Effectiveness of an assess and restore program in treating older adults with physiological and functional decline: The HEART program

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ABSTRACT

Objectives: The study aimed to determine the effectiveness of an "assess and restore" model, Humber's Elderly Assess and Restore Team (HEART) program, in reducing length of stay, avoiding becoming designated as alternate level of care (ALC), facilitating home discharge, and reducing hospital readmissions.

Methods: The electronic health records of community-dwelling adults aged ≥65 years admitted to a large community hospital from September 4, 2018 to March 31, 2020 were extracted. Propensity score matching was used to compare HEART participants and patients eligible for the program who did not participate in terms of excessive length of stay, ALC status, discharge destination, 30-day hospital readmission, and 30-day visits to the emergency department. Mann-Whitney U tests and regression analyses were used to determine associations between HEART participation and outcome variables.

Results: After propensity score matching, 1094 patients were included: 547 HEART participants and 547 non-participants. Compared to non-participants, HEART patients had a lower excessive length of stay (Mdn=0.1 vs 0.5 days, p=.04), were less likely to become ALC (OR=0.30, 95% CI=0.13-0.69), and were more likely to be discharged home (OR=2.85, 95% CI=2.03-3.99). HEART participation was not associated with 30-day readmission to the hospital nor emergency department visits.

Conclusions: The HEART program can preserve hospital resources and reduce the need for further rehabilitative care but does not affect future visits to the hospital. An assess and restore program may be beneficial in the care of hospitalized older adults.

1. Introduction

The global older population is growing rapidly, with the number of persons aged 65 years or older expected to more than double by 2050 (United Nations, Department of Economic and Social Affairs, 2019). With this increase comes a need to consider the medically complex nature of this population, as older adults who experience a medical event and visit the hospital are at risk of functional decline that could become permanent (Buurman & de Rooij, 2015). This decline is common in hospitalized older adults, as older adults in acute care settings are often bedridden and have little opportunity for physical activity (Resnick & Boltz, 2019). Previous findings have suggested that approximately 30 to 60% of hospitalized older adults experience functional decline (Hoogerduijn et al., 2012). This accelerated functional loss is often difficult to overturn and may result in a future inability to cope and dependency in performing activities (Kleinpell et al., 2008). Patients who experience this decrease in function are then at a greater risk for adverse outcomes

including falls (Covinsky et al., 2011), continued functional decline (Boyd et al., 2008; Gill, 2004), and subsequent readmissions to the hospital (Tonkikh et al., 2016), creating a problematic cycle.

In addition to these adverse outcomes, older adults who experience this functional decline and are unable to safely return home often have to remain in acute hospital even after treatment of their acute condition is completed in order to be placed for further care. These patients become designated as Alternate Level of Care (ALC), which is concerning due to the myriad of health problems associated with longer hospital stays (e.g., further loss of strength, nosocomial infections)(Hassan et al., 2010; Zisberg et al., 2015) and the detriments to the healthcare system (e.g., reduced access to acute care beds, decreased patient flow, and increased burden on the healthcare system) (Zisberg et al., 2015). It is therefore important to prevent functional decline and return older adults to home with appropriate supports in place and strategies to reverse decline.

Comprehensive Geriatric Assessments (CGA) are multi-dimensional

diagnostic and therapeutic processes to examine the medical, functional, cognitive, and social abilities of the older adult in order to manage them appropriately (Ellis et al., 2017). Inpatient CGA programs where patients are assessed and treated by a mobile team have shown associations with living at home and decreased admission to nursing homes (Ellis et al., 2017). Ontario has developed a similar model of treatment in older adults known as Assess and Restore (A&R). These programs provide short-term restorative care to hospitalized older adults with a reversible loss of functional ability in order to increase strength, mobility and functional ability (Ministry of Health and Long-Term Care, 2014). These interventions are novel in Ontario, Canada and their anticipated results are a return to community living, a decreased Length of Stay (LOS), a reduction in ALC days and a reduction in hospital readmissions. Some Ontario hospitals have begun to implement these programs across the care continuum with the intention of extending the functional independence of community-dwelling seniors. However, the success of these A&R programs in reducing adverse outcomes is unknown as there is a paucity of research examining this type of model. It is therefore essential to examine the effectiveness of these programs in order to examine their suitability for further implementation in Ontario hospitals.

Humber's Elderly Assess and Restore Team (HEART) is a novel A&R program conducted through Humber River Hospital that offers both inpatient and outpatient care to hospitalized older adults with physiological and functional decline. The team consists of physiotherapists, occupational therapists, rehabilitation assistants, and registered practical nurses. Upon admission to the hospital, participants are screened for suitability to the program within 24 hours and, if appropriate, are assessed by the team's physical or occupational therapist. While in the hospital, patients are given a tailored care plan and receive daily treatments from the HEART clinicians. Daily treatment involves both occupational and physical therapy treatments whereby patients perform exercises such as ambulation, transfers, activities of daily living (e.g., grooming, dressing, etc.), and range of motion activities as assigned based on the original functional assessment of the patient. This is in contrast to usual care, where participants would receive physical therapy treatment approximately two to three times per week. When participants are ready for discharge, they get customized discharge planning where they are connected with community services (e.g., Meals on Wheels, transportation services) and outpatient services (e.g., Geriatric Outreach Team) they may require while at home. Following discharge, a HEART registered practical nurse follows up with the patient at home to ensure that they have accessed resources and do not require further services.

This study aimed to provide insight into the effectiveness of an A&R model in patient outcomes. This was done by examining the success of the HEART program in reducing patient LOS, avoiding becoming ALC, increasing discharge to home, and reducing future visits to the hospital (30-day visits to the Emergency Department (ED) and 30-day hospital readmissions). We compared HEART participants with patients eligible but not enrolled (because of refusal or because the program was at capacity) for these outcome variables. These results may provide insight into whether the implementation of these types of models in other hospitals could provide benefit to the hospitalized older adult.

2. Materials and methods

2.1. Study population

This retrospective observational study used data from patients admitted to the Wilson site of Humber River Hospital between September 4, 2018 and March 31, 2020. Humber River Hospital is a large, multi-site community-based hospital in Toronto, Canada with 722 acute inpatient beds. All patients admitted during this time who met HEART eligibility criteria were included (n=6087). To be eligible for the HEART program, the patient must be aged ≥ 65 years, community-

dwelling, admitted to internal medicine, weight bearing as tolerated, not requiring a mechanical lift, at a high risk for decline in mobility or activities of daily living, and have the potential to return to community living. Patients are considered to be at a high risk for decline if they have a Blaylock score greater than 10, a measure indicating complexity for discharge planning (Hodgins et al., 2018). HEART therapists also use their clinical judgement to determine if a patient is at high risk by performing chart reviews and examining nursing documentation of the patient's ability. Participants were then removed from the study if they were missing data on a continuous covariate (i.e. Blaylock score) (n=356). This left an eligible sample of 5722 individuals.

2.2. Heart participation

The primary exposure variable was HEART participation. We reviewed electronic health records for HEART eligibility status as determined by a physiotherapist or occupational therapist. If a participant was eligible for the program, we examined their records to see if participants were enrolled in and completed the HEART program. If the patient completed the HEART program, they were considered a HEART participant. A patient was considered a non-participant if they were never enrolled in HEART or if they were enrolled but did not complete the program (i.e., refused therapy, no longer medically appropriate for daily therapy).

2.3. Confounding variables

To reduce potential bias, we considered several confounding variables. These included sex, age, marital status, place of dwelling, condition upon admittance, Blaylock score and comorbidities. If a participant was missing categorical covariate data, we placed them in a 'missing' category instead of removing them from analysis. As stated above, we removed participants from analysis if they were missing continuous covariate data.

We examined hospital administrative databases to gather the patient's sex (male or female), age, condition, Blaylock score and number of pre-admission comorbidities. The participant's condition upon admittance was determined using their Health Based Allocation Model (HBAM) Inpatient Grouping (HIG), an acute inpatient grouping methodology used by the Ontario Ministry of Health (Canadian Institute for Health Information, 2021). The final two confounders, marital status and place of dwelling, were obtained from various clinicians' notes. Marital status was defined as married/living with a partner, single and living with someone other than their partner, or single and living alone. Place of dwelling was defined as home (private residence) or retirement home.

2.4. Outcomes

We collected all outcome measures from hospital administrative databases. We defined LOS as the number of days a patient spent in the hospital from admission to discharge. LOS was also considered in terms of the patient's Expected Length of Stay (ELOS) as calculated through HBAM methodology (taking the participant's HIG and additional factors into consideration) (Canadian Institute for Health Information, 2021). Excessive Length of Stay (eLOS) was defined as the difference between the participant's LOS and ELOS. ALC status was defined as remaining in the hospital after treatment for the patient's condition was complete and medical stability has been reached ("Alternate Level of Care Definition for Ontario," 2009). Discharge destination was defined as whether the participant returned to home or not (e.g., discharged to long term care, rehabilitative centre).

We defined readmission to the hospital as admission to inpatient medicine for the same condition within 30 days after discharge. An avoidable ED visit was a visit to the ED for the same condition without being admitted to the hospital within 30 days. These were collected from

hospital administrative databases that used standard coding methodologies to indicate whether admission was for the same condition.

2.5. Statistical analysis

To minimize potential selection bias, we conducted propensity score matching to improve comparability between HEART participants and non-participants. The variables included in the propensity score model included all the aforementioned covariates. Using the package "MatchIt" in R, version 4.1.0 (The Comprehensive R Archive Network, http://cran.r-project.org), we matched HEART participants to non-participants using a 1:1 nearest neighbour approach, without replacement and within a caliper of 0.2 (Wang et al., 2013). To evaluate covariate balance after matching, we examined standardized mean differences and found differences less than 0.1, a threshold recommended for stating imbalance (Zhang et al., 2019).

We performed all other analyses using SPSS Statistics Version 28 (IBM Corporation, Armonk, NY). We conducted t-tests and chi-square tests to compare continuous and categorical demographic variables in the non-matched and propensity-matched groups. Differences in LOS and eLOS between groups were determined using a Mann-Whitney U test. Logistic regressions were conducted to examine the associations between HEART participation and both ALC status and discharge to home. Cox proportional hazards regressions were used to compare risk of readmission to the hospital and risk of visit to the ED within 30 days. The proportional hazards assumption was tested and held for both models.

2.6. Ethics approval

This study received ethical clearance from Veritas Institutional Review Board.

3. Results

3.1. Participant characteristics

As shown in Fig. 1, we matched 547 participants who completed the HEART program to 547 patients who were eligible for HEART but did not participate. Table 1 describes the descriptive characteristics of the 5722 eligible participants before matching and the 1094 participants included in the analyses after matching. The five most common conditions are listed, with all other conditions grouped into a category labelled 'other'. Out of the 1094 included study participants, a majority of the participants were female (~61%) and had a mean age of ~84

years. Prior to matching, there were significant differences in all variables except for Blaylock score between HEART participants and non-participants. After matching, no variables were significantly different between groups.

3.2. LOS, ALC, and return to home

Table 2 shows the associations between HEART participation and LOS and eLOS. LOS was significantly associated with HEART participation, with HEART participants having a lower median LOS compared to non-participants (p=.04). Further, HEART participants had significantly shorter median eLOS compared to non-participants (0.10 days vs 0.50 days, p=.04).

Table 3 describes the likelihood of becoming ALC and discharge to home. A total of 30 participants became ALC. HEART participants were significantly less likely to be designated as ALC (OR=0.30, 95% CI=0.13-0.69) compared to matched non-participants. There were 890 participants discharged home. Those in the HEART program had a 185% increased likelihood of being discharged home compared to non-participants (OR=2.85, 95% CI=2.03-3.99).

3.3. Readmission and visits to the ED

Table 3 shows the Hazard Ratios (HRs) for the risks of readmission to the hospital and visiting the ED within 30 days. There were 82 readmissions to the hospital within 30 days of discharge. Those who were readmitted to the hospital were admitted at an average of 10.98 (SD=7.66) days after discharge in non-HEART participants and 12.53 days (SD=8.00) in HEART participants. Participation in HEART was not associated with 30-day readmission (HR=0.86, 95% CI=0.56-1.32). There were 42 avoidable visits to the ED within 30 days of discharge. Those who visited the ED returned at an average of 13.16 (SD=9.31) days after discharge in non-HEART participants and 11.30 (SD=8.43) days after discharge in HEART participants. 30-day ED visits was not associated with HEART participation (HR=1.16, 95% CI=0.63-2.15).

4. Discussion

The objective of this study was to determine if an A&R program (HEART) was associated with LOS, ALC, discharge destination, 30-day hospital readmissions, and 30-day ED visits. We observed that those who participated in the HEART program had a shorter eLOS, a lower likelihood of becoming ALC, and an increased likelihood of returning to home. HEART participation was not associated with hospital readmissions nor ED visits.
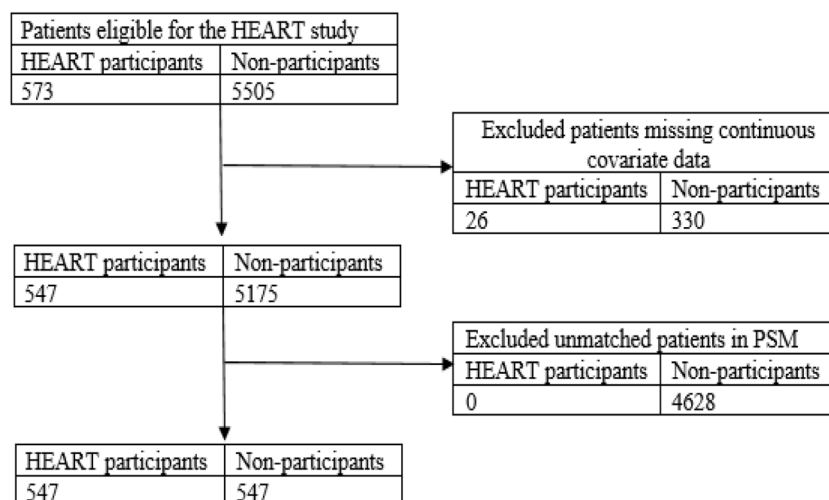

Fig. 1. Flow chart depicting the inclusion and exclusion of study participants. HEART, Humber's Elderly Assess and Restore Team; PSM, Propensity score matching

Table 1

Descriptive characteristics of study participants.

Variable	Before matching			After matching		
	HEART participants (n=547)	HEART eligible, did not participate (n=5175)	P	HEART participants (n=547)	HEART eligible, did not participate (n=547)	P
Female sex, n (%)	337 (61.6)	2636 (50.9)	<.001	337 (61.6)	334 (61.1)	.85
Age, mean ± SD	83.8 ± 7.2	81.1 ± 8.5	<.001	83.8 ± 7.2	83.9 ± 7.8	.74
Number of pre-admission comorbidities, mean ± SD	3.8 ± 2.4	4.4 ± 3.1	<.001	3.8 ± 2.4	3.5 ± 2.6	.06
Marital Status, n (%)			<.001			.20
Married/living with partner	192 (35.1)	2240 (43.3)		192 (35.1)	180 (32.9)	
Single, lives with someone other than partner	151 (27.6)	1275 (24.6)		151 (27.6)	147 (26.9)	
Single, lives alone	200 (36.6)	1516 (29.3)		200 (36.6)	208 (38.0)	
Missing	4 (0.7)	144 (2.8)		4 (0.7)	12 (2.2)	
Blaylock Score, mean ± SD	12.8 ± 5.0	12.7 ± 6.2	.79	12.8 ± 5.0	12.5 ± 6.1	.49
Pre-admission dwelling, n (%)			.006			.76
Home (private residence)	494 (90.3)	4836 (93.4)		494 (90.3)	497 (90.9)	
Retirement home	53 (9.7)	339 (6.6)		53 (9.7)	50 (9.1)	
Conditions, n (%)			<.001			.17
Viral/unspecified pneumonia	57 (10.4)	311 (6.0)		57 (10.4)	45 (8.2)	
Heart failure without coronary angiogram	82 (15.0)	542 (10.5)		82 (15.0)	87 (15.9)	
Lower urinary tract infection	36 (6.6)	166 (3.2)		36 (6.6)	22 (4.0)	
General symptom/sign	26 (4.8)	180 (3.5)		26 (4.8)	20 (3.7)	
COPD without lower respiratory infection	24 (4.4)	171 (3.3)		24 (4.4)	19 (3.5)	
Other	322 (58.9)	3805 (73.5)		322 (58.9)	354 (64.7)	

COPD: chronic obstructive pulmonary disease; HEART: Humber's Elderly Assess and Restore Team; SD: standard deviation.

Table 2

Length of stay based on HEART participation.

	HEART participants (n=547)	HEART eligible, did not participate (n=547)	U	P-Value
Length of stay, median (IQR)	6.0 (5.0)	6.0 (8.0)	139054.0	.04
Excessive length of stay, median (IQR)	0.1 (4.8)	0.5 (7.6)	138925.5	.04

IQR: interquartile range; U: Mann-Whitney U test (z-score).

Table 3

Associations between HEART status and outcome variables.

	OR (95% CI)	P-Value
Alternate level of care designation	0.30 (0.13, 0.69)	.005
Return to home	2.85 (2.03, 3.99)	<.001
	HR (95% CI)	P-Value
30-day emergency department visit	1.16 (0.63, 2.15)	.64
30-day readmission to the hospital	0.86 (0.56, 1.32)	.48

Reference group= Non-HEART participants. CI: confidence interval; HR: hazard ratio; OR: odds ratio.

To our knowledge, this is the first study to examine the effectiveness of an A&R program in reducing LOS, ALC, discharge destination, hospital readmissions and visits to the ED. Some literature has suggested that CGAs can reduce averse outcomes such as institutionalization (Ellis et al., 2017), long-term hospitalization/LOS (Hosoi et al., 2020; Parker et al., 2017), and readmission (Parker et al., 2017). Thus, there is promising evidence for improvement in geriatric care with the implementation of a specialized geriatric intervention in addition to usual care. However, this is the first study to specifically look at the Ontario A&R model. As such, our findings provide novel insight into the effectiveness of these models. Our finding that HEART participation was associated with a lower LOS aligns with a scoping review that noted that LOS was lower in those with greater in-hospital mobility (Smart et al., 2018). The association between HEART participation and return to home also reflected known associations with discharge to home and early physical therapy intervention (Hartley et al., 2019), in-hospital mobility (Suriyaarachchi et al., 2020), and mobile CGA programs (Ellis et al., 2017). However, findings on in-hospital mobility and readmission have been mixed, as one systematic review (Smart et al., 2018) noted two studies that found decreased readmission rates (Azuh et al., 2016; Wood et al., 2014) and another finding null results (Hastings et al., 2014). Further, while we noted some CGAs have shown a reduction in hospital readmissions, a meta-analysis noted that inpatient CGA programs using a mobile team have not shown associations with readmission to the hospital (Ellis et al., 2017).

This study has implications for healthcare practices. Our results provide insight into the effectiveness of an A&R program in reducing adverse outcomes in hospitalized older adults. The finding that HEART participation decreases LOS suggests that the program may provide both an economic and a physical benefit (e.g., prevention of nosocomial infection and functional decline). It is especially important to note that this association held for eLOS, as it indicates that the success of the program is not due to choosing patients whose LOS may have been low regardless of involvement. The HEART program's ability to decrease the likelihood of becoming ALC suggests that HEART participants are less likely to occupy acute care beds following treatment and utilize hospital resources. Further, the program's success in returning the patient to home allows patients to continue to age safely at home, thus reducing the need for rehabilitative beds and premature institutionalization. By increasing discharge to home and reducing ALC rates, the HEART program presents a potential strategy for increasing independent living and improving resource utilization in a subset of older adults. Lastly, as this study found promising evidence for the HEART program, it opens the door for future research into A&R programs and provides Ontario hospitals with return on investments for implementing similar programs.

While this study provides exciting insights into an A&R program, it was not free of limitations. The retrospective nature of the study meant that the authors were limited to the variables reported and may have missed potentially important confounding variables (e.g., ethnicity). This may have led to biased estimates in the propensity score matching procedure and increased selection bias. Further, while covariates appeared to be balanced, participants could not be perfectly matched on all criteria so some selection bias could have occurred. Additionally, readmissions and ED visits were determined from hospital

administrative databases, so it is possible that we missed some readmissions or ED visits if a participant visited a different hospital. Future studies should consider pairing with regional databases to gather information on hospital readmission. It is also possible that there was error in reporting readmission and ED visits, as we only counted these if the visit was for the same condition. The participant's diagnosis may have differed between visits based on the physician treating the patient and would therefore not be captured as a readmission or ED visit. Further, few participants were readmitted to the hospital or visited the ED so it is possible that an association existed but could not be detected. It is also important to note that few participants became ALC so researchers could not examine ALC as a continuous variable. Future research should be conducted over a longer span of time with a larger cohort to consider the number of ALC days accumulated based on participation in an A&R program. Finally, the generalizability of the study results may be limited. The HEART program serves only a subset of older adults with physiological and functional decline, so it is unclear whether study findings would apply to other populations. It should also be noted that the HEART program has both an inpatient and outpatient arm, so it is unknown if the study findings apply to A&R programs with a different design.

5. Conclusion

Our results suggested that participation in the HEART program is associated with decreased hospital resource utilization and increased discharge to independent living. This provides insight into the A&R model and suggests that their implementation in Ontario hospitals may be beneficial in the care of older adults. However, further research is required to see if these models are effective in a wider population of older adults and in programs with only an inpatient or outpatient arm.

Credit Author Statement

Beatrise Edelstein: Conceptualization, Methodology, Writing- review & editing.

Jillian Scandiffio: Conceptualization, Methodology, Data curation, Formal analysis, Writing-original draft.

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Declaration of Competing Interest

The authors have declared no conflicts of interest for this article.

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