

## Association Between Physical Therapy in the Emergency Department and Emergency Department Revisits for Older Adult Fallers: A Nationally Representative Analysis

Adriane Lesser, MS, Juhi Israni, MS, Tyler Kent, and Kelly J. Ko, PhD

**ABSTRACT: OBJECTIVES:** To determine whether providing physical therapy (PT) services in the emergency department (ED) improves outcomes for older adults who fall.

**DESIGN:** We used Medicare claims data to examine differences in recurrent fall-related ED revisit rates of older adults who presented to the ED for a ground-level fall and whether they received PT services in the ED. Our logistic regression model controlled for age, sex, Medicaid eligibility, acute injury, and certain known chronic comorbidities associated with risk of falling.

**SETTING:** We analyzed national 2012–13 Medicare claims data for individuals aged 65 and older.

**PARTICIPANTS:** This was a claims-based analysis. We defined an index visit as any ED claim that included an *International Classification of Diseases, Ninth Revision, Clinical Modification* E-Code indicating a ground-level fall. Visits resulting in admission were excluded, as were claims associated with an individual who died during follow-up; 17,975 of the 560,277 claims for eligible outpatient index visits included revenue center codes for PT services.

**MEASUREMENTS:** We calculated the proportion of index visits associated with a fall-related ED revisit within 30 and 60 days and assessed differences in these proportions between individuals who did and did not receive PT services in the ED.

**RESULTS:** Receiving PT services in the ED during an index visit for a ground-level fall was associated with a significantly lower likelihood of a fall-related ED revisit within 30 days (odds ratio (OR)=0.655,  $p<.001$ ) and 60 days (OR=0.684,  $p<.001$ ).

**CONCLUSION:** Expanding PT services in the ED may reduce future fall-related ED use of older adults.

Additional analyses could assess characteristics of individuals receiving PT in the ED and follow-up PT use after discharge. *J Am Geriatr Soc* 2018.

**Key words:** falls; emergency department; physical therapy; revisits

Falls are the leading cause of morbidity and mortality in Americans aged 65 and older<sup>1</sup>, resulting in \$31.9 billion in estimated direct medical costs to Medicare in 2015<sup>2</sup>. In 2014, approximately 2.8 million older adults visited the emergency department (ED) for a fall-related injury<sup>1</sup>, and an analysis of the National Hospital Ambulatory Medical Care Survey determined that the ED visit rate for falls of older adults has grown over time, from 60.4 per 1,000 older adults in 2003 to 68.8 per 1,000 older adults in 2010<sup>3</sup>. Older adults presenting to the ED for a fall are at high risk of ED revisits and mortality, with some estimates indicating that 25% of individuals presenting to the ED for a fall had at least 1 ED revisit and that 15% died within the following year<sup>4</sup>.

There is growing recognition that EDs could play an important role in implementing contextually appropriate fall prevention strategies targeting older adults at high risk of falls<sup>3</sup>. A range of conditions has been associated with high fall risk, including history of prior falls<sup>5</sup>, dementia and other cognitive impairment<sup>5,6</sup>, Parkinson's disease<sup>7</sup>, depression<sup>5,8</sup>, polypharmacy,<sup>5,9</sup> certain medications<sup>8,10–12</sup>, osteoarthritis<sup>13,14</sup>, anemia<sup>15</sup>, various heart conditions, and diabetes<sup>16</sup>. Geriatric care experts have recommended that older adults presenting to the ED be screened for fall risk and referred when appropriate<sup>17</sup>. The Geriatric Emergency Department Guidelines that relevant professional societies have released advocate for similar management<sup>18</sup>, although

From the West Health Institute, La Jolla, California.

Address correspondence to Adriane Lesser, West Health Institute, 10350 N. Torrey Pines Rd., La Jolla, CA 92037. E-mail: aless@westhealth.org

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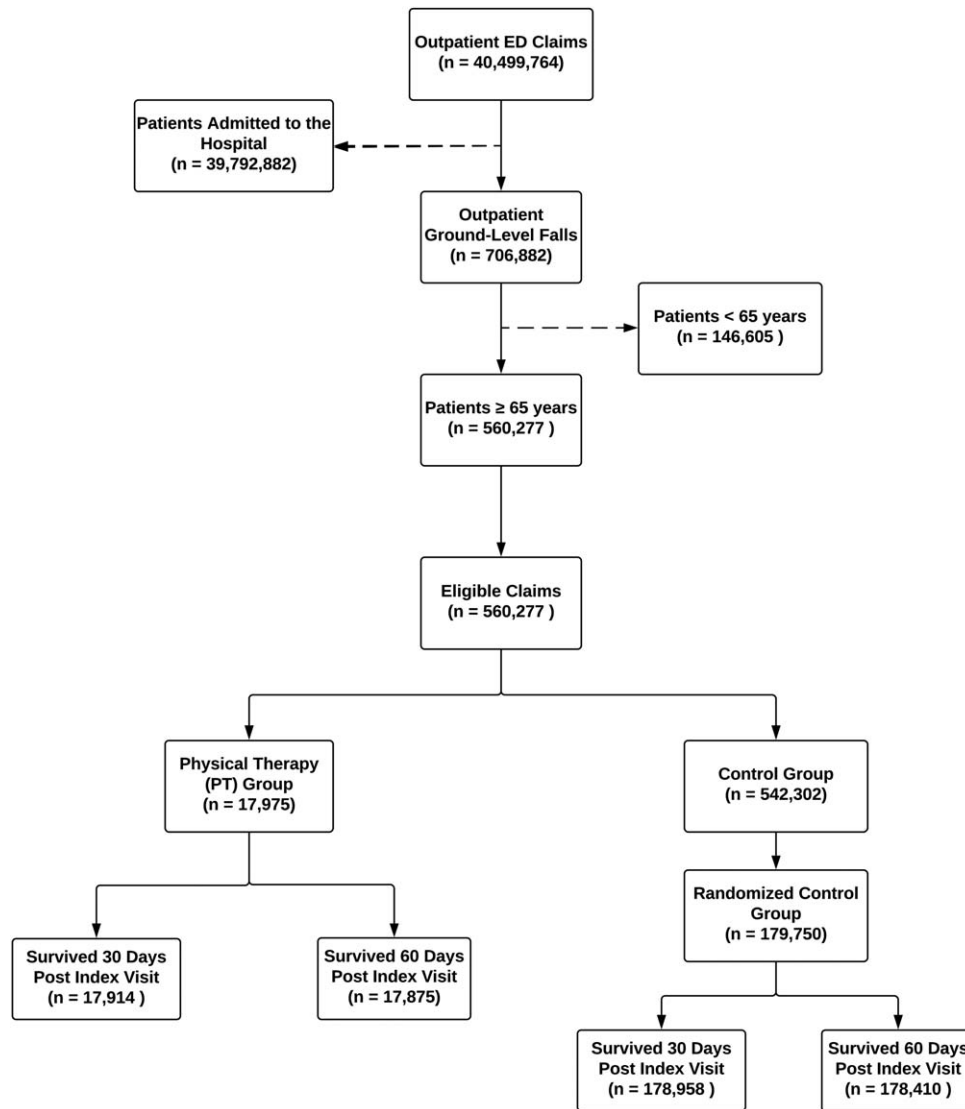


Figure 1. Flowchart of sample inclusion and exclusion criteria.

a chart review at an academic teaching hospital suggested that these recommendations are often not implemented<sup>19</sup>.

Given the prevalence of fall-related ED visits, there may be an opportunity to reduce fall-related revisits by offering physical therapy (PT) services to high-risk individuals in the ED, including information, diagnosis, and referral for follow-up PT after discharge. Several studies have demonstrated that older adults following a variety of PT or exercise regimens after a fall can reduce the risk of future falls<sup>20–22</sup>, but in spite of these findings, PT assessment and referral services are rare in U.S. EDs,<sup>23</sup> and even older adults who present to the ED for a fall often do not receive appropriate assessment and referral<sup>24</sup>.

There is a need for more information on a wider scale about whether providing PT services and referrals in the ED improves outcomes. To evaluate this potential, we used nationally representative Medicare claims data to compare ED revisit rates of older adults who presented to the ED for a ground-level fall and received PT services in the ED with ED revisit rates of those who did not receive such services.

## METHODS

### Data Source

We analyzed data from the Centers for Medicare and Medicaid Services (CMS) distributed by the Research Data Assistance Center, specifically inpatient and outpatient ED-only base claims and revenue center Standard Analytical Files from the 2012–13 Limited Data Sets. Medicare claims data provide a unique opportunity to examine nationwide trends in older adult health care in all nonfederal EDs. Medicare claims data from this period include information for all beneficiaries enrolled in traditional Medicare plans (Parts A and B), which accounts for a majority of Medicare enrollment<sup>25</sup>.

### Cohort development

Figure 1 summarizes how the analysis sample and cohorts were constructed.

## Index ED visit

An index ED visit was defined as any claim associated with an ED visit including an *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) E-Code indicating a ground-level fall (E880.1, E884.2, E884.3, E884.4, E884.6, E884.9, E888.0, E888.1) anywhere in the diagnosis. (We did not require that the fall be the primary diagnosis.)

## Inclusion criteria

We included only outpatient (including observation status) ED visits for consideration in determining the index ED visit under the premise that the outpatient population would derive greater protective benefits from PT services than the inpatient population (who are probably less likely to benefit from PT, at least during the short-term period of this study, given the likelihood of serious injury and frailty among older adults admitted after a fall).

## Exclusion criteria

Claims for individuals younger than 65 were excluded. Fall-related ED visits that resulted in an inpatient stay were excluded from consideration as an index visit. Index visits associated with an individual who died during the follow-up period were also excluded. (Follow-up periods of 30 and 60 days were assessed.)

## Defining cohorts

Eligible index visits were categorized into 1 of 2 cohorts: those that received PT services during the index ED visits and those that did not. We considered the index visit to have included a PT consultation in the ED if the claim included at least one of the following revenue center codes: 0420, 0421, 0422, 0423, 0424, 0429.

## Measuring a fall-related revisit

We classified a fall-related revisit as a claim pertaining to an individual with an eligible index visit that subsequently had a visit to any ED for which the claim included an ICD-9-CM E-Code indicating a ground-level fall anywhere in the diagnosis. Fall-related ED revisits were included regardless of whether the individual was discharged from the ED or was later assigned an observational or inpatient status.

## Outcome Measures

Our primary outcome measure was the proportion of 30- and 60-day fall-related ED revisits among patients who received PT services during a fall-related index ED visit compared to patients who did not receive PT services during such a visit, given survival to the end of the follow-up period.

## Statistical Methods

We assessed unadjusted and adjusted differences in proportion of index visits with a fall-related ED revisit within 30 and 60 days. Our model excluded index claims

associated with individuals who did not survive to the end of the specified follow-up period.

Our adjusted analysis used a logistic regression model that controlled for beneficiary age, sex, Medicaid dual eligibility status (as a proxy for economic status), acute injury severity, and certain chronic comorbidities. To measure injury severity, we calculated the New Injury Severity Score (NISS) for each index claim. The NISS score ranges from 0 to 75 and is calculated based on the Abbreviated Injury Severity (AIS) ICDMAP<sup>26</sup>. A NISS score of 0 does not necessarily indicate the absence of injury but may indicate that an injury or injuries are not considered sufficiently acute or traumatic to have the AIS ICDMAP assign a value. The NISS has been demonstrated in several studies to provide an accurate estimate of the time it takes for someone to regain his or her health after an injury<sup>27</sup>. Our model also included certain chronic comorbidities that have been associated with risk of falling: depression<sup>5,8</sup>; anemia<sup>15</sup>; diabetes<sup>16</sup>; Alzheimer's disease and related disorders<sup>5,6</sup>; osteoporosis and osteoarthritis conditions<sup>13,14</sup>; and heart conditions, including history of acute myocardial infarction<sup>12,28</sup>, atrial fibrillation<sup>28</sup>, heart failure<sup>29,30</sup>, ischemic heart disease<sup>12</sup>, and stroke or transient ischemic attack<sup>31</sup> (the risk from these heart conditions is largely linked to syncope and some medications associated with these conditions<sup>12,28,30,32</sup>). These conditions were flagged according to the CMS Comorbidity Conditions Warehouse (CCW), which uses standardized algorithms to identify certain conditions in the Medicare data. For each claim, the CCW score was calculated based on information from claims within the study period that occurred before the index visit.

To support more robust analyses, we reduced the number of index claims that did not receive PT to be 10 times the size of the index claims that received PT, in accordance with accepted statistical methods<sup>33</sup>. This reduction in index claims was achieved through random selection.

## RESULTS

### Demographic Characteristics and Unadjusted Results

Table 1 contains a summary of the demographic information and unadjusted results for the analysis sample. Of the 560,277 unique outpatient claims for a fall-related ED visit, we identified 17,975 claims for PT services associated with an index ED visit, 17,914 of which survived to 30 days and 17,875 of which survived to 60 days after the index visit. In the control arm of the analysis sample (179,950 claims), 178,958 survived to 30 days and 178,410 survived to 60 days after the index visit. At 30 days, all-cause ED revisits were higher for individuals who did not receive PT services at the index visit (21.7% of those who did not receive PT in the ED, 20.4% of those who did), but by 60 days, there was not an appreciable difference in all-cause revisit rates between the groups (30.1% of those who did not receive PT in the ED, 30.0% of those who did).

For claims with PT services associated with individuals surviving to each time point, ED revisit rates for a fall

**Table 1. Summary of Sample Demographic Characteristics**

Characteristic	Physical Therapy	Control (No Physical Therapy)
Claims, n	17,975	179,750
Beneficiaries, n	17,791	173,651
Index claims associated with death during follow-up period, days, n (%)		
30	61 (0.3)	792 (0.4)
60	100 (0.6)	1,340 (0.7)
All-cause ED revisits of survivors, days, n (%)		
30	3,663 (20.4)	38,845 (21.7)
60	5,354 (30.0)	53,636 (30.1)
Fall-related ED revisits of survivors, days, n (%)		
30	296 (1.7)	4,469 (2.5)
60	460 (2.6)	6,469 (3.6)
Age, n (%)		
65–74	3,499 (19.5)	49,826 (27.7)
75–84	6,511 (36.2)	64,504 (35.9)
≥ 85	7,965 (44.3)	65,420 (36.6)
Age, mean	82.4	80.6
Sex, n (%)		
Female	12,655 (70.4)	119,009 (66.2)
Male	5,310 (29.5)	60,741 (33.8)
Race, n (%)		
Caucasian	16,432 (91.4)	160,404 (89.2)
African American	892 (5.0)	11,867 (6.6)
Asian	184 (1.0)	1,914 (1.1)
Hispanic	223 (1.2)	2,591 (1.4)
Native American	69 (0.4)	803 (0.4)
Other	175 (1.0)	2,171 (1.2)
New Injury Severity Score		
0 (no injury)	17,019 (94.7)	102,802 (57.2)
1–3 (minor)	367 (2.0)	46,421 (25.8)
4–8 (moderate)	519 (2.9)	27,846 (15.5)
9–15 (serious)	52 (0.3)	2,065 (1.15)
16–24 (severe)	18 (0.1)	561 (0.3)
25–75 (critical)	0 (0)	55 (0.03)
New Injury Severity Score, mean	0.20	1.21
Medicaid dual eligibility	2,785 (15.5)	35,310 (19.6)
Primary diagnosis (International Classification of Diseases, Ninth Revision, Clinical Modification code), n (%)		
Injury (800–999)	11,105 (61.8)	156,315 (87.0)
Symptoms (782–789)	1,949 (10.8)	8,651 (4.8)
Musculoskeletal (710–739)	2,161 (12.0)	8,1901 (4.6)
Urogenital (580–629)	665 (3.7)	1,417 (0.8)
Endocrine (240–279)	501 (2.8)	895 (0.5)
Cerebrovascular (430–459)	480 (2.8)	1074 (0.6)
Cardiovascular (390–429)	384 (2.1)	901 (0.5)
Mental, neurological (290–319)	306 (1.7)	995 (0.6)
Respiratory (460–519)	221 (1.2)	796 (0.4)
Digestive (520–579)	107 (0.6)	337 (0.2)
Neoplasm (140–239)	53 (0.3)	98 (0.05)
Infectious disease (0–139)	43 (0.2)	81 (0.05)

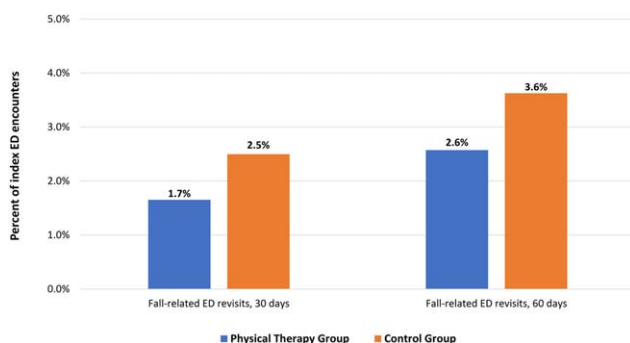
All characteristics are distinct claim counts, except where explicitly stated otherwise (e.g., total beneficiaries).

ED = emergency department.

were 1.7% within 30 days and 2.6% within 60 days, compared with 2.5% within 30 days and 3.6% within 60 days for those who did not receive PT service in the ED and survived to each time point (Figure 2). Chi-square analysis of the unadjusted results demonstrate a significant difference in revisit rates for a fall between the PT and non-PT cohort at 30 and 60 days ( $p < .001$ ).

The summary demographic characteristics of the analysis sample indicate some differences between the cohorts.

Mean age of those receiving PT services was slightly older (82.4) than the control group (80.6). Mean NISS was significantly lower in the PT arm (0.20) than in the non-PT arm (1.21); 94.7% of those who received PT in the ED had a NISS of 0. The distribution of the full set of principal CCW conditions are summarized in Supplementary Table S1. Those receiving PT services in the ED were more likely to have some chronic conditions, whereas other conditions associated with fall risk were higher in



**Figure 2.** Fall-Related emergency department revisits at 30 and 60 days

those who did not receive PT services, although most of the differences between groups were small.

### Logistic Regression Results

The results of our logistic regression models are presented in Table 2. Controlling for specified CCW conditions associated with fall risk (NISS, age, sex, Medicaid dual eligibility), receiving PT services in the ED during an index visit for a ground-level fall was associated with a significantly lower likelihood of a fall-related ED revisit within 30 (OR = 0.655,  $p < .001$ ) and 60 (OR = 0.684,  $p < .001$ ) days.

Being male and Medicaid eligibility were associated with greater odds of an ED revisit, with both factors being significant at the .001 level in the 30- and 60-day models. Age was not significant in either adjusted model. Of the CCW conditions in our model, all but atrial fibrillation, myocardial infarction, stroke, and diabetes were significant at the .05 level. (Diabetes was significant at the .10 level.) All significant CCW conditions were associated with greater odds of a revisit, with the Alzheimer's disease and related disorders category having the highest odds of the conditions examined (OR=2.12 at 30 days). NISS was not significant in the 30- ( $p = .11$ ) or 60-day model ( $p = .79$ ). Because a greater proportion of those who received PT services had a NISS of 0 (no injury noted) than of those in the control group, we conducted a sensitivity analysis to determine whether the trends we observed held when examining only claims for individuals with a NISS of 0. The results of this sensitivity analysis are available as Supplementary Table S2. In summary, there was some reduction in significance of certain CCW comorbidities in the 30- and 60-day models, but PT offered in the ED remained a significant predictor of ED revisit for a recurrent fall, and the odds of this outcome were similar (in fact, slightly lower) at 30 (OR=0.621) and 60 (OR=0.656) days.

### DISCUSSION

Our results suggest that EDs could play an important role in reducing fall-related ED revisits by linking individuals who have fallen with appropriate follow-up care, yet data suggest the likelihood of receiving a PT referral from the ED after a visit for a fall is rare; only 3.2% of older adults

presenting for a fall-related ED visit received PT services during that visit according to claims data. To our knowledge, this is the first U.S.-based study in the literature to report on this metric. (A chart review at a community-based teaching hospital in Toronto, Canada, found that only 4.3% saw a physical or occupational therapist during their ED visit for a fall.)<sup>23</sup>

A PT consultation in the ED may not always be appropriate for an older adult presenting for a fall. Injuries sustained during the fall may preclude a PT consultation during the ED visit because of location of injuries or pain. This is reflected in our results, with those receiving a PT consultation in the ED being much more likely to have a NISS of 0. In addition, studies have found that PT programs in older adults are less effective in the presence of certain comorbidities. For example, the Steps to Avoid Falls in the Elderly Study (STEPS) in Singapore conducted a prospective randomized trial measuring the effect of a PT intervention that included a program of gait, balance, and strength training over 3 months after discharge from a fall-related ED visit and found that intervention success was lower in individuals with more than 1 major comorbidity<sup>21</sup>. A randomized controlled trial found that individuals with dementia did not benefit from a comprehensive PT intervention implemented after a fall-related ED visit<sup>34</sup>, and a systematic review determined that there is lack of evidence that PT regimens are beneficial for individuals with dementia<sup>35</sup>. Further research could attempt to determine which comorbidities present the greatest impediments to likelihood of success of a PT regimen to more effectively target resources and inform treatment plans.

After accounting for comorbidity, the STEPS program achieved statistically significantly fewer individuals having another fall compared to those discharged from the ED after a fall who were not enrolled in the program. Although the STEPS program had markedly better odds (OR=0.34, 95% CI=0.17–0.67,  $p = .002$ ) than the current study (which evaluated shorter follow-up periods compared to STEPS' follow-up period of 9 months), the STEPS program actively implemented a 3-month PT regimen, whereas the current study measured only whether a PT consultation in the ED was provided. (The extent of future outpatient PT services rendered was not determined.) This suggests that the odds of a fall-related ED revisit may be even lower in individuals who that followed through on PT referral advice received in the ED. (Future research could investigate this.)

### Limitations

There are a number of limitations to this study. Some individuals presenting to the ED with a fall may not have been properly identified at index visit if a fall-related ICD-9 E-code was not recorded. Because these codes do not independently trigger a Medicare reimbursement, there is probably a greater tendency for them to be omitted in a claims database than codes specifically linked to reimbursement. Thus, the absolute number of falls in both cohorts may have been greater. It is also possible that claims-based data were less sensitive than hospital records in identifying follow-up falls, but the fall-related revisit rate at 30 days in our control group (2.5%) was comparable with the fall-

**Table 2. Logistic Regression Model Results for 30- and 60-Day Fall-Related Emergency Department Revisits**

Model	Estimate	Odds Ratio	P-Value
<b>Model 1: 30-day fall-related revisits</b>			
Intercept	-4.128	0.016	<.001
Physical therapy in the ED	-0.423	0.655	<.001
Age	-0.002	0.998	.23
Male	0.153	1.166	<.001
NISS	0.011	1.011	.11
Medicaid dual eligibility	0.166	1.180	<.001
CCW flag			
Anemia	0.138	1.147	<.001
Depression	0.168	1.183	<.001
Diabetes	0.066	1.068	.06
Alzheimer's disease	0.128	1.137	.002
Alzheimer's disease and related disorders	0.753	2.124	<.001
Atrial fibrillation	0.041	1.042	.59
Chronic heart failure	0.073	1.076	.047
Ischemic heart disease	0.105	1.111	.002
Myocardial infarction	0.050	1.052	.61
Stroke	0.093	1.098	.16
Osteoporosis	0.073	1.076	.14
Osteoarthritis	0.139	1.149	<.001
<b>Model 2: 60-day fall-related revisits</b>			
Intercept	-4.059	0.017	<.001
Physical therapy in the ED	-0.380	0.684	<.001
Age	0.001	1.001	.53
Male	0.141	1.152	<.001
NISS	-0.002	0.998	.79
Medicaid dual eligibility	0.171	1.187	<.001
CCW flag			
Anemia	0.123	1.131	<.001
Depression	0.247	1.280	<.001
Diabetes	0.053	1.054	.07
Alzheimer's disease	0.136	1.145	<.001
Alzheimer's disease and related disorders	0.831	2.296	<.001
Atrial fibrillation	-0.031	0.970	.64
Chronic heart failure	0.076	1.079	.01
Ischemic heart disease	0.106	1.112	<.001
Myocardial infarction	-0.014	0.987	.87
Stroke	0.058	1.060	.29
Osteoporosis	0.106	1.112	.009
Osteoarthritis	0.193	1.213	<.001

ED = emergency department; NISS = New Injury Severity Score; CCW = Chronic Conditions Warehouse.

related revisit rate after an index fall identified in a study based on health records databases from 2 hospitals (3.2%). (That study included individuals who were admitted, who were probably frailer or with acute injury at their index fall, which could predispose them to a higher revisit rate.) We also did not have enough detailed information in the data to exclude that an ED revisit in our study may have been related to an unresolved symptom from the index fall (e.g., back pain); it is possible that such a visit could be coded as another fall because there is no specific code for adverse events related to a prior fall. Also, because we had access to only 2 years of claims data, and index claims reflected a range of dates in this period, we were not always able to calculate comorbidities based on the full reference period that the CMS CCW algorithm prescribes.

Although use of Medicare claims data enables analysis of a large, national sample at multiple time points, in many respects, this type of data lacks the level of detail that may

be obtained from various types of records and surveys in smaller, hospital-based studies such as severity of fall and any injuries, exact nature of PT services provided (PT procedure codes were not available in the dataset analyzed), and other potentially relevant contextual factors such as caretaker situation. Lack of this information impedes the ability to control for these potentially relevant factors in the logistic regression model. Likewise, our markers of comorbidity are limited because the CCW flags only capture presence of documentation of a set of chronic conditions and does not factor in severity, and we could not fully account for all other factors that may have contributed to a person's status and likelihood of benefitting from PT services or falling in conjunction with an ED revisit. For example, we did not have access to data regarding use of sedative or psychotropic medications, which have been linked to fall risk<sup>8,10,11</sup>.

Finally, this study did not assess the extent to which PT services in the ED were tied to further PT use through

outpatient services after the index visit, which may be the most likely pathway through which reduction in future falls would be achieved. Although our study suggests that PT services in the ED, limited though they may be, are independently associated with a reduction in fall-related revisits, future research assessing what additional PT services the person received after the index visit could improve understanding of the factors influencing the association we observed. A 2010 systematic literature review found that 14 of 25 studies reported a lower risk of falling after the exercise or PT intervention under evaluation<sup>20</sup>, demonstrating the potential of such regimens but also suggesting the need for better understanding about which services and for which populations PT may be most beneficial.

## CONCLUSION

In a large, nationally representative sample, we found that 30- and 60-day fall-related ED revisit rates after ED visits for a ground-level fall were significantly lower for older adults who received PT services during their index ED visit than for those who did not. According to our findings, expanding PT services in the ED, including providing relevant information, diagnosis, and referrals for future outpatient PT services, may reduce future fall-related ED use of older adults. Additional analyses could assess this trend in more depth, including evaluation of outpatient PT services after a consultation in the ED.

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**Author Contributions:** All authors: study conception and design; review, revision, and approval of manuscript. AL, JI, TK: data analysis. AL: drafting the manuscript.

**Sponsors' Role:** All authors are employees of the non-profit, nonpartisan West Health Institute, which did not influence the design, execution, or reporting of this study.

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## SUPPORTING INFORMATION

**Table S1: Chronic Condition Warehouse (CCW) Prevalence.** \*Included in the regression model. Values in both tables represent distribution of CCW conditions at time of index visit, prior to excluding claims linked to

patient death during the followup period of 30 or 60 days.

**Table S2: Sensitivity Analysis: Logistic regression model results among those with a New Injury Severity Score of 0.**

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