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Prognosis of hospitalised older people with different levels of functioning: a prospective cohort study

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Abstract

Background: hospitalised older people are at risk for poor functioning after hospital discharge. We aimed to validate the predictive ability of the Identification Seniors At Risk-Hospitalized Patients (ISAR-HP) screening questionnaire to identify older patients at risk for functional dependence by comparing groups with different ISAR-HP scores on cognitive and physical functioning, mortality, health-related quality of life (HRQoL) and loneliness.

Design: a longitudinal prospective cohort study.

Setting: a 450-bed hospital in the Netherlands.

Subjects: four hundred and sixty patients 65 years or older admitted between June 2010 and October 2010.

Methods: participants were classified into five risk groups at hospital admission using the ISAR-HP. We interviewed patients at hospital admission and at 3 and 12 months after admission using validated questionnaires to score HRQoL, physical functioning, cognitive functioning and loneliness. Differences in survival were quantified by a concordance statistic (c).
Results: Cognitive functioning, physical functioning, loneliness and HRQoL differed significantly between groups during the 1-year follow-up after hospital admission (all comparisons $P < 0.05$), with high-risk groups having lower scores than low-risk groups for functioning and loneliness, although not always for HRQoL. The lowest risk group (ISAR-HP = 0) scored consistently higher on functioning and HRQoL than all other groups. Mortality differed significantly between groups ($P < 0.001$, $\epsilon = 0.67$).

Conclusions: The ISAR-HP can readily distinguish well-functioning older patients from patients with low functioning and low HRQoL after hospital admission. The ISAR-HP may hence assist in selecting patients who may benefit from individually tailored reactivation treatment that is provided next to treatment of their medical condition.

Keywords: HRQoL, functioning, mortality, older patients, older people

Introduction
Older hospitalised people are at risk for functional decline, which may lead to lower reported health-related quality of life (HRQoL), renewed hospital admission or early death [1–3]. Multidisciplinary, individualised reactivation care focused on physical functioning, cognitive functioning and social–emotional functioning [4, 5] may prevent functional dependence caused by complications or other hospital stay-related causes [2, 6, 7]. Identifying hospitalised people at risk for functional dependence is important, as it allows for reactivation treatment to be tailored to individual patients [6, 8, 9].

Several instruments may identify people at risk for low functioning [10, 11, 12]. The Identification Seniors At Risk-Hospitalized Patients (ISAR-HP) is an easily administered questionnaire specifically designed for hospitalised seniors [13, 14]. We studied if the ISAR-HP is predictive of physical functioning, cognitive functioning, HRQoL, loneliness, and mortality at 3 and 12 months after hospital admission.

Methods
Data collection
Patients aged 65 years or older from a regional hospital in the Netherlands were interviewed by trained research assistants at hospital admission (T0, baseline). Follow-up interviews were held 3 months (T3) and 12 months (T12) after admission [15, 16] in the participant’s home environment for maximum compliance and reliability [17].

The ISAR-HP was administered at hospital admission. It consists of four yes/no questions regarding ability to travel independently, ability to walk, educational level and independence in housekeeping. Scores range from 0 to 5; two points can be given for walking ability, with higher scores corresponding to higher risk for low functioning.

Other questionnaires included the Mini-Mental State Examination (MMSE) for cognitive functioning [18], the Katz 6-item Index of independence in basic activities of daily living (ADLs, [19]) and the Lawton instrumental activities of daily living (IADL) scale [20] for physical functioning, the Loneliness scale [21] for loneliness and the Short Form-20 (SF20, [22]) to measure six subdomains (physical functioning, role functioning, social functioning, mental health, current health perceptions and pain) of HRQoL (see the study protocol [23] for more details, NTR2317).

Statistical analysis
Lost to follow-up patients were compared with included patients on baseline characteristics (e.g. age, gender), functioning and HRQoL. Since no significant differences were found, analyses were simply performed using available cases. Differences between groups were assessed using the Kruskal–Wallis test. A linear mixed model of repeated measurements estimated differences in means between ISAR-HP groups over time, both unadjusted and adjusted for possible confounders (i.e. age, gender and multi-morbidity). Survival differences were analysed with a concordance statistic ($\kappa$), Kaplan–Meier curves and a Cox proportional hazards model. Analyses were performed using SPSS 20.0 (SPSS, Inc., Chicago, IL, USA) and R Software (version 2.7.1, The R Foundation for Statistical Computing, Vienna, Austria). The study was approved by the medical ethics committee of the Erasmus Medical Centre, Rotterdam, the Netherlands, protocol MEC2011-041.

Results
Patient recruitment
Between June and October 2010, a total of 2671 patients aged 65 years or older from a regional hospital in the Netherlands were approached. We excluded patients who refused participation, stayed in-hospital for <48 h, were unable to follow instructions, were terminally ill, participated during previous admission or were not contacted in time before discharge. Four hundred and sixty patients signed an informed consent form and participated. At T3 and T12, 279 and 205 people were interviewed, respectively, with 118 lost to follow-up and 63 dead before T3, and 58 more lost to follow-up and 16 more dead before T12.

Baseline characteristics
Mean age ± SD was 76 ± 9 years, and 56% of the participants were female (Table 1). People with higher ISAR-HP
scores were older, more likely female, less likely married, more likely to live independently alone and more often had two or more diseases than participants with lower ISAR-HP scores. Half of the participants (52%) had cognitive problems at hospital admission, 39% was dependent in basic ADLs and 39% had symptoms of loneliness (Table 1).

**Functioning and HRQoL outcomes**

ISAR-HP groups differed significantly in ADL functioning, IADL functioning, cognitive functioning and loneliness at all times (baseline, T3, T12: $P < 0.05$, Figure 1A). High-risk ISAR-HP groups were more dependent in ADL and IADL than low-risk groups, with the clearest distinction between ISAR-HP 0 and other groups. All groups scored lower on cognitive functioning and higher on loneliness than group 0. At T3, all groups had higher ADL and IADL functioning than at admission (both $P < 0.001$, Figure 1A1 and A2), with IADL functioning significantly higher at T12 compared with baseline ($P = 0.024$, Figure 1A2). Most groups had higher cognitive functioning at T3 than at baseline ($P = 0.024$, Figure 1A3), while loneliness did not differ over time (Figure 1A4). The magnitude of the changes differed between groups over time for ADL, IADL and cognitive functioning ($P < 0.05$).

Figure 1B shows that all HRQoL outcomes, except for pain at T0, mental health at T12 and current health perceptions at T12, differed significantly between ISAR-HP groups, with high-risk groups reporting lower HRQoL than low-risk groups ($P < 0.05$). Group 0 differed most clearly from other groups on mental health, physical functioning, role functioning and current health perceptions. Group 1 scored similarly to group 0 on social functioning, while group 2, 3 and 4 + scored significantly lower on social functioning than group 0. On pain only group 4 differed clearly from group 0. Between admission and three months after admission, physical functioning, current health perceptions and pain changed significantly ($P = 0.007$; $P < 0.001$; $P = 0.016$). Between T3 and T12, scores on social functioning, mental health, current health perceptions and pain differed significantly ($P < 0.001$; $P < 0.001$; $P = 0.033$, respectively). The magnitude of the changes on the subscales did not differ between groups over time (see Supplementary data, available at Age and Ageing online, Appendix 1, for details).

**Differences in mortality between groups**

Mortality differed significantly between ISAR-HP groups with 1-year survival rates of 89, 91, 90, 75 and 69% for ISAR-HP groups 0, 1, 2, 3, 4 + , respectively (log-rank test, $P < 0.001$). The hazard ratios for the ISAR-HP groups 3 and 4 + were 2.4 (95% CI: 1.1–5.1) and 3.3 (95% CI: 1.8–6.0), respectively, compared with the ISAR-HP = 0 group ($P < 0.001$). The ISAR-HP could reasonably predict mortality up to 1 year among hospitalised older people ($\chi$-statistic 0.67).

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**Table 1. Baseline characteristics, functioning and HRQoL for all participants and ISAR-HP groups**

<table>
<thead>
<tr>
<th>Variable</th>
<th>All, $n = 460$</th>
<th>ISAR-HP, 0, $n = 128$</th>
<th>ISAR-HP, 1, $n = 92$</th>
<th>ISAR-HP, 2, $n = 59$</th>
<th>ISAR-HP, 3, $n = 56$</th>
<th>ISAR-HP, 4 +, $n = 125$</th>
<th>$P$-value* group difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>76 (7.2)</td>
<td>73 (5.8)</td>
<td>75 (6.4)</td>
<td>77 (6.8)</td>
<td>78 (6.9)</td>
<td>80 (7.0)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Gender, female, $%$ (%)</td>
<td>256 (56)</td>
<td>51 (40)</td>
<td>43 (53)</td>
<td>38 (64)</td>
<td>38 (68)</td>
<td>86 (70)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Married $%$ (%)</td>
<td>257 (56)</td>
<td>91 (71)</td>
<td>60 (65)</td>
<td>33 (56)</td>
<td>25 (45)</td>
<td>48 (38)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Living environment</td>
<td></td>
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<tr>
<td>pre-hospital admission, $%$:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independent alone</td>
<td>181 (39)</td>
<td>31 (24)</td>
<td>33 (36)</td>
<td>25 (42)</td>
<td>30 (54)</td>
<td>62 (50)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Independent with others</td>
<td>262 (57)</td>
<td>97 (76)</td>
<td>59 (64)</td>
<td>31 (53)</td>
<td>25 (45)</td>
<td>50 (40)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Elderly home/nursing home</td>
<td>17 (4)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>3 (5)</td>
<td>1 (2)</td>
<td>13 (10)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Multi-morbidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two or more diseases, $%$:</td>
<td>337 (73)</td>
<td>77 (60)</td>
<td>66 (72)</td>
<td>40 (68)</td>
<td>45 (80)</td>
<td>109 (87)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Physical functioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent in ADL, $%$ (%)</td>
<td>181 (39)</td>
<td>44 (34)</td>
<td>21 (23)</td>
<td>23 (39)</td>
<td>22 (39)</td>
<td>71 (57)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Lawton (IADL), mean (SD)</td>
<td>4.8 (2.1)</td>
<td>5.6 (2.3)</td>
<td>5.4 (2.1)</td>
<td>4.5 (2.0)</td>
<td>4.6 (1.9)</td>
<td>3.9 (1.6)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Cognitive functioning, $%$:</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problems</td>
<td>220 (48)</td>
<td>95 (74)</td>
<td>34 (37)</td>
<td>26 (45)</td>
<td>27 (48)</td>
<td>38 (31)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Moderate to light problems</td>
<td>216 (48)</td>
<td>32 (25)</td>
<td>54 (59)</td>
<td>29 (50)</td>
<td>27 (48)</td>
<td>74 (61)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Severe problems</td>
<td>18 (4)</td>
<td>1 (1)</td>
<td>3 (3)</td>
<td>3 (5)</td>
<td>2 (4)</td>
<td>9 (7)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Loneliness, $%$ (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms of loneliness</td>
<td>178 (39)</td>
<td>35 (27)</td>
<td>42 (46)</td>
<td>19 (32)</td>
<td>24 (43)</td>
<td>58 (47)</td>
<td>0.007</td>
</tr>
<tr>
<td>HRQoL (SF20), mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical functioning</td>
<td>51 (33)</td>
<td>73 (28)</td>
<td>59 (29)</td>
<td>48 (32)</td>
<td>37 (27)</td>
<td>29 (25)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Role functioning</td>
<td>48 (48)</td>
<td>76 (42)</td>
<td>60 (46)</td>
<td>36 (45)</td>
<td>34 (45)</td>
<td>23 (39)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Social functioning</td>
<td>68 (36)</td>
<td>76 (32)</td>
<td>78 (31)</td>
<td>65 (36)</td>
<td>63 (39)</td>
<td>56 (39)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Mental health</td>
<td>74 (19)</td>
<td>81 (15)</td>
<td>73 (18)</td>
<td>74 (15)</td>
<td>69 (19)</td>
<td>69 (22)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Health perceptions</td>
<td>47 (26)</td>
<td>56 (26)</td>
<td>50 (25)</td>
<td>47 (25)</td>
<td>43 (26)</td>
<td>36 (24)</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Pain</td>
<td>55 (44)</td>
<td>52 (44)</td>
<td>51 (3)</td>
<td>59 (41)</td>
<td>52 (44)</td>
<td>57 (45)</td>
<td>0.179</td>
</tr>
</tbody>
</table>

*P*-value calculated using the Chi-square test for categorical variables and the Kruskal-Wallis test for continuous variables.
We found that ISAR-HP groups differed on ADL functioning, IADL functioning, HRQoL-physical functioning and HRQoL-role functioning, thus supporting our hypothesis that the ISAR-HP predicts the level of risk for low functioning in these domains. Differences in cognitive functioning, loneliness and the HRQoL subscales of social functioning, mental health, current health perceptions and pain were less consistent, but still statistically significant between groups.

Limitations included the fact that our detailed comparison of five groups left us with relatively small numbers to analyse at follow-up times. Nevertheless, the groups showed clear differences on most outcomes. We measured functioning at admission instead of pre-admission, which may have led to lower reported baseline functioning and HRQoL. This may well explain the clear improvement in ADL and IADL functioning between admission and T3. Measuring pre-admission functioning should be considered in future studies for validation of our findings.

A cut-off of ISAR-HP 0 versus 1+ could best distinguish between people at risk and those not at risk in our analysis. Cut-off scores of 1 or 2 have been suggested earlier [13, 23], but the choice of a cut-off of 1 or 2 will depend on the clinical context. Overall, our results support a broad view of functioning including physical functioning, cognitive functioning and dimensions such as mental health and social functioning. This broader view is often discussed in relation to the concept of ‘frailty’, which has not yet been defined clearly and consistently [24]. Originally, the concept of frailty was predominantly medically focused; using the physical domain to identify frail older people [25]. This focus is now increasingly

![Figure 1](image.jpg)

**Figure 1.** (A) Average functioning of older patients with different levels of risk for low functioning at hospital admission, and 3 and 12 months after admission. * = average scores are significantly different between groups at the 0.05 level. (B) Average HRQoL of older patients with different levels of risk for low functioning at hospital admission, and 3 and 12 months after admission. * = average scores are significantly different between groups at the 0.05 level; Note: For HRQoL pain (see 1B6), higher scores correspond to higher pain and thus lower HRQoL, whereas for the other HRQoL subscales a higher score reflects better HRQoL.

**Discussion**

We performed available case analysis since lost to follow-up patients did not differ significantly from included patients on age, gender, marital status, functioning and HRQoL. Nevertheless, differences between these groups on other variables (e.g. diagnosis) not analysed and the possibly associated adverse outcomes for people lost to follow-up may have biased our results.

A cut-off of ISAR-HP 0 versus 1+ could best distinguish between people at risk and those not at risk in our analysis. Cut-off scores of 1 or 2 have been suggested earlier [13, 23], but the choice of a cut-off of 1 or 2 will depend on the clinical context. Overall, our results support a broad view of functioning including physical functioning, cognitive functioning and dimensions such as mental health and social functioning. This broader view is often discussed in relation to the concept of ‘frailty’, which has not yet been defined clearly and consistently [24]. Originally, the concept of frailty was predominantly medically focused; using the physical domain to identify frail older people [25]. This focus is now increasingly
challenged by a more integral concept including not only physical functioning but also cognitive and psychological functioning [26]. Our results support this integral view of frailty.

Our results have clinical implications. Adequate identification of hospitalised older patients at risk for low physical and cognitive functioning, increased loneliness and low HRQoL may improve multidisciplinary, individually tailored treatment focused on specific individual needs, thus helping older patients regain or maintain independence in daily life [15]. Further study of such multidisciplinary interventions is urgently required.

**Conclusion**

The ISAR-HP is a simple tool that adequately identifies hospitalised older people at risk for low physical and cognitive functioning, mortality, loneliness and, to a lesser extent, HRQoL at 3 and 12 months after hospital admission. Further studies should evaluate treatments tailored to the needs of these risk groups, thereby focusing on both medical condition and domains of reactivation care, such as cognitive functioning. Consequently, patients may have a better prognosis after
discharge, thus preventing dependence on informal and formal health care and its associated costs.

**Key points**

- Identification of older hospitalised patients at risk for low functioning.
- Prognosis of older hospitalised patients.
- HRQoL, cognitive functioning.
- Physical functioning, and loneliness of older hospitalised patients.

**Authors’ contributions**

K.J.E.A.-S. and E.W.S.: analysing and interpreting data and drafting the manuscript. P.L.d.V.: acquisition of data and drafting the manuscript. J.P.M., A.P.N. and T.J.E.M.B.: conception and design of the study. I.E.F: comments and suggestions on drafting manuscript and interpretation of data. G.J.J.M.B.: statistical analysis support. All authors contributed to writing and critically reviewing the manuscript and approved its final version. Other contributors to this paper are Rianne van Eijsden (data manager at the Erasmus University Medical Center), whose work on data acquisition was indispensable, and Caspar Looman (statistician at the Erasmus University Medical Center), whose comments and advice on statistical analysis were a valuable contribution to this article.

**Conflicts of interest**

None declared.

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**Supplementary data**

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

**References**


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