Predictors and Outcomes of Revisits in Older Adults Discharged from the Emergency Department

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Predictors and Outcomes of Revisits in Older Adults Discharged from the Emergency Department

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OBJECTIVES: To study predictors of emergency department (ED) revisits and the association between ED revisits and 90-day functional decline or mortality.
DESIGN: Multicenter cohort study.
SETTING: One academic and two regional Dutch hospitals.
PARTICIPANTS: Older adults discharged from the ED (N=1,093).
MEASUREMENTS: At baseline, data on demographic characteristics, illness severity, and geriatric parameters (cognition, functional capacity) were collected. All participants were prospectively followed for an unplanned revisit within 30 days and for functional decline and mortality 90 days after the initial visit.
RESULTS: The median age was 79 (interquartile range 74–84), and 114 participants (10.4%) had an ED revisit within 30 days of discharge. Age (hazard ratio (HR)=0.96, 95% confidence interval (CI)=0.92–0.99), male sex (HR=1.61, 95% CI=1.05–2.45), polypharmacy (HR=2.06, 95% CI=1.34–3.16), and cognitive impairment (HR=1.71, 95% CI=1.02–2.88) were independent predictors of a 30-day ED revisit. The area under the receiver operating characteristic curve to predict an ED revisit was 0.65 (95% CI=0.60–0.70). In a propensity score–matched analysis, individuals with an ED revisit were at higher risk (odds ratio=1.99 95% CI=1.06–3.71) of functional decline or mortality.
CONCLUSION: Age, male sex, polypharmacy, and cognitive impairment were independent predictors of a 30-day ED revisit, but no useful clinical prediction model could be developed. However, an early ED revisit is a strong new predictor of adverse outcomes in older adults. **J Am Geriatr Soc 66:735–741, 2018.**

Key words: Emergency Department; revisits; older patients; adverse outcomes; emergency medical services

Emergency department (ED) use by older adults is increasing, and up to 22% have a revisit to the ED within 1 month after discharge from the ED.[1–6] Some stakeholders view early ED revisits unfavorably, and they are sometimes used as a proxy for preventable adverse outcomes. Revisit might be preventable if it were possible to identify a group of individuals with greater risk of returning to the ED at their first visit. Published studies have had inconsistent results in identifying risk factors.[3,7,8]

International guidelines to provide optimal emergency care to older adults include recommendations for safe discharge planning.[9,10] The recommendations positively influence the care of older adults and contribute to better outcomes. In the first 3 months after an ED visit, older adults are at greater risk of functional decline and mortality.[11] It can be speculated that older adults who need to return to the ED early may even be at greater risk of adverse health outcomes, but to our knowledge this has not been studied.

We conducted a cohort study in individuals aged 70 and older visiting 3 EDs in the Netherlands. The aim of the present study was to identify predictors of a 30-day ED revisit and to investigate the association between an early ED revisit and the composite outcome of 90-day functional decline or mortality.

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METHODS

Study design and setting

We performed a cohort study in older adults visiting EDs in the Netherlands, the Acutely Presenting Older Patients Study.[12] Older adults who presented to the Leiden University Medical Center (LUMC, Leiden) ED from September to November 2014, the Alrijne Hospital (Leiderdorp) from March to June 2015, and the Haaglanden Medical Center (HMC Bronovo, The Hague) from May to July 2016 were included. Inclusion was conducted during a 3-month period in the LUMC (7 days a week, 24 hours a day) and in the Alrijne hospital (7 days a week from 10:00 a.m. to 10:00 p.m.). In the HMC Bronovo, we aimed to include a total of 500 participants, 6 days a week from 10:00 a.m. to 10:00 p.m. The eligibility criteria were not restrictive; all individuals aged 70 and older who visited the ED during the predefined period were included. Exclusion criteria were red triage category according to the Manchester Triage System[13] (highest acuity), unstable medical condition, no permission of nurse or physician to approach the individual, language barrier, and inability to provide informed consent. Relatives were allowed to answer questions, except for the cognition test. For the present study, all individuals discharged from the ED who had not had a prior ED visit within 30 days were used. The medical ethics committees of all hospitals waived the necessity for formal approval of the present study, because the study closely follows routine care. All participants or authorized relatives provided written informed consent before inclusion. The Strengthening the Reporting of Observational Studies in Epidemiology[14] and Transparent Reporting of a Multivariate Prediction Model for Individual Prognosis or Development reporting guidelines were used.[15]

Revisits

An early ED revisit was defined as an unscheduled ED revisit during the 30 days after discharge from the ED that was not part of prearranged care (e.g., ED return on doctor's request, e.g., during the weekend).[16] Records were checked to assess data on revisits. To reduce the risk of missing revisits to other hospitals, after 90 days of follow-up, participants were asked over the telephone whether they had made an ED visit to another hospital after the index visit, and information was subsequently verified. In the Netherlands, individuals who return to the hospital after being discharged are always brought to the ED first. Training was provided before the telephone calls were made to make sure that callers understood the script. JdG, JL, and a medical student collected follow-up information.

Potential predictors of ED revisits

Participants had to answer a limited set of questions within 30 to 45 minutes after arrival at the ED. Data were collected in 3 categories. First, information was collected on demographic characteristics, including age, sex, living arrangement, and level of education. Living arrangement was defined as living independently with others, independently alone, or in a residential care center or nursing home. Vocational training or university was considered high education. Second, severity of medical condition was assessed according to arrival by ambulance, fall-related ED visit, triage category, and chief complaint determined according to the Manchester Triage System (MTS). [13] The MTS was part of routine clinical care in all hospitals and includes standardized series of flow charts for various presentations to determine urgency in a 5-level triage color, comparable with the Emergency Severity Index.[17] The 52 MTS chief complaints were classified into 7 main groups (Supplementary Table S1). Third, geriatric parameters were polypharmacy, use of a walking device, Katz activity of daily living (ADL) score,[18] and cognition measured using the 6-item Cognitive Impairment Test (6-CIT).[19] Polypharmacy was defined as the use of 5 or more different medications at home, self-reported by the individual. The Katz ADL questionnaire consists of 6 yes-or-no questions on basic ADLs, with higher scores indicating greater dependency. We asked about ADL ability 2 weeks before the ED visit to exclude negative effects of the acute medical complaint on functional status. The 6-CIT is a short cognition test with scores ranging from 0 to 28. A score of 11 or higher is comparable with the conventional cut-off of 23 or lower on the Mini-Mental State Examination and indicates moderate to severe cognitive impairment, irrespective of the cause (e.g., delirium, dementia, depression, medical illness).[20–22] Two authors (JdG, JL) and trained medical students prospectively collected patient data using structured data collection forms at all three hospitals. Training sessions occurred before the beginning of the study to ensure consistency in questionnaire administration.

Outcomes

The primary adverse health outcome was the composite outcome of functional decline or mortality at 90 days of follow-up Functional decline was defined as a 1-point or greater increase in Katz ADL score or new institutionalization 90 days after the ED visit. Mortality was incorporated into the composite outcome because to omit death would ignore the ultimate functional decline. Data on mortality were obtained from municipal records. Participants were contacted by telephone 90 days after the ED index visit, and a limited set of questions was asked, including living arrangement, functioning, and ED revisits in other hospitals. If there was no response after 3 attempts, the general practitioner was contacted to verify the telephone number and living arrangement (new institutionalization). Finally, a letter was sent to participants who could not be contacted with a request for a written response.

Statistical analysis

Descriptive characteristics are presented as medians with interquartile ranges (IQRs) and numbers with percentages. P-values were calculated using the chi-square test for categorical data and the Mann-Whitney U test for non-normally distributed numeric data. Missing data are

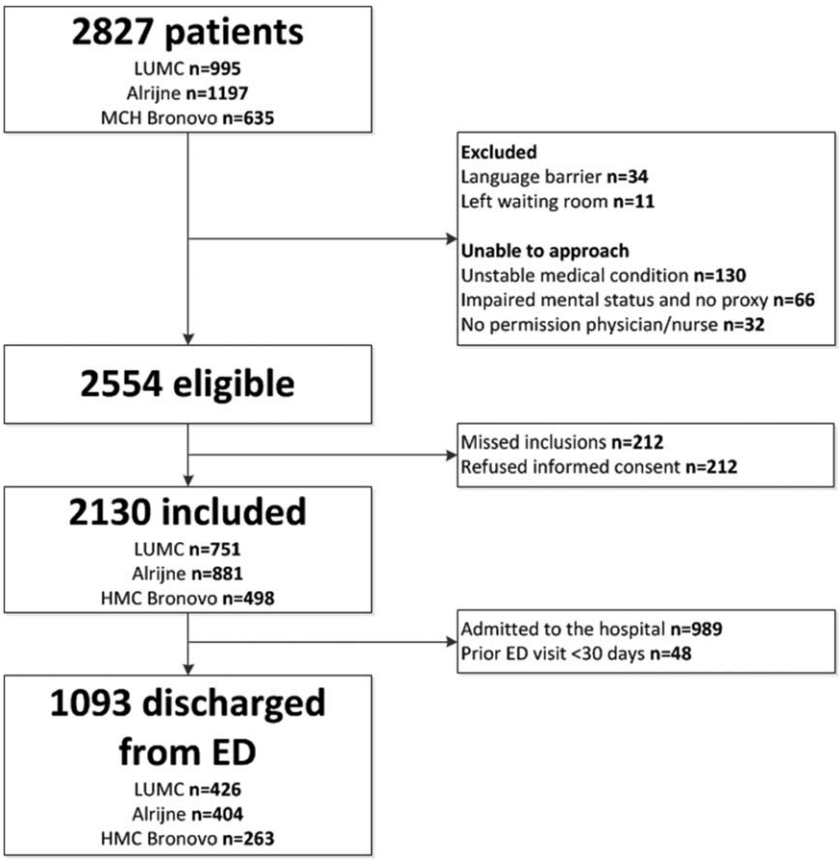

Figure 1. Flowchart of study population.

reported in the table footnotes. A Kaplan-Meier curve was used to show the cumulative incidence of 30-day ED revisits. Multivariable Cox regression was used to investigate the association between all baseline characteristics at the index visit and a 30-day ED revisit. The proportional hazards assumption for each prognostic factor was tested using time-dependent covariates, and a prediction model was developed with logistic regression using backward elimination with the Akaike Information Criterion. Ten events per candidate predictor are required to obtain adequate predictions.[23] Discrimination was assessed by calculating the area under the curve (AUC), and calibration was quantified using the Hosmer and Lemeshow test.[24] Predictive performance for the participants with the highest 30%, 20%, and 10% predicted risk was evaluated according to sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio (LR+), and negative likelihood ratio (LR–), with 95% confidence intervals (CIs). A propensity score–matched analysis was conducted to account for the risk of an ED revisit.[25] First a propensity score was estimated for early revisit from the entire population by including the variables demographic characteristics, severity of medical condition, and geriatric parameters. Second, controls were matched at a 1:1 ratio with a propensity score tolerance of 0.05 to minimize potential confounding and selection biases.

The association between an early ED revisit and 90-day adverse health outcome was assessed using binary logistic regression analysis using the group with early ED revisits and the matched control group. Predictive performance of an early revisit was shown using sensitivity, specificity, LR+, LR–, and AUC with 95% CIs. $P<.05$ was considered statistically significant. All analyses were conducted using SPSS Statistics version 23.0 (IBM, Corp., Armonk, NY) and Stata version 14.0 (Stata Corp., College Station, TX).

RESULTS

Figure 1 shows the flowchart of the study population. During the study period, 2,827 individuals aged 70 and older visited the LUMC, Alrijne Hospital, and HMC Bronovo EDs, of whom 2,554 were eligible, of whom 83.4% (2,130/2,554) were included. For the present study, all individuals discharged from the ED to home were used (51.3%, 1,093/2,130).

The baseline characteristics of the study population are shown in Table 1. Median age was 79 (IQR 74–84), 486 participants (44.5%) were male, and 438 (40.1%) arrived by ambulance. Median Katz ADL score was 0 (IQR 0–1), and 189 participants (18.2%) had cognitive impairment.

Predictors of an ED revisit

One hundred fourteen of 1,093 participants (10.4%) had an ED revisit within 30 days of follow-up (Supplementary Figure S1): 33 from the LUMC, 48 from Alrijne Hospital,

Table 1. Baseline Characteristics of Older Adults Discharged from the Emergency Department (ED) (N = 1,093)

Characteristic	Value
Demographic	
Age, median (IQR)	79 (74–84)
Male, n (%)	486 (44.5)
Living arrangement, n (%)	
Independent with others	603 (55.2)
Independent alone	396 (36.2)
Residential care or nursing home	94 (8.6)
High education, n (%)	250 (23.0)
Severity of medical condition	
Arrival by ambulance, n (%)	438 (40.1)
Triage urgency, n (%)	
>1 hour (green)	434 (39.7)
<1 hour (yellow)	543 (49.7)
<10 minutes (orange)	116 (10.6)
Chief complaint, n (%)	
Minor trauma	463 (42.4)
Chest pain	206 (18.8)
Malaise	141 (12.9)
Abdominal pain	75 (6.9)
Dyspnea	68 (6.2)
Loss of consciousness	52 (4.8)
Other	88 (8.1)
Fall before ED visit, n (%)	352 (32.2)
Geriatric parameters	
Polypharmacy, n (%)	560 (51.2)
Use of walking device, n (%)	406 (37.3)
Katz ADL score, median (IQR)	0 (0–1)
Cognitive impairment, n (%)[a]	189 (18.2)

Missing data: education level, n = 7; use of walking device, n = 5; Katz activity of daily living (ADL) score, n = 13; cognition score, n = 53.
[a]Six-item Cognitive Impairment Test score ≥11, includes 69 participants with history of dementia.
IQR = interquartile range.

and 33 from HMC Bronovo. Baseline characteristics of those with and without an ED revisit can be found in Supplementary Table S2. In the multivariable analysis, an increase in age of 1 year above the age of 70 (hazard ratio (HR)=0.96, 95% CI=0.92–0.99), male sex (HR=1.61, 95% CI=1.05–2.45), polypharmacy (HR=2.06, 95% CI=1.34–3.16), and cognitive impairment (HR=1.71, 95% CI=1.02–2.88) were associated with a 30-day revisit (Table 2). A prediction model was developed that included age, sex, polypharmacy, and impaired cognition (Supplementary Table S3). Accuracy of the prediction model was poor, with an AUC of (95% CI=0.60–0.70), the Hosmer and Lemeshow goodness of fit p-value was .86, and the formula to compute the individual risk of a revisit can be found in Supplementary Table S3 footnotes. The positive predictive value was 0.18 (95% CI=0.13–0.24) for the 20% of patients at highest risk (Supplementary Table S4).

The association between ED revisits and outcomes

Fifty-one of 1,093 participants (4.7%) were lost to follow-up for data on physical functioning, but we verified that they were alive from municipal records. These individuals were considered not to be experiencing functional decline. After allocation based on 1:1 propensity score matching, baseline covariates were similar in the matched cohort (Supplementary Table S5). Patients with an early ED revisit were at higher risk of experiencing the composite outcome (OR=1.99, 95% CI=1.06–3.71, p=.03) (Table 3). The predictive performance of an early ED revisit had a sensitivity of 0.63 (95% CI=0.49–0.75), specificity of 0.54 (95% CI=0.46–0.62), LR+ of 1.37 (95% CI=1.05–1.78), LR– of 0.69 (95% CI=0.49–0.98), and AUC of 0.59 (95% CI=0.50–0.67).

DISCUSSION

Approximately 10% of older adults return to the ED within 30 days after being discharged. Older age, male sex, polypharmacy, and impaired cognition were identified as independent determinants of an ED revisit, but the prediction model is not efficient for clinical use. More importantly, participants with an early ED revisit were twice as likely to experience functional decline or mortality.

It is difficult for ED providers to determine who will return to the ED. To prevent a revisit, identification of older adults who are at high risk enables individualization of discharge planning with concurrent use of the community care network. Prospective studies on 30-day ED revisits in older adults discharged from the ED have been performed.[3,8,26,27] All studies consistently had poor predictive accuracy for ED revisits, with different predictors in the final prediction models. A study in Australia showed that chronic obstructive pulmonary disease, cognitive impairment, a previous ED visit, and a low triage score were independent determinants of a revisit,[3] whereas a study in Canada identified history of diabetes, a recent ED visit, hospital admission during the previous 6 months, depression, and lack of support as independent determinants of a revisit.[8] A risk nomogram on 30-day ED revisits was developed in Austria and included prior number of attendances, age, male sex, polypharmacy, cognition score, and malignancy,[1] but discrimination of the model was poor, and the ED revisit rate of 28% was much high than in our study.[28] We were unable to replicate all findings of previous studies, possibly because we have looked to other predictors than the other studies. Only age, male sex, polypharmacy, and cognitive impairment were associated with risk of an ED revisit. In line with previous studies, we were unable to develop an accurate prediction model on 30-day ED revisits. Other factors that may influence the risk of returning to the ED may explained the differences between studies in predictors associated with an ED revisit and the difficulties of developing a useful prediction model. Four common themes are described that are related to a revisit; the individual, severity of illness, organization of the healthcare system, and the role of the clinician.[29] Within these themes, some factors take too much time or are difficult to measure in the ED, such as individuals' personal experiences and feelings after being discharged, such as fear, uncertainty, and lack of trust in the system.[30] Other factors can potentially positively be influenced, like aftercare provided by the general practitioner and various home health and paramedicine initiatives. To prevent a revisit, randomized controlled trials and cohort studies

Table 2. Univariate and Multivariate Association Between Baseline Characteristics and 30-Day Emergency Department (ED) Revisits in Older Adults Discharged from the ED

Characteristic	Multivariable Hazard Ratio (95% Confidence Interval)	P-Value
Demographic		
Age	0.96 (0.92–0.99)	.01
Male	1.61 (1.05–2.45)	.03
Living arrangement (reference independent with others)		
Independent alone	1.07 (0.69–1.66)	.75
Residential care/nursing home	0.78 (0.32–1.91)	.59
High education	0.99 (0.61–1.61)	.97
Hospital (reference Leiden University Medical Center)		
Alrijne	1.85 (1.12–3.04)	.02
Haaglanden Medical Center Bronovo	2.23 (1.32–3.79)	.003
Severity of medical condition		
Arrival by ambulance	1.12 (0.72–1.74)	.61
Triage urgency (reference >1 hour (green))		
< 1 hour (yellow)	1.05 (0.69–1.62)	.81
< 10 minutes (orange)	1.04 (0.47–2.33)	.92
Chief complaint (reference minor trauma)		
Chest pain	0.60 (0.29–1.22)	.19
Malaise	0.68 (0.32–1.43)	.31
Abdominal pain	1.16 (0.53–2.58)	.71
Dyspnea	1.47 (0.72–3.02)	.29
Loss of consciousness	0.55 (0.16–1.88)	.34
Other	1.25 (0.62–2.51)	.53
Fall before ED visit	0.80 (0.45–1.41)	.44
Geriatric parameters		
Polypharmacy	2.06 (1.34–3.16)	.001
Use of walking device	1.32 (0.81–2.15)	.26
Katz activity of daily living score	0.96 (0.80–1.17)	.71
Cognitive impairment	1.71 (1.02–2.88)	.04

All listed variables were included. The multivariable analysis included 1,020 individuals with 107 events.

were conducted,[1,2,5,31,32] but the number of ED revisits could not be reduced.[33] It may be that the intervention is inefficient, but it is more likely that the intervention is ineffective in those in whom it is used. The mixed results and heterogeneous causes of revisits complicate identification of older adlts who will return to the ED and challenges whether ED-based interventions can efficiently and reliably reduce ED revisits

To our knowledge, the association between early ED revisits and subsequent adverse health outcomes has never been evaluated, despite the fact that it is used as a quality-of-care indicator.[29] After balancing the population on the propensity of experiencing an early ED revisit, participants with an early ED revisit were twice as likely to experience functional decline or mortality 3 months after the index visit. Although the difference was not significant, participants with an ED revisit used more medications and were more likely to have cognitive impairment than matched controls. It may be that adverse drug events resulted in ED revisits or cognitive impairment played a role in the reason to return to the ED or it may be proxies for illness severity. Alternatively, participants with an ED revisit were comparable in most characteristics with those without an ED revisit. It could be that an early ED revisit incorporates multiple determinants that are difficult to quantify but are associated with adverse health outcomes, such as the ability to rely on a caregiver, adherence to discharge instructions, and duration of recovery. Early ED revisits are considered to be a negative outcome for older adults, although an ED revisit could be part of the treatment plan (e.g., return to ED when symptoms worsen while being treated with oral antibiotics). Although any visit to the hospital is a burden, other outcomes such as functional dependency are at least as important for older adults. Based on our results, an early ED revisit can be considered as a predictor of functional decline or mortality, even in older adults that are not presenting in extremis.

Table 3. Association Between Early Revisit and Functional Decline or Mortality in Propensity Score–Matched Cohort

	Total Cohort, N = 1,093	Early Revisits, n = 108	Matched Controls, n = 108
Composite outcome, n (%)	253 (23.1)	35 (32.4)	21 (19.4)
Odds ratio (95% confidence interval)		1.99 (1.06–3.71)	

A propensity score was not computed for 6 participants (5.3%) with an early emergency department (ED) revisit and 54 (5.5%) with no early ED revisit because of missing predictors. The missing predictors are described in the Table 1 footnotes.

Clinical implications

Improving quality of care for older adults is among the highest priorities of multiple stakeholders (American Geriatrics Society, Hartford Foundation Society for Academic Emergency Medicine, National Institute on Aging, New Frontiers). It is challenging to assess vulnerability in the ED setting[34] and to discern which individuals would benefit most from specific geriatric follow-up interventions.[35] A decision rule can assist clinicians in making that decision,[36] but existing and widely used screening instruments lack the ability to accurately distinguish who is at the highest and lowest risk.[37] Results of the present study call into question whether it is efficient to screen for individuals at high risk of an early ED revisit routinely. Instead of using early revisit as a negative or nonreimbursable outcome, it could be used as an independent predictor of adverse outcomes in new or existing prediction models. In the clinic, an early revisit should trigger a thorough assessment of other geriatric determinants of adverse outcomes, with the aim of positively influencing outcomes.[38]

Our study has several limitations. First, we were not able to investigate all possible predictors associated with ED revisits or adverse outcomes, such as medical history, presence of caregivers, and visits to a general practitioner shortly after discharge. The study was designed to reflect daily practice as much as possible, and therefore the aim was to include a representative percentage of patients rather than a subset of the ED population who were healthy enough to complete all questionnaires. As a consequence, the number of potential confounding variables assessed was reduced. Second, it is possible that we missed ED revisits to other hospitals, although we proactively asked participants over the telephone and cross-referenced participants. Third, selection bias could have occurred, because 4.7% of participants were lost to follow-up. We verified in municipal records that these individuals were alive. Instead of excluding them from further analysis, we considered them as not having functional decline, which could have resulted in an underestimation of the outcome. In a sensitivity, results were comparable when these participants were excluded or assumed the have functionally declined. Fourth, the power to develop the prediction model for ED revisits was not sufficient. Results were similar when repeating the analysis with fewer candidate predictors by excluding chief complaint and living arrangement. A strength of the present study was that an unselected representative group of older adults (83% of all eligible individuals) attending the ED was included and that the follow-up rate was high (95.3%). Second, because of the propensity score matching analysis, participants and matched controls had a comparable chance for an early ED revisit.

In conclusion, older age, male sex, polypharmacy, and cognitive impairment were independently associated with a 30-day ED revisit. No useful clinical prediction model could be developed. However, an early ED revisit is a strong new predictor of adverse outcomes in older adults.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Table S1. Chief complaints.

Table S2. Baseline characteristics of the study population.

Table S3. Final prediction model for ED revisits.

Table S4. Predictive performance of the final prediction model to predict early ED revisits.

Table S5. Baseline characteristics of propensity matched cohort.

Figure S1. A Kaplan-Meier curve of 30-day unscheduled ED revisits in older patients discharged from the Emergency Department.

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