Review


# Risk of emergency department use among community-dwelling older adults: a review of risk factors and screening methods

## Practice points

- Community-dwelling older adults have higher rates of emergency department (ED) use than younger cohorts, and their rates of ED use are increasing.
- A large number of risk factors have been associated with ED use by community-dwelling older adults. Data suggest that need for care characteristics, including: past use, cardiorespiratory conditions, cognitive impairment, nutritional risk, polypharmacy, challenges with locomotion and visual/spatial impairment might be useful for risk assessment.
- Real and perceived continuity and accessibility of primary care, as opposed to visit frequency, has been found to moderate the risk of ED use and should be considered alongside risk factors.
- Systematically identifying older adults who are at highest risk of ED use may be useful for targeting enhanced preventative care. Risk tools known as the Community Assessment Risk Screen and Elders Risk Assessment Index are the most supported ED specific risk screening tools in the literature.
- Ultimately, risk assessment for ED use among community-dwelling older adults should be individualized, taking into account risk screening results as well as additional risk factors and moderators.

Growing use of emergency departments (EDs) among community-dwelling older adults represents a challenge for the entire health system and a potential opportunity for improved identification and management among community healthcare providers. Studies have examined risk factors for ED visits among samples of noninstitutionalized older adults. They suggest that need for care characteristics are robust risk factors for ED use. Six screening tools have been developed or validated to predict ED utilization among community-dwelling older adults. Some evidence suggests that risk screening tools are useful to stratify patients into meaningful risk gradients. Future empirical studies should employ a comprehensive set of potential risk factors and utilize contemporary risk modeling methods to improve existing knowledge and risk screeners.

**Keywords:** case finding • emergency department • older adults • risk assessment • risk screening

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## Introduction

Emergency department (ED) use among older adults (defined here as age 65 years or older) is of increasing concern for clinicians and policy makers. EDs are a common entry point to acute inpatient care, psychiatric care, social services and community care services among older adults [1–3]. Some ED visits are also signs of declining health and function, declining informal care capacity or poor care transitions [4]. Studies consistently find that older adults use EDs at higher

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rates than younger persons [1,5], representing 12–21% of all ED visits [6] and approximately 38% of ambulance transports [7]. The population of older adults is increasing rapidly [8] in all industrialized nations, and North American data suggest that the proportion of ED visits accounted for by older adults has increased substantially over the last decade [6].

Most EDs are not suited for the care of older adults with complex chronic conditions and psychosocial care needs. The common ED care paradigm of swift evaluation, treatment of presenting complaint and rapid discharge are poorly suited to the core principles of quality geriatric care [9–14]. Specifically, acuity-oriented care relevant for younger adults has been found to be inappropriate for older adults with chronic conditions [9–14]. Older patients have longer lengths of stay compared with younger individuals and are subject to more diagnostic testing, yet have higher rates of misdiagnoses [15–17]. The social and personal concerns of the elderly are frequently not addressed in EDs [13,18–20]. Older adults discharged to the community from the ED are also more likely to return to the ED compared with younger acuity-matched cohorts [21–25].

Detecting the drivers of ED use among older adults is fundamental to clinical risk assessment and may be useful for designing effective prevention strategies. Programs designed to prevent ED use in primary and community care settings are a high priority for clinicians and policy-makers [26]. Many are attempting to improve secondary and tertiary preventative care within larger schemes for integrated geriatric services in community care settings. However, improved clinical practice and preventative strategies are likely to be untargeted, potentially misdirected and poorly organized without a comprehensive understanding of determinants of ED use among community-dwelling seniors as well as practical methods for case finding.

The purpose of this review is to identify the risk factors of ED use by community dwelling, noninstitutionalized, older adults and evaluate existing risk screening tools. We included quantitative empirical studies that used primary or secondary sources of data; those with representative samples of noninstitutionalized older adults living in the community (age 65 or older); those testing at least one independent variable; and those with ED visits as a dependent variable. We made no exclusion regarding country. Relevant studies were identified through MEDLINE, CIHAHL and Scopus for English language literature. Additional literature was identified through a review of the bibliographies. Using published conceptual frameworks we summarize the determinants of ED use among community dwelling older adults and examine the derivation and validation of clinical risk screening tools.

## Conceptual perspectives

Conceptual frameworks are visual representations that help clinicians, policy-makers and researchers make logical distinctions and organize ideas related to complex clinical phenomena. A few such frameworks have been applied or produced to describe ED use among older adults.

The Andersen behavioral model of Health Services Use, initially developed in the late 1960s, remains the dominant conceptual framework used to examine ED use by older adults [27,28]. Andersen, a medical sociologist, originally developed the framework to describe why persons use health services [27]. This was the first model to conceptualize components of health service utilization in a coherent multi-dimensional framework. Andersen's framework suggests that a person's use of healthcare services is a reflection of three person-level characteristics: their predisposition, enabling factors and need for care. Predisposing characteristics are those that are relatively fixed and make someone inclined to use a particular health service. Enabling characteristics are those, external to the person, which encourage or impede a person from accessing the particular health service. Finally, need for care characteristics are perceived or evaluated burden of disease, symptoms and disability (Table 1). Andersen's behavioral model suggests that predisposing and enabling factors are largely constant and insufficient for ED use, whereas need for care is necessary and sufficient for ED use [27].

McCusker *et al.* (2003) modified the Andersen behavioral model to better account for the confounding relationship between primary care and ED use by separating predisposing and enabling factors that drive these separate pathways [29]. Their framework suggests that need for care and unspecific predisposing and enabling determinants will result in ED utilization only in the absence of predisposing and enabling determinants for primary care utilization. Where predisposing and enabling determinants exist for primary care, ED utilization is less likely. For example, assuming equal need of ED care, an older adult is more likely to access primary care if they believe they will receive better care (predisposing) or if they have better access to primary care (enabling). The strength of the McCusker adaptation is its ability to account for the demonstrated modulating effect of primary care access on ED utilization [30,31].

Given the inherent subjectivity of categorizing determinants of ED use within the Andersen behavioral model, Grunier *et al.* (2010) proposed an alternate framework of ED utilization based on McCusker *et al.*'s adaptation [32]. Their framework solely conceptualizes need for care characteristics as a function

Table 1. Examples of the individual characteristics of health service use (Andersen behavioral model).

| Individual characteristic | Examples |
|---|---|
| Predisposing | Age, sex, marital status, race/ethnicity, place of residence, occupation, education, values, attitudes, knowledge |
| Enabling | Insurance, income, access to health services |
| Need for care | Perceived health status, disability, frailty, disease, symptoms |

of inadequate proactive primary and supportive care without explicit reference to predisposing or enabling characteristics. The notion of enabling characteristics is captured as inadequate proactive primary and predisposing characteristics are only acknowledged to the extent that need for care characteristics underlie their influence on ED use.

Conceptual frameworks for ED use among older adults were based on empirical literature, but none have been empirical tested for accuracy or reliability in real samples of older adults. Overall the use of conceptual frameworks to drive practice and policy related to ED utilization is limited without validations and elaborations of predisposing, enabling, and need for care characteristics. Further investigation is needed to test the accuracy of existing conceptual frameworks, including which class of characteristics accounts for the majority of variance in ED use. Such studies would require a representative sample of community-dwelling seniors as well as comprehensive data that span Andersen's three person-level characteristics.

## Risk factors among community dwelling older adults

Since 1987, 18 separate studies have examined risk factors for ED visits among representative samples of noninstitutionalized older adults (Tables 2 & 3). Overall, they suggest that a large number of diverse risk measures are predictive of ED use by community-dwelling older adults.

### Predisposing characteristics

Demographic risk factors such as age, marital status and living arrangement were found to be significant determinants of ED visits in just over half of the studies where they were employed. Age categories of 75–84 years and ≥85 years drive the effect [3,13,15,45,51–54]. Marital status – particularly widowhood – has been found to be a significant risk factor of ED visits in some studies [33,46,49]. However, results are inconsistent and effect sizes are relatively weak. Sex or gender was found to be a significant risk factor for ED visits in one of the five studies that examined this variable. Socioeconomic status – expressed in terms of income, education or occupation – is an inconsistent risk measure of ED utilization. Studies that demonstrate measures of socioeconomic status to be significant risk factors of ED visits also report relatively weak effect sizes [30,46].

### Enabling characteristics

Studies of enabling characteristics of ED utilization were relatively rare. Access and continuity of primary care were generally found to be robust risk factors of ED utilization where better access and more consistency were associated with less ED use [30,31,38,39,41,45,49]. Both IonescuIttu *et al.* [30] and Rosenblatt *et al.* [45] further examined the effect of primary care access and found that socioeconomic status or age strata did not change the effect. IonescuIttu *et al.* also found that the continuity of primary care had a stronger protective effect in urban than in rural areas. This differential effect on ED visits may be due to less variation in provider continuity rural locations, where persons living in small communities are less likely to have any access to primary care beyond their main provider [50]. In addition, it's possible that more rural primary care providers also provide ED care. McCusker *et al.* found that access to a specialist community-based physician predicted greater ED use [31]. This effect is probably explained by the greater severity of illness among patients referred to specialist care.

### Need for care characteristics

Conditions that are directly or indirectly associated with cognitive deficits were commonly found to be significant risk factors of ED visits, including: dementia, stroke and memory difficulty [33,37]. Measures of functional status – including restrictive activities or use of home health aids – were occasionally found to be significant risk factors of ED visits [34,37,46,48]. The prognostic value of functional status was often tested given that functional performance is a common pathway through which physical, cognitive and psychosocial illness also materialize. However, half of the studies that examined measures of functional status did not find a significant relationship with ED visits [35,36,44,49]. Sensory deficits related to vision were significant risk factors of ED visits, which may represent the increased risk for falls [37,38]. With the exception of

Table 2. Summary of studies, by study design.

| Study (year), location | Sample | Age (years) | Dependent variable | Number of independent variables | Ref. |
|---|---|---|---|---|---|
| **Cohort studies** | | | | | |
| Crane *et al.* (2010), USA | n = 12,650, primary care clinic roster | 60+ | Number of ED visits. Follow-up: 2 years retrospective. Source: medical records | 12 - Obs. period: 2 years. Source: medical records | [33] |
| Gill *et al.* (2003), USA | n = 754, random sample of nondisabled members of a large health plan | 70+ | Monthly rate of ED visits. Follow-up: 15 months prospective. Source: survey | 1 - Obs. period: 15 months. Source: survey | [34] |
| Hansell *et al.* (1991), USA | n = 690, random sample from a large health plan (66% response rate) | 62+ | Number of ED visits. Follow-up: 1 year prospective. Source: medical records | 8 - Obs. period: point in time. Source: survey | [35] |
| Shelton *et al.* (2000), USA | n = 1465, medicare beneficiaries (90% response rate) | 65+ | Any ED visits. Follow-up: 1 year prospective. Source: medical records | 12 - Obs. period: 12 months. Source: survey and medicare claims | [36] |
| Walker *et al.* (2005), UK | n = 2307, primary care clinic roster | 75+ | Any ED visit. Follow-up: max. 2 years. Source: medical records | 15- Obs. period: point in time. Source: survey | [37] |
| **Cross-sectional studies** | | | | | |
| Bazargan *et al.* (1998), USA | n = 998, random sample of low-income African American community dwellers with senior services (88.5% response rate) | 62+ | Number of ED visits. Source: survey | 22 - Source: survey. | [38] |
| Ginsberg *et al.* (1996) Israel | n = 605, random sample of metropolitan community dwellers | 70+ | Any ED visit. Source: survey | 6 - Source: survey | [39] |
| Ionesculttu *et al.* (2007), Canada | n = 95,173, random sample of provincial community dwellers | 65+ | Rate of ED use per 1000 days at risk. Source: medical records | 6 - Source: medical records | [30] |
| Lishner *et al.* (2000), USA | n = 354,782, population sample of rural Washington State Medicare beneficiaries | 65+ | Any ED visit. Source: Medicare data | 2 - Source: Medicare data | [40] |
| Mccusker *et al.* (2009), Canada | n = 66,216, regional, random sample of ED outpatients | 65+ | Any ED visit from index. Source: medical records | 7 - Source: survey | [41] |
| Mcgee *et al.* (2008), Ireland | n = 2,033, national, random sample community dwellers (68% response rate) | 65+ | Any ED visit. Source: survey | 13 - Source: survey | [42] |
| Murphy *et al.* (1996), USA | n = 759, random sample from a large urban health plan | 65+ | Number of ED visits. Source: Medicare claims | 2 - Source: Medicare claims | [43] |

ED: Emergency department; Obs. period: Observation period.

Table 2. Summary of studies, by study design (cont.).

| Study (year), location | Sample | Age (years) | Dependent variable | Number of independent variables | Ref. |
|---|---|---|---|---|---|
| Parboosingh *et al.* (1987), Canada | n = 75, random sample ED outpatients from single hospital site | 65+ | Number of ED visits. Source: medical records | 16 - Source: survey | [44] |
| Rosenblatt *et al.* (2000), USA | n = 354,782, Washington State Medicare beneficiaries | 65+ | Any ED visit. Source: Medicare records | 2 - Source: Medicare records | [45] |
| Shah *et al.* (2001), USA | n = 9784, national sample of noninstitutional Medicare beneficiaries | 66+ | Any ED visit. Source: medical records | 13 - Source: survey and administrative records | [46] |
| Soghikian *et al.* (1991), USA | n = 1073, random sample of a large health plan (80% response rate) | 60+ | Rate of ED visits per year. Source: medical records | 1 - Source: medical records | [47] |
| Walter Ginzburg *et al.* (2001), Isreal | n = 1487, random sample of community dwellers (76% response rate) | 75+ | Any ED visits. Source: survey | 13 - Source: survey | [48] |
| Wolinsky *et al.* (1983), USA | n = 401, random sample of community dwellers | 65+ | Number of ED visits. Source: survey | 19 - Source: survey | [49] |

ED: Emergency department; Obs. period: Observation period.

one study [44], self-reported health was observed to be a significant predictor of ED visits [35,38,39,46,48].

Risk measures related to a declining health trajectory, including nutritional issues were consistent predictors of ED utilization [33,35,49]. Measures of disease status, including: cardiac conditions, diabetes, stroke, cancer, number of comorbidities and polypharmacy were inconsistently associated with ED visits. However, studies that did observe measures of disease status to be significant risk factors usually reported relatively large effect sizes [33,36–38,46,48]. Measures of past hospital utilization (ED and inpatient) were found to be the most predictive risk factors of future ED utilization [33,36,39,44]. Without exception, studies that documented one or more prior hospital encounters found a highly positive association with future ED utilization. A sensitivity analysis found that the inclusion of prior hospital utilization in multivariate models substantially increased the explained variance in ED use [33].

## Evidence for conceptual frameworks

Five of the eighteen empirical studies that examined risk factors of ED use explicitly utilized the Andersen behavioral model to conceptualize their potential risk factors for ED use [38,44,46,48–49]. With one exception [44], all of the studies that employed the Andersen behavioral model found that need for care characteristics were the most powerful class of risk factors of ED visits [38,46,48,49]. Bazargan *et al.* found that need for care characteristics accounted for half of the explained variance in their ED prediction model [38]. Enabling characteristics were the least useful domain. They accounted for 5% more explained variance when combined with need for care characteristics, and only 3.5% more explained variance when combined with predisposing characteristics and need for care characteristics. It is suggested that the extent to which need for care characteristics account for greater variance in ED utilization relative to enabling characteristics reflects more equitable access to primary and ED care [28,41]. Overall, the literature suggests that predisposing and enabling characteristics are relatively weak predictors of unplanned ED compared with need for care. Conceptual frameworks as well as clinical policy and practice should therefore reflect the relative importance of need for care characteristics given that they appear to be relatively potent predictors for ED use among older adults.

Table 3. Summary of determinants of emergency department utilization among community-dwelling older adults, by Andersen's person-level characteristics.

| Characteristic | Studies | Determinants tested | | Ref. |
|---|---|---|---|---|
| | | Evidence for significant effect | No effect found | |
| Predisposing | Crane (2010) | **Attitude toward preventative care** | Race | [33] |
| | Hansell (1991) | **Rurality** | Occupation | [35] |
| | Shelton (2000) | Health locus of control | Retirement status | [36] |
| | Walker (2005) | Age | Nutritional knowledge | [37] |
| | Bazargan (1998) | Martial status | | [38] |
| | Ginsberg (1996) | Sex | | [39] |
| | Ionesculttu (2007) | Education | | [30] |
| | Lishner (2000) | Socioeconomic status | | [40] |
| | Mcgee (2008) | Living arrangement | | [42] |
| | Murphy (1996) | | | [43] |
| | Parboosingh (1987) | | | [44] |
| | Rosenblatt (2000) | | | [45] |
| | Shah (2001) | | | [46] |
| | Soghikian (1991) | | | [47] |
| | WalterGinzburg (2001) | | | [48] |
| | Wolinsky (1983) | | | [49] |
| Enabling | Bazargan (1998) | **Continuity of PCP** | Increased informal support | [38] |
| | Ginsberg (1996) | **Perceived PCP accessibility** | Primary care scope of services | [39] |
| | Ionesculttu (2007) | **Distance from PCP** | Frequency of PCP visits office-based PCP | [30] |
| | Mccusker (2009) | PCP accessibility | Health insurance | [41] |
| | Mccusker (2012) | Perceived informal support | | [50] |
| | Parboosingh (1987) | | | [44] |
| | Rosenblatt (2000) | | | [45] |
| | Wolinsky (1983) | | | [49] |
| Need for Care | Crane (2010) | **Prior hospital use** | IADL Impairment | [33] |
| | Gill (2003) | **Dementia or memory problem** | Renal Disease | [34] |
| | Hansell (1991) | **Higher body awareness** | Presence of pain | [35] |
| | Shelton (2000) | **Multimorbidity** | Energy/fatigue level | [36] |
| | Walker (2005) | **Polypharmacy** | Problem with hearing | [37] |
| | Bazargan (1998) | **Visual impairment** | Hip fracture | [38] |
| | Ginsberg (1996) | **Use of a walking aid** | Mood symptoms | [39] |
| | Mcgee (2008) | **Heart disease** | | [42] |
| | Parboosingh (1987) | **Nutritional risk** | | [44] |
| | Shah (2001) | **Cancer** | | [46] |
| | WalterGinzburg (2001) | Stroke | | [48] |
| | Wolinsky (1983) | Respiratory disease | | [49] |
| | | Diabetes | | |
| | | ADL Impairment | | |
| | | Self-perceived health | | |
| | | Restrictive activity | | |

Bold text indicates consistent significant effect across at least two studies.
ADL: Activities of daily living; IADL: Instrumental activities of daily living; PCP: Primary care physician.

## Limitations

Threats to validity challenge much of the literature on risk factors among community dwelling older adults and the overall quality of the literature could be considered low. In particular, the choice or availability of outcome measures, the comprehensiveness of potential risk factors and the study designs employed limit the reliability and validity of the results. Follow-up periods varied from 90 days to up to 2 years. Studies that sought to determine ED use in a longer follow-up period were less likely to find associations between transient clinical characteristics, and were more likely to find associations between nontransient sociodemographic determinants. Some studies utilized a self-

report of ED use rather than objective sources [38–39,42,48–49,55]. These studies were also more likely to find that self-rated health and access to other sources of care were significant determinates of ED use. The effect of self-rated health in such studies may reflect a self-fulfilling bias, where persons who rated poorer health may be more likely to remember past ED use.

Six of the eighteen studies reported the effect of only one or two potential risk factors [40,42,43,45,47,55]. Of those that reported more than two potential risk factors, many lacked a comprehensive set that comprised multiple health domains. The lack of a comprehensive set of potential risk factors increases the risk of finding spurious associations. The prevalent use of cross-sectional designs also introduces concerns for temporal validity between the potential predictors and dependent measures [30,38–40,42–48,55]. For example, it is difficult to distinguish whether self-reported health, activity and views of the health system were causes of ED utilization or were the result of an ED visit.

## Current risk screening methods

Systematically identifying older adults who are at highest risk of ED use can be useful for targeting enhanced preventative care [56,57]. The literature suggests that risk screening tools may be useful to stratify patients into meaningful risk gradients and may improve the cost–effectiveness of community-based interventions [58,59]. For example, results from a single nonexperimental study suggests that risk screening tools with a 20–30% positive predictive value can enhance the cots–effectiveness of targeted case management [59]. In addition, prognostic screening tools are particularly valuable when risk is diverse and when many potential factors contribute to increased risk [60]. The majority of published risk screening tools have been developed to predict ED and inpatient readmissions and, therefore, have less utility for screening older adults living in the community for whom the majority are not post-acute. From a strategic perspective, identifying high-risk older adults in the community before hospital use is likely to enable earlier and more effective prevention. To our knowledge, six community-based screening tools have been developed or validated to predict ED utilization among community-dwelling older adults (see Table 4).

### Probability of repeated admissions

Boult *et al.* produced the Probability of Repeated Admissions (PRA) from a longitudinal study of community-dwelling older adults [61]. Though not specifically predictive of ED utilizations, the PRA does capture ED visits that result in inpatient admissions. The PRA score is computed using a logistic equation that is based on an eight-question, 11-item self-administered postal questionnaire. Predictive performance is commonly expressed by the area under the curve (AUC) of the receiver operating characteristic – a widely recognized measure of discriminatory power. The AUC is a single value that characterizes the overall sensitivity and specificity across binary predictive measures or predictive scales. An area of 1 represents a perfect test (i.e., 100% sensitivity and 100% sensitivity) whereas an area of 0.5 represents a meaningless test (i.e., 50% sensitivity and 50% sensitivity). Boult *et al.* (1993) report an AUC value of 0.61 and Wallace *et al.* (2013) report an AUC value of 0.69 in a larger systematic review [62].

### Community Assessment Risk score

A study by Shelton *et al.* developed a tool to predict ED utilization (in addition to hospital utilization) known as the Community Assessment Risk Screen (CARS) [36]. The CARS was based on a self-report survey where three items were found to be predictive of ED use based on a multivariate logistic regression model. The adjusted effect size (odds ratio) of each question item is added to produce a score. Scores range from 0–7, and the authors suggested to collapse scores greater than or equal to 4 as high risk and all others as low risk. Shelton *et al.* reported an AUC value of 0.67 based on the suggested division of patients into high and low risk.

### Emergency Admission Risk likelihood index

Lyon *et al.* developed the Emergency Admission Risk Likelihood Index (EARLI) based on a prospective study of older primary care patients [63]. Similar to the PRA, EARLI was developed to predict inpatient admissions and does not specifically predict ED visits. Similar to the PRA and CARS, the EARLI is based on a short (6 item) self-administered survey. Adding the effect sizes for each of the 6 items produces risk scores, which are then divided into four groups: very high, high, moderate and low-risk. The authors reported an AUC value of 0.66 using an external validation sample.

### Elders Risk Assessment

Crane *et al.* (2010) developed the Elders Risk Assessment Index (ERA) based on the use of primary care electronic medical records [33]. ERA is based on an index of nine items (identified using stepwise linear regression) that are weighted according to each item's effect size. The ERA produces 5 risk groups that represent ranked quartiles where the highest quartile is further split by the top decile. The validation sample yielded an AUC value of 0.64 for the prospective number of ED visits.

Table 4. Summary of prognostic tools developed or tested to predict emergency department utilization among community dwelling older adults.

| Tool | Items | Derivation sample | Information collection | Dependent variable | AUC (validation sample) | Ref. |
|---|---|---|---|---|---|---|
| Probability of Repeated Admission (PRA) score, USA | In general, would you say your health is excellent, very good, good, fair, poor?<br>In the previous 12 months, have you stayed overnight as a patient in a hospital?<br>In the previous 12 months, how many times did you visit a physician or clinic?<br>In the previous 12 months, did you have diabetes?<br>Have you ever had?<br>coronary heart disease<br>angina pectoris<br>a myocardial infarction<br>Is there a friend, relative or neighbor who would take care of you for a few days, if necessary?<br>Are you male, female?<br>What is your date of birth? | Random sample of community residents<br>Age(s): 70+ years<br>n = 5876 | Self-administered postal survey | 2+ hospital admissions in 4 years | 0.61<br>0.69 | [61,62] |
| Community Assessment Risk Screen (CARS), USA | Having two or more comorbidities<br>Taking five or more prescription medications<br>Having had a hospitalization or ED visit in the previous year | Medicare beneficiaries<br>Age(s): 65+ years<br>n = 1465 | Self-administered postal survey | Hospital or ED visits | 0.67 | [36] |
| Sherbrooke Questionnaire, UK | Problem with memory<br>Problem with sight<br>Uses a walking aid<br>Taking three or more medications<br>Problem with hearing<br>Living alone | Primary care patients<br>Age(s): 75+ years<br>n = 2307 | Self-administered postal survey | Any ED visit | Unknown | [37] |

CAD: Coronary artery disease; CHF: Congestive heart failure; COPD: Chronic obstructive pulmonary disorder; ED: Emergency department.

Table 4. Summary of prognostic tools developed or tested to predict emergency department utilization among community dwelling older adults (cont.).

| Tool | Items | Derivation sample | Information collection | Dependent variable | AUC (validation sample) | Ref. |
|---|---|---|---|---|---|---|
| Emergency Admission Risk Likelihood Index (EARLI), UK | Do you have heart problems?<br>Do you have leg ulcers?<br>Can you go out of the house without help?<br>Do you have problems with your memory and get confused?<br>Have you been admitted to hospital as an emergency in the last 12 months?<br>Would you say the general state of your health is good? | Primary care patients<br>Age(s): 75+ years<br>n = 3032 | Self-administered postal survey | Any admissions | 0.66 | [63] |
| Vulnerable Elders Survey (VES), Ireland | Age<br>Fair or poor health;<br>Difficulty:<br>Stooping<br>Lifting<br>Reaching above shoulder<br>Writing<br>Walking quarter mile<br>Heavy housework<br>Dependence due to conditions:<br>Shopping<br>Finances<br>Walking in room<br>Light housework<br>Bathing | Random sample of community residents.<br>Age(s): 65+ years<br>n = 2033 | Clinician-administered questionnaire | Any ED visit | Unknown | [42] |
| Elders Risk Assessment Index (ERA), USA | Age<br>Martial status<br>Prior hospital admissions<br>Diabetes<br>CAD or CHF<br>Stroke<br>COPD<br>Cancer (excl. skin)<br>Dementia | Primary care patients<br>Age(s): 60+ years<br>n = 12,650 | Existing electronic medical records | Number of ED visits | 0.64 | [33] |

CAD: Coronary artery disease; CHF: Congestive heart failure; COPD: Chronic obstructive pulmonary disorder; ED: Emergency department.

### Vulnerabe Elders Survey & Sherbrooke Questionnaire

Two other studies tested existing tools that were not originally developed to predict health services utilization. The Vulnerable Elders Survey (VES) is a clinician-administered questionnaire, containing mostly functional measures, developed by Saliba *et al.* (2001) to predict future functional decline or death among a random sample of Medicare beneficiaries over age 65 [64]. McGee *et al.* (2008) tested this 13–item/13-point scale by comparing high and low scores based on a two-level split [42]. The authors show that there is some ability to differentiate based on relative frequency results but do not report any information on relative risk or predictive accuracy. Similarly, Walker *et al.* (2005) [37] tested the Sherbrooke Questionnaire – a six-item tool developed by Hébert *et al.* (1996) [65] – to predict functional decline. Based on the best two-level score split the authors report an odds ratio of 1.94 (95%; CI: 1.6–2.4) for ED attendance and 2.62 (95%; CI: 2.0–3.5) for ED admission. No indication of overall predictive accuracy was provided.

### Limitations

All of the risk screening tools reported in the literature are based on a scoring approach that sums effect sizes for each risk screening item. These additive methods of risk screening may limit use in point of care clinical decision-making because of the difficultly to comprehend the specific risk profile of any given risk score. A given risk score could be the result of multiple combinations of risk factors and it may be difficult to plan appropriate interventions without a clear understanding of the discrete risk factors that underlie each patient's relative risk. Given that risk screening tools typically support decision-making for referral, which can include consideration of eligibility, the ability to ascertain the clinical profile of at risk persons is also a crucial component for care planning. With exception to the most basic among them, additive methods of risk assessment may be difficult to translate into clinical practice settings.

The usability of some existing risk screening tools at the point of care is also problematic. Specifically, many risk tools are based on self-administered postal surveys (where older adults complete the risk tool independently). The feasibility of self-administered risk screening in clinical practice is largely untested. However, the low response rate reported by most of the studies suggests that self-administered risk screening may not be realistic for a primary care practice or supportive care agency (Table 2). In addition, the ability of non-clinicians to comprehend screening questions and to complete a clinical self-assessment objectively may reduce the reliability and validity of self-administered risk screening in real clinical practice. This concern is especially pertinent for older adults with cognitive impairment. Future studies should directly compare the reliability and validity of clinician-administered and self-administered screening approaches.

The ERA and CARS show modest predictive accuracy among community-dwelling older adults, and the lack of appropriate validation for ED utilization severely limits the use of some existing risk tools. In particular, the validity of the VES and the Sherbrooke Questionnaire as predictive tools for ED utilization is unknown given their alternate development and failure to report discriminatory power. Where predictive accuracy is given, existing risk screening tools have AUCs higher than 0.60 but lower than 0.70. This level of performance is similar to that of prediction tools for hospital readmission [66]. Informal conventions for evaluating predictive accuracy are commonly based on diagnostic testing. Unlike diagnostic testing, where testing is usually expensive or invasive and attempts to detect existing disease or it's severity, risk screening for ED use is typically less expensive and meant to target additional patient-specific evaluation and, where confirmed, preventive care. For instance, false-positives are much less concerning for risk screening given that unnecessary patient-specific evaluation and preventative care does not pose a direct health hazard. Some suggest that AUCs greater than 0.60 are useful for risk management [62]. However, the accuracy of existing risk screening tools suggests that patient-specific clinical decision-making should be used when interpreting screening results and determining appropriate interventions. Further inquiry is needed on acceptable standards of discrimination for such risk screening tools.

The ability of PRA, EARLI and CARS to specifically predict ED visits is unknown given that they were developed and validated on the prediction of inpatient admissions or a combined outcome. Studies find that approximately half of ED visits by older adults do not result in an acute admission [15,17,54,67–68]. Therefore, a large portion of ED visits was not accounted for in these studies. Risk factors for admitted ED cases may differ from those who are discharged back to the community. A specific focus on acute admission rather than ED use may identify older adults that are less responsive to preventative interventions given that admitted cases are more likely to be the result of unpredictable acute events.

## Conclusion

Empirical studies of ED utilization among community-dwelling older adults have identified multiple

potential determinants of ED utilization. Need for care characteristics, including: past use, cardio-respiratory conditions, cognitive impairment, nutritional risk, polypharmacy, challenges with locomotion and visual/spatial impairment are the most predictive risk factors that should be considered during patient risk assessment. The continuity of primary care moderates risk and should also be considered in patient risk assessment. A number of risk screening tools have been developed that exhibit modest predictive accuracy. The CARS is the most supported tool for in-person risk screening, whereas the ERA is the most supported tool where adequate electronic health records are available. Screening results should be interpreted within the broader context of identifiable risk factors and risk moderators given their modest accuracy.

The existing evidence for risk factors and development of risk screening tools is limited mainly by the comprehensiveness of the potential risk factors that have been investigated. Large and representative studies utilizing more comprehensive sets of potential risk factors are needed to expand the evidence base on risk factors and produce more accurate risk screening tools. This evidence is likely to evolve conceptual frameworks by testing the relative contribution of specific predisposing, enabling and need for care characteristics. Despite limitations, the existing evidence provides a guide to begin to develop more effective risk screening and preventative interventions among community-dwelling older adults at risk for ED use.

## Future perspective

As the use of electronic health records becomes more widespread, detailed and interoperable, more comprehensive information will be available to understand patterns of ED use among community-dwelling older adults. The secondary use of clinical data from these electronic health records represents an opportunity to improve on existing studies without substantial investment in primary data collection. In addition, recursive partitioning methodologies are particularly useful for the development of risk screeners and offer distinct advantages relative to common additive modeling methods given their ability to utilize interactions among clinical characteristics. Beyond predictive performance, risk screening tools must also be interpretable and intuitive in clinical practice. Recursive partitioning provides specific visual descriptions of each risk group and encourages pattern recognition, making it more useful for clinical risk prediction, in addition to clinical education.

In addition to improving the quality of the evidence, there is a need to expand the evidence base to important subpopulations of older adults. To our knowledge, no published risk-prediction models exist for ED or hospital use among predominantly frail clinical populations of older adults living in the community, including those receiving in-home care. Home health services occupy an increasingly prominent role in many healthcare systems [69,70] and older adults receiving in-home care are likely at high risk for ED use. The preventability of ED visits in the community setting also remains unclear. Experimental studies are required to examine what type and intensity of services and coordination should be offered based on established chronic disease management models. The cost–effectiveness of preventative care must also be examined to unsure that effective practices are also sustainable in community care.

### Disclaimer

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