cameron-Comasco@beaumont.org (L. Cameron-Comasco).

https://doi.org/10.1016/j.ajem.2022.02.027
0735-6757/

providing high quality care that not only addresses the patient's individual complaint, but identifies further needs, we are in the position to intervene to prevent further decline. However, ED visits can cause or exacerbate functional decline, as they carry with them the risk of iatrogenic complications such as polypharmacy, falls, and infection [17]. To counter this, geriatric-focused Emergency Departments began to be established in the early 2000s, and Geriatric Emergency Department Guidelines were published in 2013 through collaboration with multiple Emergency Medicine organizations [18]. The number of geriatric-focused EDs have continued to increase since the adoption of the Geriatric Accreditation program by the American College of Emergency Physicians in 2018 [19]. Multiple prior studies have trialed geriatric-specific interventions in the ED and have shown decreased ED length of stay (LOS), decreased admission rate, decreased hospital LOS, and decreased 30-day ED revisit rate [20-27]. In this study, we show that a geriatric-specific intervention involving geriatric assessments, occupational therapy evaluation, and geriatric care management results in decreased hospital admission rate and decreased hospital length of stay.

2. Methods

2.1. Methodology

We implemented a Geriatric Emergency Medicine Assessment (GEMA) team as part of our Emergency Department achieving Level 2 Geriatric Emergency Department Accreditation by the American College of Emergency Medicine. The aim of this study was to quantify the effect this GEMA team had on ED LOS, hospital LOS, admission rate, and 30-day ED revisit rate. The implementation of the GEMA team was related to larger changes made in our ED as a result of the accreditation process. Therefore, the study design was by necessity pragmatic rather than randomized. This study received approval from our institution's Institutional Review Board with a waiver for consent.

2.2. Data collection

Data on all patients meeting inclusion criteria from December 1, 2018 through November 30, 2019 were abstracted from EPIC software (Epic, Verona, WI). Inclusion criteria were the following:

- age 65 or older at time of visit
- initial presentation to the ED between 8 am and 6 pm, Monday through Friday
- Estimated Severity Index (ESI) of 2 or higher

The data abstracted on all patients were the following:

- medical record number (to allow linking of data)
- hospital account ID for the visit in question
- birthdate
- time and date of presentation
- time and date of ED discharge or hospital admission
- time and date of hospital discharge, if admitted
- disposition status (discharge, admission to hospital)
- ESI score
- presenting complaint
- admitting diagnosis if admitted
- past medical history as listed in their medical record
- presence of a revisit to the Emergency Department within 30 days of the initial presentation

Admission was defined as an electronic request for a bed assignment on an inpatient floor.

Additionally, data on patients who were assessed by the GEMA team were collected prospectively by the GEMA team. This included Identification of Seniors At Risk (ISAR) score and the results of any additional tests or interventions as detailed in the GEMA assessment protocol (see below). GEMA data were linked to abstracted data by MRN and date of assessment.

Patients were divided into two groups: 1) “assessed” patients were those that were seen and assessed by the GEMA team; 2) “unassessed” patients were those patients who met inclusion criteria but were not seen and assessed by the GEMA team. To reduce the bias inherent in this kind of pragmatic trial, we included in the “unassessed” group both those patients who presented in the six months prior to GEMA implementation and those patients who presented during the time that the GEMA team was active but who were not assessed.

2.3. Geriatric Emergency Medicine Assessment (GEMA) intervention

The GEMA intervention was implemented on June 1st, 2019 as part of our accreditation process for Level 2 Geriatric Emergency Department Accreditation (GEDA). As well as the creation of the GEMA team, the additional policies and procedures that were enacted as part of our facility obtaining Level 2 GEDA accreditation included standardization of discharge paperwork for geriatric patients and additional geriatric CME requirement for attending physicians and nurses. The GEMA team consisted of a Geriatric Emergency Medicine-trained Advance Practice Provider (APP) (either a nurse practitioner or a physician assistant) and a Geriatric Care Manager, plus a pharmacy technician and occupational therapist, as appropriate.

Inclusion criteria for GEMA assessment were the following:

- Age 65 or older
- Presenting to the ED Monday through Friday between the hours of 8 am and 6 pm
- Presenting with an Estimated Severity Index (ESI) of 2–5
- Stable for assessment as determined by the primary Emergency Physician

The APP chose patients to assess based on the inclusion criteria. The initial assessment consisted of performing an ISAR screen [28]. If the patient scored ≥2 on the ISAR, further assessments were triggered. This included a Short Blessed Test [29], a Brief Confusion Assessment Method [30], a Timed Up-and-Go test [31], and a Katz Activities of Daily Living assessment [32]. Depending on the results of the assessment, interventions activated by the APP included: involvement of our dedicated Geriatric Care Manager to arrange outpatient follow up with our Geriatric Clinic, provide community resources, or facilitate discharge to a Subacute Rehabilitation Facility (SAR); assessment by Occupational Therapy and arrangement of home or outpatient PT/OT, if indicated; medication reconciliation and assessment for polypharmacy by a pharmacy technician; and implementation of delirium management precautions while in the hospital. Results of the APP's assessment and any further interventions or assessments were communicated with the primary Emergency Physician who was managing care of the patient.

2.4. Statistical analyses

Descriptive statistics (mean, median, proportion, standard deviation) were calculated for patient characteristics. Differences in categorical variables were assessed by a chi-squared test of two proportions if dichotomous; otherwise, categorical variables were assessed by Mann-Whitney U tests of the medians. Differences in continuous variables were assessed by independent sample t-tests of the means. Age was considered a continuous variable; all other patient characteristics were considered categorical variables.

Modified Charlson Comorbidity Index [33,34] (CCI) scores were calculated for each patient by assigning past medical history abstracted from patients' charts to each domain within the CCI. CCI was treated as a categorical variable. Because most patients scored low on the Charlson Comorbidity Index, patients were binned into either a “low CCI” (CCI score ≤ 2) or a “high CCI” (CCI score > 2) category. An ESI score was assigned to each patient at triage during admission to the ED as part of the usual protocol of our ED. ESI was treated as a categorical variable. The presence or absence of a 30-day ED revisit was treated as a dichotomous categorical variable. A "severe" diagnosis on admission was based off the work of Probst et al. [35] and included the following diagnoses: death; cardiac arrhythmia; myocardial infarction; stroke or intracranial bleed; sepsis; acute renal failure; pulmonary embolism; aortic dissection; severe anemia; acute pulmonary edema; pneumonia; acute surgical issue necessitating immediate surgery. Severe diagnoses were abstracted from the chart based on admitting diagnosis ICD-10 code. Patients were binned into "severe" or "not severe" admitting diagnosis, which was treated as a dichotomous categorical variable.

ED LOS and hospital LOS were considered continuous variables. The ED LOS was defined as the time from presentation, when the patient was checked in to the ED and an electronic record of their visit was initiated, to the placement of either a discharge or admit order. The hospital LOS was defined as the time from the placement an admit order to the placement of a hospital discharge order. Kaplan-Meier survival curves were calculated for ED length of stay with "admission" and "discharge" as competing risks [36]. Kaplan-Meier survival curves were also calculated for hospital length of stay. Additional Kaplan-Meier survival curves were calculated for hospital length of stay after binning hospitalized patients into "low CCI" and "high CCI" groups as described above and analyzed separately.

Logistic regressions were performed to account for potential confounding factors. A hierarchical binomial regression was performed on ED disposition (admission or discharge) with CCI, ESI, and gender as components in the first model and the addition of assessment status in the second model. A hierarchical logistic regression was performed on hospital LOS with CCI, ESI, and presence of a "severe" diagnosis on admission in the first model and the addition of assessment status in the second model. Two-way ANOVA was performed on hospital LOS with assessment status and "low" vs "high" CCI score as the independent variables. Significance was calculated as $\alpha = 0.05$. All statistical analyses were performed in SPSS (IBM Corporation, version 27.0, Armonk, NY).

3. Results

3.1. Patient characteristics

A total of 11,690 patients met inclusion criteria. Of these, 815 patients were in the "assessed" group and 10,875 were in the "unassessed" group. Baseline patient characteristics can be seen in Table 1. Mean age was 78 for both groups and was not significantly different ($p = 0.824$). Forty-two percent of the assessed group was male, versus 38% of the unassessed group, a significant difference ($p = 0.04$). Estimated severity index (ESI) and Charlson-Manitoba Comorbidity Index (CCI) were also significantly different.

Table 1
Emergency Department patient characteristics.

Characteristics	Unassessed patients	Assessed patients
Age – mean (sd)	78 (8.7)	78 (8.9)
Male gender – n (%)	4564 (42)	312 (38)
Estimated Severity Index – n (%)*		
2 – More Urgent	4472 (41)	172 (21)
3	5820 (53)	539 (66)
4	565 (5)	103 (13)
5 – Least Urgent	18 (0)	1 (0)
Charlson-Manitoba Comorbidity Index – n (%)**		
≤ 2	5020 (50)	400 (66)
> 2	4994 (50)	208 (34)

sd, standard deviation; n, number; %, percent.
* Note: Percentages may not add up to 100 due to rounding.
** Note: Not all patients had comorbidity data that allowed calculation of the CCI.

3.2. Changes in emergency department patients

As seen in Fig. 1, approximately 71% of unassessed patients were admitted to the hospital, compared to 46% of assessed patients. As described above, assessed patients differed significantly in gender, ESI score, and CCI score. Performing a hierarchical binomial logistic regression, it was found that ESI score and CCI score contributed to the probability of admission significantly ($p < 0.001$ for both), but gender did not ($p = 0.27$). The model was improved by the addition of assessment status, indicating that assessment status is also a significant contributor to the probability of admission ($p < 0.001$). After adjusting for ESI and CCI scores, assessed patients were more likely to be discharged from the ED than unassessed patients (OR 2.06; 95% CI: 1.73, 2.47).

The difference in mean ED LOS was found to be just over 19 min (95% CI: 0.14, 0.50), a significant difference ($p < 0.001$). The median ED LOS differed by 30 min. The rate of 30-day Emergency Department revisits did not change for assessed vs unassessed groups (OR 1.008; 95% CI: 0.245, 1.203).

3.3. Changes in hospitalized patients

The mean length of stay for hospitalized patients was 5.54 days for unassessed patients and 4.50 days for assessed patients, a difference of 1.04 days, or about 25 h ($p = 0.003$). The median hospital LOS was 3.80 days for unassessed patients and 2.86 days for assessed patients, which is also a difference of about 25 h ($p < 0.001$). The difference in hospital LOS can be seen in Fig. 2. Although median CCI score differed significantly for all patients assessed in the ED, when looking at hospitalized patients only, the median CCI was not significantly different (median score of 2 for both assessed and unassessed patients, $p = 0.087$).

Because we were concerned that the difference in hospital LOS was due to a factor other than assessment, hierarchical logistic regression was used to determine if the hospital length of stay differed between assessed and unassessed patients after accounting for CCI score, ESI score, and presence of a "severe" diagnosis on admission. The full model of CCI, ESI, severe diagnosis, and assessment status was statistically significant, $R^2 = 0.035$, $p < 0.001$. The additional of assessment status also led to a statistically significant increase in R^2 of 0.001, $p < 0.001$, indicating that after CCI score, ESI score, and severity of diagnosis were taken into account, assessment status still led to a significant difference in the hospital LOS.

Exploring the effect of baseline illness on hospital LOS further, there was no statistically significant interaction between CCI category and assessment status by a two-way ANOVA analysis ($p = 0.85$). There was a significant difference in hospital LOS between assessed and unassessed groups for both the low CCI category ($p < 0.001$) and high CCI category ($p = 0.02$), again by two-way ANOVA. This was confirmed by Kaplan-Meier survival curves of the hospital LOS, seen in Fig. 3, for admitted patients in both low and high CCI categories. Differences were significant to $p < 0.001$ for low CCI patients and $p = 0.02$ for high CCI patients by the log-rank test.

3.4. Cost savings

An average of 62 assessed patients were admitted to the hospital every month. Using the national average of $2653 as the cost of 24 h of inpatient care in a non-profit hospital [37], the total cost savings associated with a 25-h reduction in hospital LOS is $2763, for a total reduction in cost of $171,340 per month. As seen in Table 2, our program cost $25,196 per month. This averages to a cost of $406 per admitted patient. This does not include the cost of an occupational therapist or the revenue generated as a result of their independently billed consultations. The resulting cost savings is therefore $146,144 per month, or $1,753,728 per year.

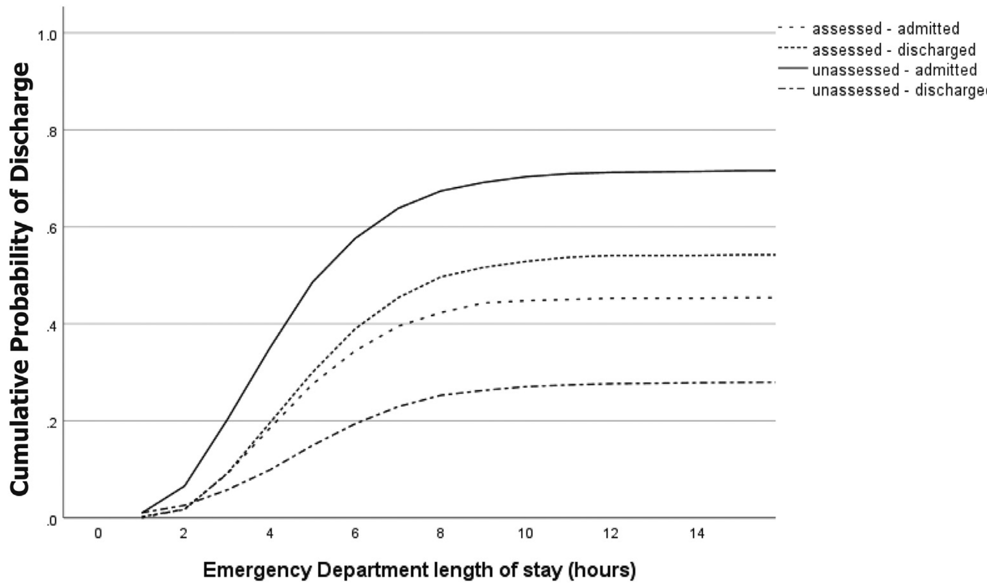

Fig. 1. Cumulative probability of disposition from the Emergency Department (ED) by assessment status. Hospital admission and discharged from the ED were treated as competing risks. Data is not adjusted for cofactors. Patients were censored after 15 h.

4. Discussion

4.1. Primary objectives

As individuals age, they have increasing interactions with the health care system. It has been found that the oldest 15% of adults consume almost half of health care resources [38]. For the older adult, such interactions are not without risk; hospitalization is associated with functional and cognitive decline and subsequent loss of independence, which leads to further health care utilization as well as decreased quality of life [11]. The incidence of functional decline is proportional to the length of time spent in the hospital, as are the risks of iatrogenic complications such as delirium, falls, polypharmacy, and infections [39]. Because the majority of hospitalizations are initiated in the Emergency Department, geriatric-focused interventions in the ED setting have the potential to have the greatest impact on reducing the burden of hospitalization on the geriatric population [18]. In addition, over one-third of outpatient care is delivered as acute care, primarily in EDs, so that ED-based interventions can have effects on health care outcomes beyond just hospitalization [40].

Our program has a demonstrated ability to substantially reduce the hospital admission rate and hospital length of stay for geriatric patients. This has the potential to have dramatic effects on the future independence of older adults and on the rising cost of health care, especially for an institution such as ours, which routinely admits over 60% of its geriatric patients. The GEMA assessment ran concurrently with the patients' medical workup, keeping the total increase in ED LOS to only 20 min on average. Implementation of the program involves the hiring additional full-time staff members (Advanced Practice Provider and Care Manager) and the involvement pharmacy and ED staff. However,

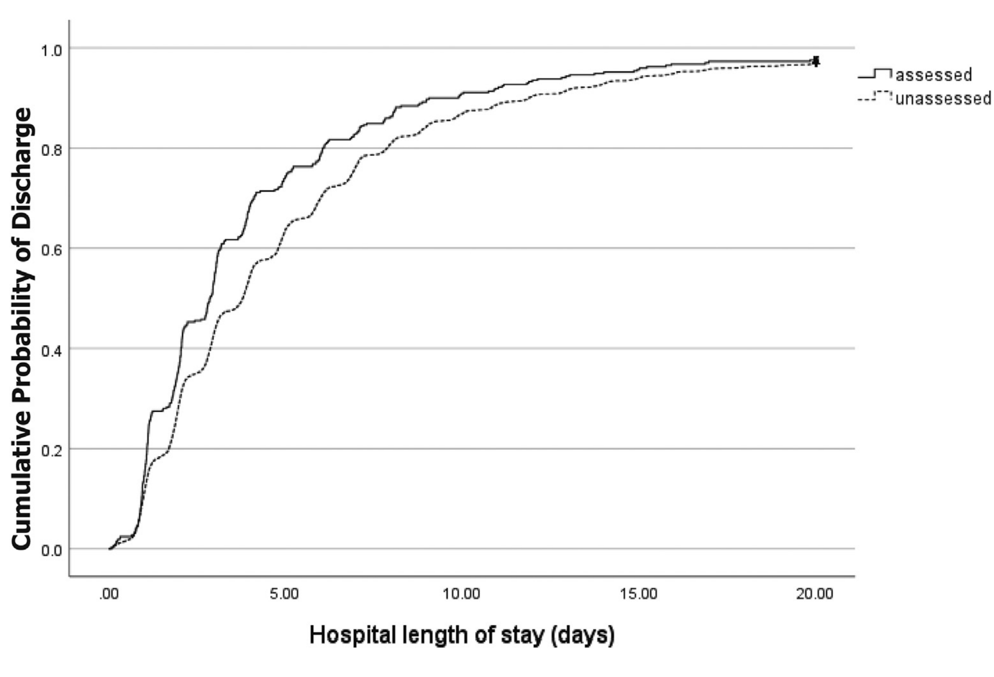

Fig. 2. Kaplan-Meier survival curves of the hospital length of stay for assessed and unassessed patients. Patients were censored after 20 days.

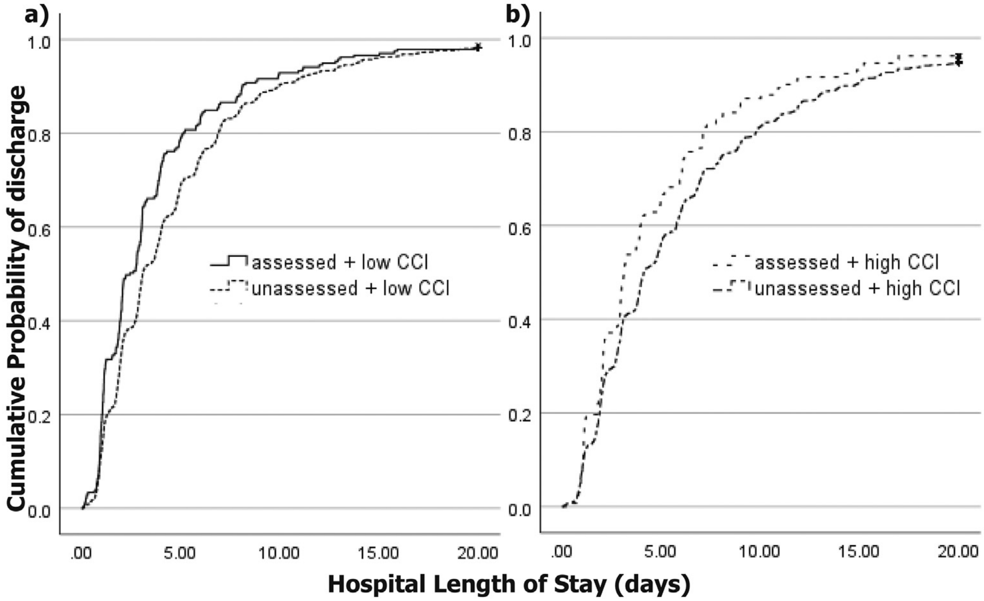

Fig. 3. Kaplan-Meier survival curves of the hospital length of stay for assessed and unassessed patients after binning for Charlson-Manitoba Comorbidity Index (CCI) score. (A) Hospital length of stay of patients with CCI ≤2. (B) Hospital length of stay of patients with CCI >2. Patients were censored after 20 days.

the reduction in hospital length of stay provides significant cost savings even when accounting for the costs of the program. Should the volume of consults through the Emergency Department warrant increased staffing, occupational therapy may choose to hire an additional therapist. Further work investigating the biggest contributors to the reduction in hospital LOS is ongoing, as well as establishing the geriatric population in whom intervention will make the biggest impact.

This trial joins a body of literature examining the effects of a dedicated geriatric Emergency Department team on admission rate, revisit rate, and ED and hospital LOS, although the components of the ED team vary by study [24-27,41]. Our program differs from prior programs primarily in the early involvement of occupational therapy in discharge planning. Our program also demonstrates a cost savings of $2413 per patient after accounting for program costs, for a total cost savings of $1.7 million annually. Prior papers have looked at cost reduction in similar programs [22,42,43]. However, these studies have analyzed cost savings related to reduction in ICU admissions [22], total Medicare expenditures at 30 and 60 days after their index ED visit [42], and financial feasibility for independently billed geriatric consults in the ED and cost reduction based on reduction in falls [43]. Our paper is the first to determine cost savings for admitted patients based on a reduction in length of stay.

4.2. Limitations

This was a pragmatic trial that looked at the total population of geriatric patients who presented to our Emergency Department during the period in question, rather than a randomized, case-control, or propensity-matched cohort study. As such, the characteristics of assessed and unassessed patients differed. We combined the patients who presented to the ED in the six months prior to the initiation of the GEMA program with the unassessed patients who presented during the first six months of the program to help counter both the biases inherent in pre-post studies as well as biases that may have arisen due to the non-randomization of the GEMA assessment protocol. However, a degree of bias undoubtedly remains. We sought to eliminate the effects of such biases using statistical analysis whenever possible.

Table 2
Costs associated with the first year of the GEMA program at our institution.

Line item	Cost per month	Cost per year
APP salary	$12,000	$144,000
Care manager salary	$7391	$88,692
Physician salary at 0.2 FTE	$4762	$57,144
GENE training for nursing	$834	$10,000
Supplies	$209	$2500
Total cost	**$25,196**	**$302,500**

GEMA, geriatric emergency medicine assessment; APP, advance practice provider; FTE, full-time equivalent; GENE, geriatric emergency nursing education.

5. Conclusion

This study examined the effects of a Geriatric Emergency Medicine Assessment team on admission rate, ED LOS, hospital LOS, and 30-day revisit rate. We found that admission rate and hospital LOS were significantly lower, while ED LOS was slightly higher, and 30-day revisit rate was unchanged. The baseline health status of all patients who were assessed in the ED was better than unassessed patients, as measured by the Charlson Comorbidity Index, which may contribute to the higher discharge rate among assessed patients. However, in a multivariate regression analysis, the discharge rate remained higher among assessed patients even after accounting for CCI. When looking at only admitted patients, the baseline health status was similar among assessed and unassessed patients, and assessment remained a significant contributor to the reduced LOS after accounting for CCI and severity of diagnosis. Together, this indicates that assessment acts to reduce hospital admissions and hospital length of stay.

Financial disclosure

The program was supported by Beaumont Health Foundation.

Prior presentations

Keene, S.E., Cameron-Comasco, L. Geriatric Emergency Medicine Assessment in the Emergency Department results in yearly savings of $3 million. Society of Academic Emergency Medicine (SAEM) annual meeting 2021, Atlanta, GA (virtual). May 2021.

Keene, S.E., Cameron-Comasco, L. A geriatric assessment program in the Emergency Department is associated with increased discharge rate and decreased hospital length of stay. American College of Emergency Physicians (ACEP) 2020 scientific assembly, Dallas, TX (virtual). October 2020.

CRediT authorship contribution statement

Sarah E. Keene: Data curation, Visualization, Writing – review & editing, Formal analysis, Writing – original draft. **Lauren Cameron-Comasco:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing.

Declaration of Competing Interest

None.

References

[1] Kahn JH, Magauran Jr BG, Olshaker JS, Shankar KN. Current trends in geriatric emergency medicine. Emerg Med Clin North Am. 2016;34(3):435–52. https://doi.org/10.1016/j.emc.2016.04.014.
[2] Baum SA, Rubenstein LZ. Old people in the emergency room: age-related differences in emergency department use and care. J Am Geriatr Soc. 1987;35(5):398–404. https://doi.org/10.1111/j.1532-5415.1987.tb04660.x.
[3] Singal BM, Hedges JR, Rousseau EW, et al. Geriatric patient emergency visits. Part I: Comparison of visits by geriatric and younger patients. Ann Emerg Med. 1992;21(7):802–7. https://doi.org/10.1016/s0196-0644(05)81025-x.
[4] Roberts DC, Mckay MP, Shaffer A. Increasing rates of emergency department visits for elderly patients in the United States, 1993 to 2003. Ann Emerg Med. 2008;51(6):769–74. https://doi.org/10.1016/j.annemergmed.2007.09.011.
[5] Pines JM, Mullins PM, Cooper JK, Feng LB, Roth KE. National trends in emergency department use, care patterns, and quality of care of older adults in the United States. J Am Geriatr Soc. 2013;61(1):12–7. https://doi.org/10.1111/jgs.12072.
[6] Budnitz DS, Shehab N, Kegler SR, Richards CL. Medication use leading to emergency department visits for adverse drug events in older adults. Ann Intern Med. 2007;147(11):755–65. https://doi.org/10.7326/0003-4819-147-11-200712040-00006.
[7] Šteinmiller J, Routasalo P, Suominen T. Older people in the emergency department: a literature review. Int J Older People Nursing. 2015;10(4):284–305. https://doi.org/10.1111/opn.12090.
[8] Schwarzkopf R, Ho J, Snir N, Mukamel DD. Factors influencing discharge destination after total hip arthroplasty. Geriatric Orthop Surg Rehabilit. 2015;6(3):215–9. https://doi.org/10.1177/2151458515593778.
[9] Maguire PA, Taylor IC, Stout RW. Elderly patients in acute medical wards: factors predicting length of stay in hospital. BMJ. 1986;292(6530):1251–3. https://doi.org/10.1136/bmj.292.6530.1251.
[10] Sirois M-J, Émond M, Ouellet M-C, et al. Cumulative incidence of functional decline after minor injuries in previously independent older Canadian individuals in the emergency department. J Am Geriatr Soc. 2013;61(10):1661–8. https://doi.org/10.1111/jgs.12482.
[11] Brown CJ, Kennedy RE, Lo AX, Williams CP, Sawyer P. Impact of emergency department visits and hospitalization on mobility among community-dwelling older adults. Am J Med. 2016;129(10). https://doi.org/10.1016/j.amjmed.2016.05.016. 1124 e9-1124 e15.
[12] Cole MG, Ciampi A, Belzile E, Zhong L. Persistent delirium in older hospital patients: a systematic review of frequency and prognosis. Age Ageing. 2008;38(1):19–26. https://doi.org/10.1093/ageing/afn253.
[13] Girard TD, Jackson JC, Pandharipande PP, et al. Delirium as a predictor of long-term cognitive impairment in survivors of critical illness. Crit Care Med. 2010;38(7):1513–20. https://doi.org/10.1097/CCM.0b013e3181e47be1.
[14] Han JH, Shintani A, Eden S, et al. Delirium in the emergency department: an independent predictor of death within 6 months. Ann Emerg Med. 2010;56(3):244–252 e1. https://doi.org/10.1016/j.annemergmed.2010.03.003.
[15] Kakuma R, Du Fort GG, Arsenault L, et al. Delirium in older emergency department patients discharged home: effect on survival. J Am Geriatr Soc. 2003;51(4):443–50. https://doi.org/10.1046/j.1532-5415.2003.51151.x.
[16] The Long Term Outlook for Health Care Spending. Washington DC: Congressional Budget Office; 2007.
[17] Aminzadeh F, Dalziel WB. Older adults in the emergency department: a systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. Ann Emerg Med. 2002;39(3):238–47. https://doi.org/10.1067/mem.2002.121523.
[18] American College of Emergency P, American Geriatrics S, Emergency Nurses A, Society for Academic Emergency M, Geriatric Emergency Department Guidelines Task F. Geriatric emergency department guidelines. Ann Emerg Med. 2014;63(5):e7–25. https://doi.org/10.1016/j.annemergmed.2014.02.008.
[19] Southerland LT, Lo AX, Biese K, et al. Concepts in practice: geriatric emergency departments. Ann Emerg Med. 2020;75(2):162–70. https://doi.org/10.1016/j.annemergmed.2019.08.430.
[20] Davis RA, Dinh MM, Bein KJ, Veillard A-S, Green TC. Senior work-up assessment and treatment team in an emergency department: A randomised control trial. Emerg Med Australasia. 2014;26(4):343–9. https://doi.org/10.1111/1742-6723.12256.
[21] Foo CL, Siu VW, Tan TL, Ding YY, Seow E. Geriatric assessment and intervention in an emergency department observation unit reduced re-attendance and hospitalisation rates. Australas J Ageing. 2012;31(1):40–6. https://doi.org/10.1111/j.1741-6612.2010.00499.x.
[22] Grudzen C, Richardson LD, Baumlin KM, et al. Redesigned geriatric emergency care may have helped reduce admissions of older adults to intensive care units. Health Aff. 2015;34(5):788–95. https://doi.org/10.1377/hlthaff.2014.0790.
[23] Hughes JM, Freiermuth CE, Shepherd-Banigan M, et al. Emergency department interventions for older adults: a systematic review. J Am Geriatr Soc. 2019;67(7):1516–25. https://doi.org/10.1111/jgs.15854.
[24] Hwang U, Dresden SM, Rosenberg MS, et al. Geriatric emergency department innovations: transitional care nurses and hospital use. J Am Geriatr Soc. 2018;66(3):459–66. https://doi.org/10.1111/jgs.15235.
[25] Shanley C, Sutherland S, Tumeth R, Stott K, Whitmore E. Caring for the older person in the emergency department: the ASET program and the role of the ASET clinical nurse consultant in South Western Sydney. Australia J Emerg Nurs. 2009;35(2):129–33. https://doi.org/10.1016/j.jen.2008.05.005.
[26] Wallis M, Marsden E, Taylor A, et al. The Geriatric Emergency Department Intervention model of care: a pragmatic trial. BMC Geriatr. 2018;18(1):297. https://doi.org/10.1186/s12877-018-0992-z.
[27] Wright PN, Tan G, Iliffe S, Lee D. The impact of a new emergency admission avoidance system for older people on length of stay and same-day discharges. Age Ageing. 2014;43(1):116–21. https://doi.org/10.1093/ageing/aft086.
[28] McCusker J, Bellavance F, Cardin S, Trepanier S, Verdon J, Ardman O. Detection of older people at increased risk of adverse health outcomes after an emergency visit: the ISAR screening tool. J Am Geriatr Soc. 1999;47(10):1229–37. https://doi.org/10.1111/j.1532-5415.1999.tb05204.x.
[29] Katzman R, Brown T, Fuld P, Peck A, Schechter R, Schimmel H. Validation of a short orientation-memory-concentration test of cognitive impairment. Am J Psychiatry. 1983;140(6):734–9. https://doi.org/10.1176/ajp.140.6.734.
[30] Han JH, Wilson A, Vasilevskis EE, et al. Diagnosing delirium in older emergency department patients: validity and reliability of the delirium triage screen and the brief confusion assessment method. Ann Emerg Med. 2013;62(5):457–65. https://doi.org/10.1016/j.annemergmed.2013.05.003.
[31] Bassett AM, Siu K-C, Honaker JA. Functional measures for fall risk in the acute care setting: a review. West J Nurs Res. 2018;40(10):1469–88. https://doi.org/10.1177/0193945917705321.
[32] Katz S. Assessing self-maintenance: activities of daily living, mobility, and instrumental activities of daily living. J Am Geriatr Soc. 1983;31(12):721–7. https://doi.org/10.1111/j.1532-5415.1983.tb03391.x.
[33] Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. J Clin Epidemiol. 1994;47(11):1245–51. https://doi.org/10.1016/0895-4356(94)90129-5.
[34] Quan H, Li B, Couris CM, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. Am J Epidemiol. 2011;173(6):676–82. https://doi.org/10.1093/aje/kwq433.
[35] Probst MA, Su E, Weiss RE, et al. Clinical benefit of hospitalization for older adults with unexplained syncope: a propensity-matched analysis. Ann Emerg Med. 2019;74(2):260–9. https://doi.org/10.1016/j.annemergmed.2019.03.031.
[36] Wolkewitz M, Cooper BS, Bonten MJ, Barnett AG, Schumacher M. Interpreting and comparing risks in the presence of competing events. BMJ. 2014.;349:g5060. https://doi.org/10.1136/bmj.g5060.
[37] Hospital Adjusted Expenses per Inpatient Day. Kaiser Family Foundation; 2019..
[38] Alemayehu B, Warner KE. The lifetime distribution of health care costs. Health Serv Res. 2004;39(3):627–42. https://doi.org/10.1111/j.1475-6773.2004.00248.x.
[39] Zisberg A, Shadmi E, Gur-Yaish N, Tonkikh O, Sinoff G. Hospital-associated functional decline: the role of hospitalization processes beyond individual risk factors. J Am Geriatr Soc. 2015;63(1):55–62. https://doi.org/10.1111/jgs.13193.
[40] Marcozzi D, Carr B, Liferidge A, Baehr N, Browne B. Trends in the Contribution of Emergency Departments to the Provision of Hospital-Associated Health Care in the USA. Int J Health Serv. 2018;48(2):267–88. https://doi.org/10.1177/0020731417734498.
[41] Arendts G, Fitzhardinge S, Pronk K, Donaldson M, Hutton M, Nagree Y. The impact of early emergency department allied health intervention on admission rates in older people: a non-randomized clinical study. BMC Geriatr. 2012;12(1):8. https://doi.org/10.1186/1471-2318-12-8.
[42] Hwang U, Dresden SM, Vargas-Torres C, et al. Association of a geriatric emergency department innovation program with cost outcomes among medicare beneficiaries. JAMA Netw Open. 2021;4(3):e2037334. https://doi.org/10.1001/jamanetworkopen.2020.37334.
[43] Southerland LT, Savage EL, Muska Duff K, et al. Hospital costs and reimbursement model for a geriatric emergency department. Acad Emerg Med. 2020;27(10):1051–8. https://doi.org/10.1111/acem.13998.