Can an Emergency Department–Initiated Intervention Prevent Subsequent Falls and Health Care Use in Older Adults? A Randomized Controlled Trial

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Study objective: We determine whether an emergency department (ED)–initiated fall-prevention intervention can reduce subsequent fall-related and all-cause ED visits and hospitalizations in older adults.

Methods: The Geriatric Acute and Post-acute Fall Prevention intervention was a randomized controlled trial conducted from January 2018 to October 2019. Participants at 2 urban academic EDs were randomly assigned (1:1) to an intervention or usual care arm. Intervention participants received a brief, tailored, structured, pharmacy and physical therapy consultation in the ED, with automated communication of the recommendations to their primary care physicians.

Results: Of 284 study-eligible participants, 110 noninstitutionalized older adults (≥65 years) with a recent fall consented to participate; median age was 81 years, 67% were women, 94% were white, and 16.3% had cognitive impairment. Compared with usual care participants (n=55), intervention participants (n=55) were half as likely to experience a subsequent ED visit (adjusted incidence rate ratio 0.47 [95% CI 0.29 to 0.74]) and one third as likely to have fall-related ED visits (adjusted incidence rate ratio 0.34 [95% CI 0.15 to 0.76]) within 6 months. Intervention participants experienced half the rate of all hospitalizations (adjusted incidence rate ratio 0.57 [95% CI 0.31 to 1.04]), but confidence intervals were wide. There was no difference in fall-related hospitalizations between groups (adjusted incidence rate ratio 0.99 [95% CI 0.31 to 3.27]). Self-reported adherence to pharmacy and physical therapy recommendations was moderate; 73% of pharmacy recommendations were adhered to and 68% of physical therapy recommendations were followed.

Conclusion: Geriatric Acute and Post-acute Fall Prevention, a postfall, in-ED, multidisciplinary intervention with pharmacists and physical therapists, reduced 6-month ED encounters in 2 urban EDs. The intervention could provide a model of care to other health care systems aiming to reduce costly and burdensome fall-related events in older adults. [Ann Emerg Med. 2020;76:739-750.]

Please see page 740 for the Editor's Capsule Summary of this article.

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INTRODUCTION

Background

The mortality for falls in adults aged 65 years and older is increasing[1] in the United States. Geriatric falls come at a considerable cost to individuals and payers; they lead to 3 million annual US emergency department (ED) visits,[2] are a leading cause of institutionalization and functional decline,[3] and contribute an estimated $50 billion[4] in US medical costs each year. Falling once doubles the chance of falling again,[5] making older adults who present for falls to the ED a high-risk group for intervention.[6,7] Although multidisciplinary interventions drawing on professionals such as pharmacists and physical therapists have shown promise in other countries, US ED fall-prevention interventions have not been rigorously tested.[7,8]

Importance

We recently reported the short-term results of a randomized, controlled trial, the Geriatric Acute and Post-acute Fall Prevention Intervention (GAPcare), that determined that a brief, tailored, structured, pharmacy and physical therapy consultation is feasible in the ED because it does not prolong ED length of stay and pharmacy and physical therapy assessments are completed in 20 minutes,

Editor's Capsule Summary

What is already known on this topic

Falls are a common reason for emergency department (ED) visits by older adults, a group at higher risk for recurrent falls and fall-related injuries.

What question this study addressed

This clinical trial assessed the feasibility and estimated the effect of ED pharmacist and physical therapist consultations for community-dwelling adults who present to the ED after a fall.

What this study adds to our knowledge

Compared with usual care, patients receiving the intervention had similar ED lengths of stay and substantially decreased fall-related ED visits during the subsequent 6 months.

How this is relevant to clinical practice

This trial demonstrates that ED-based interventions may reduce future fall-related ED visits.

on average.[9] Additionally, we established acceptability of GAPcare through detailed interviews and surveys with patients, caregivers, and clinicians.[9-11] Geriatric emergency medicine guidelines suggest that a multidisciplinary team composed of pharmacists and physical therapists could aid emergency physicians with fall assessments.[12,13] Pharmacist-led interventions that use motivational interviewing techniques to modify behavior surrounding medication use (medication therapy management) have been shown to be useful in reducing fall-risk-increasing medication[14,15] and adverse drug event–related health care visits.[16,17] Additionally, physical therapy services in the ED for a ground-level fall were associated with a significantly lower likelihood of a fall-related ED revisit within 30 days (odds ratio=0.655; $P<.001$) and 60 days (odds ratio=0.684; $P<.001$).[18]

Goals of This Investigation

Some EDs currently consult these professionals, in particular as part of ED observation care, but this care is clinician prompted and therefore subject to unmeasured clinician-, patient-, and facility-level factors, which makes outcome attribution and measurement challenging.[19] GAPcare, as a randomized controlled trial, could provide a solution to this problem. The aim of this investigation was to determine whether GAPcare could reduce subsequent fall-related and all-cause ED visits and hospitalizations.

MATERIALS AND METHODS

Setting

We conducted a randomized controlled trial of the GAPcare intervention at 2 urban academic EDs in Providence, RI: the Miriam Hospital and Rhode Island Hospital. The Miriam Hospital is an academic community hospital with 82,000 adult ED patient visits per year. The Rhode Island Hospital ED is the only Level I trauma and tertiary referral center in the state and has an annual volume of 100,000 adult ED patient visits.

Selection of Participants

ED patients aged 65 years and older were eligible to participate if they presented to the ED within 7 days of a fall, they could communicate in English or Spanish, and the ED clinician planned to discharge them from the ED (ie, not admit to the hospital). Individuals with altered mental status (eg, intoxicated), who were homeless, or could not provide a telephone number for follow-up were excluded. Because patients in skilled nursing facilities already have access to physical therapy and because fall-prevention strategies differ in facilities (eg, home safety evaluations not relevant), we excluded such patients.

Research staff reviewed the electronic health record of potentially study-eligible ED patients when pharmacy and physical therapy were available for consultation (7 AM to 4 PM Monday to Friday). Research staff approached all patients aged 65 years and older who presented from the community or an assisted living facility and whose electronic health record did not indicate that any exclusion criteria were present. Patients were asked whether they had experienced a "slip, trip, or fall" in the past week. If the patients met this criterion, the research staff assessed their study eligibility and determined whether the ED clinicians planned to discharge them. For patients interested in participating in the study who scored less than 4 on the Six-Item Screener[20] (signifying high likelihood of cognitive impairment), their legally authorized representatives were asked to provide written consent.

After consent, at each study site the research staff used Research Electronic Data Capture[21] (version 8.10.6; Vanderbilt University, Nashville, TN) to randomly assign participants to usual care or the intervention arm (1:1 allocation) with block sizes of 6 and 4, stratified by hospital. We performed block randomization to balance randomization between hospital sites because one is a trauma center and the other lacks trauma designation. Randomization tables were generated in SAS (version 9.4; SAS Institute, Inc., Cary, NC) and uploaded to Research Electronic Data Capture[21]; study arm assignment for each

participant was available only to research assistants after completion of the consent process. The hospital institutional review board approved this study.

Participants first were assessed by an ED clinician, who directed their medical care. For patients randomly assigned to the intervention arm, the research staff initiated a pharmacist and physical therapist consultant, who evaluated participants consecutively at their bedside. Our previously published protocol provides more details about the intervention.[22] The pharmacist and physical therapist documented their encounter with a structured note[9] that was integrated into the electronic health record to enhance information sharing with other hospital-based and outpatient clinicians. Study instruments and the time of assessment are included in Table E1 (available online at http://www.annemergmed.com).

Pharmacists performed a bedside evaluation after reviewing an electronic health record list of recently dispensed medication for each participant. During a brief medication therapy management session, pharmacists used motivational interviewing to ask open-ended questions to determine patients' knowledge of their medications and willingness to change medications to reduce fall risk. The pharmacists identified 1 to 3 medications that could be stopped or modified to reduce fall risk and communicated the medication-related action plan in writing to participants and the ED treatment team. The medication-related action plan was automatically faxed to each participants' primary care physician at the end of the ED visit; it specified that medication changes were at the discretion of the primary care physician and were not necessarily enacted by the ED clinician.

After diagnostic imaging was reviewed and the ED clinician determined it was safe for the participant, the physical therapist performed a bedside evaluation. He or she also performed a gait, balance, and lower extremity strength assessment, using common fall-risk instruments (the Timed Up and Go,[23] AM-PAC "6 Clicks,"[24] Tinetti,[25] and Five Times Sit-to-Stand[26]). Although many measures of function are available, we chose these assessments because they have been validated for fall prediction (Table E1, available online at http://www.annemergmed.com), local physical therapists already use them for hospitalized patients, they are integrated into our electronic health record, and they were recommended by our geriatric-trained physical therapist. The physical therapist also provided physical therapy–related discharge planning and recommended a physical therapy action plan, which was individually tailored to the patient's needs. For instance, patients without significant impairment in balance and strength were referred to a community fall-prevention program, whereas others were advised to receive outpatient, home physical therapy, occupational therapy, or a home-safety evaluation, or, if necessary, were advised to be directly admitted to a skilled nursing facility. The physical therapy action plan was communicated in writing to the patient and ED clinician and faxed together with the medication-related action plan to primary care physicians.

Participants randomly assigned to the usual care arm received medical care as guided by the ED clinician and a "Check for Safety" brochure by the Centers for Disease Control and Prevention,[27] which contains a checklist of home safety measures to prevent falls. The ED clinician could choose to contact the primary care physician, consult case management, and provide medical equipment (eg, walkers, canes) for participants in both arms, but in-ED pharmacy and physical therapy consultations were not available to usual care participants.

Participants were telephoned at 1, 3, and 6 months and asked to complete surveys detailing their falls and health care visits. At 6 months after the ED visit, they were interviewed in their home to obtain their self-reported adherence to pharmacy and physical therapy recommendations, review their current medication lists, and inquire about self-reported fall occurrence and health care visits.

To increase data collection accuracy, we followed recommendations[28] for manual electronic health record review and data extraction, including creating and using a standardized data extraction form, implementing a standardized protocol for manual data extraction, training the data extractors, blinding data extractors to the study arm, and conducting quality assurance by reviewing a 10% sample of the data collected. We also searched obituaries and called primary care physicians for information on all patients missing follow-up. When participant-reported and electronic health record extracted data differed, 2 study authors (E.M.G. and S.J.M.) reviewed both records and reconciled them. If reconciliation using existing records was not possible or data relevant to the study outcomes were missing, the lead investigator (E.M.G.) called the patient, family, primary care physician, or medical examiner to obtain additional information.

A meta-analysis of fall-prevention programs found a 30% reduction in the incidence rate of falls.[29] In a previous study, 31% of older patients presenting to the ED after a fall had a subsequent fall within 6 months.[26,30] Using these findings, we planned to recruit 120 participants with 60 in each arm. With this sample size, we could detect at least a 25% absolute reduction in subsequent falls occurring within 6 months with 80% power (α=.05) (31% in usual care versus 6% in the intervention arm).

Primary Data Analysis

Outcomes were analyzed according to an intention-to-treat principle, with all participants analyzed in the arm to which they were randomized. If disposition was changed after randomization from ED discharge to hospital admission, participants were still analyzed according to the group they were assigned. Because each participant could contribute a different amount of follow-up time (eg, because of death), we calculated person-month rates for our measured outcomes of fall-related ED visits, all ED visits, fall-related hospitalizations (excluding procedures and other planned surgeries), and hospitalizations. Finally, we used a negative binomial regression model to compare fall event rates between the 2 arms and conducted sensitivity analyses with Anderson Gill models. Negative binomial regression with robust standard errors and Anderson Gill models are preferable for fall-related event analyses because they allow variable follow-up time and consideration of multiple recurrent events.[31,32] In addition, they allow investigation of the intervention effect and the effects of confounding variables; in all models, we excluded periods of hospitalization from time at risk.

We chose a negative binomial model over a Poisson model because of overdispersion present in our data. We also fit zero-inflated models, but they did not improve model fit. We calculated the number needed to treat by using the Nelson-Aalen estimator to estimate the cumulative number of expected events.[33] We developed mean cumulative function graphs for all and fall-related ED visits to show the mean number of events over time and illustrate when during follow-up the intervention was helpful. Finally, we report adherence to our pharmacy and physical therapy recommendations (as measured during the 6-month follow-up assessment) to illustrate uptake of recommendations by participants. Analyses were completed with SAS.

We adjusted for sex, age, number of falls in the 3 months before the ED visit, comorbidities (Charlson comorbidity index), baseline function (activities of daily living), injury severity, and hospital site (trauma versus nontrauma center). These factors were identified a priori before analyses were conducted. We also included several variables in our model that we thought were relevant to reduced falls and health care use according to our clinical expertise and previous falls research, particularly that by Close et al[34] in their landmark clinical trial on falls. Specifically, Close et al[34] included baseline function (Barthel's activity of daily living scores) and previous falls. We also know that unintentional falls increase with age (Ashman et al[35]). In addition to age, function, and previous falls, we adjusted for sex, comorbidities (Charlson comorbidity index), injury severity, previous assistive equipment use, number of falls in the previous 3 months, and hospital site (trauma versus nontrauma center). Because women have a higher life expectancy than men, the total number of falls during their lifetime is higher. The Charlson comorbidity index is a frequently used variable in geriatric health services research because it is predictive of mortality in this population, as well as health care use. We hypothesized that people with more injurious falls, previous falls, and existing assistive equipment use would be more likely to experience recurrent falls and health care use. Similarly, patients who experience more severe injuries after a fall are more likely to be transported by ambulance to a trauma center, so we included this as both a blocking factor and a covariate.

RESULTS

Characteristics of Study Subjects

Of 478 ED patients assessed for study eligibility from January 25, 2018, to March 31, 2019, 284 were eligible for inclusion and 110 consented to participate (Figure 1). The main reasons for ineligibility were that the ED clinician originally planned to admit the patient to the hospital, the patient resided in a skilled nursing facility, or the patient had an altered mental status. The primary reasons patients cited for declining to participate were a belief that falls were not a problem for them and that family members were present in the ED.

We enrolled 110 participants in GAPcare. Although we initially intended to recruit 120 participants, the study was closed early to recruitment in accordance with the advice by the study's data safety monitoring board, which believed that feasibility and initial efficacy were sufficiently established. Of the 55 participants in the intervention arm, 54 received the pharmacy intervention and 46 completed the physical therapy intervention. The physical therapist did not complete an evaluation on every intervention participant for several reasons: newly diagnosed spine fracture, intracranial hemorrhage, desire to leave the ED before physical therapist arrival, and deferral request by orthopedic surgery or physical therapy. No participants experienced any adverse events as a result of participating in the intervention. Median time from consultation request to arrival was 14 minutes (interquartile range [IQR] 10 to 20 minutes) for pharmacy and 22 minutes (IQR 14 to 34 minutes) for physical therapy. Median duration of consultation was 20 minutes for pharmacy (IQR 13 to 24 minutes) and 20 minutes for physical therapy (IQR 14 to 29 minutes). ED length of stay was not increased in the intervention arm: usual care 5.3 hours versus intervention

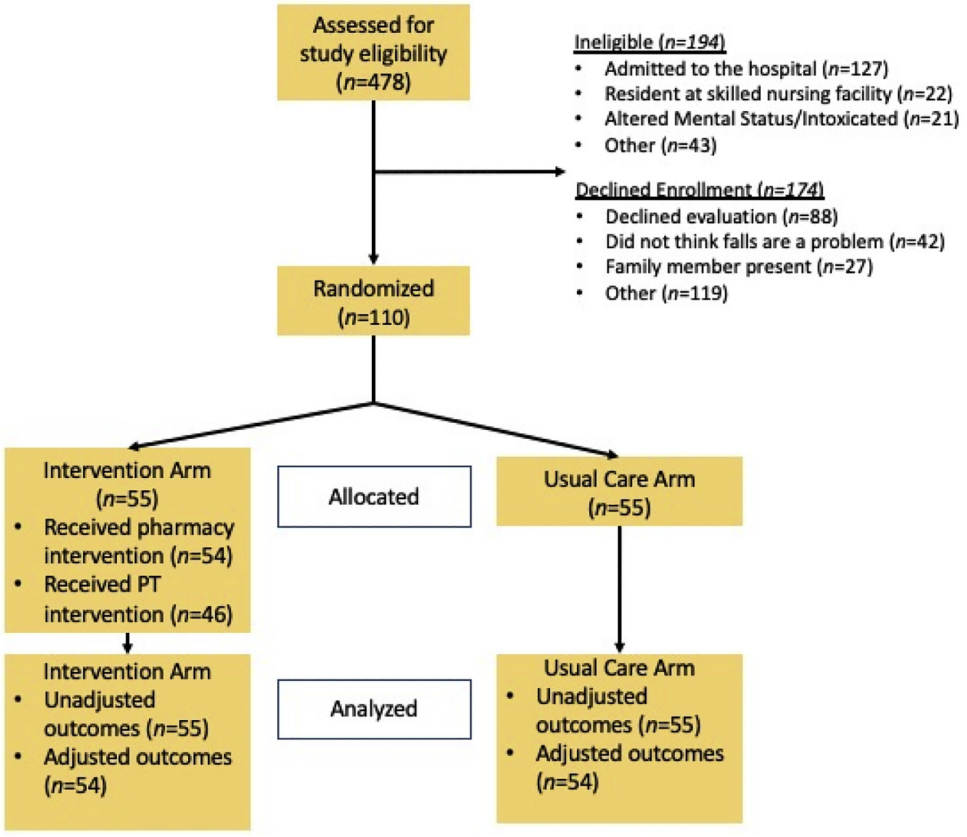

Figure 1. Consolidated Standards of Reporting Trials (CONSORT) flow diagram of trial participants.

5.0 hours ($P<.94$). Additional feasibility outcomes are reported in our previous GAPcare article.[9]

Of the 110 participants, most were women (67%) and white (96%), with a median age of 81 years (Table 1). There were no statistically significant differences ($P<.05$) in sex, race, age, presence of cognitive impairment, and major comorbidities between arms. After the index ED visit, 39 control participants (70.9%) and 35 intervention participants (63.6%) were discharged home ($P=.58$) (Table 2).[9] Of the remaining participants, 6 control participants (10.9%) and 10 intervention participants (18.8%) went to a skilled nursing facility. In both the control and intervention arm, 10 participants (18.8%) per arm were admitted.

Table 2 shows that intervention participants had fewer all-cause ED visits, fall-related ED visits, all-cause hospitalizations, and fall-related hospitalizations than the usual care arm. Twelve (11%) of the 110 study participants died or transitioned to hospice during follow-up, predominantly from the usual care arm. Eight patients withdrew and 11 were lost to follow-up but consented to continued electronic health record data abstraction.

In the adjusted analyses, we found that participants in the intervention arm had half the rate of all-cause ED visits compared with the usual care arm (Table 3). Moreover, participants receiving the intervention had nearly one third the rate of fall-related ED visits per month. Intervention participants experienced half the rate of all hospitalizations, but confidence intervals (CIs) were wide. There was no difference in fall-related hospitalizations between groups (Table 3 and Table E2, available online at http://www.annemergmed.com). The number needed to treat for the GAPcare intervention to prevent 1 ED visit in 6 person-months was 2 (95% CI 1 to 7); and to prevent 1 fall-related ED visit, 4 (95% CI 2 to 24). We also conducted exploratory analyses on how participants' permanent move to a skilled nursing facility may have affected our findings; we found no major differences in results when we removed time in a skilled nursing facility from time at risk (Table E3 and Figure E1, available online at http://www.annemergmed.com).

Figure 2*A* shows the mean cumulative function difference curves indicating that the intervention prevented all-cause ED visits in the first 2 months and between 4 and

Table 1. Participant characteristics by study arm.

	Study Arm			
	Usual Care (n=55)		Intervention (n=55)	
Characteristic	**No.**	**%**	**No.**	**%**
Sex				
Women	37	67	37	67
Men	18	33	18	33
Ethnicity*				
Hispanic/Latino	2	4	0	0
Non-Hispanic/non-Latino	53	96	54	100
Race				
White	54	98	51	93
Black	0	0	2	4
American Indian/Alaskan Native	0	0	1	2
White and Asian	0	0	1	2
Other	1	2	0	0
Age, mean (SD), y	80.1	(8.5)	81.9	(8.3)
Education level†				
Grades 1–8 (elementary/middle school)	3	6	4	8
Grades 9–11 (some high school)	7	14	4	8
Grades 12 or general education diploma (high school graduate)	21	41	18	36
College 1–3 y (some college or technical school)	9	18	8	16
College ≥4 y (college graduate)	11	22	16	32
Cognitive impairment (Six-Item Screener score)‡				
≤3	8	15	10	20
4	13	24	2	4
5	17	31	20	39
6	17	31	22	43
Number of falls in previous 3 months‡				
0	25	45	29	57
1	10	18	10	20
2	10	18	5	10
3	4	7	5	10
4	1	2	2	4
≥5	5	9	3	6
Number of injurious falls in previous 3 months‡				
No falls	25	45	29	57
0	16	29	15	29
1	8	15	9	17
2	4	7	1	2
3	2	4	0	0
Injured during current fall‡				
No	11	20	12	22
Yes	44	80	42	78
Current use of assistive device‡				
No	15	27	14	26
Yes	40	73	40	74

Table 1. Continued.

Characteristic	Study Arm			
	Usual Care (n=55)		Intervention (n=55)	
	No.	%	No.	%
Life-limiting comorbidities (Charlson comorbidity index)[§]				
0	10	18	11	20
1	14	26	15	28
2	13	24	16	30
3	6	11	8	15
4	4	7	4	7
6	4	7	0	0
7	3	6	0	0
Function (activities of daily living), median (IQR)	18	(16–20)	18	(15–20)

*One intervention arm participant selected did not know.
[†]Data for 4 usual care participants and 5 intervention arm participants.
[‡]Data for 1 intervention arm participant missing.
[§]All items of the Charlson comorbidity index were missing for 1 intervention and 1 usual care participant; 13 participants (8 usual care, 5 intervention) were missing 1 Charlson comorbidity index item, and 4 participants (all intervention) were missing 2 items. Data from these individuals are shown.

Table 2. Outcomes by study arm.

Outcomes	Usual Care (n=55)	Intervention (n=55)
Initial disposition, No. (%)		
Discharged to home	39 (71)	35 (63)
Discharged SNF	6 (11)	10 (18)
Admitted	10 (18)	10 (18)
Disposition at end of study, No. (%)*		
Home or short-term stay in SNF	41 (75)	47 (85)
Permanent move to SNF	4 (7)	5 (9)
Died/hospice	10 (18)	3 (5)
Days spent by location, No. (%)		
At home or short-term stay in SNF	87.3	80.8
Hospitalized	2.3	1.6
Permanent move to SNF	7.0	7.6
Died	10.0	3.4
Health care use outcomes by events		
Total no. of person-months	297	319
Fall-related ED visits	24	9
All ED visits	66	30
Fall-related hospitalizations	6	7
All hospitalizations	34	19
Health care use outcomes by participant, No. (%)		
≥1 fall-related ED visit	15 (27)	8 (15)
≥1 ED visit	29 (53)	20 (36)
≥1 fall-related hospitalization	6 (11)	6 (11)
≥1 hospitalization	21 (38)	13 (23)

SNF, Skilled nursing facility.
*Participants who moved permanently to SNF and then died or entered hospice were counted in the "died/hospice" category.

Table 3. Unadjusted and adjusted health care event rates and incident rate ratios from negative binomial models.

	Unadjusted Rate per 10 Person-Months (95% CI)			Adjusted Rate per 10 Person-Months* (95% CI)		
	Usual Care (n=55)	Intervention (n=55)	IRR (95% CI)	Usual Care (n=54)	Intervention (n=54)	IRR (95% CI)
Fall-related ED visits	0.84 (0.56–1.25)	0.29 (0.15–0.56)	0.35 (0.16–0.75)	0.34 (0.12–0.99)	0.12 (0.04–0.38)	0.34 (0.15–0.76)
All ED visits	2.30 (1.81–2.93)	0.97 (0.68–1.38)	0.42 (0.27–0.65)	1.54 (1.04–2.30)	0.73 (0.45–1.17)	0.47 (0.29–0.74)
Fall-related hospitalizations	0.24 (0.12–0.51)	0.19 (0.09–0.32)	0.79 (0.27–2.36)	0.22 (0.09–0.56)	0.22 (0.08–0.52)	0.99 (0.31–3.27)
All hospitalizations	1.19 (0.85–1.66)	0.61 (0.39–0.96)	0.52 (0.30–0.91)	0.77 (0.46–1.31)	0.44 (0.24–0.82)	0.57 (0.31–1.04)

Adjusted for sex, age, number of falls in previous 3 months, Charlson comorbidity index, activities of daily living, injured during index fall, hospital site, and previous assistive equipment use (except for fall-related hospitalizations models because of quasi-complete separation).
*N=54 for adjusted analysis because of missing data.

5 and a half months of the study; during this period, the difference between the usual care (blue) and intervention (red) arms increased. Overall, the intervention prevented approximately 0.75 falls per 6 person-months. For fall-related ED visits (Figure 2*B*), the usual care arm slope is steeper than the intervention arm slope, particularly initially. The greatest difference between the curves is at 4 and a half months, indicating that the effects built throughout follow-up; this plot shows that the intervention prevented approximately 0.3 falls per 6 person-months.

Pharmacists made 219 medication suggestions about 120 medications, with an average of 2.2 recommendations per participant. Among the 154 recommendations with follow-up data, 73% of the recommendations made by the pharmacist to reduce subsequent fall risk were adhered to partially or fully; 51% (79) of the recommendations were fully adhered to, 22% (34) were partially adhered to, and 27% (41) were not adhered to. These recommendations included using over-the-counter alternatives to a medication (11%; 25), using increased precaution when receiving a medication with known adverse effect of falls (11%; 25), stopping a medication completely (9%; 19), and changing timing of medication (9%; 20).

Physical therapists made 156 recommendations, with an average of 3.3 recommendations per participant who received physical therapy in the ED. Of the 100 recommendations assessed at 6-month follow-up, participants reported being fully adherent to 45% of recommendations (45), partially adherent to 23% of recommendations (23), and nonadherent to 32% of recommendations (32). Physical therapists provided general education about falls to 84% of participants (39) and recommended new or increased walker use to 52% (24), home physical therapy to 41% (19), skilled nursing facility stay to 41% (19), footwear education to 37% (17), and initiation of home exercises to 22% (10).

Several lessons were learned during implementation of the GAPcare model that could be helpful for other EDs planning to institute a similar intervention and are highlighted in Table 4 (adapted from a previously published study on GAPcare[9]).

LIMITATIONS

Although we found clinically important and significant differences in health care use between arms in the GAPcare study, we originally designed it to evaluate feasibility and initial efficacy to reduce falls. It is possible we had incomplete capture of data by using the electronic health record, but we believe we captured a majority of the data because Rhode Island Hospital ED is the only tertiary referral and trauma center in the state, and the health system is the largest in the state (256,000 ED visits annually of 446,000 ED visits statewide in 2018) and encompasses 4 acute-care hospitals, all of which use the same electronic health record. We lack a complete understanding of the role skilled nursing facilities played in participant outcomes; our exploratory analyses showed no major differences in outcomes for patients who permanently moved to a skilled nursing facility, but we do not know whether there were differences in short-term skilled nursing facility use between arms and whether those may have affected the efficacy of the intervention. We did not have sufficient sample to evaluate whether ethnic and racial minority adults benefit from this intervention. Similar to other fall-prevention trials in multimorbid, frail patients,[36] many patients declined enrollment (n=174), potentially reducing the generalizability of our results. Implementing GAPcare may be challenging at hospitals that lack a geriatric ED champion, buy-in from ED directors, and pharmacy and physical therapy leadership, so securing interest in the intervention by these parties is an important first step. It is

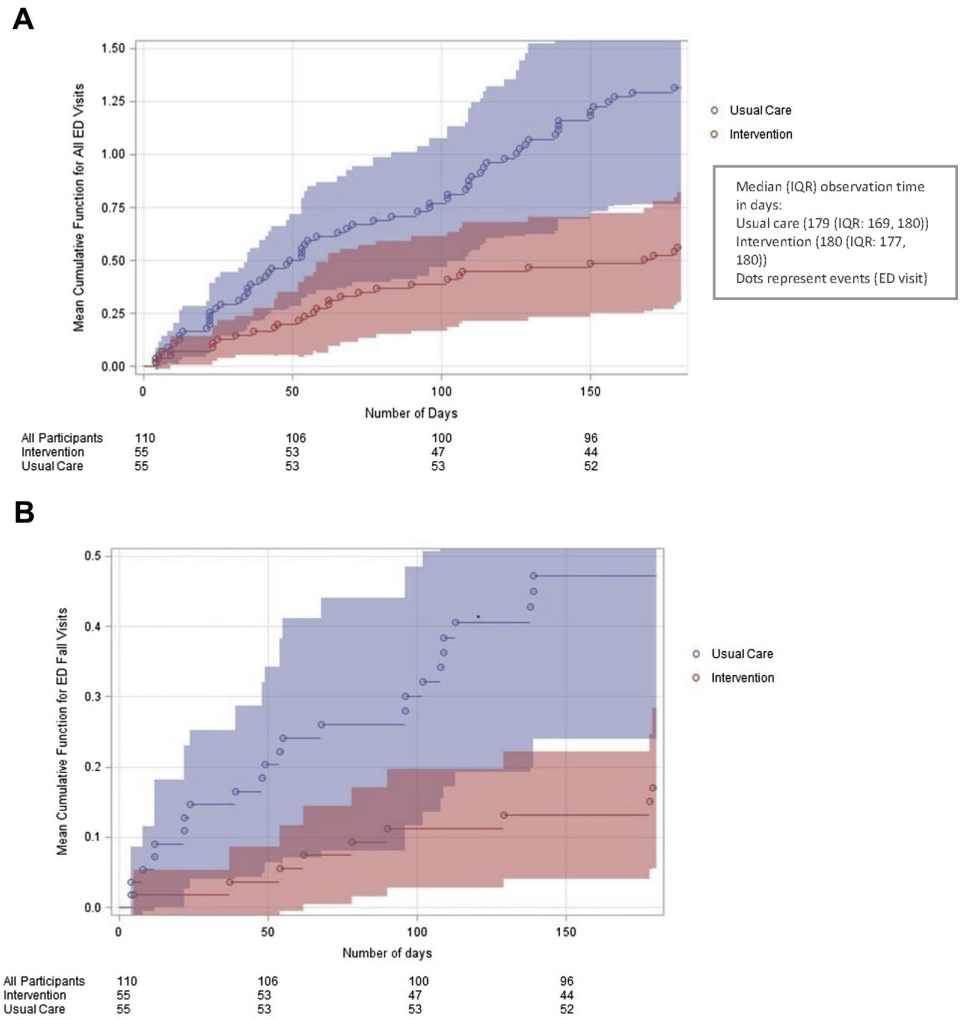

Figure 2. *A,* Mean cumulative function curves for all ED visits. *B,* Fall-related ED visits over time.

Table 4. Lessons learned and planned adaptations.

Category	Lessons Learned	Adaptations and Planned Improvements
Recruitment	Delayed identification of potentially eligible participants with falls by the research staff, and disqualification because of missed falls	Instituted automated alert in EHR to research staff for patient ≥65 y receiving head/neck imaging (probable fall). Broadened eligibility to include falls 1 wk before ED visit.
Eligibility criteria	PT assessment of intervention participants changed planned ED disposition to SNF instead of home	Changed eligibility criteria: participants remained in study regardless of ED disposition to allow observation of PT effect on disposition (intention-to-treat principle)
Staffing	Limited availability of PT and pharmacists during evening and weekend hours	Initiated discussions with hospital leaders to expand pharmacist and PT coverage. Board-certified resident pharmacists will be trained to supplement the main ED pharmacist's activities.
Outcome assessment	Participants often experienced hospitalizations, SNF stays, worsening medical conditions, or death in follow-up, making self-reported outcome reporting inconsistent.	Relied primarily on EHR rather than self-reported outcomes for analysis. Future studies (GAPcare II) will use objective measures for fall events, such as wearable sensors.

EHR, Electronic health record; *PT*, physical therapy.

unclear whether pharmacy or physical therapy consultation contributed more to fall reduction; future research could include a factorial trial design to better disentangle the treatment effects of these 2 intervention components.

DISCUSSION

In this randomized controlled trial of 110 participants, we found that a brief, tailored, structured, fall-prevention intervention administered by pharmacists and physical therapists reduced subsequent ED visits whether related to falls or not. Pharmacy and physical therapy recommendations were generally followed. The study findings are promising and indicate the value of further examining this intervention in a larger trial with a longer follow-up period and more diverse patient population.

GAPcare might have been efficacious because the intervention occurred immediately after the fall while the patient was in the ED. Performing a fall-prevention intervention in the ED (as opposed to after the ED visit) decreases the delay to evaluation and treatment, which is critical because older adults are at high risk of subsequent falls in the immediate postfall period.[37-39] A London-based study of 397 older ED patients who had a fall and received a home-based occupational therapy assessment significantly reduced falls (odds ratio 0.39; 95% CI 0.23 to 0.60),[34] but when this program was implemented in the Netherlands, there was no reduction in falls.[40] In the latter study, although recruitment was initiated in the ED, fall assessments were completed on average 5 to 10 weeks after the initial ED visit.

We believe GAPcare was successful because it greatly improves on the status quo of fall evaluation in the ED. Emergency clinicians primarily perform a trauma assessment of older adults who present for falls. Reasons for the fall are rarely investigated[6,41] and so valuable prevention opportunities are missed. By engaging pharmacists and physical therapists to help identify and recommend changes to medication- and function-related risk factors, we believe we achieved success in reducing future undesirable events. We suggest clinicians consider falls a symptom rather than a discrete clinical complaint. A fall often indicates that there has been a decline in strength, vision, cognition, balance, or another vital health parameter in an older person; falls are rarely purely environmental or "mechanical."[41] In a study by Sri-On et al[41] of older adults presenting to the ED with a fall, there were high rates of 6-month adverse events—recurrent falls (21%), ED visits (43%), and hospitalizations (33%)—and rates were similar whether the ED clinician termed the fall "mechanical" or not. If risk factors for the fall are not recognized and ameliorated while patients are in the ED or if referral to primary care colleagues is relied on, opportunities to reduce fall-related morbidity and mortality will be missed.

Another reason we believe our intervention was successful is because we combined physical therapy with pharmacist-led medication therapy management. Deprescribing interventions, in which modifying fall-risk medication is the only component of the intervention, may not reduce falls.[42,43] Qualitative studies on deprescribing showed that physicians avoid discussing deprescribing because "preventative medication is not easy to reduce,"[44,45] there is a "lack of benefit/risk information [about] prescribing,"[44,45] and "medications [are] initiated by specialists."[44] We may have had success with GAPcare because the fall was a trigger event that necessitated deprescribing and because motivational interviewing is promising in bringing about behavior change.[46] Also, specialists with access to the electronic health record could view the pharmacist note and could modify the drugs they prescribed. We may have also had more success because older patients who seek care in EDs may be receiving more fall-risk-increasing medication, and could therefore experience a greater benefit from deprescribing. Early physical therapy, such as in GAPcare, reduces pain and improves patient satisfaction,[47] and exercise-based interventions can reduce falls.[48] Because physical therapists are skilled in determining patients' ability to mobilize safely and recognizing the patient needs for social and environmental support, patients receiving physical therapy consultations may have had fewer unrecognized and unmet needs on discharge, which contributed to a reduction in subsequent ED visits.

It is important to consider the cost of the GAPcare intervention because cost and staffing could be a barrier to widespread uptake. Physical therapists can bill for their ED evaluations,[49] and medication therapy management by pharmacists is covered by Medicare for patients with polypharmacy (receiving 5 or more medications). Southerland et al[50] evaluated the financial feasibility of multidisciplinary consultations in the ED and found that per workday a pharmacist is financially self-sustaining at 7.7 medication reconciliation consultations and a physical therapy is self-sustaining at 5.7 consultations. An average fall-related ED visit costs Medicare $5,000 to $6,000.[51] Future research can help determine whether GAPcare reduces health care costs and is cost-effective.

In summary, to our knowledge GAPcare is the first ED-initiated randomized controlled trial in the United States evaluating a multidisciplinary pharmacy and physical therapy consultation in the ED to reduce future fall-related and all-cause health care visits. Our findings suggest that

ED visits are decreased after a brief structured fall-prevention intervention. Implementation of the GAPcare intervention in other EDs could help improve emergency care for falls, start prevention efforts when they are most needed, and reduce subsequent burdensome health care visits.

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