Improving care for acutely presenting older patients visiting the emergency department: the implementation of geriatric screening in routine care

Blomaard, L.C.

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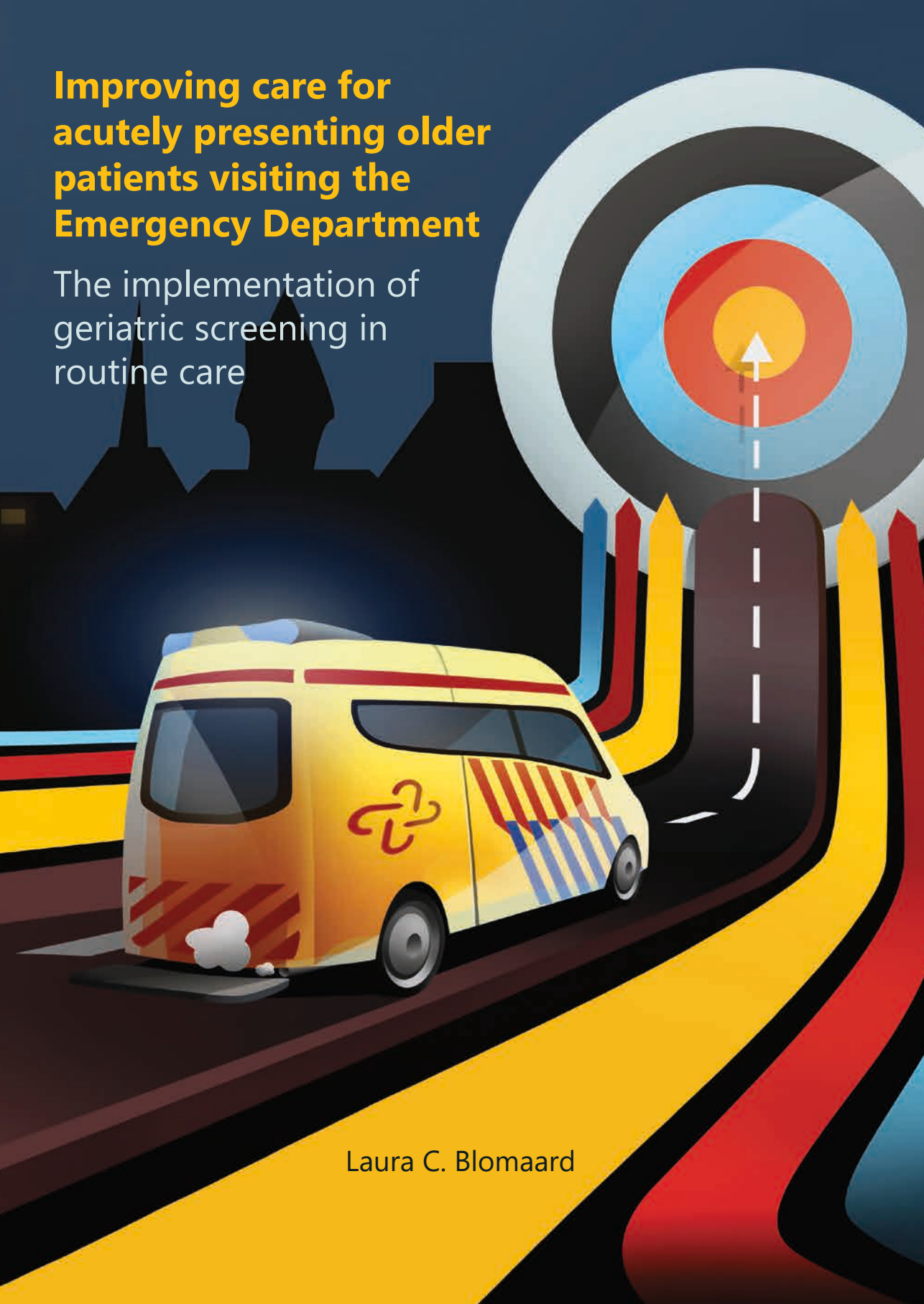

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Improving care for acutely presenting older patients visiting the Emergency Department: The implementation of geriatric screening in routine care

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Table of Contents

Chapter 1

General Introduction

Background

Worldwide, Emergency Departments (EDs) provide immediate care of acutely ill or injured patients, and are characterized by a high patient turnover, rapid triage, acute intervention and fast disposition[1;2]. In the past decades, the growing number of older people presenting to EDs is slowly transforming the practice of emergency medicine[3], and the new field of geriatric emergency medicine addresses the challenges of providing acute care for older ED patients. Compared to younger patients, older patients use emergency services more often, have longer stays in the ED and are more likely to be admitted or to have repeat ED visits[4-6]. Additionally, delivering good emergency care to older people is challenging because older patients more often have non-specific disease presentations, have higher rates of serious illnesses and tend to have more comorbidities, polypharmacy and cognitive disorders compared to younger patients[7;8]. All these factors taken together complicate the ED presentation, diagnosis and management of older patients. Furthermore, older ED patients are at high risk of adverse health outcomes, such as mortality or functional decline. The risks are particularly high in the first three months after an ED visit, with a mortality rate around 10% and increased functional dependence between 10-45%[4]. However, not all older people presenting to the ED are at high risk of adverse outcomes, because they represent a very heterogeneous group: some are vital, others have considerable frailty[9]. The early identification of different risks followed by personalized treatment could lead to an improvement in ED care for older patients.

Comprehensive Geriatric Assessment (CGA) is an effective method to identify older patients at increased risk of adverse health outcomes and consequently improve patient outcomes[10]. However, performing a complete CGA of all older patients in the ED setting is often impossible due to time constraints, the lack of specific training to undertake CGA and often the condition of the patient[11-13]. Alternatively, a two-step approach can be used with an early identification of patients at highest risk as a first step, followed by targeted interventions according to the principles of CGA[14]. This two-step approach is increasingly used in various health care settings, for example by general practitioners for case-finding in primary care and in oncologic care in hospitals[15;16]. In the ED setting, several risk stratification tools and screening instruments have been specifically developed for older ED patients[17]. Some of these tools use geriatric parameters to measure frailty, while others predict the risk of various short-term adverse health outcomes[18-20]. Even though these tools therefore measure different things, the terms for tools are used interchangeably in literature. In this thesis, the term 'geriatric screening' is used. The comparison of tools is challenging due to the use of different endpoints, and the development and validation in different health care settings and countries. Therefore, there is no consensus on which tool regarding predictive value and feasibility is best to use in clinical ED practice. More importantly, the clinical value of using geriatric screening in the ED is still unclear[21]. Limited research has been conducted on the extent to which geriatric screening parameters, combined with other

characteristics measured in the ED, contribute to the risk of adverse outcomes in older patients. In the ED, risk stratification is executed by means of triage tools, which are based on the patients' clinical urgency only. It might be of added value to take frailty into account by combining a geriatric screening tool and an urgency triage tool in older ED patients. Furthermore, approximately 20-25% of older patients visit the ED due to a fall and since falls may indicate underlying frailty, the association between geriatric screening and fall characteristics with adverse health outcomes needs to be further explored. Finally, it is unknown whether geriatric screening parameters measured in the ED are associated with long-term adverse health outcomes, although this could aid in individualized treatment decisions to optimize outcomes for older patients.

The following challenge for the field of geriatric emergency medicine is the implementation of screening in routine ED practice. Although many geriatric screening instruments have been reported in literature, and the use of these instruments is promoted in international guidelines, widespread dissemination remains scarce[22]. One of the important reasons why screening of older ED patients is rarely carried out in routine care, is the fact that little is known about the practical issues and feasibility of implementation in the fast-paced environment of everyday ED practice[23]. Understanding how tools are likely to be used in routine clinical practice is important to ensure that they are accepted by ED care providers and older patients, which increases the chance of successful implementation[24]. Tools can have the best validated predictive values, but there will be no benefit for patients if they are not used due to unsuccessful implementation in practice[25]. The gap between research and practice needs to be bridged by focusing more on implementation outcomes, such as the feasibility of screening, the effects of implementation on process of care, the acceptability among care providers and the experiences of older patients[26].

One of many developed screening instruments for the ED is the Acutely Presenting Older Patient (APOP) screener[27]. The APOP screener identifies the individual risk of 90-day functional decline and/or mortality and signs of impaired cognition for ED patients aged 70 years and older. The instrument was developed in the Netherlands and cross-validated in four Dutch hospitals[28]. In order to increase the chance for successful implementation, the screener was refined according to international methodological standards. The final screener consists of nine questions and can be administered within two minutes. In this thesis, the APOP screener was used as an instrument for geriatric screening to answer our research questions.

Aim of the thesis

To improve care for acutely presenting older patients visiting the ED, this thesis has two aims. The first aim of this thesis is to study the association of geriatric screening parameters collected in the ED with various adverse health outcomes in different subgroups of older ED patients. The second aim of this thesis is to investigate the

feasibility, impact and experiences of implementing a geriatric screening program in routine ED practice.

Outline of the thesis

This thesis is divided in two parts. The first part of this thesis describes the motivation regarding the strategy of using geriatric screening in ED care. In **chapter 2** we study the effect of geriatric screening parameters on the association of triage urgency levels and adverse health outcomes in a broad population of older ED patients. **Chapter 3** studies the relationship between geriatric screening and fall characteristics with three months and one year functional decline and mortality in older patients who presented themselves to the ED with a fall. In **chapter 4** we describe a population of acutely hospitalized older internal medicine patients and the association between geriatric parameters, measured with screening in the ED, and clinical outcomes and long-term adverse health outcomes.

The second part of this thesis consists of studies about the implementation of geriatric screening in routine ED care. **Chapter 5** studies the feasibility and acceptability of the use of geriatric screening in the ED, by evaluating these outcomes after implementation of the APOP screener in routine ED care in the Leiden University Medical Center. In **chapter 6**, the effects of the implementation of the APOP screening program are evaluated in a before-after design, by assessing the compliance with program interventions and the impact on process of care measures. In **chapter 7** we explore the experiences with and attitudes towards geriatric screening in routine ED care among older ED patients using qualitative research methods.

Finally, in **chapter 8** the main conclusions of this thesis are summarized and discussed, and future perspectives are proposed.

Overview of used patient cohorts

APOP prospective cohort

The APOP prospective cohort is collected within an observational multicenter study that was performed in four Dutch hospitals: the Leiden University Medical Center (LUMC), Alrijne Hospital location Leiderdorp, Haaglanden Medical Center (location Bronovo) and Erasmus University Medical Center. Patients were included between September 2014 and January 2017. All consecutive patients visiting the ED, aged 70 years or older, were included. After routine urgency triage, data were collected by trained medical students on demographics, severity of disease indicators and geriatric measurements (i.e. Katz activities of daily living questionnaire and six-item Cognitive Impairment Test). The endpoints of this study were three months and one year functional decline and mortality.

APOP implementation cohort

The APOP implementation study was executed in the ED of the LUMC and used a before-after design. The APOP screening program was incorporated after routine urgency triage from March 2018. All consecutive patients aged 70 years or older who visited the ED in the two months before implementation (December 2017 – February 2018) and two months after implementation (April 2018 – June 2018) were included. In both data collection periods, we collected patient characteristics, organization-related characteristics (i.e. the number of available personnel and measurements of crowding), the execution of program interventions and process of ED care measures (i.e. ED length of stay). Patient characteristics and process of care measures were collected from medical records. Organization-related measurements and the execution of interventions were collected with real-time observations by trained medical students. In the two months period after implementation, additional data was collected on the screening rate. The endpoints of this study were two-fold. First, the feasibility of screening, evaluated by measuring the screening rate and patient- and organization-related determinants of screening completion after implementation. Second, the effects of implementation, evaluated by the compliance with interventions and the impact on process of care after implementation compared to before implementation.

APOP qualitative interview cohort

The APOP qualitative interview cohort is the result of an explorative qualitative study conducted between September 2019 and January 2020. The target population was comprised of older patients aged 70 years and older who recently visited the ED of the LUMC and had completed the APOP screening tool during their stay in the ED. Fourteen individual face-to-face semi-structured interviews were conducted to gain insight in the experiences with, and attitudes towards screening in routine ED care among older people.

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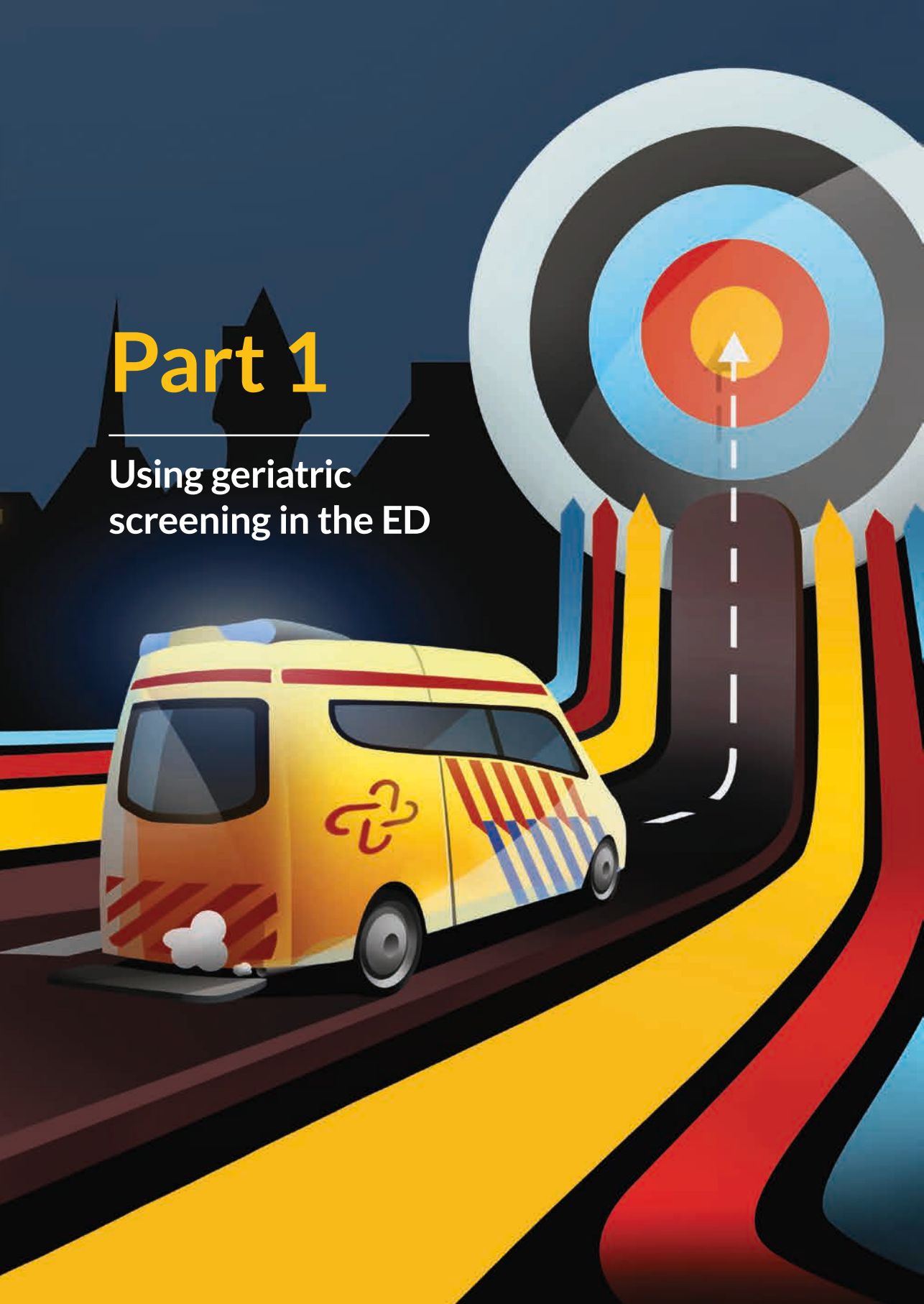
Part 1

Using geriatric screening in the ED



Chapter 2

Geriatric screening, triage urgency and 30-day mortality in older Emergency Department patients

Laura C. Blomaard, Corianne Speksnijder, Jacinta A. Lucke, Jelle de Gelder, Sander Anten, Stephanie C.E. Schuit, Ewout W. Steyerberg, Jacobijn Gussekloo, Bas de Groot, Simon P. Mooijaart

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ABSTRACT

Background: Urgency triage in the Emergency Department (ED) is important for early identification of potentially lethal conditions and extensive resource utilization. However, in older patients, urgency triage systems could be improved by taking geriatric vulnerability into account. We investigated the association of geriatric vulnerability screening in addition to triage urgency levels with 30-day mortality in older ED patients.

Design: Secondary analysis of the observational multicenter Acutely Presenting Older Patient (APOP) study.

Setting: EDs within four Dutch hospitals.

Participants: Consecutive patients aged 70 years or older, who were prospectively included.

Measurements: Patients were triaged using the Manchester Triage System (MTS). In addition, the APOP screener was used as a geriatric screening tool. The primary outcome was 30-day mortality. Comparison was made between mortality within the geriatric high- and low-risk screened patients in every urgency triage category. We calculated the difference in explained variance of mortality by adding the geriatric screener (APOP) to triage urgency (MTS) by calculating Nagelkerke R^2.

Results: We included 2608 patients with a median age of 79 (interquartile range = 74-84) years, of whom 521 (20.0%) patients were categorized as high risk according to geriatric screening. Patients were triaged on urgency as standard (27.2%), urgent (58.5%), and very urgent (14.3%). In total, 132 (5.1%) patients were deceased within a period of 30 days. Within every urgency triage category, 30-day mortality was threefold higher in geriatric high-risk compared to low-risk patients (overall = 11.7% vs. 3.4%; $p<0.001$). The explained variance of 30-day mortality with triage urgency was 1.0% and increased to 6.3% by adding the geriatric screener.

Conclusion: Combining triage urgency with geriatric screening has the potential to improve triage, which may help clinicians to deliver early appropriate care to older ED patients.

INTRODUCTION

Emergency Department (ED) urgency triage aims to prioritize patients based on their clinical urgency, rapidly diagnose potentially lethal illness, and reduce the negative impact of a delay in treatment on prognosis. Within the last 30 years, several triage tools have been developed and implemented within routine ED care to manage ED crowding[1]. The Australasian Triage Scale[2], the Canadian Triage and Acuity Scale (CTAS)[3], the Manchester Triage System (MTS)[4], and the Emergency Severity Index[5] are frequently used and have reasonable overall validity and reliability in allocating clinical priority[6-8]. However, despite the increase in older patients visiting the ED, abovementioned commonly used triage tools seem to allocate urgency less effective within this population[9-11]. Potentially, different reference values of vital signs, atypical disease presentations, or the presence of cognitive impairment could be contributing factors[12]. Older patients are therefore at risk for "undertriage", an assignment of an inappropriately low triage level, resulting in longer wait times and risk of adverse outcomes due to harm by delay in treatment[13-17].

Although it is known that frail older patients have high risks of adverse outcomes and tend to have less functional organ capacity, making this population more vulnerable to adverse outcomes when ED treatment is delayed, this is not incorporated in urgency triage tools. However, several geriatric screening tools have been developed to identify vulnerable geriatric patients in the ED[18], like the Identification of Seniors At Risk (ISAR)[19], Triage Risk Screening Tool (TRST)[20], and the Acutely Presenting Older Patient (APOP) screener[21]. Although there is still room for improvement in predictive performance[18], these geriatric vulnerability screening tools may still have added value as they enhance awareness and understanding of geriatric patients beyond the ED presenting complaint[22].

Geriatric screening tools are prognostic tools on longer-term adverse outcomes, while urgency triage tools are primarily designed as diagnostic tools to assign short-term clinical priority and secondarily to predict short-term mortality. Although geriatric screening tools and triage tools serve different purposes, it was hypothesized that the combination of these tools could improve triage and prediction of early mortality in older patients[23-26]. However, the added value of combining a geriatric screening tool and an urgency triage tool in the ED has not been studied before.

Therefore, the aim of this study was to explore the combination of geriatric screening with triage urgency by means of studying the association of geriatric screening in addition to triage urgency levels with 30-day mortality in older ED patients. To explore this proof of principle, the APOP screener was used as a geriatric screening tool and the MTS was used as a triage tool.

METHODS

Study design

This was a secondary analysis of the APOP study: a prospective multicenter cohort study that was performed in four Dutch hospitals. A detailed description has been published elsewhere[27]. In short, patients visiting the ED at the Leiden University Medical Center (LUMC; September 2014-November 2014), Alrijne Hospital (March 2015-June 2015), Haaglanden Medical Center (HMC), location Bronovo (May 2016-July 2016) and Erasmus University Medical Center (July 2016-January 2017) were included. Inclusion occurred 24/7 within the LUMC, 7 days a week (from 10 AM to 10 PM) within the Alrijne Hospital, 6 days a week (from 10 AM to 10 PM) within the HMC Bronovo, and 4 days a week (from 10 AM to 10 PM) within the Erasmus University Medical Center. Written informed consent was obtained from all patients. The study was approved by the Medical Ethics Committees of all four hospitals.

Setting

In all participating EDs, a triage nurse prioritized patients based on their disease severity by using the MTS as an urgency triage tool at patient arrival[4;28]. Triage nurses are trained to use the MTS by standardized approaches and protocols, which generally results in substantial interrater reliability[29]. The MTS consists of 52 presenting complaint-based flowcharts, and each of the flowcharts uses key discriminators to determine urgency in a five-level scale: red (immediate assessment required; eg, respiratory failure, shock, coma); orange (very urgent, seen within 10 minutes; eg, chest pain); yellow (urgent, seen within 60 minutes; eg, pneumonia); green (standard, can wait 120 minute; eg, ankle sprain); and blue (nonurgent, can wait 240 minutes; eg, abrasions). The 52 possible chief complaints were classified into seven main groups[21]. As the nonurgent level is not used in routine care within the participating EDs and patients with the immediate urgency level were excluded, patients presenting with triage urgency levels standard, urgent, and very urgent were included in the present study.

Study participants

In the APOP study, all consecutive patients aged 70 years or older, visiting the ED were included. We excluded patients who were triaged “red” according to the MTS, because due to immediate required assessment geriatric screening would not be possible or beneficial for these patients[4]. In addition, patients with an unstable medical condition, those with impaired mental status without a proxy to provide informed consent, those with a language barrier, and patients who refused to participate were excluded. For the present study, all older ED patients with an APOP screening result at baseline were included.

Outcomes

The primary outcome of the present study was 30-day mortality. Secondary outcomes were hospital admission rate (after ED visit) and 7-day mortality.

Data collection

Patient characteristics

At baseline in the ED, data on three domains were assessed: demographics, severity of disease indicators, and geriatric measurements. Demographics consisted of age, sex, and living arrangement. Severity of disease indicators consisted of arrival by ambulance, fall-related ED visit, triage urgency, and chief complaint according to MTS. Geriatric measurements consisted of polypharmacy (≥5 different medications stated by the patient), use of a walking device, Katz activities of daily living questionnaire (functional status 2 weeks before the ED visit)[30;31], six-item Cognitive Impairment Test (6-CIT)[32-34], and history of diagnosed dementia reported by the patient or a proxy.

Geriatric screening

As a geriatric screening tool, the APOP screener was used. The APOP screener is a prognostic instrument that uses geriatric impairments on functional and cognitive domains to predict the individual risk of mortality and/or functional decline within 3 months in older patients presenting to the ED[27]. The screener has been validated in one study in four Dutch hospitals and has been implemented in the electronic health record system (HiX, Chipsoft) of approximately half of all Dutch hospitals[35]. The screener comprises seven predictors which are collected in less than two minutes after ED arrival: age, sex, arrival by ambulance, need of regular help, need for help with bathing and showering, hospitalization in the past 6 months, and impaired cognition (defined as having dementia, an incorrect answer on at least one out of two 6-CIT questions ["what year is it now?" and/or "say the months in reverse order"], or no data of cognition) (Supplementary table 1). For the present study, the result of the APOP screener was retrospectively calculated. The APOP screener indicates patients with the highest 20% predicted risk on the composite outcome of mortality and/or functional decline within 3 months. The threshold for a "high risk" APOP screening result is a predicted risk of 45% or greater[27].

Follow-up data

Hospital admission rate was measured by using the discharge destination from the patient's electronic health record. Data on mortality were obtained from municipal records.

Data analyses

Continuous data were presented as median (interquartile range [IQR]). Categorical data were presented as number (percentage). The χ^2 test was used to compare differences in

clinical outcomes within every MTS category between the APOP high-risk and low-risk screened patients. Relative Risks (RRs) were calculated, and we presented outcomes with 95% confidence intervals (95% CIs).

The Nagelkerke R^2 was used to calculate the proportion of the explained variance of clinical outcomes by MTS and APOP screening, separate and combined. For comparison with other studies, we additionally assessed the discrimination of the models with the area under the receiver operating characteristic curve (AUC [95% CI]) for the primary outcome, 30-day mortality. To solely assess the effect of age on predicting mortality, we performed identical analyses with MTS and age younger or older than 80 years.

Finally, we developed a reclassification concept for 30-day mortality, in which every patient with an APOP high-risk screening result was upgraded one MTS category. Taking into consideration that up triage of patients to the highest urgency level requiring immediate assessment (MTS category red) would not be feasible in practice, very urgent patients with an APOP high-risk result remained in the same very urgent category. We compared 30-day mortality rates between the original MTS classification and the reclassification model. A $p<0.05$ was determined as statistically significant. Statistical analyses were performed using IBM SPSS Statistics version 23.

RESULTS

Within the APOP study, 2629 individual ED patients aged 70 years or older, were included in four hospitals. We excluded 21 patients with an incomplete APOP screening, resulting in 2608 patients included in the analyses (Supplementary figure 1).

In the total study population, the median age was 79 (IQR 74-84) years and 1227 (47.0%) patients were male (Table 1). In total, 710 (27.2%) patients were assigned as standard, 1525 (58.5%) patients were assigned as urgent, and 373 (14.3%) patients were assigned as very urgent. Half of all patients arrived by ambulance, with an increasing percentage with increasing urgency levels: standard (28.2%), urgent (55.7%), and very urgent (75.1%). The most common chief complaint was minor trauma in the standard category (46.3%), while in the very urgent category the most common complaint was chest pain (31.9%). The presence of polypharmacy increased with increasing urgency levels: standard (53.1%), urgent (59.0%), and very urgent (64.1%). In total, 521 (20.0%) patients were high risk according to the APOP screener, which showed an increase with increasing urgency levels: standard (13.7%), urgent (22.3%), and very urgent (22.5%).

In total, 132 (5.1%) patients died within 30 days after their ED visit: 23 (3.2%) standard patients, 83 (5.4%) urgent patients, and 26 (7.0%) very urgent patients (Figure 1). There

was a higher mortality rate within 30 days in the APOP high-risk patients compared to APOP low-risk patients (11.7% vs. 3.4%; p<0.001).

Table 1. Patient characteristics stratified by MTS triage urgency

	MTS category			
	Standard (N = 710)	**Urgent (N = 1525)**	**Very urgent (N = 373)**	**All (N = 2608)**
Demographics				
Age, median (IQR), y	79 (74-84)	79 (74-84)	78 (74-83)	79 (74-84)
Male, n (%)	315 (44.4)	721 (47.3)	191 (51.2)	1227 (47.0)
Living arrangement, n (%)				
Independent alone or with others	662 (93.2)	1390 (91.1)	340 (91.2)	2392 (91.8)
Nursing home/residential care	48 (6.8)	134 (8.8)	33 (8.8)	215 (8.2)
Severity of disease indicators				
Arrival by ambulance, n (%)	200 (28.2)	849 (55.7)	280 (75.1)	1329 (51.0)
Fall prior to ED visit, n (%)	209 (29.4)	396 (26.0)	51 (13.7)	656 (25.2)
Chief complaints, n (%)				
Minor trauma	239 (46.3)	431 (28.3)	47 (12.6)	807 (30.9)
Malaise	107 (15.1)	300 (19.7)	54 (14.5)	461 (17.7)
Chest pain	82 (11.5)	192 (12.6)	119 (31.9)	393 (15.1)
Dyspnea	63 (8.9)	190 (12.5)	64 (17.2)	317 (12.2)
Loss of consciousness	21 (3.0)	96 (6.3)	28 (7.5)	145 (5.6)
Abdominal pain	65 (9.2)	179 (11.7)	36 (9.7)	280 (10.7)
Others	43 (6.1)	137 (9.0)	25 (6.7)	205 (7.9)
Geriatric measurements				
Polypharmacy, n (%)	377 (53.1)	899 (59.0)	239 (64.1)	1515 (58.1)
Use of walking device, n (%)	265 (37.4)	684 (44.9)	158 (42.4)	1107 (42.5)
Katz ADL score, median (IQR)	0 (0-1)	0 (0-1)	0 (0-1)	0 (0-1)
6-CIT score, median (IQR)	4 (0-8)	4 (2-10)	4 (2-8)	4 (2-8)
Diagnosis of dementia, n (%)	31 (4.4)	89 (5.8)	18 (4.8)	138 (5.3)
APOP screening result				
Low risk	613 (86.3)	1185 (77.7)	289 (77.5)	2087 (80.0)
High risk	97 (13.7)	340 (22.3)	84 (22.5)	521 (20.0)

Abbreviations: 6-CIT, six-item Cognitive Impairment Test; ADL, activities of daily living; APOP, Acutely Presenting Older Patient; MTS, Manchester Triage System.

Missing data: 1 living arrangement, 5 use of walking device; 27 Katz ADL score, 283 6-CIT score.

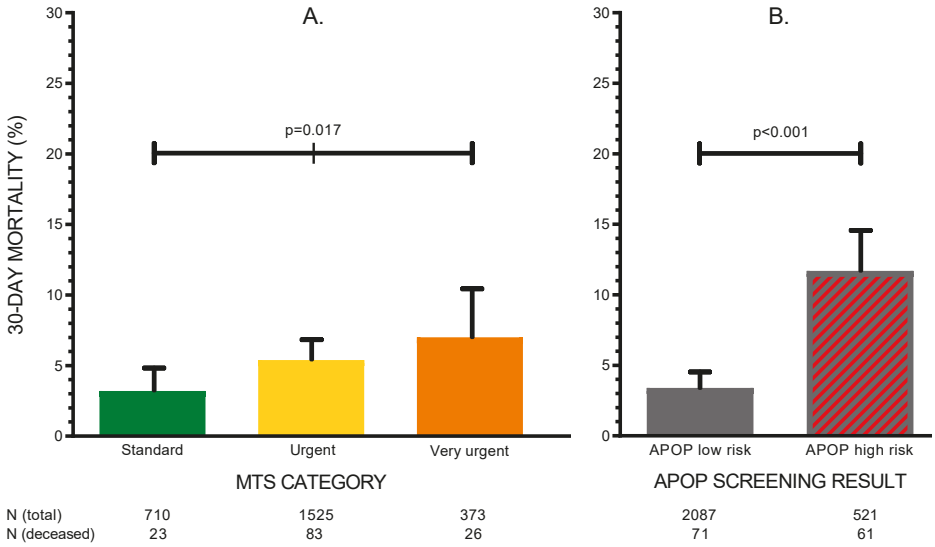

Figure 1. The 30-day mortality by Manchester Triage System (MTS) category and Acutely Presenting Older Patient (APOP) screening result separately. Panel A, The 30-day mortality rate for patients stratified by MTS category standard, urgent, or very urgent. The χ^2 test was used to compare differences in mortality between the MTS categories. Panel B, The 30-day mortality rate for patients stratified by APOP low-risk or high-risk screening result. The χ^2 test was used to compare differences in mortality between the APOP low-risk and high-risk screened patients. The upper 95% confidence intervals for proportion are shown.

Figure 2 shows the percentages of deceased patients in the first 30 days stratified by MTS categories and the APOP screening result. Mortality increased with increasing urgency levels. The differences in mortality between APOP high- and low-risk patients were statistically significant within the standard category (RR 2.8; 95% CI 1.2-6.5; p=0.021), the urgent category (RR 3.4; 95% CI 2.3-5.1; p<0.001), and the very urgent category (RR 3.4 95% CI 1.7-7.1; p=0.001). APOP high-risk patients triaged as standard had higher mortality rates (7.2%) than APOP low-risk patients triaged as very urgent (4.5%). One percent of the variability in 30-day mortality was explained by MTS category alone (Nagelkerke R^2 1.0%), whereas 5.6% was explained by the APOP screener alone. The R^2 increased to 6.3% when combining MTS with the APOP screener. The AUC was 0.57 (95% CI 0.52-0.61) for MTS alone, 0.64 (95% CI 0.59-0.69) for the APOP screener alone, and 0.66 (95% CI 0.61-0.72) for MTS and the APOP screener combined. To assess the effect of age alone on the variability of 30-day mortality, we performed identical analyses with MTS and age younger or older than 80 years. In total, 2.5% of the variability in 30-day mortality could be explained by high age alone, with an AUC of 0.60 (95% CI 0.55-0.65).

The secondary outcomes hospital admission rate and 7-day mortality are shown in Supplementary figures 2 and 3. Similar trends were found as for the primary outcome. Overall, APOP high-risk patients had a higher admission rate (high risk vs. low risk = 61.4% vs. 46.0%; p<0.001) and higher 7-day mortality rate (high risk vs. low risk = 3.5% vs. 1.5%; p=0.003), compared to APOP low-risk patients.

A reclassification concept for the primary outcome, 30-day mortality, in which every patient with an APOP high-risk screening result is upgraded one MTS category, is presented in Figure 3. This reclassification concept induces a decrease of 30-day mortality in the standard category (reclassified vs. original = 2.6% vs. 3.2%) and the urgent category (reclassified vs. original = 3.8% vs. 5.4%), and an increase in the very urgent category (reclassified vs. original = 9.4% vs. 7.0%).

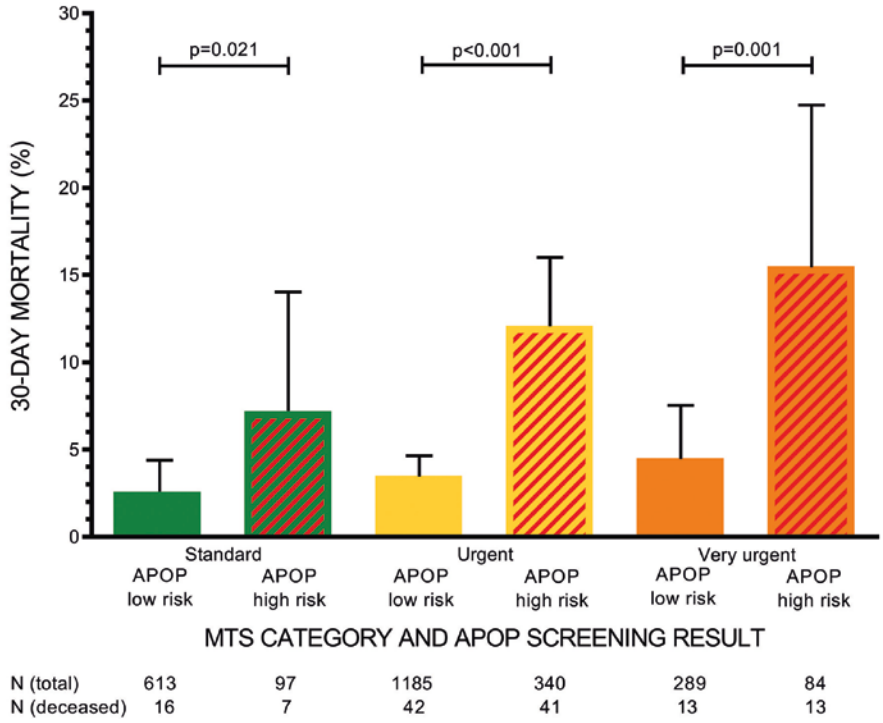

Figure 2. The 30-day mortality by Manchester Triage System (MTS) category and Acutely Presenting Older Patient (APOP) screening result combined. The 30-day mortality percentages for patients stratified by MTS category and APOP screening result combined. The upper 95% confidence intervals (CIs) for proportion are shown. Relative risks (RRs) were calculated to compare differences in mortality between APOP low-risk and high-risk screened patients within all three MTS categories, resulting in significant differences within the standard category (RR 2.8; 95% CI 1.2-6.5; p=0.021), the urgent category (RR 3.4; 95% CI 2.3-5.1; p<0.001), and the very urgent category (RR 3.4; 95% CI 1.7-7.1; p=0.001). Nagelkerke R^2 was calculated for MTS alone (R^2 0.010), APOP alone (R^2 0.056), and MTS and APOP combined (R^2 0.063).

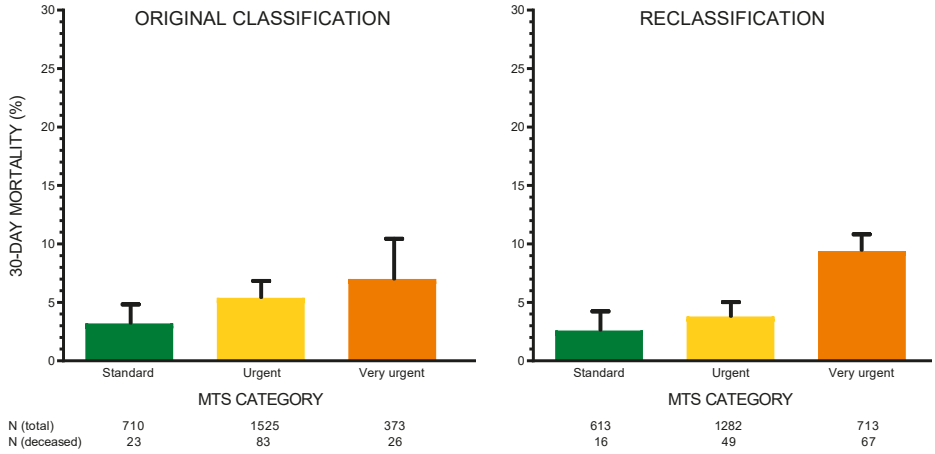

Figure 3. Reclassification concept: upgrade of one Manchester Triage System (MTS) category for Acutely Presenting Older Patient (APOP) high-risk patients. A reclassification concept for the primary outcome, 30-day mortality, in which every patient with an APOP high-risk screening result is upgraded one MTS category. Very urgent patients with an APOP high-risk result remained in the same very urgent category.

DISCUSSION

The main finding of this proof-of-principle study is that within every triage urgency category, older patients with a high-risk geriatric screening result had a three times higher 30-day mortality rate compared to patients who were identified as low risk during geriatric screening. Combining geriatric screening with triage urgency explained more of the variability of 30-day mortality in older ED patients than triage urgency alone.

To proof the principle that addition of geriatric screening has the potential to improve routinely used urgency triage, we used the APOP screener as a geriatric screening tool and the MTS as an urgency triage system since these tools were already implemented in the study hospitals. Other commonly used triage or geriatric screening tools may have given the same results. We used reclassification and measures of predictive performance, like AUCs and correlation coefficients, to be able to compare the combination of geriatric screening and urgency triage in contrast with urgency triage alone, and to compare our results with literature, not to quantify predictive performance of the APOP screening or the MTS.

It was shown that the MTS alone had a low discriminative performance for 30-day mortality in older ED patients with an AUC of 0.57, which is in line with literature[36;37].

We found that older patients who were identified by the APOP screener as high risk had a higher 30-day mortality compared to APOP low-risk patients. These results are in line with other studies demonstrating that frailty is associated with short-term adverse outcomes, such as hospital admission or in-hospital mortality[26;38;39]. Previous studies of other geriatric screening tools, such as ISAR and TRST, did not evaluate short term (eg, 30-day) mortality[18]. In line with studies in which geriatric characteristics (impaired mobility[40] or clinical frailty scale[23]) were combined with early warning scores, we also found that the combination of the MTS with the APOP screener improved the prediction of mortality. Recently, the CTAS guideline was revised with a "frailty modifier", which allows triage nurses to manually increase triage urgency for nonurgent complaints based on geriatric impairments[3]. To our best knowledge, this modification of CTAS has not been formally tested yet, but is supported by a recent study that investigated the relationship between triage acuity measured with CTAS and frailty[26]. In comparison with the definition of the frailty modifier of the CTAS, our results within the MTS indicate that considering age older than 80 years during triage is already a good start to differentiate between older patients at risk for adverse outcomes. However, the explained variance for 30-day mortality was higher when taking into account more geriatric characteristics than age only. The MTS is known for performing worse in allocating priority in both children and older adults[11;41]. Previously, the MTS has been modified for use in children[41], additionally, the opportunity remains to improve the MTS for older adults as well.

Triage tools are diagnostic tools with the aim to determine urgency and early clinical need, while geriatric screening instruments are prognostic tools for adverse outcomes. Although triage tools and geriatric screening tools serve different purposes, they could be combined as predictors of "disease urgency" and "geriatric urgency" to improve prediction of early mortality in older patients. Combining triage urgency with geriatric impairment could be executed in two ways. First, current triage tools and existing geriatric screening tools can be used next to each other. Second, current triage tools can be adjusted, taking geriatric impairments into account. Adjusting triage by adding geriatric screening could improve risk stratification early at ED arrival and could in all probability reduce undertriage in older patients. Triage tools aim to prioritize patients who will benefit from early treatment (eg, patients with myocardial infarction [who benefit from early revascularization] or shock [who benefit from early fluid resuscitation]), thereby contributing to prevention of acute organ failure and thus mortality[42;43]. However, older patients are often undertriaged due to atypical disease presentations, nonspecific complaints (eg, generalized weakness), and inappropriate interpretation of vital signs[13-16]. Older patients with geriatric impairments will be generally more sensitive to delays in treatments (caused by undertriage) due to less physiological reserve related to chronic comorbidity. This may, at least partially, explain that the addition of the APOP screener to the MTS increases the explained variance and improves prediction of 30-day mortality. Reclassification of APOP high-risk patients to a higher triage urgency level will result in a higher number of older ED patients who

are allocated to the very urgent urgency level (Figure 3), which would reduce time to treatment in the ED. Adjustment of triage by adding geriatric screening has the additional advantage that the atypical disease presentation and different interpretation of vital signs are automatically taken into account, potentially improving triage. Additionally, cognitive impairment can partially be explained by acute disturbance of brain perfusion and oxygenation, which might be improved with optimal resuscitation after early recognition with geriatric screening at triage[44]. In other words, combining diagnostic triage tools with prognostic geriatric screening tools has the potential to provide a comprehensive understanding of the individual risk of poor outcomes using both disease severity and geriatric impairments, with the possibility to acquire more personalized care in acutely ill older patients as early as arrival in the ED. Future studies should investigate whether it is possible to replicate this proof of principle of combining urgency triage with geriatric screening by using other tools and whether implementation of a concept of reclassification would result in less undertriage and therefore less mortality in older patients, without unanticipated consequences like overtreatment.

This study has several limitations. First, patients with MTS category red were not included within the study due to immediately required care. However, given the severity of disease that required immediate action, these patients already belong to a vulnerable patient group who cannot be undertriaged by definition. Second, MTS might have had a better predictive performance in more short-term outcomes, such as in-hospital mortality, but, despite our large sample size, the numbers of the present study were too small to examine that outcome. Nonetheless, the same trend was found for 7-day mortality as for our primary outcome, 30-day mortality. Third, for the present study, the development and validation cohort of the APOP study was used, and the APOP screener was calculated retrospectively. However, we considered the degree of selection or information bias due to the retrospective design minimal because of the prospective follow-up of the study and inclusion of all consecutive older ED patients. Finally, to explore the study aim, the APOP screener was used as a geriatric screening instrument that is developed and validated in The Netherlands, limiting generalizability. As this study explored a proof of principle, other geriatric screening instruments were not compared to the APOP screener with the purpose to investigate which geriatric screening tool has the best predictive performance. It would be interesting to study the concept of combining urgency triage with geriatric screening further by using other instruments in other countries.

Strengths of this study can be accounted to the broad and unselected inclusion of patients in four hospitals. In addition, there was no missing data within the outcome measures. Finally, the APOP screener can be performed in less than 2 minutes after ED arrival and is therefore feasible to use in clinical practice on a large scale. The fact that the APOP screener recently has been implemented in the electronic health record

system (HiX, Chipsoft) used by approximately half of all Dutch hospitals and has been put into routine use by several EDs throughout The Netherlands is promising[35].

In conclusion, combining triage urgency with geriatric screening has the potential to improve triage, which may help clinicians to deliver early appropriate care to older ED patients.

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Supplementary table 1. The Acutely Presenting Older Patient screener

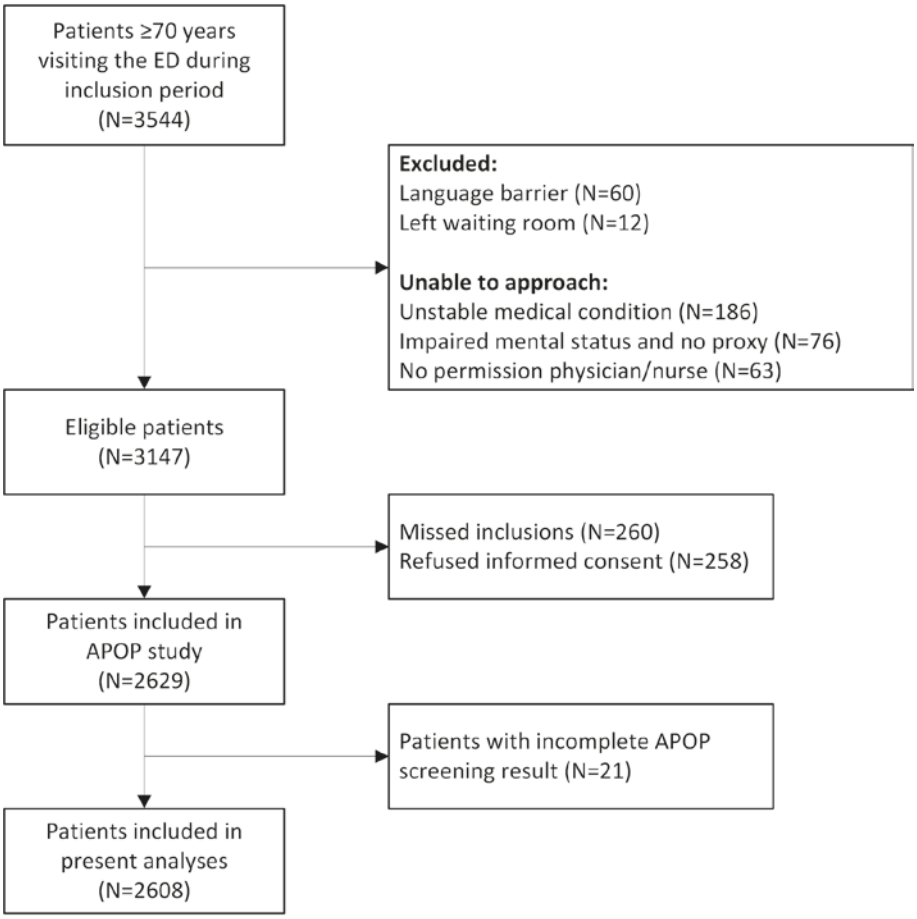
Predictors	Questions
Age (per 5 years increase)	What is the age of the patient?
Male	What is the gender of the patient?
Arrival by ambulance	Did the patient arrive by ambulance?
Need help prior to ED visit (IADL)	Before the illness or injury that brought you to the ED, did you need someone to help you on a regular basis? (like housekeeping, preparing meals)
Need help bathing or showering	Before the illness or injury that brought you to the ED, did you need assistance in bathing or showering?
Hospitalized past six months	Have you been hospitalized during the past six months?
Impaired cognition	Are you diagnosed with dementia? What year is it now? Say the months in reversed order

Abbreviations: ED = emergency department, IADL = instrumental activities of daily living.

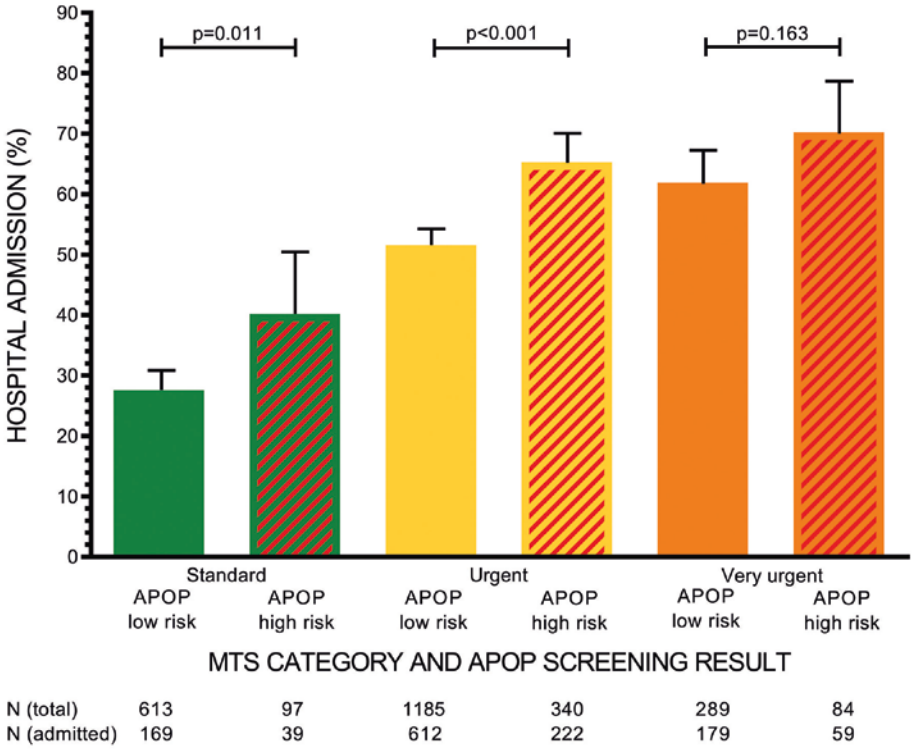
The first three questions of the screener are filled out by the triage nurse; the remaining questions are asked to the patient. If the patient is diagnosed with dementia (question seven) or if the patient incorrectly answers question eight or nine, cognition is considered to be impaired.

Prediction model: 1/(1+exp(-(-5.848 + 0.262 x '(age/5)' + -0.072 x 'male' + 0.460 x 'arrival by ambulance' + 0.534 x 'need help prior to ED visit' + 0.567 x 'need help bathing or showering' + 0.432 x 'hospitalized past six months' + 0.255 x 'impaired cognition')))

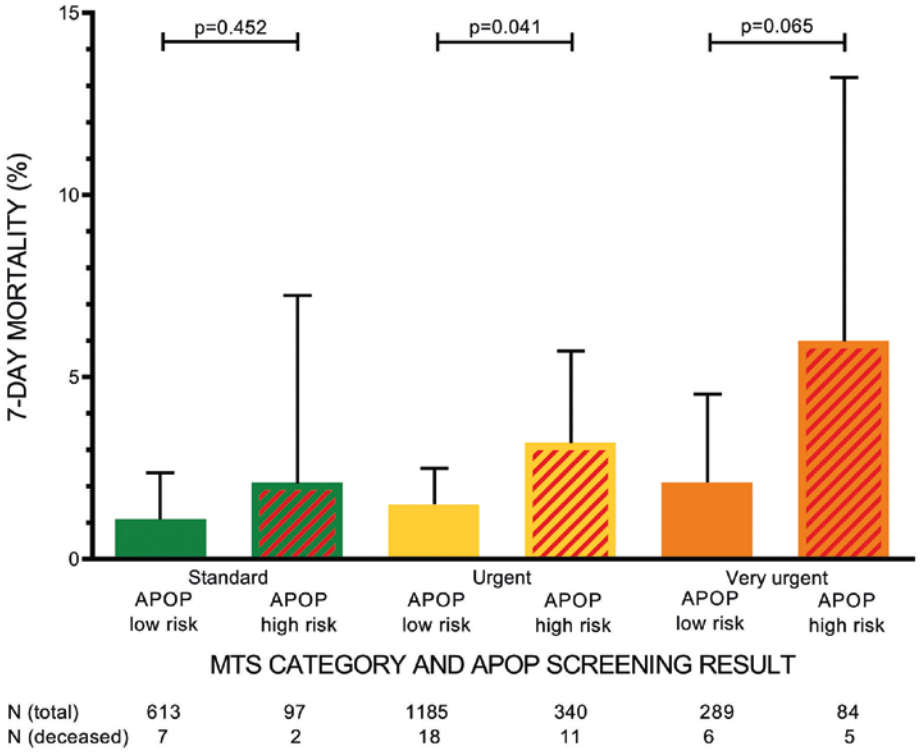
Application: http://screener.apop.eu/



Supplementary figure 1. Flowchart of study population



Supplementary figure 2. Hospital admission by Manchester Triage System (MTS) category and Acutely Presenting Older Patient (APOP) screening result combined. Hospital admission rate for patients stratified by MTS category and APOP screening result combined. The upper 95% confidence intervals for proportion are shown. Nagelkerke R^2 was calculated for MTS alone (R^2 0.083), APOP alone (R^2 0.020), and MTS and APOP combined (R^2 0.096).



Supplementary figure 3. The 7-day mortality by Manchester Triage System (MTS) category and Acutely Presenting Older Patient (APOP) screening result combined. The 7-day mortality percentages for patients stratified by MTS category and APOP screening result combined. The upper 95% confidence intervals for proportion are shown. Nagelkerke R^2 was calculated for MTS alone (R^2 0.008), APOP alone (R^2 0.017), and MTS and APOP combined (R^2 0.019).

Chapter 3

Geriatric screening, fall characteristics and 3- and 12 months adverse outcomes in older patients visiting the Emergency Department with a fall

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ABSTRACT

Background: Falls in older Emergency Department (ED) patients may indicate underlying frailty. Geriatric follow-up might help improve outcomes in addition to managing the direct cause and consequence of the fall. We aimed to study whether fall characteristics and the result of geriatric screening in the ED are independently related to adverse outcomes in older patients with fall-related ED visits.

Methods: This was a secondary analysis of the observational multicenter Acutely Presenting Older Patient (APOP) study, of which a subset of patients aged ≥70 years with fall-related ED visits were prospectively included in EDs of two Dutch hospitals. Fall characteristics (cause and location) were retrospectively collected. The APOP-screener was used as a geriatric screening tool. The outcome was 3- and 12-months functional decline and mortality. We assessed to what extent fall characteristics and the geriatric screening result were independent predictors of the outcome, using multivariable logistic regression analysis.

Results: We included 393 patients (median age 80 (IQR 76-86) years) of whom 23.0% were high risk according to screening. The cause of the fall was extrinsic (49.6%), intrinsic (29.3%), unexplained (6.4%) or missing (14.8%). A high risk geriatric screening result was related to increased risk of adverse outcomes (3-months adjusted odds ratio (AOR) 2.27 (1.29-3.98), 12-months AOR 2.20 (1.25-3.89)). Independent of geriatric screening result, an intrinsic cause of the fall increased the risk of 3-months adverse outcomes (AOR 1.92 (1.13-3.26)) and a fall indoors increased the risk of 3-months (AOR 2.14 (1.22-3.74)) and 12-months adverse outcomes (AOR 1.78 (1.03-3.10)).

Conclusions: A high risk geriatric screening result and fall characteristics were both independently associated with adverse outcomes in older ED patients, suggesting that information on both should be evaluated to guide follow-up geriatric assessment and interventions in clinical care.

INTRODUCTION

Falls among older people are common and often result in injuries and Emergency Department (ED) visits[1;2], which are associated with adverse outcomes such as ED revisits, functional decline and mortality[3-6]. Even minor injuries can result in functional decline and reduction of quality of life[7]. However, not all older people presenting to the ED with a fall are at high risk of adverse outcomes because they are a very heterogeneous group: some are vital, others have considerable frailty. It is known that frail older patients have high risks of adverse outcomes and therefore several geriatric screening tools have been developed to identify high risk geriatric patients in the ED[8].

In older people, falls can be a representation of underlying frailty[9]. Falls may also have other causes like extrinsic causes (e.g. traffic accidents), intrinsic causes (e.g. syncope) and unknown causes, which may result in different outcomes[10;11]. Someone who has tripped over the carpet at home may be at higher risk of poor outcomes than someone who fell outside during cycling[12]. Although fall-related injuries (e.g. hip fracture) have been shown to be associated with adverse outcomes, it is unknown to what extent falls can be attributed to frailty and whether the cause and circumstances of falls are associated with adverse outcomes apart from the result of geriatric screening in the ED. It is possible that some causes or circumstances have a greater impact on short- and long-term outcomes in patients who have a high risk on adverse outcomes according to geriatric screening compared to patients with a low risk. Patients in whom the cause and circumstances of the fall are associated with adverse outcomes may benefit from more comprehensive ED management and geriatric follow-up, whereas for patients in whom the fall is not associated with adverse outcomes standard ED management may be appropriate[13;14]. It would be more (cost-)effective to use our scarce resources and follow-up for those patients who need it most.

The aim of the present study was therefore to assess whether the result of geriatric screening in the ED and fall characteristics (cause and circumstance of falls) are independently related to 3- and 12-months adverse outcomes in older patients with fall-related ED visits. We hypothesized that the majority of older patients with fall-related ED visits would have a high risk geriatric screening result, and that a high risk screening result would increase the impact of the cause or location of the fall on adverse outcomes.

METHODS

Study design

This was a pre-planned secondary analysis of the Acutely Presenting Older Patient (APOP) study, a prospective multicenter cohort study which included older patients

visiting the EDs of four Dutch hospitals from September 2014 till January 2017[15;16]. For the present study, additional data of patients with fall-related ED visits was retrospectively collected from two hospitals: the Leiden University Medical Center, an academic hospital with a level 1 trauma center, and the Alrijne Hospital, a teaching hospital with a level 2 trauma center. The EDs of these hospitals together serve the region of Leiden, including all older patients who need to visit an ED due to a fall. Written informed consent was obtained from all patients. The Medical Ethics Committees of all hospitals approved the study.

Study participants

In the present study, all consecutive patients aged ≥70 years with a fall-related ED visit were included. Whether the visit was fall-related was obtained by asking patients the question: 'Is the reason for your ED visit related to a fall?'. Exclusion criteria were triage category 'red' on the Manchester Triage System (MTS)[17], patients who were unable to approach due to an unstable medical condition, an impaired mental status (i.e. coma) without an authorized proxy present to provide informed consent, a language barrier or refusal to participate[15].

Data collection

Baseline data

Data was collected on demographics, disease severity and geriatric measurements. Demographics consisted of age, sex and living arrangement. Disease severity included arrival by ambulance, triage urgency according to the MTS[17], chief complaint[16], and the treating specialist in the ED. Geriatric measurements consisted of the use of a walking device, the number of self-reported medications (≥5 medications meaning polypharmacy), Katz index of Activities of Daily Living (ADL) score (assessing the functional status two weeks before ED presentation)[18] and cognitive impairment assessed with the Six-item Cognitive Impairment Test (6CIT)[19].

Geriatric screening

As a geriatric screening tool, the APOP screener was used. The APOP screener is a risk stratification instrument which was developed and validated to identify older ED patients at risk for mortality and/or functional decline within three months[16]. The screener comprises seven predictors which are collected in less than two minutes after ED arrival. The result of the APOP screener was retrospectively calculated for patients with fall-related ED visits. In routine ED care, a cut-off point is used to indicate clinicians which older patients are at highest risk of adverse outcomes and therefore need extra care. The APOP screener indicates patients with the highest 20% predicted risk of the composite outcome of mortality and/or functional decline within 3 months. The threshold for a 'high-risk' APOP screening result is a predicted risk of 45% or greater[16]. The APOP screener is not a frailty screener per se, which means that high risk patients

might not represent the frailty population in general, but there is probably a large overlap.

Follow-up data
To obtain data on functional status, patients were contacted by telephone 3 and 12 months after their ED visit. Data on mortality was obtained from municipal records.

Fall-related ED visit
Additional fall-related data were retrospectively collected from medical records. If the patient indicated that the ED visit was related to a fall, but the medical record indicated otherwise, the information in the medical file was decisive and the patient was excluded from the analyses.

Cause of the fall
The cause of the fall was collected from medical records and categorized into four categories by two independent researchers (LCB and LJvM). In case of disagreement, a third researcher decided upon the final category (BdG). The case selection, variables and fall categories were defined prior to data collection by all researchers (Supplementary table 1)[20]. The four categories were: extrinsic cause, intrinsic cause, unexplained falls and unknown cause due to missing data. Patients were categorized in the category 'extrinsic cause' when the record explicitly stated a mechanical, external cause of the fall, i.e. slipping/tripping or traffic accidents[5]. Patients had an 'intrinsic cause' when the record stated a medical reason for the fall, i.e. falls due to cerebrovascular events or syncope[21]. Patients were categorized in 'unexplained falls' when they had no recollections of events, when history taking was not possible or when no apparent cause of the fall was stated in the record, yet it was evident that the treating physician searched for a possible explanation[22;23]. If the medical record provided insufficient data about the cause of the fall, the patient had an unknown cause, which was categorized as 'missing data'. The result of frailty screening in the ED was not taken into account during categorization of causes of falls.

Circumstances of the fall and fall-related injuries
One researcher (LCB) collected data on circumstances of falls and the type of fall-related injuries. The location of the fall was categorized as indoors (inside a residence or non-residential building) or outdoors (outside a residence or building, including the driveway/yard and the street). The patient's activity prior to the fall was categorized as described previously[12].

Outcomes
The composite outcome of functional decline and/or mortality, 3 and 12 months after the ED visit, was the primary outcome. Functional status at 3- and 12 months were compared to baseline functional status, two weeks before the ED visit. Functional decline

was defined as at least one point increase in Katz-ADL score or new institutionalization (higher level of assisted living)[18]. Patients with a maximum Katz-ADL score at baseline, institutionalization at baseline, or patients who were lost to follow up were considered as having no functional decline. This assumption was made on the basis of previously executed sensitivity analyses[24].

Statistical analyses

Data are presented as means with standard deviation (SD), medians with interquartile ranges (IQRs) or numbers with percentages. Differences in patient characteristics between groups were assessed using the Mann-Whitney U test for continuous skewed data and the χ^2 test for categorical data.

Cohen's Kappa (κ) was used to quantify the inter-rater reliability of the categorization. Agreement was considered moderate (κ=0.60-0.79), strong (κ=0.80-0.90) or almost perfect (κ>0.90)[25].

Multivariable logistic regression analysis was used to assess the association between patient- and fall characteristics and 3- and 12-months adverse outcomes. First, it was assessed whether an interaction existed between a high risk result according to APOP screening and the cause or location of the fall. This was done by adding an interaction term in the model, and by performance of two separate multivariable regression analyses in which patients were stratified by their geriatric screening result. If there was no interaction between a high risk geriatric screening result and cause or location of the fall, they were possible independent predictors of adverse outcomes, and could both be included in the model. Patient characteristics (age, sex and high risk geriatric screening result) and fall characteristics (cause - and location of fall) were forced into the regression model. Models taking either the cause or the location of the fall into account were executed because of possible multicollinearity. Patients with an unknown cause of the fall (categorized as missing data) were excluded from the multivariable regression analyses on the cause of the fall. Fall-related injuries were not put in the models together with fall characteristics because injuries were in the causal pathway of events and did therefore not meet the criteria of a confounder. In addition, because fall-related injuries (e.g. hip fracture) have already been shown to be associated with adverse outcomes, and fall characteristics were the variables of interest in this study, we did not put fall-related injuries in the multivariable regression models.

Results are presented as odds ratios (ORs) or adjusted odds ratios (AORs) with 95% confidence intervals (CIs). A p-value <0.05 was considered as statistically significant. Statistical analyses were performed using IBM SPSS Statistics version 25.

RESULTS

Of the 2192 ED patients aged ≥70 years, 1965 (89.6%) patients were found eligible, of whom 1632 (83.1%) patients were included. A subset of 393 (24.1%) patients with a fall-related ED visit were included in the present study (Figure 1). The categorization of causes of falls resulted in 87.0% agreement and a strong inter-rater reliability (κ=0.802) (Supplementary table 2).

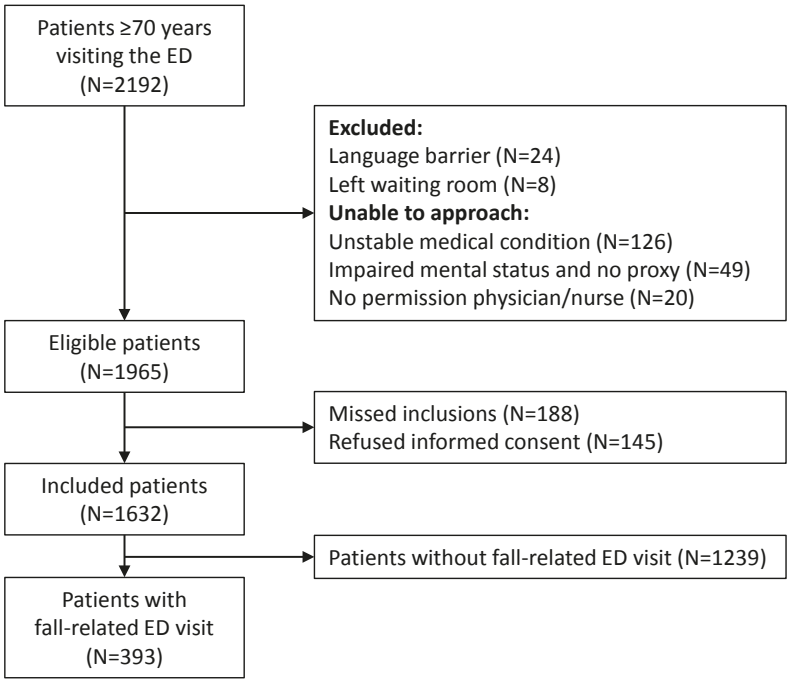

Figure 1. Flowchart of study population. In total 2192 patients aged 70 years or older visited the EDs of the two hospitals during the inclusion periods. A total of 1965 (89.6%) patients were found eligible of whom 1632 (83.1%) patients were included in the study. Of 1632 included patients 393 (24.1%) patients had a fall-related ED visit and 1239 (75.9%) patients visited the ED without a fall-related problem. Whether the ED visit was fall related was obtained by asking the patient the question: "Is the reason for your ED visit related to a fall?". After careful retrospective review of the medical files 10 patients switched to the group of patients without a fall-related ED visit.

Patient characteristics, circumstances of falls and fall-related injuries for the total study population and stratified by cause of the fall are presented in Table 1. The median age of the overall population was 80 years (IQR 76-86) and 150 (38.2%) patients were male. In total, 238 (60.6%) patients arrived by ambulance and 299 (76.1%) patients had minor

trauma as their chief complaint. In total, 193 (49.1%) patients used a walking device and 90 (23.0%) patients were high risk according to the APOP screener.

In 195 (49.6%) patients the cause of the fall was extrinsic, in 115 (29.3%) patients intrinsic, in 25 (6.4%) patients unexplained and in 58 (14.8%) patients data was missing. Patients with an extrinsic cause most often had minor trauma (90.3%) and were treated by surgeons (81.0%), while patients with an intrinsic- or unexplained cause also presented with malaise and loss of consciousness and were treated by other specialists. Differences in geriatric parameters were observed between the distinct fall groups. A walking device was used in 38.3% of patients with extrinsic causes, compared to 59.1% in intrinsic causes and 56.0% in unexplained falls. In total 15.0% of patients with extrinsic causes had a high risk screening result, compared to 33.0% with an intrinsic cause and 24.0% with an unexplained fall. The location of the fall was indoors for 195 (61.3%) patients. Patients with an extrinsic cause most often fell outdoors (58.2%), while patients with an intrinsic cause most often fell indoors (83.0%). Almost all patients who fell during cycling, driving scooter or exercise had an extrinsic cause of their fall. Patients with intrinsic causes often were walking up/down the stairs (10.2%), getting in/out of bed (16.9%) or were going to the toilet (13.6%). In total, 57 (14.5%) patients had no fall injury, 186 (47.3%) patients had a fracture and 53 (13.5%) patients had a hip fracture. Of the patients with an extrinsic cause 1.5% had no injury, compared to 33.9% in intrinsic causes and 36.0% in unexplained falls.

Table 1. Patient characteristics, the circumstance of the fall and fall-related injuries for the total population of patients with a fall-related ED visit and stratified by cause of the fall

		Cause of fall		
	All (N=393)	**Extrinsic cause (N=195)**	**Intrinsic cause (N=115)**	**Unexplained fall (N=25)**
Patient characteristics				
Age (years), median (IQR)	80 (76-86)	80 (75-86)	80 (74-86)	81 (77-88)
Male, n (%)	150 (38.2)	66 (33.8)	51 (44.3)	10 (40.0)
Living independently, n (%)	345 (87.8)	180 (92.3)	92 (80.0)	21 (84.0)
Arrival by ambulance, n (%)	238 (60.6)	114 (58.5)	82 (71.3)	15 (60.0)
Triage urgency, n (%)				
> 1 hour (green)	140 (35.6)	81 (41.5)	26 (22.6)	6 (24.0)
< 1 hour (yellow)	214 (54.5)	102 (52.3)	71 (61.7)	16 (64.0)
< 10 min (orange)	39 (9.9)	12 (6.2)	18 (15.7)	3 (12.0)
Chief complaint, n (%)				
Minor trauma	299 (76.1)	176 (90.3)	62 (53.9)	12 (48.0)
Malaise	23 (5.9)	3 (1.5)	16 (13.9)	3 (12.0)
Loss of consciousness	33 (8.4)	2 (1.0)	24 (20.9)	7 (28.0)

Table 1. Continued.

	All (N=393)	Cause of fall		
		Extrinsic cause (N=195)	Intrinsic cause (N=115)	Unexplained fall (N=25)
Others	38 (9.7)	14 (7.2)	13 (11.3)	3 (12.0)
Treating specialism, n (%)				
Surgery	251 (63.9)	158 (81.0)	48 (41.7)	8 (32.0)
Internal medicine	54 (13.7)	10 (5.1)	27 (23.5)	5 (20.0)
Others	88 (22.4)	27 (13.8)	40 (34.8)	12 (48.0)
Use of walking device, n (%)	193 (49.1)	74 (38.3)	68 (59.1)	14 (56.0)
Polypharmacy, n (%)[a]	192 (48.9)	90 (46.2)	57 (49.6)	14 (56.0)
Katz ADL score, median (IQR)	0 (0-1)	0 (0-1)	0 (0-2)	1 (0-2)
6-CIT score, median (IQR)	6 (2-11)	4 (2-8)	8 (4-17)	7 (3-13)
APOP screening result, n (%)				
Low risk	301 (77.0)	164 (85.0)	77 (67.0)	19 (76.0)
High risk	90 (23.0)	29 (15.0)	38 (33.0)	6 (24.0)
Circumstance of fall				
Location of fall, n (%)				
Indoors	195 (61.3)	69 (41.8)	83 (83.0)	18 (81.8)
Outdoors	123 (38.7)	96 (58.2)	17 (17.0)	4 (18.2)
Activity prior to fall, n (%)				
Walking	110 (39.6)	81 (43.8)	25 (42.4)	3 (25.0)
Cycling/driving (mobility) scooter	46 (16.5)	45 (24.3)	1 (1.7)	0 (0.0)
Walking up/down stairs/ stairlift	28 (10.1)	15 (8.1)	6 (10.2)	3 (25.0)
Getting in/out bed/chair/ couch/bath	25 (9.0)	9 (4.9)	10 (16.9)	1 (8.3)
Going to the toilet	15 (5.4)	1 (0.5)	8 (13.6)	3 (25.0)
Exercise	10 (3.6)	8 (4.3)	1 (1.7)	0 (0.0)
Others	44 (15.8)	26 (14.1)	8 (13.6)	2 (16.7)
Fall-related injuries[b]				
Type of injury, n (%)				
Minor injury	163 (41.5)	106 (54.4)	29 (25.2)	7 (28.0)
Head injury	135 (34.4)	75 (38.5)	34 (29.6)	12 (48.0)
Fracture	186 (47.3)	121 (62.1)	35 (30.4)	5 (20.0)
Hip fracture	53 (13.5)	32 (16.4)	16 (13.9)	1 (4.0)
No injury	57 (14.5)	3 (1.5)	39 (33.9)	9 (36.0)

Table 1. Continued.

	All (N=393)	Cause of fall		
		Extrinsic cause (N=195)	Intrinsic cause (N=115)	Unexplained fall (N=25)
Location of injury, n (%)				
Head/face	60 (17.9)	18 (9.4)	24 (31.6)	8 (50.0)
Thorax/abdomen/spine	14 (4.2)	5 (2.6)	2 (2.6)	1 (6.3)
Upper extremity	72 (21.4)	46 (24.0)	13 (17.1)	0 (0.0)
Lower extremity	102 (30.4)	57 (29.7)	24 (31.6)	3 (18.8)
Multiple locations	88 (26.2)	66 (34.4)	13 (17.1)	4 (25.0)

Abbreviations: N=number; IQR=interquartile range; ADL=activities of daily living; 6-CIT=six-item cognitive impairment test; APOP=Acutely Presenting Older Patient screening.

[a] ≥5 self-reported medications.

[b] numbers do not add up to 100% because some people had multiple types and locations of injuries.

Missings: 58 cause of the fall, 2 use of walking device, 4 Katz ADL score, 40 6-CIT score, 2 APOP screening result, 75 location of fall, 115 activity prior to fall

Patient characteristics stratified by location of the fall are presented in Supplementary table 3. More patients who fell indoors were considered to have a high risk geriatric screening result compared to patients who fell outdoors (34.9% vs. 4.9%, p<0.001).

Of all 393 patients with fall-related ED visits 26 (6.6%) patients had died and 107 (27.2%) patients experienced functional decline at 3 months follow-up. After 12 months, 61 (15.5%) patients had died and 90 (22.9%) patients experienced functional decline.

The interaction terms for 'high risk geriatric screening result', 'cause of the fall' and 'location of the fall' were all non-significant. Multivariable regression analyses for 3- and 12-months adverse outcomes stratified by geriatric screening result show that there was no effect modification by geriatric screening result and cause or location of the fall (Supplementary table 4). These results showed that the geriatric screening result was a potential independent predictor of the outcome. A high risk geriatric screening result was associated with an increased risk of adverse outcomes at 3 (AOR 2.27 (1.29-3.98)) and 12 months (AOR 2.20 (1.25-3.89)), adjusted for age and sex. In Table 2, it is shown that adverse outcomes depend on fall characteristics and geriatric screening result. Compared to an extrinsic cause, an intrinsic cause increased the odds for 3-months adverse outcomes independent of a high risk geriatric screening result (AOR 1.92 (1.13-3.26). The cause of the fall was no predictor of 12-months adverse outcomes. A fall indoors, compared to outdoors, was a risk factor for adverse outcomes at 3- (AOR 2.14 (1.22-3.74)) and 12-months (AOR 1.78 (1.03-3.10)) independent of a high risk geriatric screening result.

Table 2. Risk on adverse outcomes at 3 and 12 months in older patients with fall-related ED visits depending on fall characteristics and geriatric screening result

	Risk[a]		Risk independent of high risk geriatric screening result[b]	
	3 months	**12 months**	**3 months**	**12 months**
Cause of fall				
Extrinsic fall (n=195)	ref	ref	ref	ref
Intrinsic fall (n=115)	2.28 (1.37-3.81)	1.46 (0.88-2.42)	1.92 (1.13-3.26)	1.21 (0.71-2.06)
Unexplained fall (n=25)	2.41 (1.00-5.82)	1.34 (0.55-3.28)	2.29 (0.94-5.57)	1.28 (0.52-3.18)
Location of fall				
Outdoors (n=123)	ref	ref	ref	ref
Indoors (n=195)	2.39 (1.39-4.11)	2.01 (1.19-3.41)	2.14 (1.22-3.74)	1.78 (1.03-3.10)

Multivariable logistic regression analyses for the composite outcome of functional decline and/or mortality. Numbers represent Odds Ratios with 95% Confidence Intervals.

[a] Model adjusted for age and sex.

[b] Model adjusted for age, sex and high risk geriatric screening result.

Interaction terms 'high risk geriatric screening result'*cause of the fall and 'high risk geriatric screening result'*location of the fall were not significant

DISCUSSION

Older patients with a fall-related ED visit represent a heterogeneous group in patient- and fall characteristics. A minority of patients have a high risk on adverse outcomes according to geriatric screening. Apart from the geriatric screening result, both the cause and location of the fall are independent risk factors of 3- and 12-months adverse outcomes.

We described characteristics and outcomes of different types of falls among older patients presenting to the ED. In an overview of 12 large studies evaluating causes of falls in older people, accidents or falls stemming from environmental hazards comprised the largest fall cause category, accounting for 25% to 45%[10], comparable to the 50% in our category 'extrinsic cause'. One study found that 9% of falls in older ED patients were caused by syncope, comparable to the 11% found in our study[5]. In the present study we showed that patients who fell indoors were older and had more geriatric impairments in both ADL and cognition compared to patients who fell outdoors, correspond to previous studies[26;27]. Our findings on adverse outcomes in the total group of older ED patients with falls are comparable with literature[3;4;28]. This is the first study that compared functional decline and mortality 3- and 12-months after the ED visit between different types of falls.

A new finding of our study is the large difference in adverse outcomes among patients with different fall characteristics. Categorizing falls into different causes can be arbitrary due to the multifactorial causality and one might even argue that there is no such a thing as an extrinsic or mechanical fall[29]. Therefore, we also categorized patients into different fall circumstances (eg. the location). A minority of older patients with fall-related ED visits were at high risk according to screening, suggesting that it is not only frailty that causes falls[30]. Although we expected otherwise, we found that there was no interaction between the geriatric screening result and cause or location of the fall, indicating that the screening result did not increase the impact of cause or location of the fall. Apart from the geriatric screening result, cause and location of the fall are independent risk factors of adverse outcomes. This could be explained by the observation that older patients who fell indoors and were not screened as 'frail' were in some sort of 'pre-frail' phase that was not picked up with geriatric screening. It is also possible that the use of other screening tools, known to have different predicting values, may have resulted in slightly different classifications of 'frail' vs. 'non-frail' patients, i.e. in patients with indoor falls, but it is unlikely that this would have resulted in large differences in the association between location of fall and adverse outcomes. The cause of the fall was an independent predictor for 3-months adverse outcomes, but not for 12-months outcomes, suggesting that location of the fall and the geriatric screening result are more important for predicting long term outcomes. Because fall-related injuries were in the causal pathway of events, we did not correct for injuries as a confounder in the models, but when we did, the results remained the same.

The present study has clinical implications for clinicians in the ED. Current fall risk assessments are complex and time-consuming[31], but our results suggests that a simple geriatric screening, and assessing the location of the fall already provides important prognostic information. Patient who are high risk according to geriatric screening, fall indoors or have an intrinsic- or unexplained cause may benefit from further fall assessments and interventions. Several geriatric risk stratification tools for the ED setting exists, and although none of them has great predictive power[8], they might enhance our awareness and understanding of geriatric patients beyond their presenting complaint. Additionally, our data suggests that it remains important to unravel the cause of a fall to start interventions that possibly prevent future falls and adverse outcomes. Adding additional information from the hospital and the home situation, e.g. level of physical activity in everyday life, may further improve clinical prediction tools and tailored decision making[32]. Patients who are at high risk according to geriatric screening and their fall characteristics, could benefit from further assessments on geriatric domains and the risk of future falls by using a comprehensive geriatric assessment (CGA), which has known positive effects on patient outcomes[33]. If is not feasible to execute CGA in the ED, hospitalized patients could be assessed during admission on the ward, and discharged patients could be assessed later by a general practitioner or geriatrician in an outpatient clinic.

This study has several strengths, like a broad unselected population of older ED patients with falls and the multicenter design. There are also several limitations. First, we used self-reported reasons for ED visits to select older patients with falls, which possibly resulted in some missed inclusions. Second, there is no universal categorization of causes of falls, which limits the comparability of our findings. Additionally, the retrospective categorization of causes of falls was complicated by incompleteness of descriptions in medical records. However, terminology from literature was used to design the categories and the interrater reliability between researchers was good. Third, the APOP screening instrument was used to measure a proxy of 'frailty', while this is technically not a frailty screener but a risk stratification instrument.

Conclusion

A high risk geriatric screening result and fall characteristics were both independently associated with adverse outcomes in older patients with a fall-related ED visit, suggesting that information on both should be evaluated to guide follow-up geriatric assessment and interventions in clinical care.

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Supplementary table 1. Categorization of causes of falls

1. Extrinsic cause	The patient record describes a cause of the fall that is not medical or intrinsic. This can include i.e. slipping, traffic accidents or alcohol use.
a. Slip/trip	A fall due to slipping and/or tripping. This excludes falls with a walking device.
b. Traffic accident	A fall as a result of a traffic accident or ascending a certain vehicle. Accidents while cycling are included in this group.
c. Walking device	A fall with or because of a walking device. This excludes wheelchairs.
d. Fall out of bed or (wheel)chair	A fall out of a bed or (wheel)chair.
e. Exercise	A fall during exercise like tennis or football. Falls during cycling are excluded and included in *"extrinsic – traffic accidents".*
f. Balance	A fall because of losing balance. This loss of balance is transient and not chronically present, otherwise patients are included in *"intrinsic – gait/ balance".*
g. Other	Other causes of an extrinsic fall, including i.e. alcohol consumption.
2. Intrinsic cause	The patient record describes a clear medical reason for a fall. This includes i.e. a CVA, gait disorders, neurodegenerative diseases and muscle weakness. Syncope is also included as an intrinsic fall.
a. Neurodegenerative diseases	A fall in patients with underlying dementia or other neurodegenerative diseases which are stated in the medical record of the patient. This may include Parkinson's disease or other forms of cognitive impairment.
b. CVA/TIA	A fall due to a CVA or a TIA. Ischemia of the brain is also included. Patients who suffer hemiparesis or gait disorders due to a CVA in the past are excluded from this category and included in *"intrinsic – gait/ balance"*.
c. (near-)syncope	A fall due to syncope or near-syncope. Possible underlying causes of (near-)syncope include reflex syncope, syncope due to orthostatic hypotension and cardiac syncope (cardiovascular). (Near-) syncope eci is also included.
d. Gait/balance	A fall caused by an internal gait- or balance problem. This includes chronic presence of vertigo and dizziness and chronical problems with walking or hemiparesis caused by a CVA in the past. Parkinson's disease is excluded and included in *"intrinsic – neurodegenerative diseases".*
e. Other	Other intrinsic causes of a fall, including i.e. falls due to chronic muscle weakness or falls in patients with malaise due to internal diseases like pneumonia.

Supplementary table 1. Continued

3. Unexplained fall	No apparent cause of the fall. In the patient record, neither a medical nor a mechanical reason is described. The record must provide a context indicating physician(s) searched for a cause but could not define it or the record must explicitly state that the patient had no recollection of the fall or that history taking was not possible.
4. Missing data	The record provides no context or cause of the fall.

Supplementary table 2. Results of categorization of causes of falls

	N (%)
Extrinsic cause	
Slip/trip	98 (24.9)
Traffic accident	50 (12.7)
Walking device	9 (2.3)
Fall out of bed or (wheel)chair	5 (1.3)
Exercise	6 (1.5)
Balance	13 (3.3)
Other	14 (3.6)
Intrinsic cause	
Neurodegenerative diseases	27 (6.9)
CVA/TIA	11 (2.8)
(near-)syncope	44 (11.2)
Gait/balance	14 (3.6)
Other	19 (4.8)
Unexplained fall	25 (6.4)
Missing data	58 (14.8)

Supplementary table 3. Patient characteristics and cause of the fall stratified by location of the fall

	Location of fall		p-value
	Indoors (N=195)	Outdoors (N=123)	
Patient characteristics			
Age (years), median (IQR)	82 (76-87)	78 (74-82)	<0.001
Male, n (%)	73 (37.4)	52 (42.3)	0.389
Living independently, n (%)	162 (83.1)	119 (96.7)	<0.001
Arrival by ambulance, n (%)	138 (70.8)	74 (60.2)	0.051
Triage urgency, n (%)			0.003
> 1 hour (green)	47 (24.1)	52 (42.3)	
< 1 hour (yellow)	128 (65.6)	61 (49.6)	
< 10 min (orange)	20 (10.3)	10 (8.1)	
Chief complaint, n (%)			0.230
Minor trauma	138 (70.8)	96 (78.0)	
Malaise	15 (7.7)	4 (3.3)	
Loss of consciousness	23 (11.8)	10 (8.1)	
Others	19 (9.7)	13 (10.6)	
Treating specialism, n (%)			0.054
Surgery	109 (55.9)	93 (75.6)	
Internal medicine	28 (14.4)	11 (8.9)	
Others	58 (29.7)	19 (15.4)	
Use of walking device, n (%)	126 (64.6)	28 (23.0)	<0.001
Polypharmacy, n (%)	106 (54.4)	54 (43.9)	0.069
Katz ADL score, median (IQR)	1 (0-2)	0 (0-0)	<0.001
6-CIT score, median (IQR)	8 (4-15)	4 (0-8)	<0.001
APOP screening result, n (%)			<0.001
Low risk	127 (65.1)	116 (95.1)	
High risk	68 (34.9)	6 (4.9)	
Cause of fall			<0.001
Extrinsic cause	69 (35.4)	96 (78.0)	
Intrinsic cause	83 (42.6)	17 (13.8)	
Unexplained fall	18 (9.2)	4 (3.3)	

Abbreviations: N=number; IQR=interquartile range; ADL=activities of daily living; 6-CIT=six-item cognitive impairment test; APOP=Acutely Presenting Older Patient screening.

Missings: 75 location of fall, 1 walking device, 2 Katz ADL, 31 6-CIT; 1 APOP screening result, 31 cause of fall

Supplementary table 4. Multivariable regression analysis with adverse outcomes at 3 and 12 months in older patients with fall-related ED visits stratified by the result from APOP screening

	Risk of adverse outcome at 3 months		**Risk of adverse outcome at 12 months**	
	Low risk geriatric screening result OR (95% CI)	**High risk geriatric screening result OR (95% CI)**	**Low risk geriatric screening result OR (95% CI)**	**High risk geriatric screening result OR (95% CI)**
Patient characteristics				
Age	1.05 (1.00-1.11)	1.05 (0.96-1.16)	1.10 (1.04-1.17)	1.08 (0.97-1.21)
Male	0.86 (0.46-1.62)	0.62 (0.21-1.87)	1.47 (0.79-2.75)	0.90 (0.27-3.07)
Fall characteristics				
Cause of fall				
Extrinsic fall	ref	ref	ref	ref
Intrinsic fall	1.87 (0.92-3.81)	0.81 (0.27-2.42)	1.49 (0.73-3.04)	0.41 (0.12-1.43)
Unexplained fall	1.83 (0.61-5.55)	1.16 (0.15-9.16)	0.76 (0.23-2.54)	1.20 (0.10-15.04)
Location of fall				
Outdoors	ref	ref	ref	ref
Indoors	2.10 (1.06-4.13)	0.79 (0.11-5.89)	2.21 (1.12-4.34)	0.57 (0.05-6.48)

Abbreviations: OR= Odds ratio; CI= confidence interval.

Chapter 4

The APOP screener and clinical outcomes in older hospitalized internal medicine patients

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ABSTRACT

Background: Acutely hospitalized older patients with indications related to internal medicine have high risks of adverse outcomes. We investigated whether risk stratification using the Acutely Presenting Older Patient (APOP) screening tool associates with clinical outcomes in this patient group.

Methods: Patients aged ≥70 years who visited the Emergency Department (ED) and were acutely hospitalized for internal medicine were followed prospectively. The APOP screener assesses demographics, physical and cognitive function at ED presentation, and predicts 3-month mortality and functional decline in the older ED population. Patients with a predicted risk ≥45% were considered 'high risk'. Clinical outcome was hospital length of stay (LOS), and adverse outcomes were mortality and functional decline, 3 and 12 months after hospitalization.

Results: We included 319 patients, with a median age of 80 (IQR 74-85) years, of whom 94 (29.5%) were categorized as 'high risk' by the APOP screener. These patients had a longer hospital LOS compared to 'low risk' patients (5 (IQR 3-10) vs. 3 (IQR 1-7) days, respectively; p=0.006). At 3 months, adverse outcomes were more frequent in 'high risk' patients compared to 'low risk' patients (59.6% vs. 34.7%, respectively; p<0.001). At 12 months, adverse outcomes (67.0% vs. 46.2%, respectively; p=0.001) and mortality (48.9% vs. 28.0%, respectively; p<0.001) were greater in 'high risk' compared to 'low risk' patients.

Conclusion: The APOP screener identifies acutely hospitalized internal medicine patients at high risk of poor short and long-term outcomes. Early risk stratification at admission could aid in individualized treatment decisions to optimize outcomes for older patients.

INTRODUCTION

Older patients acutely hospitalized for complaints within the remit of internal medicine are at high risk of adverse health outcomes, with 25-35% showing functional decline during hospitalisation[1;2], which rises to 23-43% at three months, together with 10-20% mortality rates three months after acute admission[3-5]. Patients with high risks of adverse outcomes require adaptations of care and extra attention to prevent further decline[6]. Risk stratification during the initial stages of an acute care episode is therefore an important first step in targeting interventions and improving outcomes for individual older patients[7-9]. However, the identification of patients at highest risk is challenging and therefore rarely used in practice.

The Acutely Presenting Older Patient (APOP) screener is a validated instrument to predict risk for functional decline and mortality within three months for the total population of older patients presenting to the Emergency Department (ED)[10;11]. After arrival in the ED, patients can be screened for their individual risk of adverse outcomes in less than two minutes using the APOP screener, and APOP screening has already been implemented in routine ED care in several Dutch hospitals. However, how predicted risk for adverse outcomes based on APOP screening relates to various clinical outcomes in older patients who are acutely hospitalized for internal medicine needs to be further defined. For example, if the APOP screener can predict a long hospital length of stay (LOS) and 12-month adverse outcomes in this patient group, it could also be used to guide treatment decisions and care planning from a very early stage onwards during hospital admission.

Therefore, the aim of the present study was to investigate the association between predicted risk of adverse outcomes, as assessed by the APOP screener, and clinical outcomes during hospitalization and at 3 and 12-month follow-ups in acutely hospitalized older internal medicine patients. This information could be a first step in exploring whether routine APOP-based risk stratification can predict individual prognoses useful in tailoring clinical approaches in this vulnerable patient group.

METHODS

Study design and setting

This paper describes a secondary analysis of the Acutely Presenting Older Patient (APOP) study, a prospective multicenter study which was performed in four Dutch hospitals. A detailed description has been published elsewhere[10]. Briefly, consecutive older patients visiting the ED of the participating hospitals were included from September to November 2014 at the Leiden University Medical Center (LUMC); from March to June 2015 at Alrijne hospital; from May to July 2016 at Haaglanden Medical Center (HMC,

location Bronovo); and from July 2016 to January 2017 at Erasmus University Medical Center (Erasmus MC). Patients were included 24 hours a day at the LUMC; seven days a week (from 10 a.m.-10 p.m.) at Alrijne; six days a week (from 10 a.m.-10 p.m.) at HMC Bronovo; and four days a week (from 10 a.m.-10 p.m.) at Erasmus MC.

Study participants

In the APOP study, all consecutive patients aged 70 years or older visiting the ED were included. Patients who were triaged 'red' according to the Manchester Triage System (MTS)[12], patients with an unstable medical condition, patients with an impaired mental status without a proxy to provide informed consent, patients with a language barrier and patients who refused to participate were excluded. For the purposes of the present study, we included all acutely hospitalized patients allocated to the specialism internal medicine, and with an APOP screening result at baseline. The participating hospitals had no separate geriatric departments. We excluded patients who were transferred from the ED for hospitalization elsewhere. The Medical Ethics Committees of the four hospitals approved the study and written informed consent was obtained from all patients.

Outcomes

For the present study, we defined the following outcomes at hospitalization: hospital LOS in days, in-hospital mortality, and discharge destination. Adverse outcomes assessed were functional decline and mortality, 3 months and 12 months after acute hospitalization. The 3-month adverse outcome was met if a patient had died or showed functional decline at the 3-month follow-up compared to baseline functioning. The 12-month adverse outcome was met if a patient had died or showed functional decline at the 12-month follow-up compared to baseline functioning. Functional decline was defined as at least one-point increase in the Katz index of Activities of Daily Living (ADL) score or new institutionalization (higher level of assisted living)[13]. Patients with a maximum Katz ADL score at baseline, institutionalization at baseline, or patients who were lost to follow-up were considered as having no functional decline.

Data collection

Patient characteristics

Three domains were assessed at baseline in the ED: demographics, disease severity, and geriatric measurements. Demographics consisted of age, sex, living arrangements, and level of education. Disease severity consisted of characteristics related to the ED visit, including arrival by ambulance, triage urgency according to MTS, chief complaint, and a fall-related ED visit. Geriatric measurements consisted of the number of different medications as stated by the patient (≥5 medications meaning polypharmacy), use of a walking device, Katz ADL questionnaire (functional status two weeks before the ED

visit)[13], the Six-item Cognitive Impairment Test (6-CIT)[14], and a history of diagnosed dementia reported by the patient or a proxy.

The APOP screening result

The APOP screening instrument was developed and validated to identify older patients at risk for the composite outcome of mortality and/or functional decline within three months[11]. The screener comprises seven predictors which are collected at baseline in the ED: age, sex, arrival by ambulance, need of regular help, need for help with bathing and showering, hospitalization in the past six months and impaired cognition (defined as having dementia or an incorrect answer on at least one out of two 6-CIT questions ['what year is it now?' and/or 'say the months in reverse order'] or no data on cognition). For the purposes of the present study, we retrospectively calculated the APOP screening results for all acutely hospitalized patients allocated to internal medicine, meaning that the medical staff, at the time, were unaware of the screening results during admission. Validation and threshold testing of APOP screening has been described previously[11]. The threshold for a 'high risk' APOP screening result is a predicted risk ≥45% on the composite outcome of mortality and/or functional decline within three months. The final APOP screening model is calibrated to identify the approximately 20% of patients with a predicted risk ≥45%. Previously, we compared the APOP screener with the Identification of Seniors At Risk – Hospitalized Patients (ISAR-HP), another frequently used screening tool in the Netherlands, and found that the APOP screener demonstrated better predicting performance for this composite outcome[15].

Follow-up data

The outcomes at hospitalization including hospital LOS, in-hospital mortality, and discharge destination were collected from the electronic health records of the participating hospitals. Hospital LOS was measured by subtracting the date of admission to the hospital ward after the ED visit from the hospital discharge date. The discharge destination was compared with the patient's former place of residence before hospital admission. We divided discharge destination into two groups: discharge to the former place of residence (either living at home or in a nursing home) or new institutionalization at discharge. To obtain follow-up data on functional decline, patients were contacted by telephone 3 and 12 months after acute hospitalization. In cases of no response after three attempts, the general practitioner was contacted to verify phone number and living arrangements. Finally, a letter was sent requesting a written response from those patients who could not be contacted. Data on mortality was obtained from municipal records. Patients who had not died and could not be reached at follow-up were considered as having no functional decline.

Sample size estimation

The required sample size to determine differences in 12-month mortality was calculated for the present study. Taking a difference of 20% in the mortality rate as relevant, 93

patients per group were needed to detect a difference between 'APOP high risk' and 'APOP low risk' patients with 80% power and a 5% significance level.

Data analyses

Continuous data are presented as means (standard deviation: SD) if normally distributed, and as medians (interquartile range: IQR) if skewed. Categorical data are presented as numbers (n, %). Differences in patient characteristics and outcomes between the APOP 'high risk' and 'low risk' patients were assessed using the independent samples t-test for normally-distributed data, the Mann-Whitney U test for skewed data, and the χ^2 test for categorical data. For categorical data, we present outcomes with 95% confidence intervals (95% CI). Differences in risks for adverse outcomes at 3 and 12 months between the APOP 'high risk' and 'low risk' patients were calculated using relative risk (RR; 95%CI). Survival was calculated by using Kaplan Meier survival curves for the population stratified by APOP screening result. We also conducted sensitivity analyses which led to the exclusion of patients with a maximum Katz ADL score at baseline, institutionalization at baseline, and those lost to follow-up. A p-value <0.05 was considered as statistically significant. Statistical analyses were performed using IBM SPSS Statistics version 23.

RESULTS

The APOP study included 2629 individual ED patients aged 70 years and older from four hospitals, of whom, 1157 (44.0%) patients were admitted to various hospital wards of the participating hospitals. A subset of 323 (27.9%) of the 1157 patients were acutely hospitalized and allocated to internal medicine. After excluding four patients due to an incomplete APOP screening result, a total of 319 patients could be included in the present study (Figure 1).

Patient characteristics

Table 1 presents the patient characteristics of the study population in total and stratified per APOP screening result. In the total study population of 319 patients, the median age was 80 years (IQR 74-85), 152 (47.6%) patients were male, and 202 (63.3%) patients arrived at the ED by ambulance. Of the total study population, 29.5% (n=94) were identified as 'high risk' by the APOP screener. These 'high risk' patients, when compared with 'low risk' patients, were older (median 84 years vs. median 78 years, respectively; p<0.001) and less likely to live independently (75.5% vs. 97.3%, respectively; p<0.001). 'High risk' patients were also more likely to have had a fall-related visit (20.2% 'high risk' vs. 4.0% 'low risk', respectively; p<0.001) and had more geriatric-related impairments, including greater use of a walking device (89.2% vs. 41.8%, respectively; p<0.001), a higher Katz ADL score (median 3 vs. median 0, respectively; p<0.001) and a higher 6-CIT score (median 14 vs. median 4, respectively; p<0.001).

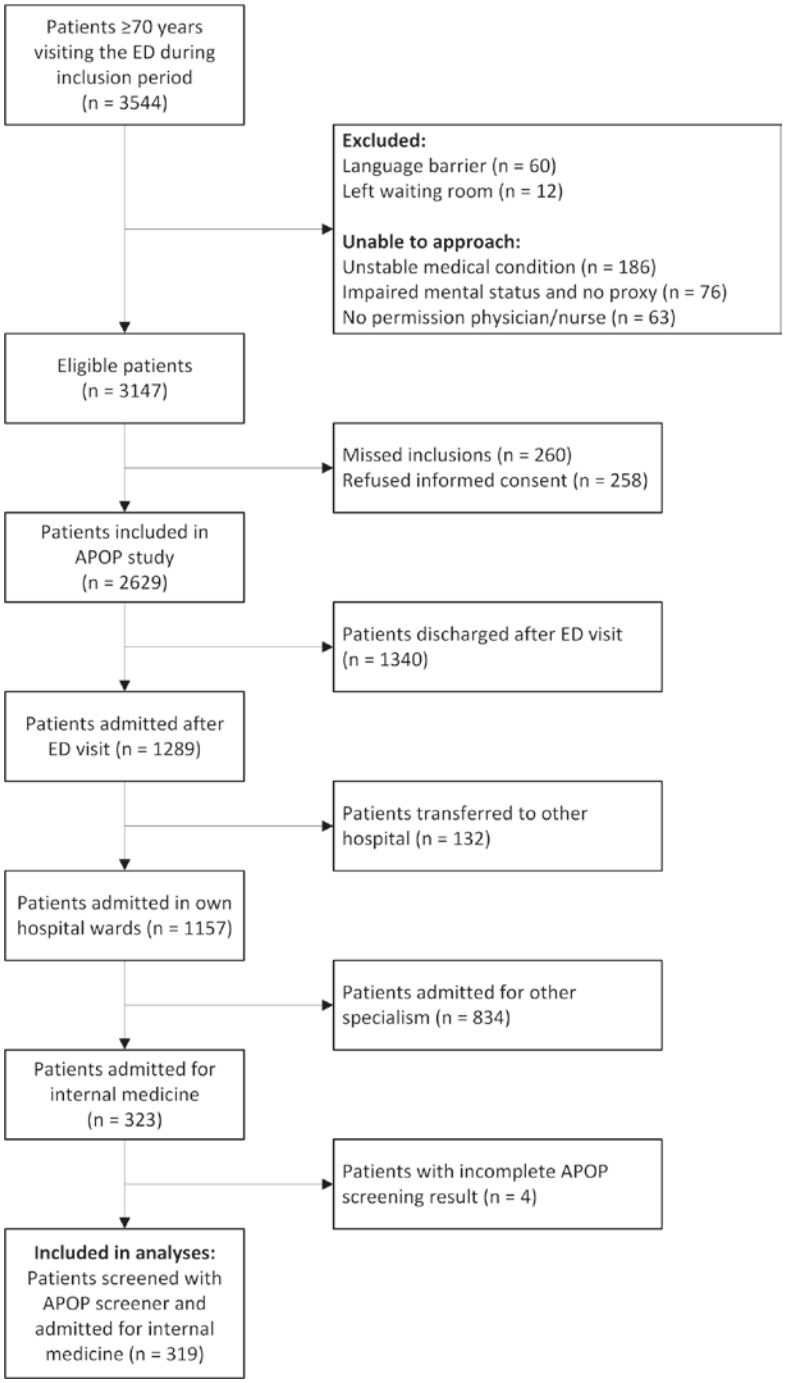

Figure 1. Flowchart of study population

Table 1. Patient characteristics of older patients acutely hospitalized for internal medicine

		APOP screening result		
	All (n=319)	**'low risk' (n=225)**	**'high risk' (n=94)**	**p-value***
Demographics				
Age (years), median (IQR)	80 (74-85)	78 (73-83)	84 (81-89)	<0.001
Male, n (%)	152 (47.6%)	111 (49.3%)	41 (43.6%)	0.351
Living independently, n (%)	294 (91.0%)	219 (97.3%)	71 (75.5%)	<0.001
High educated, n (%)	64 (20.2%)	47 (21.0%)	17 (18.3%)	0.585
Severity of disease indicators				
Arrival by ambulance, n (%)	202 (63.3%)	121 (53.8%)	81 (86.2%)	<0.001
Triage urgency, n (%)				0.768
> 1 hour (green)	42 (13.2%)	30 (13.3%)	12 (12.8%)	
< 1 hour (yellow)	226 (70.8%)	157 (69.8%)	69 (73.4%)	
< 10 min (orange)	51 (16.0%)	38 (16.9%)	13 (13.8%)	
Chief complaint, n (%)				0.139
Minor trauma	18 (5.6%)	9 (4.0%)	9 (9.6%)	
Malaise	137 (42.9%)	93 (41.3%)	44 (46.8%)	
Chest pain	14 (4.4%)	11 (4.9%)	3 (3.2%)	
Dyspnoea	48 (15.0%)	34 (15.1%)	14 (14.9%)	
Abdominal pain	67 (21.0%)	55 (24.4%)	12 (12.8%)	
Loss of consciousness	8 (2.5%)	6 (2.7%)	2 (2.1%)	
Other	27 (8.5%)	17 (7.6%)	10 (10.6%)	
Fall prior to ED visit, n (%)	28 (8.8%)	9 (4.0%)	19 (20.2%)	<0.001
Geriatric measurements				
Polypharmacy, n (%)	213 (66.8%)	152 (67.6%)	61 (64.9%)	0.645
Use of walking device, n (%)	177 (55.7%)	94 (41.8%)	83 (89.2%)	<0.001
Katz ADL score, median (IQR)	1 (0-2)	0 (0-1)	3 (2-5)	<0.001
6-CIT score, median (IQR)	6 (2-13)	4 (2-8)	14 (6-18)	<0.001
Diagnosis of dementia, n (%)	18 (5.6%)	5 (2.2%)	13 (13.8%)	<0.001

ADL = activities of daily living; ED = Emergency Department; IQR = interquartile range; n = number; 6-CIT = Six-item Cognitive Impairment Test.

* p-value between groups measured by χ^2 for categorical values and Mann-Whitney U test for non-parametric variables.

Missing information for 'low risk' patients: education level (1), Katz ADL (1), 6-CIT scores (21)

Missing information for 'high risk' patients: education level (1), walking device (1), Katz ADL (1), 6-CIT scores (26)

Outcomes at hospitalization

The median hospital LOS for the entire study population was four days (IQR 1-8) (Table 2). When stratified by APOP risk group, the 'high risk' group had a median hospital LOS that was two days longer than the 'low risk' patient group (5 (IQR 3-10) vs. 3 (IQR 1-7) days, respectively; p=0.006). In total, 21 (6.6%) patients died during hospitalization, with numbers similar in both groups (p=0.381). Following hospital admission, the discharge destination was significantly different between 'high risk' and 'low risk' patients, with 'high risk' patients more often newly institutionalized to a nursing home compared to 'low risk' patients (11.6% (6.4-20.1) vs. 3.3% (1.6-6.7), respectively; p<0.001).

Table 2. Short-term clinical outcomes in older patients acutely hospitalized for internal medicine

		APOP screening result		
	All (n=319)	**'low risk' (n=225)**	**'high risk' (n=94)**	**p-value***
Hospital LOS in days, (median; IQR)	4 (1-8)	3 (1-7)	5 (3-10)	0.006
In-hospital mortality, n (% (95%CI))	21 (6.6 (4.4-9.9))	13 (5.8 (3.4-9.7))	8 (8.5 (4.4-15.9))	0.381
Discharge	**(n=296)[a]**	**(n=210)[a]**	**(n=86)[a]**	
Discharge to former place of residence, n (% (95%CI))				<0.001
(semi) Independent at home	220 (74.3 (69.1-79.0))	173 (82.4 (76.7-86.9))	47 (54.7 (44.2-64.8))	
Nursing home	24 (8.1 (5.5-11.8))	6 (2.9 (1.3-6.1))	18 (20.9 (13.7-30.7))	
New institutionalization at discharge, n (% (95%CI))				
Other hospital	19 (6.4 (4.2-9.8))	17 (8.1 (5.1-12.6))	2 (2.3 (0.6-8.1))	
Nursing home	17 (5.7 (3.6-9.0))	7 (3.3 (1.6-6.7))	10 (11.6 (6.4-20.1))	
Rehabilitation	8 (2.7 (1.4-5.2))	2 (1.0 (0.3-3.4))	6 (7.0 (3.2-14.4))	
Hospice	6 (2.0 (0.9-4.4))	4 (1.9 (0.7-4.8)	2 (2.3 (0.6-8.1))	
Other	2 (0.7 (0.2-2.4))	1 (0.5 (0.1-2.7))	1 (1.2 (0.2-6.3))	

LOS = length of stay; n = number; 95%CI = 95% confidence interval

* p-value between groups measured by χ^2 for categorical values and Mann-Whitney U test for non-parametric variables.

[a] Numbers of survivors being discharged after admission

Missing information for 'low risk' patients: hospital LOS (1), in-hospital mortality (2), discharge destination after admission (2)

Missing information for 'high risk' patients: hospital LOS (1)

Outcomes at three months

At three months, 134 (42.0%) patients had an adverse outcome, including 67 (21.0%) who had died and 67 (21.0%) who experienced functional decline compared to their level of functioning two weeks before hospitalization. Outcomes stratified per APOP screening result are shown in Figure 2. Of the 94 'high risk' patients, 27 (28.7%) patients had died and an additional 29 (30.9%) patients showed functional decline within three months. Of the 225 'low risk' patients, 40 (17.8%) patients had died and an additional 38 (16.9%) patients had functional decline. 'High risk' patients showed an adverse outcome (deceased or functional decline) more often compared to 'low risk' patients (59.6% (49.5-68.9) vs. 34.7% (28.8-41.1), respectively; p<0.001). 'High risk' patients showed a 1.7-fold higher relative risk (95%CI 1.3-2.2) for an adverse outcome at three months compared to 'low risk' patients.

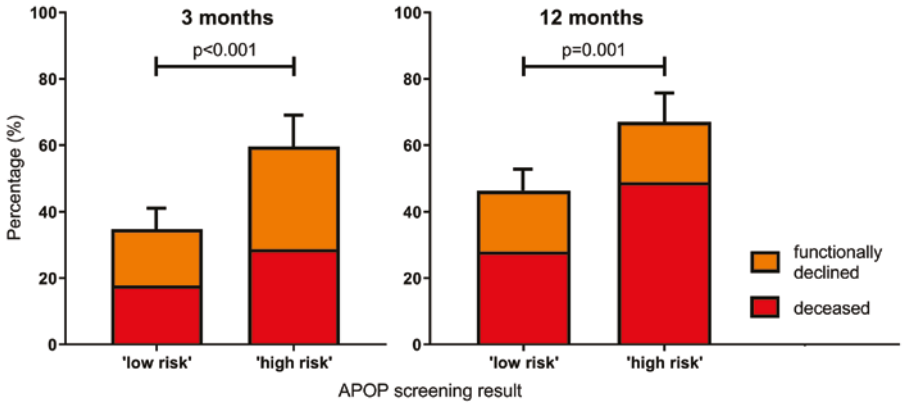

Figure 2. Functional decline and mortality, 3 and 12 months after acute hospitalization stratified by APOP screening result. Percentage of patients deceased or with declines in functioning compared to the level of functioning at baseline (2 weeks before hospitalization), at 3 months and at 12 months after acute hospitalization. Percentages are stratified by the APOP screening result in the ED. Absolute numbers at 3-month follow-up: 'Low risk' patients n=40 deceased, n=38 functional decline. 'High risk' patients n=27 deceased, n=29 functional decline. Absolute numbers at 12-month follow-up: 'Low risk' patients n=63 deceased, n=41 functional decline. 'High risk' patients n=46 deceased, n=17 functional decline. APOP = Acutely Presenting Older Patient screener.

Outcomes at twelve months

At twelve months, a total of 167 (52.4%) patients had an adverse outcome, of whom 109 (34.2%) had died and 58 (18.2%) experienced functional decline compared to their level of functioning two weeks before hospitalization. Of the 94 'high risk' patients, 46 (48.9%) patients had died and an additional 17 (18.1%) patients showed functional decline within twelve months. Of the 225 'low risk' patients, 63 (28.0%) had died and

an additional 41 (18.2%) patients had functional decline. More 'high risk' patients had an adverse outcome compared to 'low risk' patients (67.0% (57.0-75.7) vs. 46.2% (39.8-52.7), respectively; p=0.001). 'High risk' patients also showed a 1.5-fold higher relative risk (95%CI 1.2-1.8) for an adverse outcome at twelve months compared to 'low risk' patients. Supplementary figure 1 shows survival plots for 12-month mortality stratified per APOP screening result. Significantly more 'high risk' patients died within twelve months compared to 'low risk' patients (48.9% vs. 28.0%, respectively; p<0.001).

We found similar differences between APOP 'high risk' and 'low risk' patients in the sensitivity analyses of outcomes at three and twelve months, from which we first excluded those patients who were lost to follow-up for the outcome functional decline and patients who by definition could not show a decline in function (Supplementary table 1).

DISCUSSION

'High risk' acutely hospitalized older patients with indications related to internal medicine had a longer hospital LOS and were more often discharged to a nursing home compared to 'low risk' patients. One year after admission, two-thirds of this patient group was deceased or showed a decline in function, showing an overall 1.5-fold higher risk compared to 'low risk' patients.

In the present study, the APOP screener was used as a risk stratification instrument to identify risk of adverse outcomes in older patients. APOP 'high risk' patients could be considered 'frail', although no consensus on the definition of frailty exists. The present study shows how the APOP screener can be used to operationalize the concept of frailty in the ED, by showing the implications of the screener for acutely hospitalized older internal medicine patients.

Over the short term, APOP 'high risk' patients had a 2-day longer median hospital LOS and ~4 times higher risk for new institutionalization to a nursing home, compared to 'low risk' patients. These results are aligned with existing literature, in which frailty was found to be a good predictor of various short-term adverse outcomes such as hospital length of stay, in-hospital mortality, and institutionalisation[6;16;17]. A recent review concerning acutely admitted general medicine patients reported that frailty was predictive of LOS in 57% of studies and of institutionalization in 100% of studies[6]. Using frailty/risk-stratification tools at the beginning of an acute care episode may therefore have additional value because it facilitates the identification of those internal medicine patients who will be hospitalized for a longer period and are likely to be subsequently discharged to a new living environment.

At three months, around one-third of 'high risk' hospitalized internal medicine patients had died and almost half of the survivors exhibited functional decline. These proportions are very comparable to previous Dutch studies in this patient group[5;18]. More importantly, we showed that early risk stratification at admission can also predict long-term adverse outcomes at one year. Despite the fact that the APOP screener was originally designed to predict outcomes at three months, we found that higher risks for mortality or functional decline were still statistically significant at one year; our results align with another Dutch study by Buurman et al., which also reported a significant association between one-year mortality and various geriatric conditions[19].

The present study has a number of implications for clinical practice. The routine use of the APOP screener upon arrival in the ED can help to identify vulnerable patients at the very beginning of an acute episode. This risk stratification could allow better targeted assessment (i.e., comprehensive geriatric assessment) in patients who need it most and could avoid unnecessary assessment of severely frail/high-risk patients. If risk stratification is not used, care providers may be unaware of differences in frailty amongst older patients, leading to a risk of generalization of treatment advice. On the one hand, generalization might lead to overtreatment of frail older patients. This is especially problematic as frail patients are often underrepresented in clinical studies and thus the impact of treatment is often unclear or not focused on the outcomes of interest for these patients[20;21]. On the other hand, there is also a risk of undertreatment of frail older patients. Some of the effects of hospitalization, such as immobility resulting in functional decline, might be preventable by initiating assessments immediately during hospital admission[22]. Despite the fact that it is unclear why the 'high risk' patients in our study had a longer LOS, the extra two days of hospitalization could be used as a window of opportunity. In some hospitals, these patients could be admitted to specific geriatric departments, but if this is not possible, an internist ought to be aware of opportunities to improve patient outcomes. Perhaps the most important opportunity would be first, to use comprehensive geriatric assessment, which has known positive effects on prevention of institutionalization, death, and deterioration in older patients[23;24]. Second, the use of advance care planning would help to establish goals and preferences for future care[25]. And finally, safe transitions between care settings should be ensured, for example, by the use of transitional care[26]. In addition, it is also worth considering that the interventions described above could be of benefit to patients screened as 'low risk'. An important clinical impact of the use of frailty/risk-stratification tools is increased awareness of the risk of poor outcomes, which in turn, may help clinicians to tailor approaches to the individual patient. The specific details of how clinicians can do this to improve outcomes or to prevent further decline should be addressed in future research.

Our study has several strengths. First, an unselected group of acutely hospitalized older internal medicine patients was included from four separate Dutch hospitals. Second, although the APOP screener is not technically a frailty screening instrument,

it is validated to identify adverse outcomes. As it can be used directly after patient arrival in the ED and requires only two minutes to complete, it is clearly suitable for large-scale use in clinical practice.

Our study also has several limitations. First, we did not have reliable data on the medical reason or diagnosis at hospitalization, which may have influenced the risk of adverse outcomes. However, a novel aspect of the present study was the risk stratification of patients at the very beginning of an acute care episode to predict outcomes even before the final diagnosis was clear. Second, for the present study we used the development and validation cohort of the APOP study and calculated the APOP screener retrospectively. Nevertheless, we consider the degree of selection or information bias due to the retrospective design to be minimal due to the prospective follow-up design of the study and the inclusion of all consecutive older ED patients. A retrospective design could also be considered an advantage, as clinicians were unaware of the screening results and it therefore could not have influenced course and clinic. In view of the ongoing implementation of the APOP screener in several Dutch hospitals, it would be of value to repeat these analyses in different populations in the future.

In conclusion, the APOP screener identifies acutely hospitalized internal medicine patients at high risk of short and long-term poor outcomes. Early risk stratification at admission could aid in individualizing treatment decisions and therefore facilitate optimized outcomes for acutely hospitalized older patients with internal medicine-related indications.

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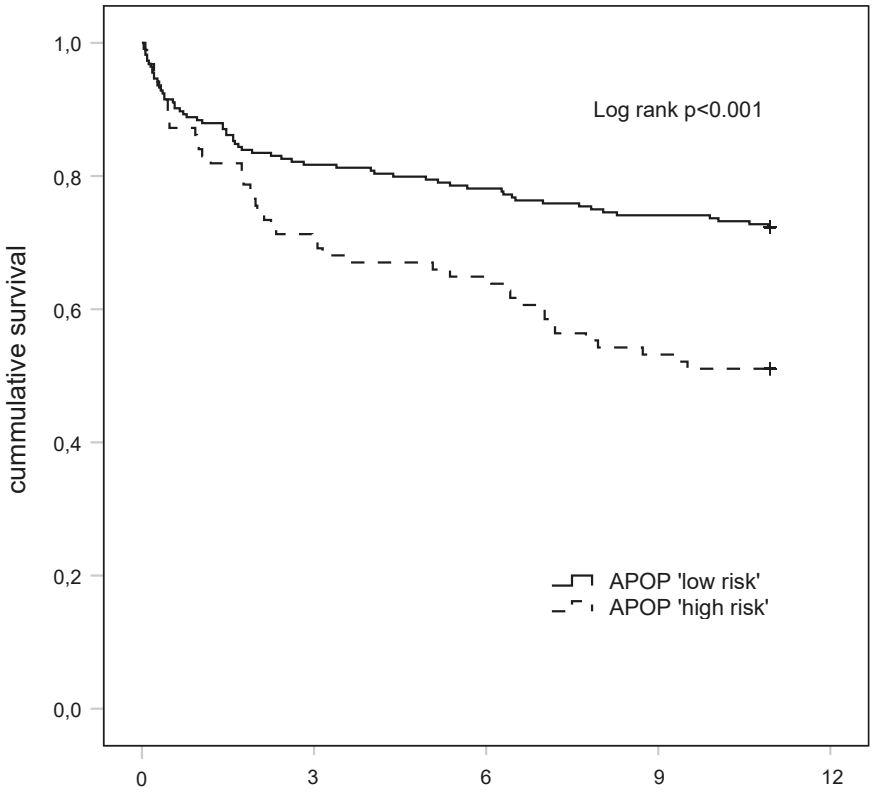


Supplementary figure 1. Survival of older internal medicine patients after acute hospitalization , stratified by APOP screening result. Kaplan Meier survival curves stratified by APOP screening result. After 12 months follow-up, 109 patients had died, consisting of 46 'high risk' patients and 63 'low risk' patients. There was an association between 'high risk' as determined by the APOP screener and mortality (Hazard Ratio 1.97 (95%CI 1.35-2.89), p<0.001). APOP = Acutely Presenting Older Patient screener

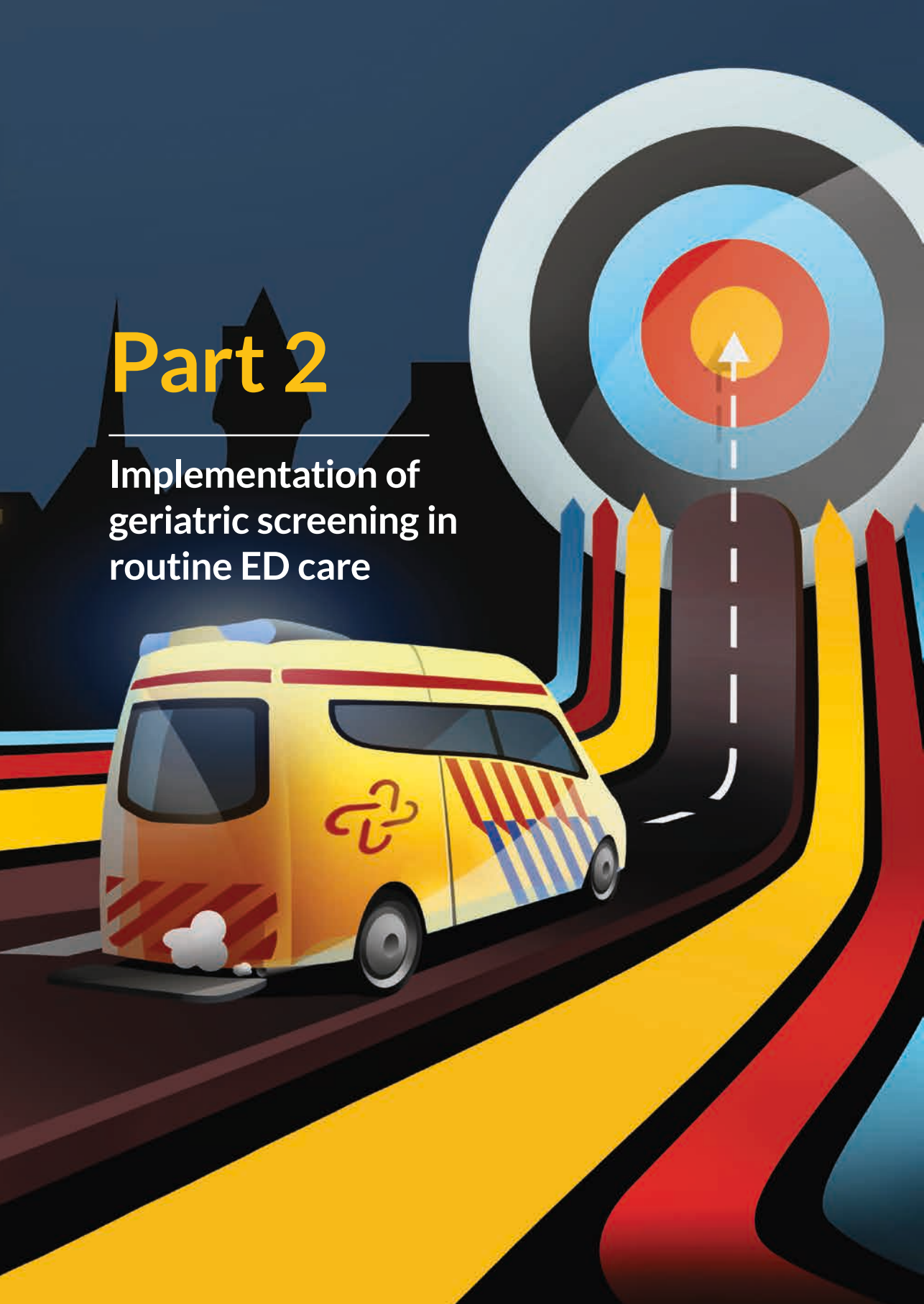
Supplementary table 1. Sensitivity analysis – adverse health outcomes in older patients acutely hospitalized for internal medicine, excluding patients who were lost to follow-up for functional decline or who could not decline (categorized as 'no functional decline') because of a maximum Katz ADL or institutionalization at baseline

		All		APOP low risk		APOP high risk	p-value
3 months							
Mortality, n (%)	n=319	67 (21.0%)	n=225	40 (17.8%)	n=94	27 (28.7%)	
Functional decline, n (%)	n=295	67 (22.7%)	n=214	38 (17.8%)	n=81	29 (35.8%)	
Composite outcome, n (%)	n=295	134 (45.4%)	n=214	78 (36.4%)	n=81	56 (69.1%)	<0.001
12 months							
Mortality, n (%)	n=319	109 (34.2%)	n=225	63 (28.0%)	n=94	46 (48.9%)	
Functional decline, n (%)	n=301	58 (19.3%)	n=217	41 (18.9%)	n=84	17 (20.3%)	
Composite outcome, n (%)	n=301	167 (55.5%)	n=217	104 (47.9%)	n=84	63 (75.0%)	<0.001

APOP = Acutely Presenting Older Patient screener; n = number

Exclusion at 3 months: 13 patients lost to follow-up and 11 patients who could not decline in function (categorized as 'no functional decline').

Exclusion at 12 months: 10 patients lost to follow-up and 8 patients who could not decline in function (categorized as 'no functional decline').



Part 2

Implementation of geriatric screening in routine ED care

Chapter 5

Feasibility and acceptability of the APOP screener in routine Emergency Department care

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ABSTRACT

Background: risk stratification tools for older patients in the emergency department (ED) have rarely been implemented successfully in routine care.

Objective: to evaluate the feasibility and acceptability of the 'Acutely Presenting Older Patient' (APOP) screener, which identifies older ED patients at the highest risk of adverse outcomes within 2 minutes at presentation.

Design and setting: 2-month prospective cohort study, after implementation of the APOP screener in ED routine care in the Leiden University Medical Center.

Subjects: all consecutive ED patients aged ≥70 years.

Methods: feasibility of screening was assessed by measuring the screening rate and by identifying patient- and organization-related determinants of screening completion. Acceptability was assessed by collecting experienced barriers of screening completion from triage-nurses.

Results: we included 953 patients with a median age of 77 (IQR 72-82) years, of which 560 (59%) patients were screened. Patients had a higher probability of being screened when they had a higher age (OR 1.03 (95%CI 1.01-1.06), p=0.017). Patients had a lower probability of being screened when they were triaged very urgent (OR 0.55 (0.39-0.78), p=0.001) or when the number of patients upon arrival was high (OR 0.63 (0.47-0.86), p=0.003). Experienced barriers of screening completion were patient-related ('patient was too sick'), organization-related ('ED was too busy') and personnel-related ('forgot to complete screening').

Conclusion: with more than half of all older patients screened, feasibility and acceptability of screening in routine ED care is very promising. To further improve screening completion, solutions are needed for patients who present with high urgency and during ED rush hours.

INTRODUCTION

Risk stratification of older patients visiting the Emergency Department (ED) may help to deliver appropriate care, but few studies address the feasibility and acceptability of screening in clinical practice[1]. Older ED patients are at higher risk of various adverse outcomes compared with younger patients[2]. This is partly explained by non-specific disease presentation or the presence of comorbidities or cognitive disorders, which complicates their ED presentation, diagnosis and management[3-5]. Risk stratification can be used to identify patients at highest risk of adverse outcomes and allows targeted interventions to be applied for those who need it most[6]. Although there are many risk-stratification tools reported in literature, widespread dissemination in routine clinical practice remains scarce.

The gap between research and practice needs to be bridged by focusing more on implementation outcomes[7;8]. Although tools can have the best validated predictive values, there will be no benefit for patients if tools are not used due to unsuccessful implementation in practice[9;10]. Only very few studies have yet focused on the feasibility of implementing risk stratification tools for older patients in the ED[1]. Understanding how tools are likely to be used in routine clinical practice is important to ensure that they are accepted by ED care providers which increases the chance of successful implementation.

The 'Acutely Presenting Older Patient' (APOP) screener identifies older patients at highest risk for functional decline and mortality and aids in the recognition of cognitive impairment[11;12]. The APOP screener is tailored for use in everyday ED practice and takes less than 2 minutes to administer directly at presentation[12]. The aim of the present study was to determine feasibility and acceptability of the APOP screener in routine ED practice.

METHODS

Study design and setting

A prospective cohort study was used to evaluate the feasibility of the APOP screener in routine care. This study was conducted in the ED of the Leiden University Medical Center (LUMC), The Netherlands[13]. In the ED, a triage-nurse first prioritizes patients based on their disease severity, using the Manchester Triage System (MTS)[14]. Patients who bypass ED triage are patients eligible for thrombolytic therapy or with an indication for cardiac catheterization. The APOP screener was incorporated after routine triage from 1 March 2018 and evaluated during a 2-month inclusion period from 2 April to 3 June 2018. Acceptability of the screener was assessed with a questionnaire, which was sent out after the 2-month inclusion period. The questionnaire was analyzed with both quantitative and qualitative methods. The medical ethics committee of the LUMC

waived the necessity for formal approval, as the study closely followed routine care. The Netherlands Trial Register number: NTR7171.

Study participants

All consecutive ED patients aged ≥70 years during the 2-month inclusion period were eligible for screening and therefore inclusion. Because the APOP screener was incorporated in the routine care process after ED triage, we excluded patients who bypassed triage. Patient who were triaged to the immediate urgency level (MTS category 'red') were excluded, because the APOP screener was not developed and validated for this population.

ED triage-nurses, the main users of the APOP screener, were included to assess the acceptability of the screener.

Intervention

The APOP screener identifies the individual risk of 90-day functional decline and/or mortality and signs of impaired cognition for patients aged ≥70 years. The screener consists of nine questions and can be administered within 2 minutes[12]. We incorporated the screener at the end of the triage-form in the electronic health records (EHRs) of all older patients. Triage-nurses were instructed to screen all older patients after routine triage. The screening results were saved in the EHRs, visible for all care providers.

Implementation strategy

Before implementation, we executed pilot studies with triage-nurses to assess the barriers and facilitators of the APOP screener[12]. Because incorporation in the EHRs was experienced as the most important facilitator, we addressed this before implementation in routine care. We carried out a 1-month education program for all ED personnel to enhance awareness and explain the procedures of screening (see Supplementary text 1)[15;16].

Data collection

Feasibility of screening

The number of screened patients divided by the total number of older patients per day yielded the screening rate. Patient characteristics, collected from EHRs, were demographics (age, gender) and severity of disease indicators (arrival by ambulance, MTS triage urgency and chief complaint[14], Charlson Comorbidity Index (CCI)[17], and discharge destination). To measure organization-related characteristics on a patient level, we used real-time prospective observations by medical students who were present in the ED 7 days a week (8.00 AM – 11.00 PM). Personnel was not informed about the reason for observation. We observed the number of personnel, the total number of ED registrations and the actual number of patients upon arrival time. Because our ED consists of 14 treatment rooms, we used this number as a cut-off point for the

analyses. The ED length of stay (LOS) was measured by subtraction of the ED arrival time from the departure time.

Acceptability of screening

To assess acceptability, triage-nurses were sent a questionnaire per email, including two reminders. The questionnaire consisted of multiple-choice questions and open textboxes (see Supplementary text 2). Five questions explored the opinions of nurses on the screener with 10-point Likert scales (1 meaning 'totally disagree' and 10 meaning 'totally agree') and two multiple-choice questions explored barriers of screening completion.

Outcome measures

Feasibility of screening was assessed by measuring (i) the screening rate and (ii) patient- and organization-related determinants of screening completion. To assess acceptability, we collected opinions and experienced barriers of screening completion.

Data analysis

Data are presented as means with standard deviation (SD), medians with interquartile ranges (IQRs) or numbers with percentages. Patient- and organization-related characteristics were compared between the screened and not screened patients with independent samples *t*-test, Mann-Whitney U test and χ^2 test. In order to identify determinants of screening completion, univariable and multivariable logistic regression analyses were performed with screening completion as the dependent variable and forced entry of patient- and organization-related determinants as independent variables. Because of potential multicollinearity, we measured the severity of disease by including only arrival by ambulance and triage urgency. As organization-related determinants, we included variables known at ED arrival: the number of patients upon arrival time, day of arrival and time of arrival. Results were presented as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value <0.05 was determined as statistically significant. To assess acceptability, we calculated median grades and frequencies of answers from the questionnaire. Statistical analyses were performed using IBM SPSS Statistics version 25.

The qualitative input alongside the quantitative answers from the questionnaire was used to assess acceptability. We used the open textboxes and selected quotes that matched the answers.

RESULTS

A total of 5188 patients visited the ED during the 2-month inclusion period, of which 1016 (19.6%) were ≥70 years old (see Supplementary figure 1). We excluded 30 patients

who bypassed triage and 33 patients who were triaged to the immediate urgency level. This resulted in 953 triaged older patients who were eligible for APOP screening and included in this study.

Table 1 shows the patient characteristics and organization-related characteristics on a patient level for the total study population. The median age was 77 (IQR 73-82) years and 471 (49.4%) patients were male. Most patients were triaged as urgent (n=443, 46.5%). The most common chief complaint was minor trauma (n=276, 29.3%). The mean number of ED registrations per day was 83 (12), and for 295 (36.7%) patients, the number of ED patients upon arrival time was higher than 14.

Table 1. Patient characteristics and organization-related characteristics on a patient level for the total study population

	N=953
Patient characteristics	
Demographics	
Age, median (IQR)	77 (73-82)
Male, n (%)	471 (49.4%)
Severity of disease indicators	
Arrival by ambulance, n (%)	293 (30.7%)
Triage urgency, n (%)	
non-urgent (green and blue)	219 (23.0%)
urgent (yellow)	443 (46.5%)
very urgent (orange)	291 (30.5%)
Chief complaint, n (%)	
Minor trauma	276 (29.3%)
Malaise	247 (26.2%)
Dyspnoea	96 (10.2%)
Abdominal pain	91 (9.7%)
Chest pain	75 (8.0%)
Loss of consciousness	41 (4.4%)
Major trauma	15 (1.6%)
Mental health problems	10 (1.1%)
Other	91 (9.7%)
CCI, median (IQR)	5 (4-7)
Destination, n (%)	
Discharged home	488 (51.5%)
Admission	422 (44.5%)
Other	38 (4.0%)

Table 1. Continued.

	N=953
Organization-related characteristics	
Number of ED personnel, mean (SD)	11 (1)
Number of ED registrations on arrival day, mean (SD)	83 (12)
Number of ED patients upon arrival time, n (%)	
0-14 patients	508 (63.3%)
>14 patients	295 (36.7%)
Day of arrival, n (%)	
Weekday	717 (75.2%)
Weekend	236 (24.8%)
Time of arrival, n (%)	
Day (8-16 h)	506 (53.1%)
Evening (16-23 h)	326 (34.2%)
Night (23-8 h)	121 (12.7%)
ED LOS (minutes), median (IQR)	196 (133-265)

Missings: 23 personnel, 150 patients upon arrival time, 2 ED LOS.

Feasibility of screening

Of all 953 triaged older patients, 560 (59%) were screened during the 2-month evaluation. The absolute numbers and percentages of screened patients are shown in Figure 1. The total number of older patients ranged between 8 and 28 patients per day. The screening rate varied between 33 and 81% and was relatively stable during the 2-month period without showing a linear trend over time. The screening rate remained stable in routine practice over a longer period (see Supplementary figure 2).

Table 2 shows the patient- and organization-related characteristics stratified by completion of screening. Screened patients were older (78 vs. 77 years, p=0.045), arrived less often by ambulance (27.3 vs. 35.6%, p=0.006), were more often triaged urgent (51.1 vs. 39.9%) and less often triaged very urgent (25.5 vs. 37.7%) (overall p<0.001) compared with patients who were not screened. Screened patients more often arrived at the ED when it was less busy due to a low amount of patients (0-14 patients) upon arrival (68.1 vs. 56.2%, p=0.001) and screened patients had a longer median ED LOS (213 vs. 176 minutes, p<0.001) compared with patients who were not screened.

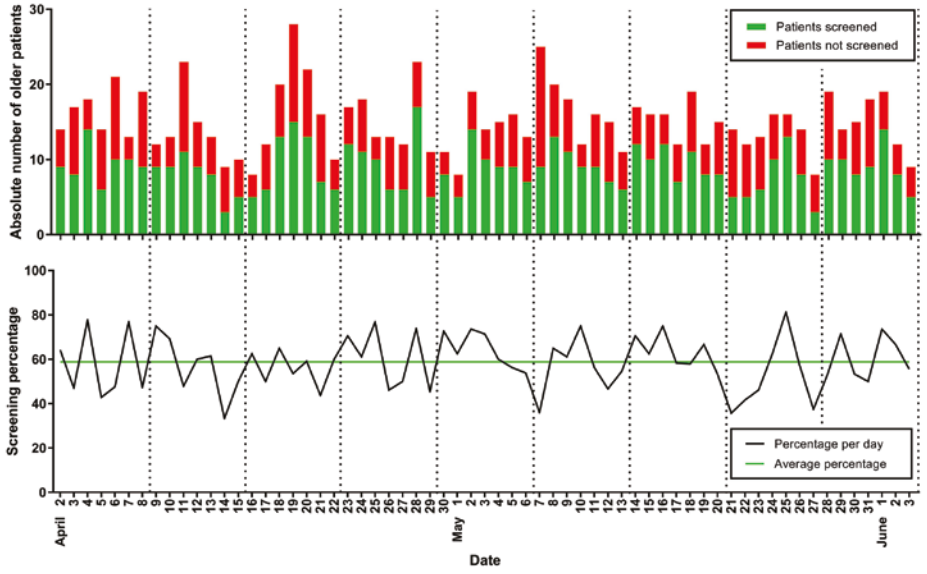

Figure 1. Screening in absolute numbers and screening rate over the study period. Absolute numbers and percentages of older patients screened in the ED during the 2-month inclusion period starting 1 month after implementation of the APOP screener. Dotted lines are placed between Sundays and Mondays to indicate the weeks. The absolute numbers of older patients visiting the ED ranged between 8 and 28 patients per day. The screening rate varied per day between 30 and 82%.

Table 2. Patient characteristics and organization-related characteristics on a patient level stratified by screening completion

	Patients screened (n=560)	**Patients not screened (n=393)**	**p-value***
Patient characteristics			
Demographics			
Age, median (IQR)	78 (73-83)	77 (72-81)	0.045
Male, n (%)	279 (49.8%)	192 (48.9%)	0.769
Severity of disease indicators			
Arrival by ambulance, n (%)	153 (27.3%)	140 (35.6%)	0.006
Triage urgency, n (%)			<0.001
non-urgent (green and blue)	131 (23.4%)	88 (22.4%)	
urgent (yellow)	286 (51.1%)	157 (39.9%)	
very urgent (orange)	143 (25.5%)	148 (37.7%)	

Table 2. Continued.

	Patients screened (n=560)	Patients not screened (n=393)	p-value*
Chief complaint, n (%)			0.004
Minor trauma	172 (31.0%)	104 (26.9%)	
Malaise	130 (23.4%)	117 (30.2%)	
Dyspnoea	70 (12.6%)	26 (6.7%)	
Abdominal pain	55 (9.9%)	36 (9.3%)	
Chest pain	43 (7.7%)	32 (8.3%)	
Loss of consciousness	22 (4.0%)	19 (4.9%)	
Major trauma	4 (0.7%)	11 (2.8%)	
Mental health problems	8 (1.4%)	2 (0.5%)	
Other	51 (9.2%)	40 (10.3%)	
CCI, median (IQR)	5 (4-7)	5 (4-7)	0.943
Destination, n (%)			<0.001
Discharged home	303 (54.4%)	185 (47.3%)	
Admission	247 (44.3%)	175 (44.8%)	
Other	7 (1.3%)	31 (7.9%)	
Organization-related characteristics			
Number of ED personnel, mean (SD)	11 (1)	11 (1)	0.803
Number of ED registrations on arrival day, mean (SD)	83 (12)	83 (12)	0.165
Number of ED patients upon arrival time, n (%)			0.001
0-14 patients	323 (68.1%)	185 (56.2%)	
>14 patients	151 (31.9%)	144 (43.8%)	
Day of arrival, n (%)			0.242
Weekday	429 (76.6%)	288 (73.3%)	
Weekend	131 (23.4%)	105 (26.7%)	
Time of arrival, n (%)			0.066
Day (8-16 h)	315 (56.3%)	191 (48.6%)	
Evening (16-23 h)	179 (32.0%)	147 (3704%)	
Night (23-8 h)	66 (11.8%)	55 (14.0%)	
ED LOS (minutes), median (IQR)	213 (150-283)	176 (115-234)	<0.001

* overall p-value between groups measured by χ^2 for categorical values and Mann-Whitney U test for non-parametric variables.

Because of the hypothesized interrelationship between patient- and organization-related characteristics, we analyzed the characteristics that were independent determinants associated with screening completion (Table 3). In the multivariable model, patients had a higher probability of being screened when they had a higher age (OR 1.03 (1.01-1.06), p=0.017). Triage urgency was associated with screening completion in a non-linear fashion (p=0.003). Patients had a lower probability of being screened when they were triaged very urgent compared with urgent (OR 0.55 (0.39-0.78), p=0.001) and when the number of ED patients upon arrival was higher than 14 (OR 0.63 (0.47-0.86), p=0.003).

Table 3. Determinants of screening completion in older ED patients

	univariable OR (95% CI)	**p-value**	**multivariable OR (95% CI)**	**p-value**
Patient-related determinants				
Demographics				
Age	1.02 (1.00-1.05)	0.032	1.03 (1.01-1.06)	0.017
Male	1.04 (0.80-1.35)	0.769	1.10 (0.82-1.47)	0.534
Severity of disease indicators				
Arrival by ambulance	0.68 (0.52-0.90)	0.006	0.80 (0.57-1.13)	0.211
Triage urgency		<0.001*		0.003*
non-urgent (green and blue)	0.82 (0.57-1.14)	0.235	0.83 (0.57-1.20)	0.316
urgent (yellow)	ref	ref	ref	ref
very urgent (orange)	0.53 (0.39-0.72)	<0.001	0.55 (0.39-0.78)	0.001
Organization-related determinants				
Number of ED patients upon arrival time				
0-14 patients	ref	ref	ref	ref
>14 patients	0.60 (0.45-0.80)	0.001	0.63 (0.47-0.86)	0.003
Day of arrival				
Weekday	ref	ref	ref	ref
Weekend	0.84 (0.62-1.13)	0.242	0.83 (0.58-1.17)	0.285
Time of arrival		0.067*		0.138*
Day (8-16 h)	ref	ref	ref	ref
Evening (16-23 h)	0.74 (0.56-0.98)	0.035	0.77 (0.57-1.05)	0.094
Night (23-8 h)	0.73 (0.49-1.09)	0.120	0.24 (0.02-2.77)	0.251

* p-value testing whether the overall variable is statistically significant for categorical variables with more than two categories.

Acceptability of screening

In total 68 triage-nurses received the questionnaire, of which 34 (50.0%) nurses returned it. The questions exploring their opinions about screening are shown in Supplementary table 1. On a scale from 1 to 10, nurses graded the importance of identifying frailty in older patients using the APOP screener with a median of 8 (IQR 7-9). They graded the question 'Do you think that the APOP program in its current form contributes to better care for the older patient in the ED?' with a median of 6 (IQR 5-7). Some nurses indicated points for improvement (quotes 1 and 2).

Quote 1

'Good aim for the vulnerable older patient. Personally, I think it's not going well yet, mainly due to the busy ED […] *I do not yet have a positive experience with regard to APOP that it leads to improvement'*

Quote 2

'There's still a long waiting time and length of stay in the ED; more than 4 hours; also for high risk screened patients. […] *Because of the increased complexity in the ED, high workload and ED crowding, older patients do not receive yet the care they should receive regarding their high risk screening result.'*

Figure 2 shows the answers of the question: 'If you were unable to complete the APOP screener, what was mostly the reason?' Some nurses experienced patient-related barriers, such as the patient was too 'sick' (n=12 nurses, quote 3) or the patient 'refused' screening (n=5, quote 4).

Quote 3

' […] *and if the patient is too sick or has to be seen by a physician immediately, it has less priority.'*

Quote 4

'Patients say 'those questions again'. So we see patients who have been asked these questions multiple times. It happened to me twice that patients refused.'

The most frequently reported barriers for screening completion were organization-related: it was too 'busy' (n=21, quote 5) and there was no 'time' to complete screening (n=6, quote 6).

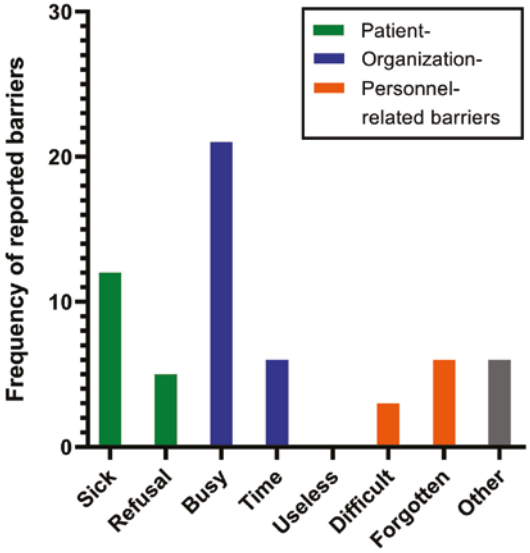

Figure 2. Experienced barriers of screening completion from triage-nurses working in the ED. Frequency of reported barriers of screening completion by 28 triage-nurses. Nurses were able to fill in multiple barriers. Patient-related barriers were 'patient was too sick' and 'patient refused screening'. Organization-related barriers were 'the ED was too busy' and 'it took too much time to complete screening'. Personnel-related barriers were 'screening was useless', 'screening questions were difficult to ask' and 'forgotten to complete screening'.

Quote 5
'During triage it is often too busy to complete the screening questions properly.'

Quote 6
'When it's busy, screening takes too much time.'

Personnel-related barriers came from nurses who stated the screening questions as 'difficult' (n=3, quote 7) and nurses who 'forgot' to complete screening (n=6, quote 8). None of the nurses stated screening was 'useless'.

Quote 7
'I sometimes find the question with the months in reversed order difficult to ask.'

Quote 8
'If the APOP screener is not completed at triage, there is no reminder [in the system]. *Because of this, I often forget to complete it when a patient arrives by ambulance.'*

DISCUSSION

The present study evaluated the feasibility and acceptability of the APOP screener in routine ED practice. The screener was completed in 59% of older ED patients, with a stable screening rate over time. Screening completion was associated with both patient characteristics – age and triage urgency and organization-related characteristics – the number of ED patients. Moreover, screening was accepted by the users, who stated it is important and useful. The experienced barriers of screening completion from triage-nurses were patient- ('patient was too sick'), organization- ('ED was too busy') and personnel-related ('forgot to complete screening').

The evaluated screening rate is somewhat higher compared with other risk-stratification tools used in the ED setting[1]. One feasibility study evaluating the Emergency Geriatric Screening tool found a screening rate of 43%[18]. Asomaning et al. showed that the Identification of Seniors At Risk (ISAR) tool could be administered in 52% of 'eligible' older ED patients[19]. However, in another study evaluating ISAR, the screening rate was 34% after implementation, followed by an increase toward 50% over the course of 7 months[20]. The observed screening rate of 59%, assessed 1 month after implementation in routine care, seems therefore acceptable compared with other studies.

Time to complete screening is an important determinant of feasibility and acceptability[1;21]. The 2-minute time to complete the APOP screener could therefore be an important facilitator of screening completion[12]. We believe that another facilitator was the incorporation of the screener in the EHRs, making screening a part of routine care procedures. The results of our study show an association between screening and ED LOS, but do not show whether a longer ED LOS is caused by screening, whether screening is caused by a longer ED LOS or whether this association is caused by other unknown factors. The determinants of screening completion were both patient- and organization-related. Firstly, patients had a higher probability of being screened with increasing age. This is probably because triage-nurses use their clinical judgement to indicate which patients are possibly vulnerable before they decide to complete the screener[21]. Secondly, we found that non-urgent and very urgent patients had a lower probability of being screened than urgent patients. We might need to improve the motivation of triage-nurses by explaining the importance of screening for these patients. However, for very urgent patients, medical care has priority and therefore a screening rate of 100% might be difficult to achieve. Although we recognize the importance to screen all older patients and identify those patients who are dying in order to deliver appropriate palliative care at the right time, the APOP screener was not validated for that use nor is it feasible. Thirdly, the number of patients upon arrival also had an impact on screening completion. This organization-related factor could be changed by reducing exit blocks from the ED[22]. Importantly, overcrowding was most often experienced as a barrier of screening completion, because it results in less time or less priority to

complete the screener. Priority can partly be determined by the experience of benefits of screening, because benefits are not always experienced by the users (shown by quotes 1 and 2), which might result in a 'lack of outcome experience', a known factor for non-adherence[23]. Although the importance of screening was graded high and screening was accepted by users, we should take the benefits for users into account in order to improve screening completion, i.e. by generating fast-track admissions for high risk screened patients with clinical indication for hospitalization, or by generating other care pathways such as a geriatric evaluation unit or a specialized geriatric acute medical ward.

Screening older patients on their risk of adverse outcomes can help ED personnel to think about the differences between older patients on a regular basis. The identification of high-risk patients can be an opportunity to ensure targeted interventions are started, and allows faster and more focused use of time, personnel and resources. In this way, risk stratification in the ED has the potential to improve outcomes for older patients. In the present study, we show that risk stratification with the APOP screener in routine care seems feasible and acceptable. More research will be needed to investigate feasibility in different hospitals and health care systems to generate guidance on how screening tools can be successfully implemented on a wide scale. The fact that the APOP screener recently has been implemented in the EHRs (HiX, Chipsoft) used by approximately half of all Dutch hospitals and has been put into routine use by several EDs throughout The Netherlands is very promising[24].

This study has several strengths. Firstly, this is the first implementation study investigating feasibility and acceptability of screening older patients in routine ED practice on a large scale. Secondly, we used real-time observations of everyday practice to measure real-time barriers. Finally, the screener was implemented for an unselected population of older ED patients, which increases generalizability. Generalizability is, however, also a limitation of this study. Although the APOP screener was validated in four Dutch hospitals, this implementation study was done in one academic hospital. Nonetheless, we believe that the barriers and facilitators found in this study could be used as guidance for implementation elsewhere.

In conclusion, with more than half of all older patients screened, feasibility and acceptability of screening in routine ED care is very promising. To further improve screening completion, solutions are needed for patients who present with high urgency and during ED rush hours.

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Supplementary text 1. Implementation strategy

Pre-implementation phase

Implementation planning for this study began with formal approval of the division boards of our hospital after the construction of a multidisciplinary project-team consisting of an ED physician, resident ED physician, ED-nurse, internist-geriatrician, geriatric nurse, AMU nurse, researchers and a general practitioner. Based on project-team experiences and literature the implementation strategy and the education program were developed.

Implementation strategy

Our implementation strategy was guided by the plan-do-study-act (PDSA) model for quality improvement[15]. In the first PDSA cycle the use of the screening instrument in practice was evaluated in a pilot study with ED triage-nurses. We assessed readiness to adopt screening, specific uptake goals and barriers and facilitators. The received input was taken into account during the development of the final screening instrument and the facilitation of the program[12]. For example, we excluded a question about polypharmacy in the final screening instrument because it took too much time to execute in practice. Triage-nurses experienced a barrier to ask for dementia, one of the questions in the APOP screener. We therefore collected input from patient representatives on how this question could be asked in the best possible way. This data was collected with focus group sessions with the older patient council of the LUMC (Ouderenberaad Zorg en Welzijn Zuid-Holland Noord). Their input was written down in the standard operating procedures of the APOP screening program. The most important facilitator for use of the screening instrument in routine care, according to the triage-nurses, turned out to be implementation in the electronic health records . This result was the starting point for following PDSA cycles in which the screening instrument was incorporated in the electronic health records.

Education program

Education was used to enhance awareness and increase knowledge of the ED personnel of different care needs of older people, especially aspects relating to frailty and geriatric syndromes, for which a broader, more holistic intervention is considered to be best practice. The other rationale for education was to influence adoption of the screening program by clarification of all program components. The education program was developed during the pre-implementation phase by the members of the multidisciplinary project-team. Outline for the education program was based on recommendations from the Curriculum for Geriatric Emergency Medicine designed by the European Task Force for Geriatric Emergency Medicine[16]. We developed 6 education sessions of 15 minutes each on the following topics: ‘Background of older patients visiting the ED’, ‘Vital signs in older patients’, ‘Cognitive disorders and delirium’, ‘Atypical presentations of older patients’, ‘How to administer the APOP-screener’ and

'Interventions for high risk patients'. During one month before the kick-off of the APOP screening program all topics were presented several times to the ED nurses and physicians before every ED dayshift.

Post-implementation phase

After the kick-off of the APOP screening program in routine care at March 1st 2018, we highlighted the program at the start of every dayshift in the ED to make personnel aware of screening. Every day one project-team member was available for questions. Screening rates, tips from the project-team and feedback from patients were all displayed in the ED newsletter and on the information board in the ED. At the end of March, we planned a joint moment for feedback with ED physicians and nurses. From April 2nd the data collection period for evaluation was started. During this two-month period we did not organize any education or feedback sessions and we observed routine care without interference from our project-team. After the data collection period we sent out questionnaires to all ED nurses and physicians and collected their feedback on the program. Simultaneously, some modifications were made in the electronic health records, resulting in a clearer overview of patients screened and not yet screened during their ED stay.

Supplementary text 2. Questionnaire APOP screening program

I am: nurse in training / nurse
Number of years working: 0 – 5 years / 5 – 10 years / 10 – 20 years / > 20 years

Part 1 – The APOP screening program in general

1. Do you find it important to identify frailty in older patients using the APOP screener?

   Totally unimportant Very important
   1 2 3 4 5 6 7 8 9 10

2. Are you motivated to complete the APOP screening program?

   Totally not motivated Very motivated
   1 2 3 4 5 6 7 8 9 10

3. Do you think that the APOP program in its current form contributes to better care for the older patient in the ED?

   Totally not contributing Very contributing
   1 2 3 4 5 6 7 8 9 10

4. Are you satisfied with how the APOP program works in the electronic health records?

   Totally unsatisfied Very satisfied
   1 2 3 4 5 6 7 8 9 10

5. Do you need more training on acute care in older patients? (i.e. vital parameters in older patients, nonspecific complaints or geriatric presentations)

   Totally no need Very much need
   1 2 3 4 5 6 7 8 9 10

Explanations on part 1:

Part 2 – Completion of the APOP screener

6. If you had to triage 10 older patients in a day, in how many patients was it possible for you to complete the APOP screener?

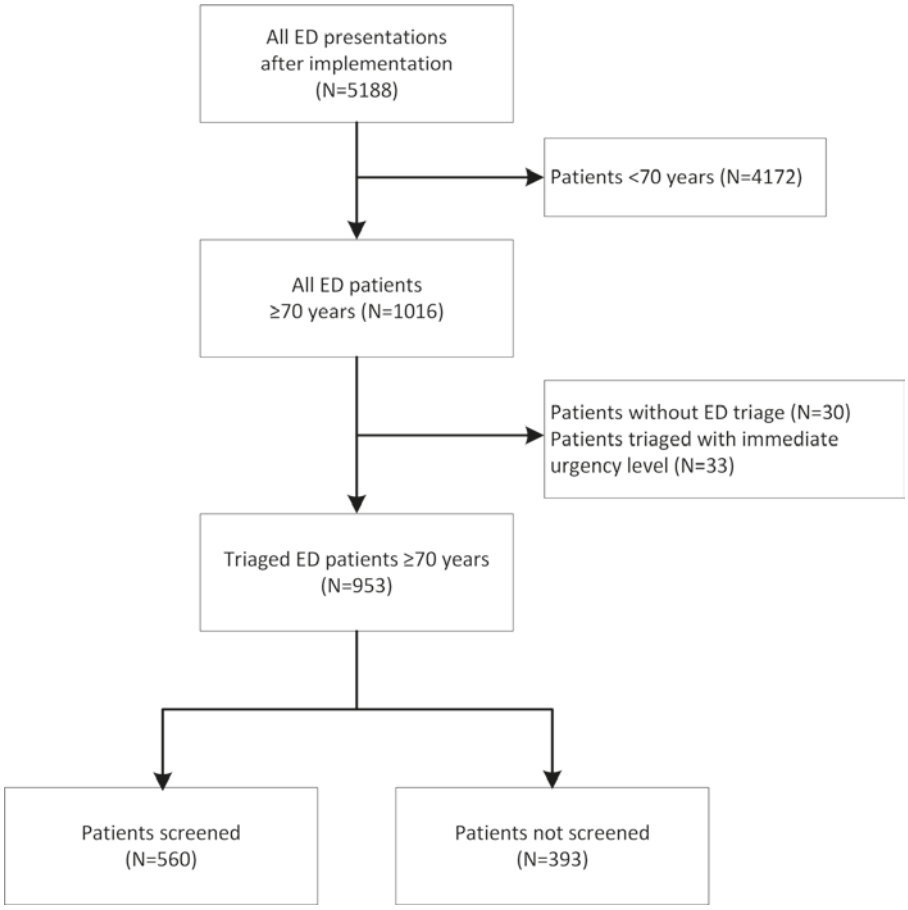
None All

1 2 3 4 5 6 7 8 9 10

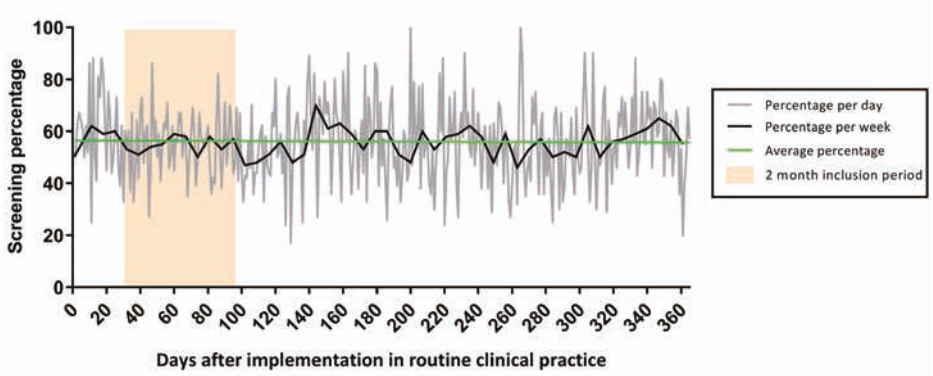
7. If you were unable to complete the APOP screener, what was mostly the reason? (*multiple answers possible*)

A. The patient was too sick
B. The patient refused screening
C. It was too busy (had no priority)
D. It took too much time to complete screening
E. I didn't think screening was useful
F. I found it difficult to ask the screening questions
G. I forgot to complete screening
H. Other reason:

Explanations on part 2:



Supplementary figure 1. Flowchart of study population



Supplementary figure 2. Screening rate over the one-year period after implementation in routine clinical practice

Supplementary table 1. Opinions of screening from triage-nurses working in the ED

	N	Answer (median (IQR))
1. Do you find it important to identify frailty in older patients using the APOP screener?	33	8 (7-9)
2. Are you motivated to complete the APOP screener?	33	7 (7-9)
3. Do you think that the APOP program in its current form contributes to better care for the older patient in the ED?	31	6 (5-7)
4. Are you satisfied with how the APOP program works in the electronic health records?	32	7 (5-8)
5. Do you need more training on acute care in older patients?	33	7 (5-8)

Question 1: 1=totally unimportant, 10=very important. Question 2: 1=totally not motivated, 10=very motivated. Question 3: 1=totally not contributing, 10=very contributing. Question 4: 1=totally unsatisfied, 10=very satisfied. Question 5: 1=totally no need, 10=very much need

Chapter 6

Implementation of the APOP screening program in routine Emergency Department care: a before-after study

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ABSTRACT

Objective: The aim of this study was to evaluate the effects of implementation of the Acutely Presenting Older Patient (APOP) screening program for older patients in routine emergency department (ED) care shortly after implementation.

Methods: We conducted an implementation study with before-after design, using the plan-do-study-act (PDSA) model for quality improvement, in the ED of a Dutch academic hospital. All consecutive patients ≥70 years during 2 months before and after implementation were included. The APOP program comprises screening for risk of functional decline, mortality and cognitive impairment, targeted interventions for high-risk patients and education of professionals. Outcome measures were compliance with interventions and impact on ED process, length of stay (LOS) and hospital admission rate.

Results: Two comparable groups of patients (median age 77 years) were included before (n=920) and after (n=953) implementation. After implementation 560 (59%) patients were screened of which 190 (34%) were high-risk patients. Some of the program interventions for high-risk patients in the ED were adhered to, some were not. More hospitalized patients received comprehensive geriatric assessment (CGA) after implementation (21% before vs. 31% after; p=0.002). In 89% of high-risk patients who were discharged to home, telephone follow-up was initiated. Implementation did not influence median ED LOS (202 min before vs. 196 min after; p=0.152) or hospital admission rate (40% before vs. 39% after; p=0.410).

Conclusion: Implementation of the APOP screening program in routine ED care did not negatively impact the ED process and resulted in an increase of CGA and telephone follow-up in older patients. Future studies should investigate whether sustainable changes in management and patient outcomes occur after more PDSA cycles.

INTRODUCTION

Older patients form an increasing proportion of emergency department (ED) visitors worldwide and are at higher risk of adverse health outcomes compared to younger patients[1]. The presence of multiple comorbidities, cognitive disorders and atypical disease presentation requires more staff time and resources[2], increases ED length of stay (LOS) and poses organizational challenges[3;4]. A comprehensive geriatric assessment (CGA) is an effective method to improve older patients' outcomes[5], but CGA is time-consuming and therefore cannot be applied routinely to every older patient attending the ED. Alternatively, a two-step approach can be used with identification of patients with the highest risk of adverse outcome as a first step, followed by targeted interventions according to the principles of CGA[6;7]. To this end, several screening instruments and interventions have been specifically developed for older patients in the ED[8;9], yet few have successfully been disseminated in clinical ED practice.

The acutely presenting older patient (APOP) screening program consists of screening with the APOP screener followed by interventions aimed to improve overall ED care and follow-up of older patients[10]. The program was implemented in routine ED care in the Leiden University Medical Center (LUMC) together with an education program to enhance awareness amongst nurses and doctors working in the ED. There is extensive evidence that effective implementation of complex interventions can be associated with better outcomes in various settings outside the ED, which implicates that evaluation of implementation is an absolute necessity in program evaluation[11;12]. One of the important reasons why screening of older ED patients is rarely carried out in routine care, is the fact that little is known about the practical issues and feasibility of implementation in everyday ED practice[13], although it was recently shown that administration of the APOP screener is feasible in routine ED practice[14].

In the present study we aimed to evaluate the effects of implementation of the APOP screening program in routine ED care by assessing the compliance with interventions in the ED, during hospital admission and after discharge, and the impact on process of care measures, shortly after implementation. We hypothesized that the implementation of the screening program would not negatively influence the usual ED process, for example no prolongation of the ED stay and it would result in improvement of the care for older patients, for example the increase in geriatric assessments.

METHODS

Study design

This was a prospective study investigating the effects of implementation of the APOP screening program with a before-after design, conducted in the ED of the LUMC. The APOP program was kicked-off as part of routine ED care on 1 March 2018. Data were collected during a 2-month observation period before implementation ("before") from 4 December 2017 until 2 February 2018, and during 2 months after implementation ("after") from 2 April 2018 until 3 June 2018. All consecutive patients aged 70 years and older attending the ED during these periods were included in the study. The medical ethics committee of the hospital waived the necessity for formal approval of this study as it closely follows routine care. All patient data were anonymized before analyses were executed. The standards for reporting implementation studies (StaRI) were used to present the study[15].

Context

The APOP screening program was implemented in the context of an ageing Dutch population where the financial crisis forced governments to stimulate older patients to stay at home longer, while the capacity of home care and nursing homes decreased seriously in the last years. The Netherlands has ~38,000 hospital beds, ~115,000 nursing home beds and ~13,000 general practitioners available for a population of 17 million people. The increased number of older patients presenting to the ED has been a constant debate in politics, and older patients are believed to be the cause of increasing overcrowding of Dutch EDs. This resulted in more attention for older ED patients and an upcoming motivation of ED care providers to improve care for this population.

Setting

The LUMC is a tertiary care centre with ~26,000 ED visits per year, of which approximately 20% are patients aged ≥70 years. In the ED, a triage nurse prioritizes patients based on their disease severity, using the Manchester Triage System (MTS)[16]. Patients who bypass ED triage are patients eligible for thrombolytic treatment and patients with an indication for telemetry or cardiac catheterization who are admitted to the emergency cardiac care unit. The ED is staffed each day of the week for 24 h by ED nurses, ED physicians, ED residents and residents of other specialties. When hospitalization is indicated after ED treatment, most patients are admitted to the acute medical unit (AMU), which is a 24-bed unit for admission up to 48h of medical, surgical and selected neurological patients.

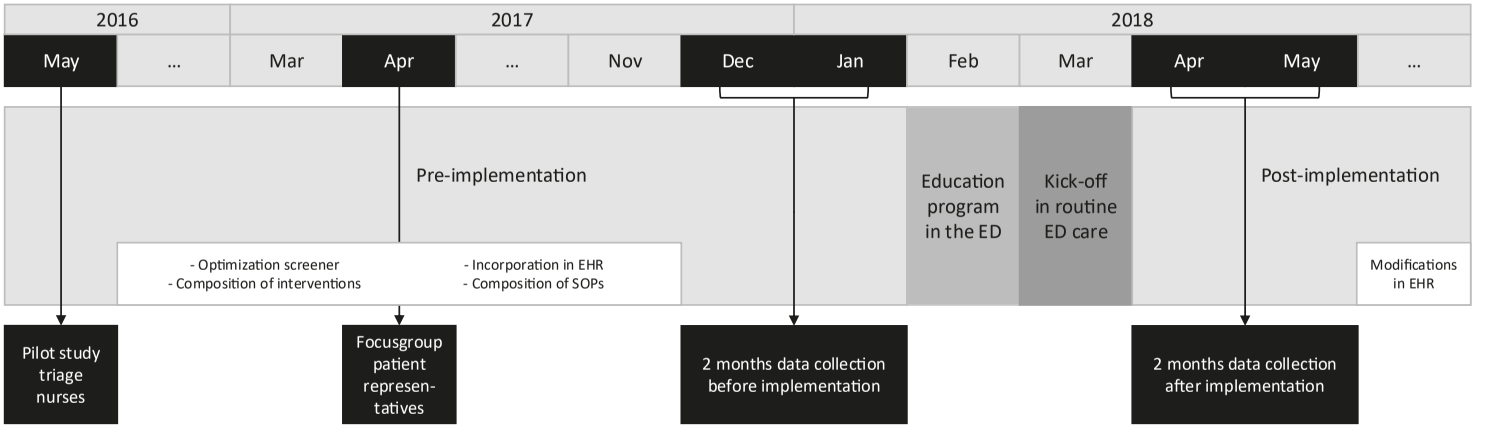

Figure 1. Overview of the implementation process and data collection periods. Data were collected in multiple periods during the implementation process. In the present study, we evaluated data collected of patients aged ≥70 years visiting the emergency department (ED) during the 2-month observation periods "before" and "after" implementation of the APOP screening program. Abbreviations: EHR = electronic health record, SOP = standard operating procedure.

Implementation strategy

The implementation strategy was guided by the plan-do-study-act (PDSA) model for quality improvement[17;18]. In the pre-implementation phase, we used recurring PDSA cycles and assessed barriers and facilitators of the program from pilot studies with ED nurses and focus groups with patient representatives (Figure 1). The received input was taken into account during the optimization of the APOP-screener[10] and the facilitation of the program in the electronic health records (EHR) and standard operating procedures (SOP). We carried out an education program for ED personnel to enhance awareness during 1 month before the kick-off in routine care. A complete description of the implementation strategy and the education program[19] can be found in Supplementary text 1.

Outline of the APOP screening program

The APOP screening program was developed for ED patients aged ≥70 years and consists of three parts (Figure 2):

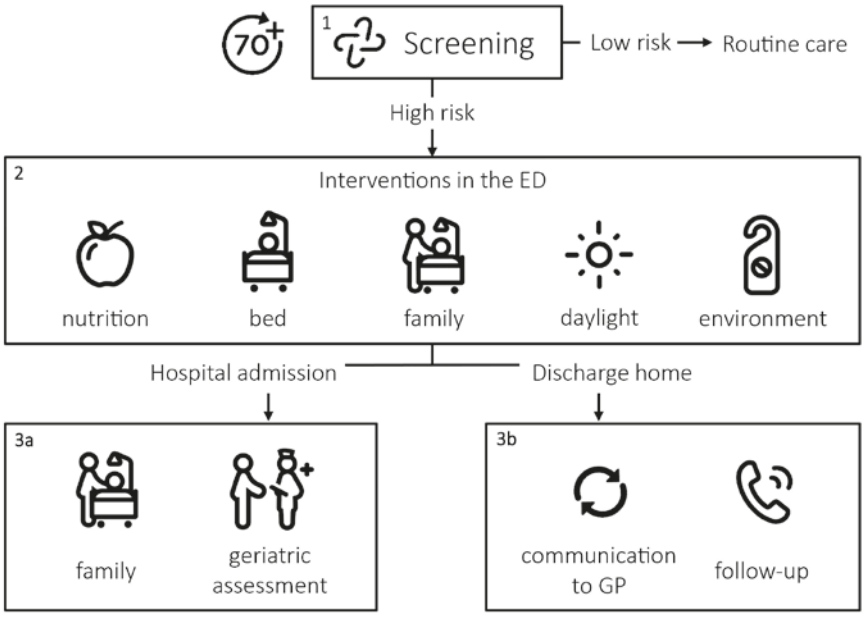

Figure 2. Overview of the acutely presenting older patient (APOP) screening program. The APOP screening program consists of three parts: firstly, screening older patients for risk of functional decline/mortality and signs of impaired cognition, secondly targeted interventions for high-risk patients in the emergency department (ED) and thirdly interventions for high-risk patients who are hospitalized or discharged home.

1. Screening

The APOP screener can be administered in 90s and identifies the patients' individual risk of 90-day functional decline and/or mortality and signs of impaired cognition in the

ED[10]. All patients aged ≥70 years are eligible for screening after routine ED triage. In this study we excluded patients who bypassed triage and patients who were triaged to the immediate urgency level (MTS category "red"), because the APOP screener was not developed and validated for this population. Screening results are saved in the EHR and are visible for all care providers. Patients with a low risk according to screening receive routine care. Patients are at high risk when having a 45% or higher risk of functional decline and/or mortality within 90 days or when having signs of impaired cognition[10;14].

2. Interventions for high-risk patients in the ED

A high risk leads to follow-up actions and interventions. Interventions were based on recommendations from geriatric emergency medicine guidelines[6;20] and were adjusted for use in the Dutch ED setting (Supplementary text 1). The APOP program is a broader program, but in this study we describe the interventions which were evaluated. A full description of these interventions is shown in Supplementary table 2. Physicians and nurses are advised to execute interventions in the ED to increase comfort, family involvement and delirium prevention.

3a. Interventions for high-risk patients admitted to the hospital

Interventions can be conducted in an early phase when high-risk patients are hospitalized. Care providers are advised to avoid a prolonged ED LOS and to arrange family involvement during transfer to the ward. The geriatric consulting team is informed automatically by the EHR to arrange a comprehensive geriatric assessment (CGA) during hospital admission.

3b. Interventions for high-risk patients discharged home from the ED

The GP is informed about the high-risk result automatically by the EHR in the discharge letter from ED physicians. For high-risk patients who are discharged home from the ED, telephone follow-up is initiated within 24h after discharge. The ED nurses contact patients to find out if they have remaining questions about the ED treatment and if they need any help (i.e. clarification of instructions).

Outcomes

The present study had the following outcome measures: Firstly, compliance with interventions of executed interventions in the ED, during hospital admission or after discharge. Secondly, impact on process of ED care measures: ED LOS and hospital admission rate.

Data collection

Patient characteristics and organizational factors

In order to evaluate potential differences between the two data collection periods, we collected patient characteristics and organizational factors before and after

implementation. Patient characteristics were collected from the EHR on demographics (age, gender) and severity of disease (Charlson Comorbidity Index (CCI)[21], arrival by ambulance, MTS triage urgency and chief complaint[16] and the specialist first assigned to treat the patient in the ED). To measure organizational factors on a patient level, we used real-time observations in the ED. During the "before" and "after" data collection periods medical students were present in the ED 7 days per week (8.00a.m. – 11.00p.m.). Observed organizational factors were: the total number of ED patients at arrival day, the actual number of ED patients at arrival time, the number of occupied AMU beds at arrival time and the national emergency department overcrowding score (NEDOCS) at arrival and departure time[22]. Our hospital uses an adapted, but not yet validated, NEDOCS applicable for Dutch EDs (NEDOCS 0-50=normal, 51-100 busy, 101-140 overcrowded, 141-180 severe, >181 disaster).

1. Screening rate

After implementation, data were collected on the number of patients with executed APOP screening and the results of screening. The number of screened patients divided by the total number of older patients per day yielded the screening rate[14].

2. Compliance with interventions – in the ED

The compliance with interventions was measured by absolute numbers of executed interventions in real-time observed older patients "before" and "after" implementation. Additionally, we evaluated the compliance in high-risk patients after implementation. Observations of executed interventions were done from a central place in the ED where most treatment rooms were visible. During the whole ED visit we observed whether older patients: 1) were offered nutrition, 2) were placed in a bed instead of a gurney, 3) had family present and 4) were placed in a room with daylight. The stressfulness of the ED environment was measured by the number of involved care providers, the number of treatment room door movements and the proportion of time the treatment room door was open for whole ED LOS. ED personnel were not informed about the reason for observation.

3a. Compliance with interventions – hospital admission

For older patients hospitalized in our hospital wards, we observed real time the accompaniment by family when leaving the ED. Consultation of the geriatric team for CGA during admission was collected from the EHR. The compliance was quantified by the number of patients who received CGA divided by the total number of hospitalized older patients.

3b. Compliance with interventions – discharge home

The novel interventions communication to GP and telephone follow-up were collected after implementation from the EHR. The compliance of communication to GP was quantified by the number of high-risk patients with an automatically incorporated discharge letter divided by the total number of high-risk discharged patients. Telephone

follow-up compliance was quantified by the number of high-risk patients who received follow-up divided by the total number of high-risk patients discharged home.

Impact on process of ED care

Process of care measures were collected from the EHR and were available for all triaged older ED patients before and after implementation. The ED LOS was measured by subtraction of the ED arrival time from the departure time. Hospital admission rate was measured by the number of patients hospitalized from the ED divided by the total number of older ED patients, during the before and after observation period.

Sample size calculation

The sample size was calculated on ED LOS and hospital admission rate. In a previous analysis of our ED, older patients had a median ED LOS of 189 minutes (interquartile range, IQR, 125-264 min) and the hospital admission rate was 43%[23]. We considered a change of 15 min ED LOS and 7% hospital admission rate as relevant. To detect a difference for the groups before and after with 80% power and 5% significance level, per group 891 patients were needed for ED LOS and 796 patients for hospital admission rate.

Statistical analyses

Continuous data are presented as mean (standard deviation, SD) if normally distributed, and as median (IQR) if skewed. Categorical data were presented as numbers and percentages (n, %). The following statistical tests were used to assess differences in patient characteristics, organizational factors and compliance with interventions between the after and before period: independent samples t-test for normally distributed data, Mann-Whitney U-test for skewed data and χ^2-test for categorical data.

To analyze the impact on process of ED care measures univariable logistic regression was performed, with ED LOS (<240 min, ≥240 min) and hospital admission (yes, no) as dependent variables and the inclusion period “after” vs. “before” as the independent variable of interest. With multivariable logistic regression we adjusted for age and gender (model 1) and for age, gender and all significantly different variables between the “after” and “before” period (model 2). The results are presented as odds ratios (OR) with 95% confidence interval (95% CI). A p-value <0.05 was determined as statistically significant. Statistical analyses were performed using IBM SPSS Statistics version 25 (IBM Corp., Armonk, NY, USA).

RESULTS

During the 2-month observation period before implementation (“before”) 4614 patients visited the ED of which 920 (20%) were patients aged ≥70 years who were triaged at

ED arrival. In the 2-month observation period after implementation ("after") 953 out of 5188 (18%) ED patients were triaged patients aged ≥70 years. Of all triaged older patients, 62% (N=574) was observed "before" and 59% (N=560) "after" in order to evaluate the compliance with interventions (Figure 3).

Patient characteristics and organisational factors

Table 1 shows the characteristics and organisational factors on a patient level 'before' and 'after'. The median age of patients was the same in both periods: 77 (73-83) years. Severity of disease indicators were comparable 'before' and 'after'. Organisational factors 'before' and 'after' differed: the mean total number of ED patients per day was higher in the 'after' period (77 (10) before vs 83 (12) after; p<0.001), but the median NEDOCS at time of ED departure was lower 'after' (62 (42-80) before vs 57 (38-72) after; p=0.001).

1. Screening rate

During the 2-month observation period "after" implementation 560 (59%) of the 953 older patients were screened[14]. As a result of screening, 190 (34%) patients were classified as having a high risk, which made them eligible for interventions.

2. Compliance with interventions – in the ED

Compliance with interventions was evaluated by comparison of executed interventions between all real time observed older patients "before" and "after" (Table 2). In the "after" period older patients more often received nutrition in the ED (7% before vs. 12% after; p=0.004). No improvements were found in nursing on a bed (35% before vs. 27% after; p=0.004), family presence (89% before vs. 84% after; p=0.043) and room with daylight (30% before vs. 34% after; p=0.235). Proxies for stressfulness of the ED environment were better "after" for median number of door movements (40 (IQR 24-62) before vs. 25 (IQR 15-40) after; p<0.001) and median number of involved staff (7 (IQR 5-10) before vs. 5 (IQR 4-7) after; p<0.001).

3a. Compliance with interventions – hospital admission

In total 362 (40%) patients "before" and 368 (39%) patients "after" were admitted to the hospital. More hospitalized patients received CGA during admission "after" compared to "before" (21% before vs. 31% after; p=0.002). Of a total of 92 admitted high-risk patients after implementation 65 (71%) patients received CGA.

3b. Compliance with interventions – discharge home

After implementation 80 high-risk patients were discharged home. In 57 (71%) patients, the high-risk result was communicated to the GP. Telephone follow-up was initiated in 70 (89%) patients. In total 81% of patients were reached by phone, of whom 37% of patients required clarification of home care instructions.

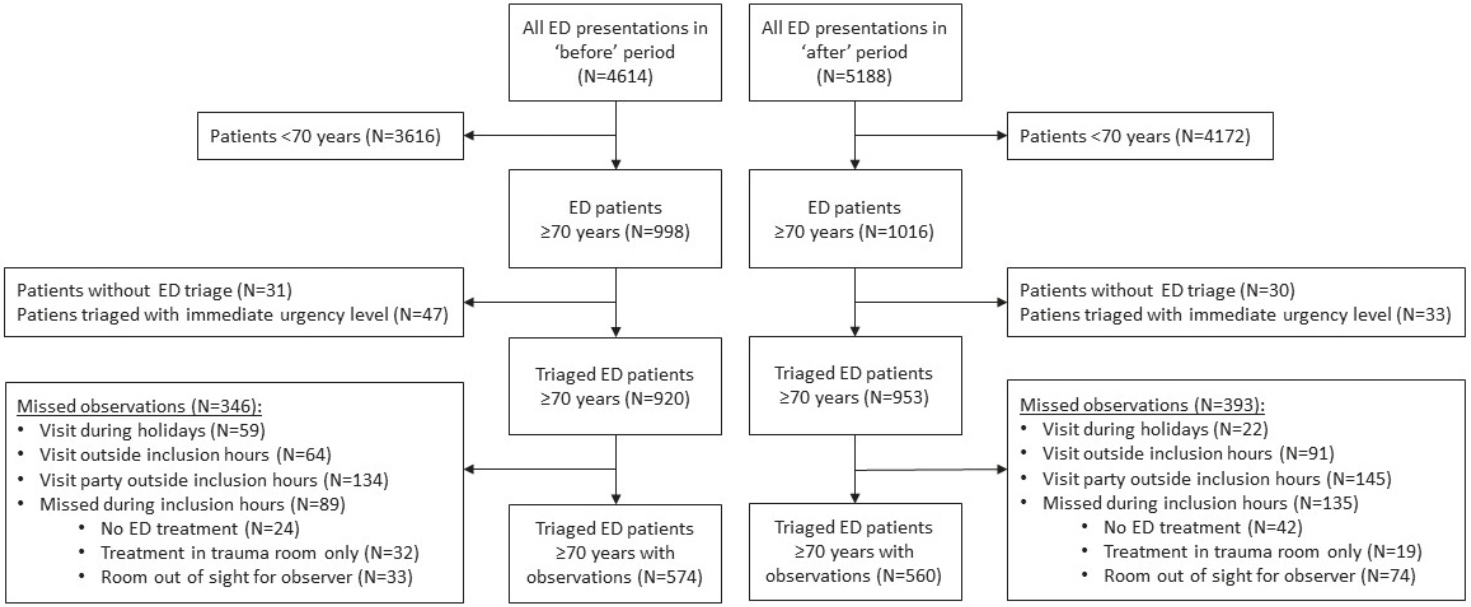

Figure 3. Flowchart of study population. All consecutive patients aged ≥70 years visiting the emergency department (ED) during the 2-month observation periods "before" and "after" implementation of the APOP screening program were included, except for patients who bypassed ED triage or patients who were triaged to the immediate urgency level. The screening rate was measured in triaged ED patients ≥70 years in the "after" period. Compliance with interventions was compared in the "before" and "after" period, using real-time observations of ED patients ≥70 years. Process of care measures were compared between all triaged ED patients ≥70 years in the "before" and "after" period.

Table 1. Patient characteristics and organizational factors before and after implementation

	Before (N=920)	After (N=953)	p-value
Demographics			
Age, years median (IQR)	77 (73-82)	77 (73-82)	0.372
Male, n (%)	439 (47.7)	471 (49.4)	0.460
Severity of disease indicators			
Charlson comorbidity index, median (IQR)	5 (4-6)	5 (4-7)	0.014
Arrival by ambulance, n (%)	316 (34.3)	293 (30.7)	0.096
Triage urgency, n (%)			0.585
> 1 hour (green and blue)	206 (22.4)	219 (23.0)	
< 1 hour (yellow)	449 (48.8)	443 (46.5)	
< 15 min (orange)	265 (28.8)	291 (30.5)	
Chief complaint, n (%)			0.533
Minor trauma	256 (28.0)	276 (29.3)	
Malaise	237 (25.9)	247 (26.2)	
Dyspnea	121 (13.2)	96 (10.2)	
Abdominal pain	97 (10.6)	91 (9.7)	
Chest pain	61 (6.7)	75 (8.0)	
Loss of consciousness	44 (4.8)	41 (4.4)	
Major trauma	13 (1.4)	15 (1.6)	
Mental health problems	6 (0.7)	10 (1.1)	
Other	80 (8.7)	91 (9.7)	
First assigned specialist in ED, n (%)			<0.001
ED physician	400 (44.3)	381 (42.1)	
Internal medicine	147 (16.3)	82 (9.1)	
Neurology	104 (11.5)	104 (11.5)	
Surgery	63 (7.0)	54 (6.0)	
Cardiology	59 (6.5)	71 (7.8)	
Other	129 (14.3)	214 (23.6)	
Observed organizational factors on patient level			
Total number of ED patients on arrival day, mean (SD)	77 (10)	83 (12)	<0.001
Number of ED patients at time of arrival, mean (SD)	13 (5)	13 (5)	0.170
Number of occupied AMU beds at time of arrival, mean (SD)	18 (4)	17 (4)	0.002
NEDOCS at time of starting medical treatment, median (IQR)	50 (27-70)	51 (28-68)	0.998
NEDOCS at time of departure from ED, median (IQR)	62 (42-80)	57 (38-72)	0.001

Demographics and severity of disease indicators were collected from electronic health records. Organizational factors were collected by real time observations during the ED visit.

Missing data

Before: 36 CCI, 5 chief complaint, 18 first assigned specialist, 4 number of ED patients at time of arrival, 4 number of occupied AMU-beds, 56 NEDOCS at time of start treatment, 57 NEDOCS at time of departure.

After: 56 CCI, 11 chief complaint, 47 first assigned specialist, 1 number of ED patients at time of arrival, 2 number of occupied AMU-beds, 75 NEDOCS at time of start treatment, 38 NEDOCS at time of departure.

N = number, IQR = interquartile range, SD = standard deviation, AMU = acute medical unit, NEDOCS = national emergency department overcrowding score, ED = emergency department.

Table 2. Compliance with interventions before vs. after implementation and compliance with interventions for high-risk screened patients after implementation

	Total group of observed older patients				p-value	High-risk screened observed patients	
	Before		After			After	
	Number observed	Compliance	Number observed	Compliance		Number observed	Compliance
Interventions in the ED							
Received nutrition, n (%)	540	37 (6.9)	528	63 (11.9)	0.004	111	27 (24.3)
Nursed on bed, n (%)	542	190 (35.1)	534	144 (27.0)	0.004	114	42 (36.8)
Family present, n (%)	536	475 (88.6)	518	437 (84.4)	0.043	113	98 (86.7)
Room with daylight, n (%)	523	158 (30.2)	508	171 (33.7)	0.235	108	44 (40.7)
Number of door movements, median (IQR)	523	40 (24-62)	513	25 (15-40)	<0.001	111	31 (17-46)
Number of staff involved, median (IQR)	524	7 (5-10)	513	5 (4-7)	<0.001	111	6 (4-8)
Proportion open door time (%)*, median (IQR)	423	15 (5-31)	508	16 (6-33)	0.190	110	22 (7-38)
Interventions at hospital admission[a]							
Family present during admission, n (%)	216	174 (80.6)	174	147 (84.5)	0.312	46	37 (80.4)
Geriatric assessment, n (%)	343	72 (21.0)	365	114 (31.2)	0.002	91	65 (71.4)
Interventions at discharge home[b]							
Communication to GP, n (%)	NA	NA	NA	NA	NA	80	57 (71.3)
Telephone follow-up, n (%)	NA	NA	NA	NA	NA	79	70 (88.6)

Total number of triaged patients ≥70 years before N=920; after N=953. Patients were observed real-time when visiting the ED between 8 a.m. and 11 p.m. Total number of observed triaged patients ≥70 years before N=574; after N=560. Total number of high-risk screened patients after implementation N=190.

N = number, IQR = interquartile range, NA = not applicable, GP = general practitioner, ED = emergency department.

*Proportion of time the treatment room door was open for whole ED length of stay in percentage.

[a] Numbers of admitted patients in our hospital: before N=362, after N=368, high-risk screened patients N=92

[b] Numbers of patients discharged home: before N=467, after N=488, high-risk screened patients N=80

Impact on process of ED care

In Table 3, process of ED care outcomes are compared for all included patients "before" and "after". The median ED LOS was comparable between both groups with 202 min (IQR 133-290min) before vs. 196 min (IQR 133-265min) after; p=0.152. No prolonged ED LOS in the "after" period was found, after adjusting for possible confounders (OR 0.88 (95%CI 0.66-1.17), p=0.371) (Supplementary table 1). Hospital admission rates were comparable between both groups: 362 (40%) patients before vs. 368 (39%) patients after; p=0.642). After adjustment for possible confounders, the hospital admission rate in the "after" period was lower (OR 0.68 (95%CI 0.50-0.92), p=0.013).

Table 3. Process of ED care outcomes for patients before and after implementation

	Before (N=920)	After (N=953)	p-value
ED LOS (min), median (IQR)	202 (133-290)	196 (133-265)	0.152
Hospital admission after ED visit, n (%)	362 (40.0)	368 (38.9)	0.642

Missing data

Before: 2 ED LOS, 15 disposition after ED visit. After: 2 ED LOS, 8 disposition after ED visit.

N = number, IQR = interquartile range, LOS = length of stay, ED = emergency department.

DISCUSSION

In this study, the first effects of implementation of the APOP screening program in routine ED care were evaluated after 1 month by assessing the compliance with interventions and the impact on process of care measures. Interventions for high-risk patients in the ED were partly adhered to. Implementation of the program resulted in increased numbers of executed CGAs during hospitalization, communication of screening results to the GP and telephone follow-up after ED discharge. Implementation had no major effects on ED LOS and hospital admission.

To the best of our knowledge, this is the first study evaluating the implementation of a multicomponent screening program for older patients comprising screening and targeted interventions in routine ED care. In a recent substudy, we showed that implementation of the APOP screener was feasible with a screening rate of 59%[14]. Compared to other studies[13;24;25], our screening rate assessed shortly after implementation in routine ED care is relatively high. A screening rate of 100% is difficult to achieve because the time restraints inherent to a busy ED will prevent nurses to administer the screener. Since there are only few ED multicomponent studies published[26], we are only able to compare single components. In one study, telephone follow-up for all older ED patients resulted in 97% successfully contacted patients of which 40% required clarification of home care instructions[27], comparable to our results in high-risk older patients. The use of a clinical

risk prediction tool to select high-risk patients and target interventions to those patients most likely to benefit, the increased proportion of patients who receive CGA and the improved communication of screening results to the GP have been associated with improved patient outcomes in other settings[8;9;28]. Definitive proof of (cost)effectiveness of the APOP screening program on patient outcomes, such as functional decline, should come from future studies, for example by using a multicenter stepped-wedge design[29].

The present study has several important findings for clinical practice. Firstly, implementation of screening in the ED resulted in improved execution of some individual interventions for older patients during their ED stay, i.e. adequate nutrition. However, the intervention "presence of family" did not increase, probably because this was already very high before implementation, i.e. a ceiling effect. The interventions "nursed on bed" and "room with daylight" also did not improve, probably because they were less feasible due to a lack of capacity (in our ED there are few beds and rooms with daylight available). Secondly, program implementation resulted in a significant increase of number of executed CGAs, which has been shown to be an effective method to improve outcomes[5]. In 71% of the high-risk patients CGAs were executed during hospitalization. Therefore, although interventions in the ED are not always executed, screening is a useful first step to ensure that high-risk patients receive optimal care during hospitalization. The same holds for high-risk patients discharged home from the ED, of which 79% were reached for telephone follow-up. Finally, implementation of our screening program did not lead to prolonged ED LOS or more hospital admissions. After adjustment for the small differences in the before and after group, there even seem to be less hospital admissions after which is important because impact on capacity is relevant to the feasibility and sustainability of the program.

The repetitive use of the PDSA model as a framework for our implementation strategy helped in understanding barriers and facilitators of implementation[14]. Continuation of future PDSA cycles can help to further improve compliance in our ED and can also help others to start implementation of this screening program elsewhere. The results of the present study are therefore the starting point for new evaluation cycles of the program. Until now, we mainly focused our implementation strategy on the ED nurses, the executors of the screening, which also resulted in mainly nurse-led interventions for high-risk patients. In future, we aim to focus more on physicians and use additional education to increase their awareness and promote a more holistic clinical assessment of older ED patients. Moreover, the interventions of our program were based on recommendations from international guidelines and quality indicators[6;20] and could be updated according to recent recommendations[30]. If other EDs would like to implement a screening program for older patients they can learn from our limitations and adjust their expectations accordingly, i.e. ensure the presence of rooms with daylight and focus on adequate nutrition during an ED stay.

Our study has several strengths. Firstly, to our best knowledge this is the first implementation study evaluating screening and interventions for older patients in routine ED care on a large scale, using real-time observations. Secondly, our implementation strategy was guided by the generally used PDSA model for quality improvement, resulting in good understanding of barriers and facilitators of implementation. Lastly, the screening program was implemented and evaluated in an unselected population of older ED patients, which is therefore generalizable to other ED populations.

Our study also has several limitations. Firstly, the before-after study design has time and seasonal variation as a limitation; however, there were no contextual changes between the two data collection periods. Also, we could not detect substantial differences in patient characteristics between the "before" and "after" group. Furthermore, the main outcome measures for the evaluation of the program were process measures – the proportion of hospitalized patients with geriatric assessment and the proportion of discharged patients with follow-up telephone calls – which are likely unaffected by time period or seasonal variation. Secondly, before implementation older patients could not be screened. Therefore, we could only compare compliance with interventions on the level of total group ED patients ≥70 years in the before and after periods. Small improvements in compliance with interventions in high-risk patients might therefore have been missed. Finally, the program was implemented in one tertiary care center which limits generalizability.

In conclusion, implementation of the APOP screening program in routine ED care did not negatively impact the ED process and resulted in an increase of CGA and telephone follow-up in older patients. Since this was a first evaluation shorty after implementation, future studies should investigate whether sustainable changes in management and patient outcomes occur after more PDSA cycles.

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Supplementary table 1. Risk of prolonged ED LOS and hospital admission after implementation compared to before (reference)

	OR (95% CI)	p-value
ED LOS ≥240 min "after" vs. "before"		
crude	0.86 (0.71-1.04)	0.126
model 1	0.86 (0.71-1.05)	0.134
model 2	0.88 (0.66-1.17)	0.371
Hospital admission "after" vs. "before"		
crude	0.96 (0.79-1.15)	0.642
model 1	0.95 (0.79-1.15)	0.621
model 2	0.68 (0.50-0.92)	0.013

Risk of prolonged ED LOS and hospital admission for patients included after implementation of the APOP screening program (N=953) compared to patients included before implementation (N=920).

Model 1: adjusted for age, gender

Model 2: adjusted for age, gender, CCI, first assigned specialist, total number of ED patients on arrival day, number of occupied AMU-beds at time of arrival and NEDOCS at departure time

OR = Odds ratio, CI = confidence interval, LOS = length of stay, ED = emergency department.

Supplementary text 1. Implementation strategy

Pre-implementation phase

Implementation planning for this study began with formal approval of the division boards of our hospital after the construction of a multidisciplinary project-team consisting of an ED physician, resident ED physician, ED-nurse, internist-geriatrician, geriatric nurse, AMU nurse, researchers and a general practitioner. Based on project-team experiences and literature the implementation strategy, outline of interventions and education program was developed. For the outline of the interventions we used usable elements of comprehensive geriatric assessment (CGA), taking into account the recommendations from international guidelines and quality indicators[6;20]. There is no evidence yet whether these interventions improve outcomes for older patients. From the recommendations in international literature we selected interventions which were practicable to implement in routine care in the Dutch ED setting. In addition, we also selected interventions based on project-team experience and input from focus groups with patient representatives and general practitioners.

Implementation strategy

Our implementation strategy was guided by the plan-do-study-act (PDSA) model for quality improvement[17]. In the first PDSA cycle the use of the screening instrument in practice was evaluated in a pilot study with ED triage nurses. We assessed readiness to adopt the interventions, specific uptake goals and barriers and facilitators. The received input was taken into account during the development of the final screening instrument and the facilitation of the program[10]. For example, we excluded a question about polypharmacy in the final screening instrument because it took too much time to execute in practice. Triage nurses experienced a barrier to ask for dementia, one of the questions in the APOP screener. We therefore collected input from patient representatives on how this question could best be asked. Data was collected with focus group sessions with the older patient council of our hospital (Ouderenberaad Zorg en Welzijn Zuid-Holland Noord). Their input was written down in the standard operating procedures of the APOP screening program. The most important facilitator for use of the screening instrument in routine care turned out to be implementation in the electronic health records (EHR). This result was the starting point for following PDSA cycles in which the screening instrument, signals of high risk results and automatic orders were incorporated in the EHR.

Education program

Education was used to enhance awareness and increase knowledge of the ED team of different care needs of older people, especially aspects relating to frailty and geriatric syndromes, for which a broader, more holistic intervention is considered to be best practice. The other rationale for education was to influence adoption of the screening program by clarification of all program components. The education

program was developed during the pre-implementation phase by the members of the multidisciplinary project-team. Outline for the education program was based on recommendations from the Curriculum for Geriatric Emergency Medicine designed by the European Task Force for Geriatric Emergency Medicine[19]. We developed 6 education sessions of 15 minutes each on the following topics: 'Background of older patients visiting the ED', 'Vital signs in older patients', 'Cognitive disorders and delirium', 'Atypical presentations of older patients', 'How to administer the APOP-screener' and 'Interventions for high risk patients'. During one month before the kick-off of the APOP screening program all topics were presented several times to the ED nurses and physicians before every ED dayshift.

Post-implementation phase

After the kick-off of the APOP program at 1 March 2018 we highlighted the APOP screening program at start of every dayshift in the ED to make personnel aware of screening. Every day one project-team member was available for questions. Screening rates, tips from the project-team and feedback from patients were displayed in the ED newsletter and information board in the ED. We also collected feedback from ED personnel on the program at the end of the first screening month during a 3-hour session with ED physicians and nurses. From 2 April the data collection period for evaluation was started. During this 2 months we did not organize any education or feedback sessions and only observed routine care without interference from our project-team. After the data collection period we send out questionnaires to all ED nurses and physicians and collected their feedback on the program. Simultaneously, some modifications were made in the EHR, resulting in a clearer overview of patients screened and not yet screened during their ED stay.

Supplementary table 2. Overview of the APOP screening program advices for interventions

Result screening	Advices triage-nurse	Advices treating ED-nurse		Advices treating physician in ED	
1. Low risk	Routine care	Routine care		Routine care	
2. High risk on functional decline and/or mortality	• Inform treating nurse and physician about high risk result.	• Provide the patient with adequate nutrition and prevent dehydration as soon as possible. • Try to put the patient on a bed instead of a gurney. • Call family or caregiver if the patient arrived alone in the ED. • Soon anticipate on the patients destination after the ED visit and prevent a long length of stay in the ED.	**Discharge** • Call the patient within 24h for telephone follow-up. **Admission** • Try to let family members accompany the patient during admission to the hospital ward.	• Provide the patient with adequate nutrition and prevent dehydration as soon as possible. • Soon anticipate on the patients destination after the ED visit and prevent a long length of stay in the ED.	**Discharge** • Screening results are automatically communicated to the GP in the discharge letter. **Admission** • The geriatric consulting team will receive an automatic order to arrange geriatric assessment during admission.

Result screening	Advices triage-nurse	Advices treating ED-nurse		Advices treating physician in ED	
3. Signs of impaired cognition	• Inform treating nurse and physician about high risk result.	• Provide the patient with adequate nutrition and prevent dehydration as soon as possible. • Try to put the patient on a bed instead of a gurney. • Call family or caregiver if the patient arrived alone in the ED. • Start delirium preventive measures: - Nurse the patient in a quiet room with normal daylight. - Reduce the degree of stressfulness and noise of the ED environment: reduce sensory over-stimulation, keep the door closed and minimize the number of care providers. - Take impaired cognition into account during history taking and instructional conversations. • Soon anticipate on the patients destination after ED visit and prevent a long length of stay in the ED.	**Discharge** • Call the patient within 24h for telephone follow-up. **Admission** • Try to let family members accompany the patient during admission to the hospital ward.	• Provide the patient with adequate nutrition and prevent dehydration as soon as possible. • Try to minimize the number of care providers. • Consider whether the patient has a delirium. • Take impaired cognition into account during history taking and instructional conversations. • Soon anticipate on the patients destination after ED visit and prevent a long length of stay in the ED.	**Discharge** • Screening results are automatically communicated to the GP in the discharge letter. **Admission** • The geriatric consulting team will receive an automatic order to arrange geriatric assessment during admission
4. High risk on both domains (2 + 3)	Advices are the same as all mentioned above.	Advices are the same as all mentioned above.		Advices are the same as all mentioned above.	

Chapter 7

Experiences with and attitudes towards geriatric screening among older Emergency Department patients: a qualitative study

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ABSTRACT

Background: The patient perspective on the use of screening for high risks of adverse health outcomes in Emergency Department (ED) care is underexposed, although it is an important perspective influencing implementation in routine care. This study explores the experiences with, and attitudes towards geriatric screening in routine ED care among older people who visited the ED.

Methods: This was a qualitative study using individual face-to-face semi-structured interviews. Interviews were conducted in older patients (≥70 years) who completed the 'Acutely Presenting Older Patient' screener while visiting the ED of a Dutch academic hospital. Purposive convenience sampling was used to select a heterogeneous sample of participants regarding age, disease severity and the result from screening. Transcripts were analyzed inductively using thematic analysis.

Results: After 13 interviews (7 women, median age 82 years), data saturation was reached. The participants had noticed little of the screening administration during triage and screening was considered as a normal part of ED care. Most participants believed that geriatric screening contributes to assessing older patients holistically, recognizing geriatric problems early and comforting patients with communication and attention. None of the participants had a negative attitude towards screening or thought that screening is discrimination on age. Care providers should communicate respectfully with frail older patients and involve them in decision-making.

Conclusions: Older patients experienced geriatric screening as a normal part of ED care and had predominantly positive attitudes towards its use in the ED. This qualitative study advocates for continuing the implementation of geriatric screening in routine ED practice.

INTRODUCTION

Screening for high risks of adverse health outcomes in the Emergency Department (ED) has been advocated by various healthcare organizations, but the experiences and attitudes regarding geriatric screening among older people who visit the ED are unknown. In the last years, identification of frailty in the ED has received more attention and the use of screening tools is strongly promoted to enhance awareness and understanding of geriatric patients beyond their ED presenting complaint[1-3]. Geriatric screening in routine ED care, however, remains scarce and there is still an ongoing public debate on the pros and cons of screening in general[4;5]. Geriatric screening is intended to assist in clinical decision making and to protect older people against age-based rationing of care[6;7]. However, it is also feared that the label 'frail' can lead to unintended ageism[8]. So far, little attention has been paid to the perspectives of older people themselves and how they experience undergoing geriatric screening in general[9;10], and experiences of older people with geriatric screening in the ED setting has not been studied before.

The consumer's perspective – in this case, of older ED patients – is often underexposed, and because it can be different from the provider or organizational perspective, it is an important perspective influencing the implementation and effects of programs[11]. Therefore, there is a need for qualitative research exploring the older people's perspective on geriatric screening in the ED[2;8]. First, because if older people have a positive attitude towards geriatric screening in the ED and they believe it has added value, this might advocate for continuing the implementation of screening in routine practice. And second, because the experiences of older people could be used to further improve geriatric screening (administration) and better the field of geriatric emergency medicine in general.

Therefore, the aim of the present study was to explore the experiences with, and attitudes towards geriatric screening in routine ED care among older people who visited the ED using qualitative research methods.

METHODS

Study design and participants

Within this explorative qualitative study, individual face-to-face semi-structured interviews were conducted between September 2019 and January 2020 in the Netherlands. The target study population was comprised of older people aged 70 years or older who had recently visited the ED of the Leiden University Medical Center (LUMC) and had completed the Acutely Presenting Older Patient (APOP) screener during their stay in the ED. Patients without treatment in the ED, patients who were not screened with the APOP screener, or patients who deceased before inclusion were excluded.

Purposive sampling was applied to ensure a heterogeneous sample of patients with regard to gender, disease severity and APOP screening result. Patients who lived close to the research location were invited for participation for convenience purposes. Interviews were conducted until data saturation was reached and no additional information or themes were observed in the data. It was expected that data saturation would be reached after around 10-15 interviews[12;13].

The APOP screening program

The APOP screening program is developed for ED patients aged ≥70 years, and consists of a screening instrument and tailored interventions (detailed descriptions in Supplementary text 1)[14;15]. This program has been implemented in routine ED care in the LUMC since March 2018 and triage nurses are instructed to screen all older patients during routine triage[16;17]. The experiences of triage nurses who execute the screening in the ED has been described previously[16]. The APOP screening instrument consists of 9 questions (i.e. about physical functioning and cognition) and can be administered within 2 minutes. The instrument identifies patients at risk of 90-day functional decline and/or mortality and signs of impaired cognition[18]. A universally accepted definition of frailty does not exists, but frailty is most often defined as an aging-related syndrome of physiological decline, characterized by marked vulnerability to adverse health outcomes[19;20]. We did not share a definition with the participants, because we were interested in their personal definition and perception of frailty. Since frailty is known to be associated with high risks of adverse health outcomes, we used the APOP risk stratification instrument which identifies older patients at high risk of adverse outcomes as a proxy for frailty. Patients were considered as 'frail' when having a 45% or higher risk of functional decline and/or mortality ('high risk on functional domain') or when having signs of impaired cognition ('high risk on cognitive domain'). For patients with a 'high risk' screening result, interventions to increase comfort, family involvement and delirium prevention are executed in the ED. A complete comprehensive geriatric assessment is executed in patients who are hospitalized. Patients receive a telephone call within 24 hours after discharge and the general practitioner is informed about the screening result.

Procedures

Two female researchers, LCB (MD, PhD candidate) and MO (MSc Vitality and Ageing, PhD candidate), conducted the interviews, transcribed the recordings and performed the analyses. There was no treatment relationship between the researchers and the participants prior or after the study.

The interviews were planned within one month after patients' ED visit. We chose this period as a trade-off between sufficient recovery time and minimalized recall bias. Eligible participants received an invitation letter by mail within three days after their ED visit or within three days after discharge from the hospital if they had been

hospitalized. One week after sending the invitation letter, participants were invited by telephone to participate by one of the researchers. The appointment for the interview was preferably made within two weeks after the telephone call. Participants received a confirmation letter of the appointment with additional information regarding the study procedure, anonymity, and confidentiality. All participants were aware of the goals and reasons of the researchers for doing this study, and agreed to recording and anonymous usage of the data. All participants gave written informed consent before taking part in the interview. People who were not able to consent themselves (i.e. due to cognitive disorders) were not included. This study was performed in accordance with the Declaration of Helsinki and was approved by the Medical Ethical committee of the LUMC (Protocol nr. P17.165).

Based on existing literature and the formulated study objective, an interview guide was created to maintain consistency in the format of the interviews (see Supplementary text 2). This interview guide consisted of four themes (1. Experiences of the ED visit, 2. Experiences with geriatric screening in the ED, 3. Attitude towards geriatric screening in the ED, and 4. Needs and goals of older patients in the ED), followed by open-ended questions. Responses were further explored using additional questions and probes. After exploring the experiences of participants with screening, an informative video about the content of the APOP screening program was shown in order to help participants to generate an opinion about the use of such a program[21]. Because we expected that some participants might not be able to distinguish the screening questions from routine triage, the video was used to provide all participants with the same level of knowledge about the content of the screening program before exploring their attitude towards it. Participants were asked about their definition of frailty and the perception of their own frailty since we hypothesized that this might influence their attitude towards screening. One pilot interview was performed by the two main researchers to evaluate the interview guide for completeness and, if necessary, to make adjustments. All subsequent interviews were performed by one researcher individually. After every three interviews, the researchers discussed their findings and additional participants were recruited.

The interviews were conducted at the participants' homes and lasted between 45 and 60 minutes. Field notes were made during the interviews. Although family members were not actively recruited for participation, they were welcome to attend and participate in the interview. Quotes of family members were occasionally used to add context to the statements of the patients.

Analysis

All interviews were audio recorded and transcribed verbatim by the two main researchers. Data was anonymized and confidentiality was ensured by using codes instead of personal names in the transcriptions. Transcripts were analyzed inductively

using thematic analysis. All transcripts were coded by both researchers and discussed to align coding strategy and judge consistency of interpretation. After open coding, the researchers used axial coding and developed a coding tree without the use of a pre-existing coding frame, by constant comparison, grouping similar themes and organizing them hierarchically. To ensure triangulation, the two main researchers discussed the preliminary themes with four other researchers (YM (PhD, medical psychologist), BdG (MD, PhD, emergency physician), JG (MD, PhD, professor primary care) and SPM (MD, PhD, internist geriatrician)). Finally, conceptual links and patterns among themes were derived from the data. All audio recordings, field notes and coded data were saved on a secured server and an audit trail was kept during the study project. The transcriptions were coded using Atlas.ti software version 8. The Consolidated Criteria for Reporting Qualitative Studies (COREQ) checklist was used to report the study.

To describe patients' characteristics, descriptive statistics were computed using data obtained from the hospital electronic health records. Data are presented as medians with ranges or numbers with percentages. These analyses were conducted using IBM SPSS Statistics version 25.

RESULTS

Participant and interview characteristics

Fourteen participants were interviewed. One interview was excluded from the analyses because the participant (who had a low risk result from geriatric screening) did not understand the procedure of the interview, and did not answer any of the questions. In total, 13 participants were included, with a median age of 82 years (range 71-94), of whom 7 (54%) were female (Table 1). Twelve interviews took place at the participants' homes, and one interview took place in a geriatric rehabilitation center. In 8 interviews (62%), a family member was present and participated during the interview. These family members all had been present during the ED visit as well. The participants had a broad range of chief complaints at ED arrival and 7 participants (54%) required very urgent care. In total, 6 participants (46%) had a high risk screening result, of whom 2 participants on the functional domain and 4 participants on the cognitive domain.

Table 1. Participant and interview characteristics

	Demographics		Characteristics of the ED visit				Characteristics of the interview	
	Sex	**Age**	**Chief complaint at ED arrival**	**Triage urgency[a]**	**Result of APOP screening**	**Hospital admission**	**Days between ED visit and interview**	**Family member present during interview**
1	Male	78	Dyspnea	Orange	Low risk	No	22	Yes
2	Female	71	Fall, wrist fracture	Yellow	Low risk	Yes	28	No
3	Male	78	Chest pain	Yellow	Low risk	No	32	Yes
4	Female	82	Malaise	Orange	Low risk[b]	Yes	34	No
5	Female	71	Malaise	Yellow	Low risk	No	38	Yes
6	Male	76	Chest pain	Orange	High risk on cognitive domain	No	36	Yes
7	Female	87	Chest pain	Yellow	Low risk	No	42	No
8	Male	84	Dyspnea	Orange	High risk on functional domain	Yes	44	No
9	Female	90	Collapse	Yellow	High risk on functional domain	No	51[c]	No
10	Female	75	Head/brain injury	Orange	High risk on cognitive domain	No	42	Yes
11	Female	82	Head/brain injury	Green	High risk on cognitive domain[d]	No	42	Yes
12	Male	94	Suspected dissection aorta	Orange	High risk on cognitive domain	No	42	Yes
13	Male	94	Hip luxation	Orange	Low risk	No	42	Yes

[a]: Triage urgency according to the Manchester Triage System: Green = standard care >1 hour, Yellow = urgent care <1 hour, Orange = very urgent care <10 minutes.

[b]: Screening was incorrectly completed, the participant turned out to have a high risk on the functional domain.

[c]: Interview took place in a geriatric rehabilitation center.

[d]: Participant with diagnosis of dementia.

Theme 1. Experiences with geriatric screening in the ED

1.1 Recall of screening administration

The majority of participants had no direct recall of the administration of geriatric screening questions in the ED during the triage process. They did not experience screening as a separate part of ED care. Some participants without recall of the screening, could also not remember other (large) parts of their ED visit due to pain, shortness of breath or other complaints. The overwhelming impressions they had during their ED visit resulted in difficulties remembering what had happened at the time.

"Actually not much, because I wasn't really approachable […] They asked me a couple of questions, but those got a bit lost as I was so out of breath that I wasn't really registering much. So, I don't actually know much about that anymore." [P8]

Some participants were able to share their experiences with the screening administration without further explanation. One participant had recognized geriatric screening as something new because the questions had not been asked during his previous ED visits. Most participants without direct recall did remember the screening after we showed them the video explaining the APOP screening program. The questions testing cognition were remembered mostly, especially the question to list the months in reversed order. None of the participants objected to answering cognition questions, although one participant indicated that it was difficult to answer these kind of questions in a hectic ED environment. Participants often explained that they were glad that they answered the cognition questions right.

"Now I remember what they asked. She asked me to list the months in reverse order from December. […] Thankfully my brain is still working fine." [P2]

According to the participants, the screening results were not shared with them. It remained unclear whether the results were indeed not shared or that the participants could not remember them being shared. The participants stated that they did not miss this, because they believed that the results were good and there was nothing to discuss. However, some of these participants has a high risk screening result. Some participants stated that the screening results are only important for care providers, but not for patients themselves.

"*No, that's your job, right? The doctor is supposed to know what is going on. If I have to be the one thinking of that, well, then I wouldn't have much of a life left over."* [P6]

1.2 Experienced consequences of screening

None of the participants experienced negative consequences from screening. Some participants reported that they had experienced a positive consequence of screening

on the care they received. They were positive about the screening questions being asked because they thought it provided care providers a complete picture of them as a patient. Among this group, the division of high- and low-risk screened participants was equal.

"It didn't bother me. At least then they have the full picture of me as a patient. [...] They asked me some specific things, like how am I doing, how do I feel. Well, that does calm you down." [P1]

Another positive consequence experienced was a perceived feeling of safety at discharge, since the home situation was checked thoroughly. Additionally, participants with a high risk screening result who were discharged home, were satisfied with the telephone call they received after discharge.

"*The other day someone from the hospital called. That was something new for me. 'How are you Mister […]?' I thought that was amazing!"* [P12]

Theme 2. Attitude towards geriatric screening of older ED patients

2.1 General attitude towards screening

The overall attitude of participants towards screening older patients for high risks of adverse outcomes or 'frailty' in the ED was positive. None of the participants had a negative attitude towards screening. One participant described screening as understandable.

"Well I think it's only positive. You will find out more about a person by knowing the background." [P5]

It was mentioned that although the intentions of geriatric screening are good, care providers should be aware that they use the results rightfully. A frail result from screening should not result in communicating with older patients in a childlike manner or treating them as if they are piteous.

"Sometimes they call you mummy and that sort of things. I know they mean well, but I just want… I'm still fully here [points at head] *and I just want to be treated as a normal person."* [P9]

Additionally, care providers must ensure that older patients can participate in decision making independent of their screening result. None of the participants thought that geriatric screening is discrimination on age. However, it was mentioned by some participants that screening might be beneficial for all patients, regardless of age.

"But I think, purely speaking about the ED, it would be good to do the same screening for everyone who is approachable, let's say from the age of 12 or 14." [P1]

Some participants described the importance of asking older people specifically about their frailty. Otherwise, people might not mention frailty themselves due to the fact that they feel ashamed or they don't think it is important. Specifically asking all older patients about their frailty was mentioned to be important because it is difficult for care providers to estimate for whom it is necessary.

"Examine the whole situation, and do that for everybody […] It is better to ask one question too many, than one question too few. You can't see from the outside whether or not it is needed […] And a lot of people would never mention it themselves, especially because it wasn't a topic that could be discussed in earlier times. People have learned to just keep quiet and don't… well, complain." [P2]

2.2 Added value of screening

Although most participants had not experienced consequences from screening themselves, they could describe the possible added value for other older ED patients. First, screening could help care providers to assess older patients holistically. Participants encouraged a holistic approach of older patients with attention for the social background, besides the medical problems.

"I think it is very important that they have a complete view of the background of older people […] The doctor is focused more on the medical part, but a person's background, someone's lifestyle, that sort of things, I think that is also very important information." [P8]

Second, the early recognition of geriatric problems was mentioned as an added value of screening. Recognizing cognition problems was found to be important for ED care providers to indicate whether someone understands the information being given. Additionally, information about frailty was found to be as important as medical information and it should be shared with other care providers.

"Someone might be having some cognitive problems without being aware of it. This could be a very early recognition […] Care providers could pass on this information to the GP, so that there can be a follow-up." [P2]

Third, geriatric screening could be used to comfort patients by means of good communication and attention. The attitude of care providers in communicating with older patients was also stated as one of the main factors for satisfaction with received care in the ED.

"Attention, that is the most important for people. That someone immediately addresses you correctly. […] That you are made at ease." [P1]

2.3 Defining frailty

Although the general attitude towards screening for frailty in the ED was positive, participants found it difficult to define what it is we should screen for. Frailty was a hard to define concept for which all participants gave different definitions (Table 2). Participants who found it hard to define frailty and participants who did not consider themselves to be frail, had difficulties explaining the added value of geriatric screening as well.

"To be honest, I doubt whether you can do anything with it. What should you do with it? Examining frailty. Do we even know what frailty is? And what are you going to do about it? […] I don't know much about it yet, but I will know it when I am at that point myself." [P4]

The perception of participants' own frailty depended on their given definition. Some participants did not meet their own definition and therefore did not feel frail. Others generally did not consider themselves frail, but contradictory did mention their own situation as examples of frailty to provide a definition. The majority of participants felt frail to a greater or lesser degree. Some participants felt frail in general, others gave examples of frailty in particular situations. For example, a visit to the ED was mentioned as a moment when you can feel frail. One participant explained that the presence of a caregiver could reduce this feeling of frailty in the ED. The most commonly mentioned definitions of frailty were: poor physical functioning or immobility, poor mental functioning or dementia, dependence or in need of care, loneliness, and lack of resilience. Some participants stated that frailty is a normal part of ageing, while others did not want to have the label 'frail' because they feel ashamed or don't want to be found piteous.

Table 2 – Overview of the definition and perception of frailty for all participants

	Frailty definition	**Perception own frailty in general**
1	Immobility, diseases, dependence, in need for care	*"Not at all! Absolutely not! […] No, I am still fit. I still do all kinds of things for other people and for myself. No, I am not frail."*
2	Poor mental functioning, loneliness, dependence, not being able to stand up for yourself	*"I feel frail on the street right now … I have to overcome my fear of falling."*
3	Forgetting things, communication problems, not being yourself, is a part of ageing	*"I feel frail because I am often searching for things and I can't figure it out by myself […] I am not very mobile anymore and I regularly need oxygen, that is frailty. But, well, that's part of [getting older]"*
4	Poor physical functioning, dementia, dependence on transport, being piteous	*"No! No, absolutely not. They shouldn't be feeling sorry for me. No, really not! That really makes me angry."*
5	Loneliness, falls	*"I feel frail when I want to go for a walk but I can't. I need someone who says, 'Hey, I will pick you up' […] At that point you are actually frail, because you are by yourself."*
6	Poor physical functioning, dependence on transport	*"Frailty, I would find that terrible. I don't think I'd just admit to that […] I don't feel frail."* Partner: *"He still drives a car, he still drives a scooter. We still do everything ourselves."*
7	In need for care	*"I take showers by myself, I can still take care of myself completely, I don't struggle with anything […] I am not frail."*
8	Not being able to do groceries, falls	*"No, the GP also says, you are very flexible for your age […] I do have some health issues which is not good. That's what's holding me back. […] But no, I do not feel frail."*
9	Immobility, poor mental functioning, lack of resilience	*"I still follow everything, the news. And I solve lots of puzzles. But I can't go out and that's difficult, you could call that a sort of frailty. […] When everything is decided by others, then I feel a bit left out […] Yes, you are more frail than a healthy, young person, but that only makes sense."*
10	(could not give a definition)	*"No, not me, no […] I do not feel frail, no […] Yes, some days you do, of course."*

Table 2 Continued.

	Frailty definition	Perception own frailty in general
11	Immobility, communication problems due to dementia, lack of resilience	*"Occasionally, yes. Because then I think, 'Oh no, are they going to ask me that?'"* Partner: *"She can't always participate in entire conversations, and if she wants to tell something, she can't anymore. Then she loses the plot a bit […] She has a bit, a little bit, of dementia … and then she can't remember sometimes.. a little Alzheimer's."*
12	Falls, diseases, dementia, loneliness and not being yourself, is a part of ageing	*"We are frail, of course. Our friends who all have died by now, that may also happen to us […] We think about our frailty, but I still drive my car and frailty is more important to my sons because they believe I shouldn't drive anymore."*
13	Immobility, poor mental functioning, lack of resilience, in need for care	Partner: *"Yes, physically of course. He is not walking well, and he is frail when walking on the street"* Participant: *"Well, yes and no. I am naturally stubborn […] and I have often had the feeling, in retrospect, I shouldn't have done that, you are taking a risk."*

DISCUSSION

This qualitative study is the first to explore perspectives of older patients on the use of geriatric screening in acute care. This study shows that older patients had predominantly positive experiences and attitudes towards the use of geriatric screening in routine ED care. Geriatric screening was considered as a normal part of routine ED care and most participants believed that screening contributes to assessing older patients holistically, recognizing geriatric problems early and comforting patients with communication and attention.

The experiences of the participants with geriatric screening during their ED visits were good, and none of the participants experienced screening as negative, unpleasant or burdensome. Literature suggests that older people tend to be positive about their received ED care[22-24], and these findings are in line with our results. The participants' positive experience with their ED visit may have influenced their experience with screening, because screening was not perceived as separate part of ED care. Furthermore, none of the participants objected to answering questions testing cognition, which is an interesting finding because we know from previous research that care providers experienced barriers asking these questions to older patients[16]. This finding underlines the importance of investigating and incorporating not only the care provider perspective, but also the often underexposed patient perspective.

In this study, we explored both experiences with geriatric screening and the overall attitude towards screening in routine ED care. It is possible that the attitude towards screening was influenced by the positive experiences with geriatric screening in the ED, but most likely also by the perception of participants' own frailty. Participants who did not feel frail themselves found it more difficult to describe the added value of screening for patients and care providers. It is unlikely that the attitude towards screening was influenced by the screening results itself, because the results were unknown to the patients. Moreover, both high risk ('frail') and low risk ('not-frail') screened participants had a positive attitude towards screening and described the potential added value of screening. Furthermore, participants described the importance of a holistic approach to unravel the older patient as a whole beyond just the medical complaints. The need of older people to receive holistic care and to be involved in decision-making has been described previously for the ED setting[25], and is corresponding to literature in community-dwelling older people and older patients in regular health care[26-29]. Our findings suggest that screening could aid in reaching this goal and additionally could help to comfort patients by means of attention for them as a person.

Frailty was a hard to define concept for the participants, which is in line with previous studies showing that both older people and care providers find it hard to define frailty[4;30;31]. Literature suggests that there is a difference in objectified frailty - 'being frail' - and how older people perceive their own frailty - 'feeling frail'[32]. Although this difference was not explicitly discussed in the interviews, this suggestion is in line with our results that showed that in more than half of the participants the result from screening did not match the perceived frailty of the participant. Furthermore, participants stated that care providers should use the screening results rightfully in their communication with frail patients. In line with literature showing that the label 'frail' could be experienced negatively[8;29;33], we found that some participants explicitly did not want to be labelled frail, for example because they did not want to be found piteous. However, none of the participants thought that geriatric screening is discrimination on age and they even believed that screening might be beneficial for all patients, regardless of age. More importantly, despite the sometimes difficult and negatively experienced concept of frailty, all participants were positive about continuing the use of geriatric screening in routine ED care. So although the term 'frailty' was often not something that participants wish to associate themselves with, because of the stereotypical images that the concept evokes (Table 2), the concept of identifying patients by measuring frailty to tailor care to the individual patients was well accepted.

This qualitative study adds valuable new information for clinical ED practice about the patient perspective on the use of geriatric screening and advocates for continuing the implementation of screening in routine practice. The results of this study might also influence the public debate in favor of using screening. Older patients had predominantly positive attitudes towards the use of geriatric screening in the ED. We will therefore

continue the use of the APOP screening program in our hospital and recommend other hospitals to implement geriatric screening in the ED as well. Our study shows that sharing the screening results with patients in the ED may not be necessary as long as the results are handled properly and care providers respectfully communicate with frail older patients and involve them in decision-making. Small actions such as arranging the presence of an informal caregiver, may already make the patient feel less frail in the ED, and could therefore be incorporated in screening programs. Future research might be needed to evaluate the experiences of older patients with other screening instruments.

Strengths of this study can be accounted to the novelty of exploring the patient perspective of geriatric screening in the ED. In addition, the older patients' experiences were not evaluated in a research setting, but during routine ED care visits. Finally, a heterogeneous group of participants was included in this study by using purposive sampling. This study also has several limitations. First, since the results relate to a small number of older ED patients from one academic hospital in the Netherlands, these are not generalizable to a global ED population. However, the number of participants was adequate for the purpose of this qualitative study and saturation of data was reached within a heterogeneous group of participants. Besides, the insights and experiences are likely to have transferable similarities for other older ED patients. Second, some of the participants could not remember screening being executed in the ED, which might be caused by good implementation or by recall bias. The interviews were planned as soon as possible, but due to sufficient recovery time and logistic reasons there was an average period of five weeks between the ED visit and the interview. Third, family members actively participated in the interviews which could have influenced the described experiences and attitudes of the patients. However, almost all family members were older people themselves and they all had been present during the ED visit, which made their opinion of added value as well. Fourth, the APOP screening instrument was used to explore the patients' perspective about geriatric screening, while this is technically not a frailty screener but a risk stratification instrument which identifies older patients at high risk of adverse outcomes. A high risk screening result was used as a proxy for frailty, which means that other screening instruments might have selected a slightly different group of people as being 'frail'. We used the APOP screener because this instrument was implemented in routine ED care in our hospital, and we aimed to explore patients' experiences with geriatric screening in a real-life setting.

Conclusions

From an ED-patients' perspective, geriatric screening was experienced as a normal part of ED care and was considered to be of added value. Older patients stated that screening contributes to assessing older patients holistically, recognizing geriatric problems early and comforting patients with communication and attention. The results from this qualitative study advocate for continuing the implementation of screening in routine ED practice.

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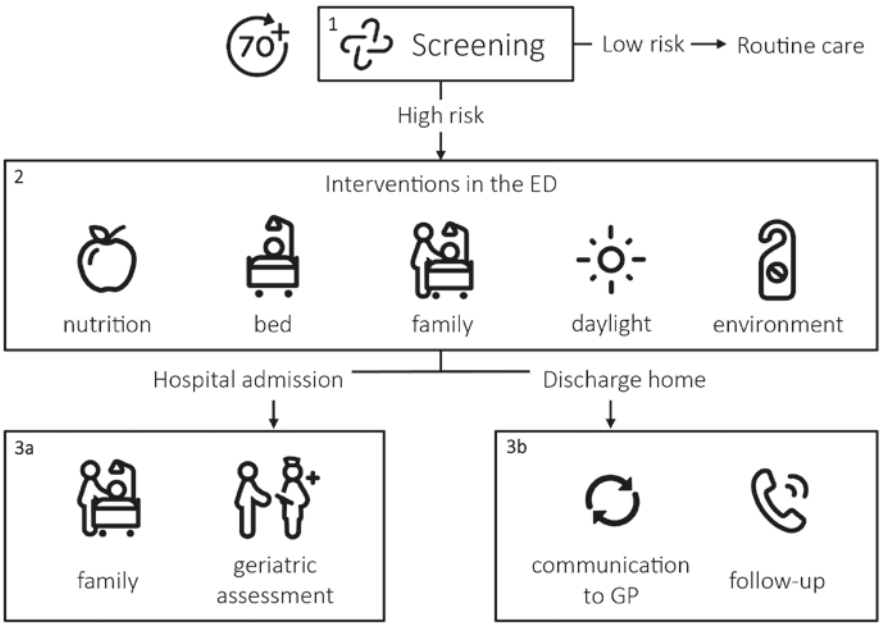
Supplementary text 1. Additional information about the APOP screening program

The APOP screening program is developed for ED patients aged ≥70 years and consists of three parts (visualized in the figure below):



1. Screening

The APOP-screener can be administered in 90 seconds and identifies the patients' individual risk of 90-day functional decline and/or mortality and signs of impaired cognition in the ED.[18] All patients aged ≥70 years are eligible for screening after routine ED triage. Only patients with unstable medical conditions (Manchester Triage System category "red": i.e. major trauma, resuscitation, thrombolysis) are not screened directly at triage, but can be screened later during their ED visit. The APOP screener and the screening results are incorporated in the hospital's electronic health records (EHRs) and are visible for all care providers.[16] Patients with a low risk according to screening receive routine care. Patients are considered ' frail' or 'high risk' when having a 45% or higher risk of functional decline and/or mortality within 90 days or when having signs of impaired cognition. This applies to roughly 30% of the older ED population. The nine questions of the APOP screener are visualized in the following table.

The Acutely Presenting Older Patient (APOP) screener

Questions	Predictors
Filled out by the triage nurse:	
What is the age of the patient?	Age (per 5 years increase)
What is the gender of the patient?	Male
Did the patient arrive by ambulance?	Arrival by ambulance
Asked to the patient:	
Before the illness or injury that brought you to the ED, did you need someone to help you on a regular basis? (like housekeeping, preparing meals)	Need help prior to ED visit (IADL)
Before the illness or injury that brought you to the ED, did you need assistance in bathing or showering?	Need help bathing or showering
Have you been hospitalized during the past six months?	Hospitalized past six months
Are you diagnosed with dementia?	Impaired cognition*
What year is it now?	
Say the months in reversed order	

Abbreviations: ED = emergency department, IADL = instrumental activities of daily living.

*: Cognition is considered to be impaired when the patient is diagnosed with dementia (question seven) or when the patient incorrectly answers question eight or nine.

Prediction model: 1/(1+exp(-(-5.848 + 0.262 x '(age/5)' + -0.072 x 'male' + 0.460 x 'arrival by ambulance' + 0.534 x 'need help prior to ED visit' + 0.567 x 'need help bathing or showering' + 0.432 x 'hospitalized past six months' + 0.255 x 'impaired cognition')))

Application: http://screener.apop.eu/

2. Interventions for high risk screened patients in the ED

A high risk result from screening leads to follow-up actions and interventions. Physicians and nurses are advised to execute interventions in the ED to increase comfort, family involvement and delirium prevention. The interventions of the program were based on recommendations from international geriatric emergency medicine guidelines and were adjusted for use in the Dutch ED setting.[1]

3a. Interventions for high risk screened patients admitted to the hospital

Interventions can be conducted in an early phase after high risk patients are hospitalized. Care providers are advised to avoid a prolonged ED length of stay and to arrange family involvement during transfer to the ward. The geriatric consulting team is informed automatically by the EHRs to arrange a comprehensive geriatric assessment during hospital admission.

3b. Interventions for high risk screened patients discharged home from the ED

High risk screened patients who are discharged home from the ED receive a telephone call within 24 hours after discharge by one of the ED nurses to inform about remaining questions about their ED treatment and the need for additional support (i.e. clarification

of instructions). The general practitioner (GP) is informed about the screening result automatically by the EHRs in the discharge letter from ED physicians.

Supplementary text 2. Interview topic list

Topic 1. Experiences of the Emergency Department (ED) visit
Example questions:

- Why did you visit the ED?
- What do you remember about your ED visit?
- How did you experience this ED visit?
- Did you understand everything that happened and what was being said to you?
- How were your wishes, expectations and personal situation taken into account? [topic 4]
- In retrospect, what could have been done differently?
- What was your experience with being discharged? What made you feel safe to go home?

Topic 2. Experiences with geriatric screening in the Emergency Department
Example questions:

- What have you noticed about questions being asked to screen for frailty?
- How did you experience being asked these questions?
- What was communicated to you about the screening results?
- What are your feelings towards how healthcare professionals acted upon the screening results?
- In your experience, what was the added value of the screening?

Video being shown which explains the APOP screening program

Topic 3. Attitude towards geriatric screening in the Emergency Department
Example questions:

- Which situations do you recognize from this video? [topic 2]
- Why do you think the ED screens for frailty?
- What is your definition of frailty?
- To what extent do you feel frail yourself? (in general, in the ED, in certain situations)
- What are your feelings towards frailty screening in older patients at arrival in the Emergency Department? [topic 4]
- How could frailty screening be of importance?
- How do you think this screening can help to improve care for the older patient?
- What can be the added value of using frailty screening?

Topic 4. Needs and goals of older patients in the Emergency Department

Additional topic – only use if there is enough time
Example questions:

- What is important for older patients who visit the Emergency Department? What are their needs?
- How are the needs of older patients different from younger patients?
- Why is it important to take differences in needs between patients into account?
- Which goals should we pursue for older patients in the Emergency Department?
- What should be the goal(s) for older patients during their treatment in the Emergency Department? And after their visit? Different from younger patients?
- What was your experience: how did your wishes and personal situation were taken into account? [topic 1]

Chapter 8

General discussion

Key findings

To improve care for acutely presenting older patients visiting the ED, this thesis had the following aims: to study the association of geriatric screening parameters collected in the ED with various adverse health outcomes in different subgroups of older ED patients, and to investigate the feasibility, impact and experiences of implementing a geriatric screening program in routine ED practice. This thesis describes how geriatric screening could add to risk stratify older people in the ED and what is needed for implementation in routine ED care. There are several key findings. First, geriatric screening in the ED can be used to identify various populations of older patients at high risk for both short- and long-term adverse health outcomes. Moreover, the addition of geriatric screening to triage urgency levels has the potential to improve routinely-used urgency triage. Second, implementation of the APOP screening program in routine ED care was feasible, and resulted in an acceptable screening rate and the execution of some of the interventions for patients with high risk screening results. In addition, older patients had a positive attitude towards the use of geriatric screening in routine ED care and believed it could be of added value for older ED patients.

Using geriatric screening in the ED

Geriatric screening and adverse health outcomes

The results of this thesis show that geriatric screening can be used to identify older ED patients at high risk of various adverse health outcomes. In our studies, the APOP screener was used as a geriatric screening instrument, which is a validated instrument to predict risk for functional decline and mortality within three months for the total population of older patients presenting to the ED. It was found that the APOP screener also identifies patients at risk for the short-term outcome 30-day mortality (**chapter 2**) and for long-term outcomes such as 1-year functional decline and mortality (**chapter 4**). The use of geriatric screening at arrival in the ED, can therefore provide valuable information for care providers in the whole acute care chain. In the ED, combining geriatric screening with currently used urgency triage tools has the potential to provide a comprehensive understanding of the individual risk of poor outcomes using both disease severity and geriatric impairments, with the possibility to acquire more personalized care in acutely ill older patients as early as arrival in the ED (**chapter 2**). Additionally, atypical disease presentation, cognitive impairment and the different interpretation of vital signs in older patients can be taken into account, potentially improving triage by reducing 'undertriage' and its negative effects by delay of treatment[1-3]. Outside the ED, for example during hospital admission, the results from geriatric screening could also aid in individualized treatment decisions to acquire more personalized care and therefore gives an opportunity to optimize outcomes for older patients. Perhaps the most important opportunity would be first, to use a comprehensive geriatric assessment (CGA), which has known positive effects on prevention of institutionalization, death, and deterioration in older patients[4;5]. Second, the use of advance care planning would

help to establish goals and preferences for future care[6]. And finally, safe transitions between care settings should be ensured, for example, by the use of transitional care[7]. The results provided by geriatric screening in the ED are therefore useful and provide valuable information for care providers in- and outside the ED.

Perspectives of geriatric screening on a patient level

An important motivation for the use of a geriatric screening strategy is that older patients themselves have predominantly positive attitudes towards the use of screening in the ED (**chapter 7**). We were the first to study the experiences and attitudes towards geriatric screening in routine care among older ED patients. Patients who were screened with the APOP screener during their ED visit experienced screening as a normal part of ED care. From an older patient's perspective, screening could contribute to assessing patients holistically, recognizing geriatric problems early and comforting patients. The need of older people to receive holistic care and to be involved in decision-making has been described previously for the ED setting[8], and is corresponding to literature in community-dwelling older people and older patients in regular health care[9-12]. Although the term 'frailty' was often not something that patients wish to associate themselves with, because of the stereotypical images that the term evokes, the concept of identifying patients by measuring frailty to tailor care to the individual patients was well accepted. The results from this thesis might therefore influence the ongoing public debate about the use of geriatric screening in practice and might allay fears that screening leads to unintended 'ageism'[13].

Although the use of geriatric screening in the ED is encouraged and expected to improve patient care, it is still unclear whether its use has any effect on reducing adverse outcomes in older ED patients. This thesis does not answer that question. Studying the effect of geriatric screening and CGA-driven interventions in the ED on a patient level has been shown to be very challenging and is therefore still one of the most important research topics in the field of Geriatric Emergency Medicine[14-16]. The results of this thesis (**chapter 6**) show that the implementation of the APOP screening program resulted in increased numbers of executed CGA's during hospitalization, which has known positive effects on patient outcomes[4;5]. Other studies exploring the effects of screening and CGA interventions in the ED have shown both positive and negative results on improving patient and operational outcomes[16-20]. This inconsistency in findings can be explained by the heterogeneity of multi-component programs and healthcare settings. In addition, the limited success of intervention studies may be a result of the fact that some adverse outcomes, such as ED revisits, may not be avoidable[21]. The use of CGA might even lead to a better identification of health problems, resulting in an increase of hospital use. When studying the effect of screening programs, it is therefore very challenging to select the endpoints we aim to improve. For example, mortality might not be a good endpoint because in some patients a shorter lifespan can be a good outcome if it goes hand in hand with a better quality of life[22]. Maybe it is best to evaluate

the effect of interventions on the patient quality of life and the appropriateness of health care service use. But still, different screening programs may include different combinations of potentially effective and ineffective components and it will be very challenging to unravel which components are truly effective. The important question to ask ourselves is whether we will stop using geriatric screening programs in future if we cannot prove the effect on a patient level, while both health care providers and patients believe that the use of programs does result in better patient care. On the one hand, one could state that the efficacy and (cost-)effectiveness should be studied before implementation of screening programs into clinical practice. On the other hand, the value of screening programs will be low if they eventually cannot be implemented in routine care successfully[23]. And without evaluation of implementation it will remain unclear whether any effects found can be attributed to the true effectiveness of the intervention or to the success of implementation. That is why the second part of this thesis focuses on the implementation of geriatric screening in routine ED care.

Implementation of geriatric screening in routine ED care

Feasibility of screening in the ED

Implementation – the act of carrying an intention into effect – can be explored within implementation research which aims to understand what, why, and how interventions work in "real world" settings and to test approaches to improve them[24]. Implementation outcomes such as acceptability, adoption, feasibility, fidelity and sustainability can all serve as indicators of the success of implementation[25]. Because these implementation outcomes are largely unclear for the use of geriatric screening in the challenging and fast-paced environment of everyday ED practice[26], we studied the feasibility and acceptability of implementing geriatric screening in routine ED care (**chapter 5**). The APOP screener was incorporated in the routine care process after ED triage in the LUMC and was evaluated shortly after implementation. It was found that geriatric screening was feasible and could be completed in approximately 60% of all older ED patients. Moreover, screening was accepted by the users (ED triage nurses) who found it important and useful. In line with previous studies, the 2-minute time to complete the APOP screener was one of the facilitators of screening[26;27]. Another important facilitator was the incorporation in the electronic health records, making screening a part of routine care procedures. Organizational factors like 'the ED was too busy' were the most important barriers of screening execution. The discovered facilitators and barriers of screening execution were evaluated only shortly after implementation. Future cycles of improvement are needed to further improve screening execution and to evaluate long-term sustainability.

Implementing interventions after screening

Because screening alone only identifies high risk patients, a two-step approach is encouraged with geriatric screening as a first step, followed by targeted interventions

according to the principles of CGA[28]. That is why, within the APOP study, we implemented and evaluated not only the APOP screener, but also interventions for high risk screened patients in routine care (**chapter 6**). In a relatively short time period, it was found that interventions for high risk patients in the ED were partly adhered to. Outside the ED, implementation of the program resulted in increased numbers of executed CGA's during hospitalization. The implementation of the APOP screening program therefore resulted in improved execution of some individual interventions for older patients, but not all interventions improved after implementation compared to before. This raises some questions. First, did we evaluate implementation properly? Our implementation strategy was guided by the well-known Plan-Do-Study-Act (PDSA) model for quality improvement[29], and we used real-time observations of the execution of interventions in a routine care setting. However, small improvements in compliance with interventions in high risk patients might have been missed, since we could only compare compliance with interventions on the level of total group older ED patients in the 'before' and 'after' implementation period. In addition, we evaluated the compliance with interventions only in a period of two months shortly after implementation. Therefore, more measurements should follow in the future, guided by recurring PDSA-cycles, to further improve the screening rate and the execution of interventions in our hospital in future. A second question that the results from this thesis evoke is: did we chose the right interventions? The interventions of the APOP screening program include elements of CGA and were based on recommendations from international geriatric emergency medicine guidelines and quality indicators[30;31]. From the recommendations in international literature, we selected interventions which were practicable to implement in routine care in the Dutch ED setting. In addition, we also selected interventions based on project-team experience and input from focus groups with patient representatives and general practitioners. There is no evidence yet whether these interventions improve outcomes for older patients[20], except for a complete CGA, which was executed more often during hospitalization after implementation of our screening program. International quality indicators, for now, are the best guidelines we have to select interventions. In future, more focus should lie on international collaborations to improve and expand guidelines and quality indicators, for example by generating guidelines more specific for the European setting[32].

Choosing a screening instrument for the ED setting

In the last years, geriatric emergency medicine research focused mostly on the question which screening instrument should be used based on its predictive value. Numerous screening instruments have been developed and new prediction models keep emerging, yet the discussion which tool is best to use continues[14]. Some state that the existing instruments still do not accurately enough distinguish high- or low-risk patients and therefore should not be used in practice, while others raise the question whether it will be possible to develop better tools because ageing in essence is chaotic and unpredictable[33]. While we continue to develop more accurate geriatric screening

instruments, we simultaneously should focus more on implementation and effectiveness research. Evaluating implementation of screening tools in routine ED care may help us answer the question which tool is most suitable for which healthcare system or hospital. In our research we used the APOP screener, which might be best suitable tool for the Dutch ED setting, because it has been developed, validated, implemented and evaluated in this setting[34]. The generalizability of the APOP screener in different settings or countries, however, has not been studied. It might very well be that a different tool works better in a different country, for example due to another selection of older patients who visit the ED. The comparison between screening instruments remains challenging due to these differences in settings.

Moreover, a recent study evaluated the quality and usability of four geriatric screening instruments among healthcare professionals in the ED and investigate the added value of clinical judgment[35]. It was found that the clinical judgment of health-care professionals has the potential to improve screening further due to its high Negative Predictive Value, especially when combined with a screening tool which has a high Positive Predictive Value (i.e. the APOP screener). Although clinical judgment is subjective and does not have a fixed outcome like screening tools, it is very sensitive for the detection of frailty and could therefore be of added value when used next to a screening tool.

Finally, another challenge in the comparison between instruments is the fact that they all measure different things. Some tools measure frailty, although no consensus exists regarding the definition of frailty, making it unclear whether frailty tools all measure the same 'frailty'[36]. Other tools are designed as risk stratification instruments, measuring risk on various adverse outcomes at various moments in time after an ED visit, i.e. hospitalization, functional decline and ED revisits. The APOP screener is a risk stratification instrument which identifies older patients at risk for 90-day functional decline and/or mortality, and therefore it is not a frailty screener pur sang. However, since frailty is defined, among other things, by an increased risk on adverse health outcomes[37], one might state that instruments that identify patients at high risk of adverse health outcomes, identify the same patients as frailty tools. The identified 'high risk' according to risk stratification tools could therefore be used as a proxy for 'frailty'.

In conclusion, there is no perfect screening instrument, so when choosing the most suitable geriatric screening instrument for an ED setting one should evaluate: 1) what the instrument measures, 2) in which setting it was developed and validated, 3) how it performs regarding predictive value, 4) and whether the feasible use in practice is evaluated.

Future steps towards broader implementation

Implementation in different ED settings

Although the results of this thesis are very promising, it is important to keep in mind that our research focused on the implementation of one screening instrument (the APOP screener) in one particular setting (a Dutch academic hospital). The success and effects of implementation are very much dependent on the context: the healthcare system, the institutional setting, the care providers, the characteristics of patients and so on. More research will be needed to investigate implementation in different hospitals and ED settings to generate guidance on how geriatric screening tools can be successfully implemented on a wide scale. Recurring cycles of evaluation and improvements will play a central role in achieving successful implementation. The evaluation of implementation with a comparison across steps, components and settings could be operationalized within a stepped-wedge cluster randomized controlled trial[38].

To share our experiences and knowledge with other Dutch hospitals, the APOP project team wrote a practical handbook about the development and implementation of the APOP screening program[39]. The fact that the APOP screener recently has been implemented in the electronic health records (HiX, Chipsoft) used by approximately half of all Dutch hospitals and has been put into routine use by several EDs throughout the Netherlands is very promising. However, a one-size-fits-all screening program does not exist and an important first step before implementing a screening program and interventions for other EDs is to unravel the setting and find out the possibilities for interventions in the ED considering time, available personnel, patient numbers and ED environment.

Interdisciplinary collaboration

Finally, the ED is only one part of the acute care chain. To improve patient care we will need to work together with all health care providers involved during the acute care episode of an older patient. Collaboration with other care providers is essential, both inside the hospital (i.e. acute care nurses and doctors, geriatricians and physiotherapists) and outside the hospital (i.e. general practitioners and nursing home staff). Due to a patient's relatively short length of stay in the ED, interventions will usually have to be executed outside the ED, which makes the transfer of information to other care providers of utmost importance[20]. But also the patient's stay in the ED can be improved by focusing on safety, comfort, mobility, memory cues and sensorial perception[30]. In order to improve the outcomes of older ED patients, further attention should be paid to collaboration, both in practice as in science. A one-size-fits-all screening program does not exist, but by implementing and evaluating different screening programs in different ED settings we can still learn from each other. The experiences with the development and implementation of the APOP screening program in routine ED care can be very

useful for other hospitals to generate guidance on how geriatric screening tools can be successfully implemented.

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Chapter 9

English summary

Nederlandse samenvatting

List of publications

Curriculum vitae

Dankwoord

ENGLISH SUMMARY

Introduction

In the past decades, the growing number of older people presenting to Emergency Departments (EDs) is slowly transforming the practice of emergency medicine. Older ED patients are at high risk of adverse health outcomes, such as mortality or functional decline. Early identification of those patients who are at highest risk gives an opportunity to target interventions and guide treatment decisions for those who need it most. This two-step approach with geriatric screening as a first step, followed by targeted interventions, is increasingly used in various health care settings, and several screening instruments have been specifically developed for older patients in the ED. However, the clinical value of using geriatric screening in the ED is still unclear and implementation of screening programs in the fast-paced environment of everyday ED practice remains scarce.

Aim of the thesis

To improve care for acutely presenting older patients visiting the ED, this thesis has two aims. The first aim of this thesis is to study the association of geriatric screening parameters collected in the ED with various adverse health outcomes in different subgroups of older ED patients. The second aim of this thesis is to investigate the feasibility, impact and experiences of implementing a geriatric screening program in routine ED practice.

Summary of key findings

This thesis is divided in two parts. The first part of this thesis describes the motivation regarding the strategy of using geriatric screening in ED care. In the ED, geriatric characteristics are not routinely measured and taken into account. Risk stratification is executed by means of triage tools, which are based on clinical urgency to prioritize patients and rapidly diagnose potentially lethal illness. In **chapter 2** the added value of combining a geriatric screening tool and an urgency triage tool in the ED was explored. Within all triage urgency levels, older patients with a high-risk geriatric screening result had a three times higher 30-day mortality rate than patients who were identified as low risk. Combining triage with geriatric screening has the potential to improve identification of high-risk older patients and facilitates a holistic approach in older patients in the ED using both disease severity and geriatric impairments. The use of geriatric screening therefore gives an opportunity to improve care in acutely ill older patients as early as arrival in the ED. This also applies to the population of older ED patients that visit the ED due to a fall, which we studied in **chapter 3**. This chapter aimed to study whether fall characteristics and the result of geriatric screening are independently associated with adverse health outcomes in older patients with fall-related ED visits. Although a minority of this population had a high-risk screening result in the ED, the geriatric screening result was an independent risk factor of 3- and 12-months functional decline

and mortality. In addition to unravelling the cause and location of the fall, geriatric screening could therefore help identifying patients at high risk of poor outcomes. Furthermore, because the ED is only one part of the acute care chain, we aimed to study whether geriatric screening in the ED could also be used to guide treatment decisions and care planning during hospital admission. In **chapter 4** we therefore investigated the association between geriatric screening in the ED and various clinical outcomes and long-term adverse outcomes in acutely hospitalized internal medicine patients. Older patients with a high-risk geriatric screening result had a longer hospital length of stay and were more often discharged to a nursing home compared with low-risk screened patients. One year after the acute admission, two-thirds of the patients with a high-risk geriatric screening result had deceased or showed a decline in function, with an overall 1.5-fold higher risk compared with low-risk screened patients. Geriatric screening in the ED therefore also identifies older patients at high risk of long-term poor outcomes and provides valuable information for care providers treating acutely hospitalized older patients.

The second part of this thesis consists of studies about the implementation of geriatric screening in routine ED care. In **chapter 5** the feasibility and acceptability of the use of geriatric screening in the ED was studied. The Acutely Presenting Older Patient (APOP) screener was implemented in routine practice in the ED of the Leiden University Medical Center (LUMC) from March 2018, and evaluated during two months shortly after implementation. Geriatric screening was feasible and could be completed in approximately 60% of all older ED patients, with a stable screening rate over time. Patients had a lower probability of being screened when they were younger, when they had a higher disease severity or when the ED was busy. Screening was accepted by the users (triage nurses) who stated it is important and useful. The busy ED environment was most often experienced as a barrier of screening completion. **Chapter 6** studied the effects of the implementation of the APOP screening program, comprising both screening and interventions for high-risk screened patients, in a before-after study design. All older ED patients two months before and two months after implementation were included in the study. Results show that interventions for high risk patients in the ED were partly adhered to. Implementation of the program resulted in increased numbers of executed comprehensive geriatric assessments during hospitalization, which has known positive effects on patient outcomes, and resulted in communication of screening results to the general practitioner and telephone follow-up after ED discharge. Implementation had no major effects on the ED length of stay and hospital admission of older patients. In **chapter 7** experiences and attitudes of older patients regarding the use of geriatric screening in the ED were explored. Within this qualitative study, individual semi-structured interviews were conducted with older patients who completed the APOP screener while visiting the ED of the LUMC. Older patients had noticed little of the screening administration during triage and screening was considered as a normal part of ED care. They had predominantly positive attitudes towards its use in the ED.

Most of the patients believed that geriatric screening contributes to assessing older patients holistically, recognizing geriatric problems early and comforting patients with communication and attention.

Discussion

The results of the first part of this thesis show that geriatric screening can be used to identify older ED patients at high risk of various short- and long-term adverse health outcomes. The geriatric screening results provide valuable information for care providers both in- and outside the ED. In the ED, geriatric screening could improve triage. Outside the ED, for example during hospital admission, the results from geriatric screening could aid in individualized treatment decisions to acquire more personalized care, and therefore gives an opportunity to optimize outcomes for older patients.

The results of the second part of this thesis show that the implementation of geriatric screening in routine ED care is feasible. Additionally, the use of screening is accepted by both the users (the triage nurses) and the consumers (the older patients). It is important to keep in mind that this thesis focused on the implementation of one screening instrument (the APOP screener) in one particular setting (a Dutch academic hospital), and that the program was evaluated only shortly after implementation. More research will be needed to investigate implementation in different hospitals and ED settings to generate guidance on how geriatric screening tools can be successfully implemented on a wide scale. Recurring cycles of evaluation and improvements will play a central role in achieving successful implementation and long-term sustainability.

Future research should focus more on implementation and effectiveness. Evaluating implementation of screening programs in routine ED care may help us answer the question which screening tool and which interventions are most suitable for which healthcare system or hospital. Whether geriatric screening and subsequent interventions have effects on reducing adverse health outcomes in older ED patients remains to be studied. In order to improve the outcomes of older ED patients, further attention should be paid to collaboration, both in practice as in science. In practice, we will need to work together with all health care providers involved during the acute care episode of an older patient. In science, we have to keep learning from each other. The experiences with the development and implementation of the APOP screening program in routine ED care can be very useful for other hospitals to generate guidance on how geriatric screening tools can be successfully implemented.

NEDERLANDSE SAMENVATTING

Introductie

In de afgelopen decennia is het aantal ouderen dat de spoedeisende hulp (SEH) bezoekt aanzienlijk gegroeid. Dit vraagt om aanpassing van de praktijk van de spoedeisende geneeskunde. Ouderen hebben na een bezoek aan de SEH een hoog risico op negatieve gezondheidsuitkomsten, zoals mortaliteit of functionele achteruitgang. Vroegtijdige identificatie van patiënten met de hoogste risico's biedt de mogelijkheid om gerichte interventies te doen en behandelbeslissingen aan te passen voor de patiënten die dit het meest nodig hebben. Deze risicostratificatie van oudere patiënten wordt geriatrische screening genoemd, en heeft als doel om de uitkomsten van ouderen te verbeteren. Een twee-staps-aanpak met als eerste stap geriatrische screening, gevolgd door gerichte interventies, wordt in toenemende mate toegepast op verschillende plekken in de gezondheidszorg. Voor geriatrische screening op de SEH zijn de laatste jaren meerdere screeningsinstrumenten ontwikkeld. De klinische waarde van het gebruik van geriatrische screening op de SEH is echter nog onduidelijk, en implementatie van screeningsprogramma's in de drukke omgeving van de dagelijkse SEH-praktijk is zeldzaam.

Doel van dit proefschrift

Dit proefschrift heeft twee doelen om de zorg voor acuut presenterende oudere patiënten op de SEH te verbeteren. Het eerste doel is om de associatie te bestuderen tussen geriatrische screening en diverse negatieve gezondheidsuitkomsten in verschillende subgroepen van oudere SEH-patiënten. Het tweede doel is om te onderzoeken wat de haalbaarheid, impact en ervaringen zijn van implementatie van een geriatrisch screeningsprogramma in routinezorg op de SEH.

Overzicht van de bevindingen

In het eerste deel van dit proefschrift wordt de motivatie voor het gebruik van geriatrische screening op de SEH beschreven. Op de SEH worden geriatrische karakteristieken niet routinematig gemeten en meegenomen in het beleid. Risicostratificatie wordt uitgevoerd door middel van triage-instrumenten, met als doel om op basis van klinische urgentie patiënten prioriteit te geven en snel een diagnose te stellen van potentieel dodelijke ziekten. In **hoofdstuk 2** is de toegevoegde waarde van het combineren van een geriatrisch screeningsinstrument en een veelgebruikt triage-instrument op de SEH onderzocht. Binnen alle urgentieniveaus van triage hadden oudere patiënten met een hoog-risicouitslag van geriatrische screening een driemaal hogere mortaliteit binnen 30 dagen dan patiënten met een laag-risicouitslag. Door de ernst van de ziekte te combineren met geriatrische parameters kan mogelijk de identificatie van oudere patiënten met een hoog risico verbeteren en kan een holistische benadering bij oudere patiënten op de SEH gefaciliteerd worden. Het gebruik van geriatrische screening biedt daarom de mogelijkheid om de zorg bij acuut zieke oudere patiënten al bij aankomst

op de SEH te verbeteren. Dit geldt ook voor de populatie oudere patiënten die de SEH bezoekt vanwege een val, hetgeen we hebben bestudeerd in **hoofdstuk 3**. In dit hoofdstuk is onderzocht of valkenmerken en de uitslag van geriatrische screening onafhankelijk geassocieerd zijn met negatieve gezondheidsuitkomsten bij oudere patiënten met valgerelateerde SEH-bezoeken. Hoewel slechts een minderheid van deze populatie als hoog-risico werd gescreend, was de screeningsuitslag een onafhankelijke risicofactor voor functionele achteruitgang en mortaliteit na 3 en 12 maanden. Naast het detecteren van de oorzaak en de locatie van de val, kan geriatrische screening op de SEH daarom helpen bij het identificeren van patiënten met een hoog risico op slechte uitkomsten. Omdat de SEH slechts een onderdeel is van de acute zorgketen, was het wenselijk om te onderzoeken of geriatrische screening op de SEH ook kan worden gebruikt als leidraad voor behandelbeslissingen en zorgplanning tijdens een aansluitende ziekenhuisopname. In **hoofdstuk 4** is daarom onderzocht wat de associatie is tussen geriatrische screening op de SEH en verschillende klinische uitkomsten en uitkomsten op de lange termijn bij ouderen die via de SEH werden opgenomen op interne geneeskundeafdelingen. Oudere patiënten met een hoog-risicouitslag van geriatrische screening op de SEH hadden een langere ligduur in het ziekenhuis en werden vaker ontslagen naar een verpleeghuis dan patiënten met een laag-risicouitslag. Een jaar na de acute opname was twee derde van de patiënten met een hoog-risicouitslag overleden of achteruitgegaan in functioneren; zij hadden een 1,5 maal hoger risico vergeleken met laag-risico gescreende patiënten. Geriatrische screening op de SEH identificeert daarom ook oudere patiënten met een hoog risico op slechte uitkomsten op de lange termijn en biedt waardevolle informatie voor zorgverleners die acuut opgenomen oudere patiënten behandelen.

Het tweede deel van dit proefschrift omvat studies over de implementatie van geriatrische screening in routinezorg op de SEH. In **hoofdstuk 5** is onderzocht in hoeverre het gebruik van geriatrische screening op de SEH haalbaar is en wordt geaccepteerd door zorgprofessionals. De Acuut Presenterende Oudere Patiënt (APOP) screener werd in maart 2018 geïmplementeerd in routinezorg op de SEH van het Leids Universitair Medisch Centrum (LUMC) en kort na implementatie gedurende twee maanden geëvalueerd. Geriatrische screening was praktisch uitvoerbaar en ongeveer 60% van alle oudere SEH-patiënten kon worden gescreend, met een stabiel screeningspercentage in de loop der tijd. Patiënten hadden een lagere kans om te worden gescreend als ze jonger waren, als ze een hogere ziekte-ernst hadden, of als het druk was op de SEH. Screening werd geaccepteerd door de uitvoerders (de triageverpleegkundigen), die van mening waren dat screening belangrijk en nuttig is. Drukte op de SEH werd het vaakst genoemd als een barrière voor het voltooien van de screening. In **hoofdstuk 6** is in een voor-na-studie onderzocht wat de effecten zijn van implementatie van het volledige APOP-screeningsprogramma, bestaande uit zowel screening als interventies voor hoog-risico gescreende patiënten. Alle oudere SEH-patiënten werden voor dit onderzoek twee maanden vóór en twee maanden na implementatie geïncludeerd. De resultaten

wijzen uit dat na implementatie de interventies op de SEH voor hoog-risicopatiënten gedeeltelijk werden nageleefd. Implementatie van het screeningsprogramma resulteerde in een toenemend aantal uitgevoerde geriatrische onderzoeken ('comprehensive geriatric assessments') tijdens ziekenhuisopname, waarvan reeds bekend is dat het aantoonbare positieve effecten heeft op de uitkomsten van patiënten. Daarnaast leidde implementatie tot de overdracht van screeningsresultaten naar de huisarts en telefonische follow-up van de patiënt binnen 24 uur na ontslag. Ten slotte had de implementatie van het screeningsprogramma geen nadelig effect op de ligduur op de SEH of op het aantal ziekenhuisopnames van oudere patiënten. In **hoofdstuk 7** zijn de ervaringen en attitudes van oudere patiënten met betrekking tot het gebruik van geriatrische screening op de SEH onderzocht. Binnen dit kwalitatieve onderzoek zijn semi-gestructureerde interviews afgenomen bij oudere patiënten die waren gescreend met de APOP-screener tijdens een bezoek aan de SEH van het LUMC. Oudere patiënten hadden weinig gemerkt van de afname van de screeningsvragen tijdens triage en zij beschouwden screening als een normaal onderdeel van de SEH-zorg. De geïnterviewde patiënten hadden een overwegend positieve attitude jegens het gebruik van screening op de SEH. De meeste patiënten waren van mening dat geriatrische screening bijdraagt aan het holistisch beoordelen van oudere patiënten, het vroegtijdig herkennen van geriatrische problemen en het zorgen voor comfort van oudere patiënten door middel van communicatie en aandacht.

Discussie

De resultaten van het eerste deel van dit proefschrift laten zien dat geriatrische screening kan worden gebruikt om oudere SEH-patiënten te identificeren met een hoog risico op negatieve gezondheidsuitkomsten op korte- en lange termijn. De uitslag van geriatrische screening levert daarmee waardevolle informatie op voor zorgverleners, zowel op de SEH als daarbuiten. Op de SEH zou geriatrische screening triage bij ouderen kunnen verbeteren. Buiten de SEH, bijvoorbeeld tijdens ziekenhuisopname, kan de uitslag van geriatrische screening helpen als leidraad voor behandelbeslissingen om meer gepersonaliseerde zorg te creëren, en kan screening daardoor mogelijk de uitkomsten van ouderen patiënten verbeteren.

De resultaten van het tweede deel van dit proefschrift laten zien dat de implementatie van geriatrische screening in routinezorg op de SEH haalbaar is. Daarnaast wordt het gebruik van screening geaccepteerd door zowel de uitvoerders van de screening (de triageverpleegkundigen) als de oudere patiënten. Het is belangrijk om in gedachten te houden dat dit proefschrift zich richt op de implementatie van één screeningsinstrument (de APOP-screener) in één bepaalde setting (de SEH van een Nederlands academisch ziekenhuis), en dat het programma enkel kort na implementatie is geëvalueerd. Er is meer onderzoek nodig naar de implementatie van screening in verschillende ziekenhuizen en SEH's om uiteindelijk richtlijnen te kunnen genereren over hoe geriatrische screeningsinstrumenten met succes op grote schaal kunnen worden

geïmplementeerd. Terugkerende evaluatiecycli zullen een centrale rol spelen bij het bereiken van succesvolle implementatie en duurzaamheid op de lange termijn.

Het is belangrijk dat toekomstig onderzoek zich zal richten op zowel de implementatie als de effectiviteit van geriatrische screening. De evaluatie van implementatie van screeningsprogramma's in de dagelijkse praktijk van de SEH kan ons helpen te achterhalen welk screeningsinstrument en welke interventies het meest geschikt zijn voor welk zorgsysteem of ziekenhuis. Ook zal moeten worden onderzocht of geriatrische screening en interventies uiteindelijk effect hebben op het verminderen van negatieve gezondheidsuitkomsten bij oudere SEH-patiënten. Om de uitkomsten van oudere SEH-patiënten te verbeteren, zal daarnaast meer aandacht moeten worden besteed aan samenwerking, zowel in de praktijk als in de wetenschap. In de praktijk zullen we meer moeten samenwerken met alle betrokken zorgverleners tijdens een acute zorgepisode van een oudere patiënt. In de wetenschap is het belangrijk dat we van elkaar blijven leren. Onze ervaringen met de ontwikkeling en de implementatie van het APOP-screeningsprogramma in routine zorg op de SEH kunnen bruikbaar zijn voor andere ziekenhuizen om geriatrische screeningsinstrumenten met succes te implementeren.

LIST OF PUBLICATIONS

This thesis

Blomaard LC, Olthof M, Meuleman Y, de Groot B, Gussekloo J, Mooijaart SP. Experiences with and attitudes towards geriatric screening among older Emergency Department patients: a qualitative study. BMC Geriatr. 2021 Mar;21(1):198. doi: 10.1186/s12877-021-02144-7.

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CURRICULUM VITAE

Laura Christina Blomaard werd op 31 mei 1991 geboren te Delft. Na het behalen van het gymnasiumdiploma in 2009 aan de Interconfessionele Scholengroep Westland te 's-Gravenzande, begon zij met de studie Psychologie aan de Universiteit van Leiden. In 2010 is zij gestart met de studie Geneeskunde aan de Universiteit van Leiden. Tijdens de wetenschappelijke stage op de afdeling Ouderengeneeskunde van het Leids Universitair Medisch Centrum raakte zij geïnteresseerd in de spoedzorg voor ouderen. Tijdens deze stage is zij betrokken geweest bij de opzet van de APOP-studie. In 2016 behaalde zij het artsexamen, waarna zij aansluitend is gestart met het promotietraject op de afdeling Ouderengeneeskunde. Tijdens het promotietraject is zij betrokken geweest bij de implementatie van het APOP-screeningsprogramma in het Leids Universitair Medisch Centrum en heeft zij bijgedragen aan de ontwikkeling van een praktisch handboek ter bevordering van implementatie in andere medische centra in Nederland. Zij presenteerde haar wetenschappelijke werk op meerdere nationale en internationale congressen en in 2017 organiseerde zij het 'Leiden Geriatric Emergency Medicine Conference' te Leiden. Zij is actief lid van de 'European Task Force on Geriatric Emergency Medicine', die zich onder andere bezig houdt met het opstellen van Europese richtlijnen voor ouderen op de Spoedeisende hulp. Sinds maart 2021 is zij in opleiding tot huisarts aan het Leids Universitair Medisch Centrum.

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