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Predicting functional decline in older emergency patients—the Safe Elderly Emergency Discharge (SEED) project

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Abstract

Objective: to profile the trajectory of, and risk factors for, functional decline in older patients in the 30 days following Emergency Department (ED) discharge.
Methods: prospective cohort study of community-dwelling patients aged ≥65 years, discharged home from a metropolitan Melbourne ED, 31 July 2012 to 30 November 2013. The primary outcome was functional decline, comprising either increased dependency in personal activities of daily living (ADL) or in skills required for living independently instrumental ADL (IADL), deterioration in cognitive function, nursing home admission or death. Univariate analyses were used to select risk factors and logistic regression models constructed to predict functional decline.
Results: at 30 days, 34.4% experienced functional decline; with 16.7% becoming more dependent in personal ADL, 17.5% more dependant in IADL and 18.4% suffering deterioration in cognitive function. Factors independently associated with decline were functional impairment prior to the visit in personal ADL (Odds Ratio [OR] 3.21, 95% confidence interval [CI] 2.26–4.53) or in IADL (OR 6.69, 95% CI 4.31–10.38). The relative odds were less for patients with moderately impaired cognition relative to those with normal cognition (OR 0.38, 95% CI 0.19–0.75). There was a 68% decline in the relative odds of functional decline for those with any impairment in IADL who used an aid for mobility (OR 0.32, 95% CI 0.14–0.7).
Conclusion: older people with pre-existing ADL impairment were at high risk of functional decline in the 30 days following ED presentation. This effect was largely mitigated for those who used a mobility aid. Early intervention with functional assessments and appropriate implementation of support services and mobility aids could reduce functional decline after discharge.

Keywords: *older people, older age, emergency department, risk, functional decline*

Introduction

Older people are an ever-growing population in Emergency Departments (EDs) across the world, with attendances increasing at a rate beyond that expected from demographic change alone [1–4]. Underlying factors include population ageing, loneliness and lack of social support, changes in the organisation of primary care, expectations for timely specialist care and convenience of a 24-hour 'one-stop shop' [5]. An ED visit for an older person has been defined as a sentinel event [6], that can lead to substantial functional decline including reduced health-related quality of life and death; and other adverse outcomes including increased risk of ED re-presentation [7–10]. Therefore, identification of risk factors for future functional decline is an important consideration prior to discharge, to enable appropriate referral and allocation of post-acute care resources. Furthermore, identifying the predictors of functional decline is relevant because of the association with increased risk of mortality, institutionalisation and service use that resulting in higher societal costs [11].

The Safe Elderly Emergency Discharge (SEED) project was established with the objective of determining best

practice for safe discharge of older emergency patients [12]. This involved prospectively mapping the demographic, clinical, functional and psychosocial profiles of an older Australian cohort over a 30-day period. One aim was to identify predictive factors for unplanned early return to the ED [13]. The aim of the current study was to determine the risk factors associated with functional decline following ED discharge, including either decrease in ability to perform personal activities of daily living (ADL) or increased dependency in skills required for functioning autonomously in the community, deterioration in cognitive function, admission to a nursing care facility or death.

Methods

The study design, setting and participants have been described in detail elsewhere [13]. In summary, we prospectively studied a cohort of older community-dwelling patients aged ≥65 years following discharge home from a metropolitan Melbourne public hospital ED, 31 July 2012 to 30 November 2013.

Data collection

Study staff conducted a structured interview with patients or their nominated informant at baseline. Follow-up interviews were conducted by telephone at 1 week and 1 month. A multidisciplinary committee developed the surveys to include measurement of factors known to be associated with functional decline, based on prior literature and expert opinion of the clinical research team.

The baseline survey comprised questions about demographic and social information including age, sex, cultural background, living arrangements, involvement of community care or support services, medication management and General Practitioner (GP) accessibility; use of primary, specialist and hospital services over the 12 months previously; together with information pertaining to the current ED visit, including reason for this visit, referral source, health service use within the previous 2 weeks and means of transport. Functional status was evaluated with tools previously validated in this age group including: cognition—Mini-Mental State Exam (MMSE) [14]; performance in personal and instrumental ADL (IADL) [Barthel Index [15] and Lawton IADL Scale [16]; falls risk—Balance Confidence Level (ABC-6) [17]; and mood—Geriatric Depression Scale-5 items (GDS-5) [18]. Self-assessed health status was measured in accordance with the Australian National Health Survey [19]. A premorbid reference period of 2 weeks before the illness/injury that brought them to ED was used for self-reporting functional performance of ADL and IADL and health status, to eliminate possible effects of the illness causing the visit [20]. Additional information including primary presenting condition (ICD-10 code), comorbid conditions, medication details, clinical status and care pathway throughout the ED visit, alongside time and day of arrival and discharge was collected from the ED Medical Record.

Follow-up telephone surveys included questions about health and community services use since the ED visit; the Barthel Index, Lawton Scale, GDS-5 and ALFI-MMSE [21].

Outcomes

The primary outcome was any decline in functional status over the 30 days following ED attendance. This was defined as either increased dependency in personal ADL, classified as a decrease of ≥2 points on the Barthel Index [22]; or increased dependency in more complex activities or necessary for functioning in community settings (instrumental ADL or IADL), defined as a decrease of ≥1 points on the Lawton Scale; or decline in cognitive function, defined as deterioration from normal to mild impairment/mild to moderate impairment/moderate to severe impairment on the MMSE and ALFI-MMSE; or admission to a nursing care home; or death.

Deterioration in (i) cognitive function, (ii) personal ADL, and (iii) IADL were examined as secondary outcomes. For secondary outcomes, patients who died or were transferred to nursing homes were excluded.

Data analysis

Descriptive statistics were estimated to determine the study sample characteristics. The primary analysis involved a two-step process. Firstly, univariate logistic regression models for each outcome were applied to estimate the association between each of the demographic, clinical, wellbeing and social covariates and the outcomes. Secondly, a saturated logistic regression model was constructed for each outcome using all risk factors with $P < 0.1$ in the univariate analysis.

Backward stepwise elimination was used to determine independent risk factors using the Akaike Information Criterion for model selection [23]. Where there was evidence of changes in the association between the predictor and the outcome in the multivariate model, interactions between predictors were explored. To avoid overfitting, different model forms for each outcome were assessed using out-of-sample cross validation. Data were randomly split into building (2/3) and validation sets (1/3). Two hundred random splits were used and the highest mean c-statistic for each model form was used to select the final model for each outcome. A P-value of 0.05 was considered statistically significant. All analyses were carried out using Stata 13 (StataCorp, Texas, USA).

Results

A total of 959 patients who met the inclusion criteria and provided voluntary informed consent were recruited (Figure 1). Table 1 outlines characteristics of the cohort. Median age was 77 years with 22% (n = 213) aged ≥85 years, and 56% (n = 535) were female. The majority (56%, n = 535) were Australian or New Zealand born, with 26% (n = 249) from

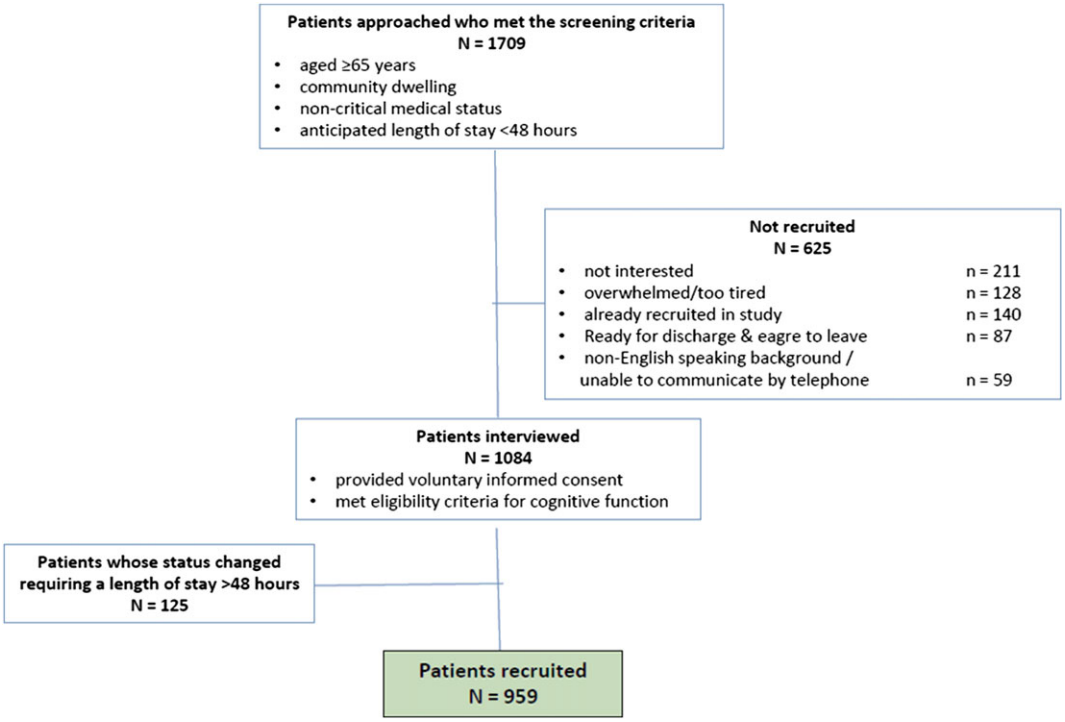

Figure 1. Study Flow.

Europe. English was the preferred language for 94% (n = 899) of patients.

Forty-five percent (n = 435) lived alone, 39% (n = 374) received formal or informal care support; with 31% (n = 293) and 38% (n = 366) dependent in one or more personal ADL or IADL, respectively, 2 weeks prior to attendance. One-third (n = 321) required assistance of a mobility aid, almost one in four (n = 223) experienced two or more falls in the previous 12 months, and 38% (n = 364) reported a balance confidence level of <50%. One in four (n = 245) had mild to moderate cognitive impairment, and 28% patients (n = 259) presented with depressive symptoms or reported having depression. The mean number of comorbid conditions was 0.7 (median = 0).

The majority (84%, n = 810) were seen by the ED allied health team and 862 patients (89%) were transferred to the SSOU for further evaluation prior to discharge home.

During the study period, 67 patients (7%) withdrew or were lost to follow-up. Reasons included: no longer interested in participating (n = 18), not well enough (n = 8), uncontactable (n = 15) or unknown (n = 26).

Primary outcome—any functional decline

In the 30 days following ED presentation, of the 892 patients who were successfully followed up, 34.4% (n = 307) experienced any functional decline, including 16.7% (n = 131) becoming more dependent in personal ADL, 17.5% (n = 139) with increased dependency in IADL, 18.4% (n = 140) patients with a decline in cognitive function, 1.03% of patients (n = 9) admitted to a nursing care home and 1.25% of patients (n = 11) who died.

As summarised in Table 2, 13 variables were associated with functional decline in univariate analysis, namely aged ≥85 years, functional impairment in ADL or IADL, use of a gait aid, <50% perceived confidence in ability to maintain balance whilst performing ADL, mild cognitive impairment, depressive symptoms, poor/fair self-rated health, receipt of formal/informal supportive care, comorbid illness, polypharmacy and ≥1 ED attendance or hospitalisation in the previous 12 months.

The multivariable model selection, conducted using backwards variable selection is summarised in Table 2. The final model included functional impairment in personal ADLs (Odds Ratio [OR] 3.21, 95% confidence interval [CI] 2.26–4.53) or in skills required for functioning independently in the community (OR 6.69, 95% CI 4.31–10.38). There was a 62% decline in risk in the relative odds of functional decline for patients with moderately impaired cognition relative to those with normal cognition (OR 0.38, 95% CI 0.19–0.75). The final model for functional decline discriminated well out of sample (mean C-statistic = 0.77) and in-sample (C-statistic = 0.78).

An interaction between functional impairment in IADL and the use of an aid for mobility improved overall model performance, where we observed a 68% decline in the relative odds of functional decline for someone who had some impairment in IADL and used a gait aid (OR 0.32, 95% CI 0.14–0.7).

Although not statistically significant, the number of medications over and above five significantly improved out-of-sample model performance. The odds ratio suggested an increase in the relative odds of functional decline for each medication over five relative to those on five or less.

Table 1. Demographic and clinical characteristics of SEED cohort

Demographic characteristics	N = 959	%
Age		
Median (IQR)	77 (70–84)	–
65–74 years	397	41
75–84 years	350	37
≥85 years	213	22
Sex: Female	536	56
Country of birth: Australia / New Zealand	533	55
English as preferred language	899	94
Living arrangements: Lives alone	435	45
Care assistance (formal/informal) in place	374	39
Has a regular GP	936	97.5
Clinical characteristics		
Ambulance arrival	547	57
Triage category upon ED arrival		
ATS2	105	11
ATS3	457	48
ATS4/5	388	40
Number of medications: mean (median)	6.2 (6)	–
Number of co-morbidities: mean (median)	0.7 (0)	–
Independently mobile unaided	638	67
Falls history (≥2) in previous 12 months	223	23
Balance—Confidence level: (ABC-6 <50%)	364	38
Poor/fair self-rated health premorbid	203	21
Cognition		
Mild impairment (MMSE 20–23)	170	18
Moderate impairment (MMSE 10–19)	75	8
Functionally independent in continence, personal, mobility ADL (2 weeks previously)	666	69
Functionally independent in IADL (2 weeks previously)	593	62
Mood: Symptoms of depression (GDS-5 ≥ 2)	259	28.5
ED attendance in previous 12 months (self-reported)	438	46
Discharge diagnosis category (ICD-10 code)		
Injury	149	16.6
Musculoskeletal condition	74	8.3
Digestive condition	76	8.5
Neurological incl. cognitive condition	48	5.4
Circulatory condition	45	5
Ear/mastoid condition	37	4.1
Skin & subcutaneous condition	27	3
Genitourinary condition	26	2.9
Respiratory condition	21	2.3
Other	393	43.9
ED processes / model of care		
Allied health involvement	810	84
Transfer for observation to SSOU/AMU before discharge	862	89

Table 2. Factors and their association with functional decline over the 30 days following an ED attendance; including increased dependency in personal ADL, independent living skills or IADL, deterioration of cognitive function, nursing care home admission or death—univariate and multivariate analyses

Variable	OR	95% CI	P
Univariate analysis		**30 days**	
Male	1.10	0.84–1.46	0.5
Living alone	0.80	0.6–1.05	0.1
Triage category			
2	0.75	0.47–1.2	0.2
3	*reference*	–	
4	1.31	0.97–1.78	0.08
5	1.35	0.6–3.02	0.5
Age group			
65–69 years	*reference*	–	
70–84 years	1.36	0.94–1.94	0.1
≥85 years	**1.80**	**1.17–2.76**	**0.007**
Personal ADL (premorbid) (Barthel < 20)	**4.16**	**3.09–5.6**	**0.000**
IADL (premorbid) (Lawton < 8)	**5.48**	**4.04–7.42**	**0.000**
Cognition			
Normal (MMSE > 24)	*reference*	–	
Mild Impairment (MMSE 20–23)	**1.76**	**1.21–2.57**	**0.003**
Moderate Impairment (MMSE 10–19)	0.83	0.46–1.51	0.5
Mood possible depression (GDS-5 ≥ 2)	**1.40**	**1.02–1.92**	**0.03**
ED visit in previous 12 months	**1.43**	**1.08–1.88**	**0.01**
Hospital admission in previous 12 months	**1.55**	**1.17–2.05**	**0.002**
Self-rated health poor/fair in general	**2.06**	**1.47–2.9**	**0.000**
Receives informal/formal care assistance or support	**1.91**	**1.43–2.54**	**0.000**
Polypharmacy more than 5 medications	**1.09**	**1.04–1.14**	**0.001**
Use of an aid for mobility	**1.96**	**1.46–2.64**	**0.000**
Fallen within the previous 12 months	**1.05**	**0.76–1.46**	**0.8**
ABC balance confidence level <50%	**2.02**	**1.51–2.71**	**0.000**
Ambulance transport for index visit	1.16	0.87–1.53	0.3
Any pre-existing comorbid conditions	**1.52**	**1.15–2.01**	**0.003**
Multivariate analysis		**30 days**	
Personal ADL (premorbid) (Barthel < 20)	**3.21**	**2.26–4.53**	**0.000**
IADL (premorbid) (Lawton < 8)	**6.69**	**4.31–10.38**	**0.000**
Use of an aid for mobility	1.16	0.62–2.18	0.65
IADL *and* use of an aid for mobility	**0.32**	**0.14–0.7**	**0.04**
Cognition Mild Impairment (MMSE 20–23)	1.24	0.8–1.91	0.34
Moderate Impairment (MMSE 10–19)	**0.38**	**0.19–0.75**	**0.005**
Self-rated health poor/fair pre-morbidly	1.34	0.9–2.0	0.08
Polypharmacy more than five medications	1.05	0.99–1.12	0.08

Bold indicates statistically significant of Odd Ratios.

Secondary outcomes

Factors associated with deterioration in the components of functional decline, namely cognition, independence with personal ADL and with skills required for autonomous community-living (IADL) are summarised in Supplementary data, Appendix 4 available in *Age and Ageing* online.

The factors independently associated with deterioration in cognitive function were presence of a comorbid condition (OR 1.57, 95% CI 1.07–2.32) and poor/fair self-rated health (OR 1.62, 95% CI 1.04–2.53); with the relative odds of decline less for patients with moderately impaired cognition relative than those with normal cognition (OR 0.25, 95% CI 0.07–0.83).

Factors independently associated with increasing dependency in personal ADL were mild cognitive impairment (OR 2.08, 95% CI 1.17–3.8), pre-existing functional impairment in personal ADL (OR 50.01, 95% CI 21.12–118.36) or IADL (OR 2.73, 95% CI 1.45–5.14). The effect was diminished in the presence of any dependency in IADL alongside use of an aid for mobility (OR 0.2, 95% CI 0.07–0.64).

The factor independently associated with deterioration in instrumental ADL was a pre-existing functional impairment in IADL. Use of a gait aid diminished the relative odds of decline (OR 0.49, 95% CI 0.3–0.8). The effect was also alleviated for patients receiving any care support in the presence of any premorbid IADL impairment (OR 0.09, 95% CI 0.02–0.44).

Discussion

Acute illness precipitating ED attendance often overlays numerous other issues in older patients. Underlying vulnerability was evident in our cohort prior to discharge, with one in three patients reporting functional dependence or mobility issues prior to the ED visit, and cognitive impairment was identified in one in four patients. Furthermore, in the subsequent month a high rate of functional deterioration was identified. Over one-third of patients experienced decline in physical and/or cognitive function, and a further 2% were either admitted to a nursing home or died. The presence of functional and psychosocial vulnerability at the time of attendance was comparable to that reported by other studies of similar cohorts [24–28]; and the mortality rate was similar to that of another Australian post-ED discharge study [29]. To our knowledge, this is the first study to examine and quantify the components of functional decline following ED discharge in an Australian cohort. This importantly enhances our understanding of associated risk factors.

Pre-existing functional and cognitive impairments are established predictors of further decline in patients following periods of hospitalisation [30] or following an ED attendance [27]; prompting implementation of numerous transitional care models pre-discharge. The use of comprehensive geriatric assessment is proven to effectively reduce functional decline when applied in the inpatient setting [31]. However, our recent meta-analysis highlighted a paucity of good quality evidence to guide care of this population alongside a knowledge gap of any specific barriers and enablers to effective care transition [32]. The majority of our cohort (89%) was transferred to SSOU for additional observation including assessment and community services referral by the ED allied health team, prior to discharge within 48 hours. Nevertheless there was a considerable rate of functional decline, highlighting the vulnerability of this cohort during the period immediately after discharge. This may also indicate issues with current care transition processes. The fast pace of the ED environment is not always conducive to patient education and engagement in developing care plans, or with timely GP liaison and seamless integration of recommended services in the following few weeks.

Reassuringly, our study suggests that use of gait aids or supportive services significantly diminished the likelihood of further functional deterioration in patients with pre-existing functional impairment. This highlights the importance of regular assessment and monitoring of older people's functional status, not only in the ED but also in community settings. The annual 75+ Health Assessment [33] provides primary care providers a structured approach for identification and management of potential physical and psychosocial issues. A recent study indicated that although there has been an increase in the number of Health Assessments performed, just 20% of those eligible partake [34]. It is well recognised that immobility leads to deconditioning, functional decline and loss of independence [35]; hence, timely identification of potential decline and intervention with referral for geriatric follow-up, appropriate gait aids and other services would be expected to assist with helping maintain mobility, muscle strength, balance and endurance. This could help prevent further ADL disability and promote functional independence, relieving both individual and health system burden.

The presence of moderate cognitive impairment was associated with reduced odds of further cognitive deterioration, rather than further physical functional decline. This may reflect that patients with pre-existing moderate impairment do not deteriorate cognitively much further over 30 days; or could indicate that the ALFI-MMSE is not sensitive enough to detect further deterioration within this timeframe. People with moderately impaired cognition would also have limitations with performing ADL that require higher cognitive functioning, as such would not be expected to decline much further [36]. Furthermore, patients with cognitive impairment may not be fully aware of their functional difficulties, so may not provide an accurate self-report of their abilities [37].

The strengths of this study include the sample size, prospective design and comprehensive data collection through patient interviews in the ED and telephone follow-up. Baseline functional level of independence was considered 2 weeks prior to the visit, to avoid confounding by the effects of the presenting acute illness. Selection bias arising from seasonal variation was avoided with recruitment conducted over 21 consecutive months. Some limitations should be considered. Our cohort is a subgroup of discharged community-dwelling patients not requiring hospitalisation or surgery and whose preferred language was English, as in other studies examining functional decline [20, 25, 27, 38]. As such it is not representative of the total older emergency population. In addition, information regarding co-morbidities was extracted from the patient's hospital file, so may be under-recorded. Although delirium screening was not conducted, patients were recruited and interviewed if they had been evaluated as medically stable, and after they were given medical clearance for discharge; however, we acknowledge that delirium is underdiagnosed in the ED [38]. Although a strict recruitment protocol was followed, patients were not included at random, so selection bias was possible. Due to personnel resource limitations, patients were recruited during day-time hours, Monday to Saturday; however as with other studies, evening arrivals were captured prior to discharge the following morning [39, 40, 7]. This was a single-site study conducted at a large metropolitan public hospital ED, so the findings may not be generalisable to other settings.

Acute illness in older people overlays a plethora of issues which may not be obvious upon initial contact in ED. Older people are also at high risk of functional decline in the month following ED presentation if they have pre-existing dependency in ADL. It is possible that early comprehensive geriatric assessment facilitates opportunistic identification of unmet need with appropriate implementation of mobility aids, targeted physical therapy to prevent functional decline, management of geriatric syndromes and implementation of

support services that could reduce further functional decline following discharge.

Key points

- Older patients have a high rate of functional decline following ED attendance.
- Risk factors include pre-existing functional impairment.
- This effect was largely mitigated in those who used a mobility aid.
- Assessment with implementation of appropriate resources could reduce functional decline.

Supplementary data

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

Conflicts of interest

None declared.

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