

## Emergency department: risk stratification in the elderly

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**Background & aims.** The older adults have very frequent access to the Emergency Department (ED). The aim of this study is to explore the ability of some geriatric screening tools validated for the ED to predict outcomes (mortality, hospitalization, ED readmission and institutionalization) at 6 months.

**Methods.** Older adults consecutively admitted to Cagliari University's ED between May and December of 2017 were enrolled. In ED older patients were screened with three tools: Identification of Seniors at Risk tool (ISAR); Triage Risk Screening Tool (TRST); International Resident Assessment Instrument Emergency Department Screener (InterRAI ED Screener). At 6 months patients were contacted by phone to verify: mortality, ED readmission, hospital admission, and institutionalization.

**Results.** Of the 421 patients (median age 77, Interquartile Range 71-83; 55.8% women) enrolled, 72.4% were positive at the ISAR, 50.1% at the TRST; moreover 44.9% of enrolled subjects needed a urgent geriatric evaluation at the InterRAI ED Screener.

The dead subjects had ISAR, TRST and InterRAI ED Screener with greater severity compared to the alive ones. The ISAR and the TRST were also more severe in subjects who had ED readmission, while those hospitalized, in addition to the ISAR, had the more severe InterRAI ED Screener.

However, applying stepwise logistic regression, of the three tools used, only the ISAR was a predictor for hospitalization (OR = 1.23; CI = 1.03-1.48; P = 0.02; AUC = 0.63).

**Conclusions.** The association of ISAR and InterRAI ED Screener may be useful in ED to intercept both critical issues typical of the elderly, and the need and priority of the geriatric evaluation.

**Key words:** elderly, emergency department, outcome, geriatric assessment

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## INTRODUCTION

Older subjects, representing about a quarter of the Italian population, are the greatest consumer of healthcare resources<sup>1</sup>. They often access the Emergency Department (ED), whether it reflects a greater burden of multimorbidity, an inappropriate access because of deficiency in outpatient care, or both<sup>2</sup>.

They also have a greater length of stay (LOS) as a consequence of their greater complexity (for example, atypical clinical presentation, polypharmacy, and cognitive impairment)<sup>3</sup>. A greater LOS has been associated with poorer health outcomes, including missed or incorrect diagnoses<sup>2</sup>.

In fact, at 3 months after ED discharge 23% had repeated access to ED, 24% were hospitalized and 10% were institutionalized or died<sup>2</sup>.

It has been hypothesized that specific screening procedures and intervention protocols may support ED physician for an appropriate evaluation of older patients, without necessarily having to make use of a time-consuming Comprehensive Geriatric Assessment (CGA)<sup>4</sup>. Identification of Seniors at Risk tool (ISAR), Triage Risk Screening Tool (TRST) and International Resident Assessment Instrument Emergency Department Screener (InterRAI ED Screener) have been proposed as valuable and reliable tools to screen high-risk older patients in the ED<sup>5</sup>.

The aim of the present study was to compare the ability of ISAR, TRST and InterRAI ED Screening to predict middle-term outcomes (mortality, hospitalization, ED readmission and institutionalization).

## MATERIALS AND METHODS

The study population consisted of all older patients admitted to the Cagliari University's ED in the mornings from Monday to Friday between May and December of 2017. Patients were excluded if younger than 65 years, unable to provide reliable information and to sign the informed consent.

### SCREENING TOOLS IN EMERGENCY DEPARTMENT

Emergency color code: is the emergency code used in Italy, it consists of 4 levels: red (immediate life-saving intervention required); yellow (high risk and unstable situation); green (it is not an emergency but the patient needs care); white (it is not an emergency and the patient doesn't need the ED intervention)<sup>6</sup>.

ISAR: is a risk-screening tool designed and validated for use in the emergency setting.

The ISAR is a 6-item self-report screening tool with simple yes/no questions that can be asked to the patient or the caregiver. Well known risk factors for adverse health outcomes in older patients are included among the questions (activities of daily living, visual and cognitive decline, hospital admission history, and polypharmacy). Consequently, it has both immediate clinical relevance and good predictive validity<sup>5</sup>. An ISAR score  $\geq 2$  (in a range from 0 to 6) suggests an increased risk for functional decline, repeated ED visits, hospitalization,

institutionalization, and death within 6 months after an ED visit<sup>7</sup>.

TRST: is another screening test for the ED, developed in the United States to be used by nurses, in which the presence of cognitive impairment or a score  $\geq 2$  in the remaining risk factors suggests an increased risk for functional decline, ED readmission, hospitalization and institutionalization 30 and 120 days after an ED visit<sup>8,9</sup>.

The InterRAI ED Screener is a screening tool to identify older adults with increased risk of needing geriatric assessment in the ED or after the discharge. This tool evaluates the patient's performance and abilities through the analysis of cognitive and physical functions, in particular: mood, understanding, falls, nutritional status and the occurrence of pain or dyspnea. The tool defines six levels of risk: Level 5 and 6 are classified as high risk and identify non-self-sufficient patients who need an urgent geriatric evaluation. Level 3 and 4 indicate intermediate risk and include patients who should refer to a geriatric service after the discharge. Level 2 includes low-risk and self-reliant patients and a referral to geriatric services may not be required, but periodic monitoring by primary care may be warranted. Finally, level 1 is defined as low risk, so the elderly patients are in good health and a geriatric evaluation may not be required<sup>10</sup>. In this study we divided into 2 groups the results of this test, the first one including subjects that do not require geriatric evaluation (score 1-2) and the second one including those that require a CGA (score 3-6).

### ASSESSMENT OF FUNCTIONAL INDEPENDENCE

Basic Activities of Daily Living (BADL): were used to assess the ability to perform tasks such as taking a bath, using the toilet, walking, urinary and fecal continence, dressing and feeding. For each of these activities carried out independently, two points are assigned, reaching a maximum score of twelve, that means total autonomy<sup>11</sup>.

Instrumental Activities of Daily Living (IADL) was used to assess the ability to perform tasks such as using a telephone, doing laundry, and handling finances. The scale measures eight domains: a score of 8 indicating total autonomy, and 0, total dependence<sup>12</sup>.

### FOLLOW-UP

Each patient received a phone call at 6 months after ED discharge. Patients and/or their caregiver were asked to report outcomes (mortality, hospitalization, ED readmission and institutionalization).

### DATA ANALYSIS

Because the variables examined were not normally distributed, data are presented as median and ranges. Data were analyzed using a Mann-Whitney test for

independent samples; instead categorical variables were analyzed by chi-square.

Cohen's kappa was used to evaluate the concordance between TRST and ISAR.

Logistic regression analysis, with each outcome (mortality, hospitalization, ED readmission) separately as dependent variable, except institutionalization due to the low number of institutionalized subjects, was then performed through a stepwise procedure, which eliminates first the least significant association and then the non-significant independent variables (age, gender, color code, waiting time, length of stay, BADL, IADL, ISAR, TRST, InterRAI ED Screener). The results are reported indicating the odds ratio (OR) with 95% confidence intervals (CI) and Area Under the Curve (AUC) (values  $\geq 0.7$  were considered accurate).

MedCalc software (Version 19.5, Ostend, Belgium) was used for the statistical analysis of the data.

A  $p$ -value  $< 0.05$  was considered indicating statistical significance.

## RESULTS

For the purpose of this study, 421 patients (median age was 77, Interquartile Range 71-83; 44.2% men) were enrolled.

Their characteristics are summarized on Table I.

Patients at greater risk of unfavorable outcome were 72.4% by ISAR and 50.1% by TRST (Cohen's kappa coefficient: 0.296). Moreover, 274 (65%) patients resulted in need of a geriatric evaluation according to the InterRAI ED Screener. This need was urgent (score 5-6) for 189 (44.9%) subjects (Tab. I).

Concerning gender differences in the study parameters, women had a worse profile for BADLs ( $P = 0.0005$ ), ISAR ( $P = 0.003$ ), TRST ( $P = 0.04$ ) and InterRAI ED Screener ( $P = 0.02$ ). (Tab. I).

The events that occurred within 6 months after ED admission were: 42 exitus (10.0%), 89 ED readmissions (21.1%), 77 hospital admissions (18.3%) and only 10 institutionalizations (2.4%) (Tab. II).

Table III shows the results obtained by comparing the subjects who had an unfavorable outcome (exitus, ED readmission, hospital admission) within 6 months by ED admission. In particular, the dead subjects had more advanced age, access code, ISAR, TRST and InterRAI ED Screener with greater severity and BADL and IADL more compromised, compared to the alive ones. The ISAR and the TRST were also more severe in subjects who had ED readmission, while those hospitalized, in addition to the ISAR, had the more severe InterRAI ED Screener (Tab. III). We applied the logistic regression, considering separately mortality, ED readmission and hospital admission

as dependent variable and age, gender, waiting time, length of stay, BADL, IADL, ISAR, TRST and InterRAI ED Screener as independent variable and we found a positive association between mortality and gender (OR = 2.45; CI = 1.16-5.16;  $P = 0.019$ ; AUC = 0.81) and IADL (OR = 0.66; CI = 0.57-0.77;  $P < 0.0001$ ; AUC = 0.81). Hospital admission was positively correlated with the ISAR (OR = 1.23; CI = 1.03-1.48;  $P = 0.02$ ; AUC = 0.63), and negatively with the length of stay (OR = 1.0; CI = 0.996-1.0;  $P = 0.03$ ; AUC = 0.63). Finally, ED readmission negatively correlated with length of stay (OR = 1.0; CI = 0.996-1.0;  $P = 0.04$ ; AUC = 0.56) (Tab. IV).

## DISCUSSION

Accesses to the ED by the elderly population increased in the last years, often in relation to inappropriate drug prescription with relevant adverse drug reactions<sup>13</sup>. This kind of patients often has atypical signs and symptoms and multimorbidities that amplify difficulty in diagnosis and treatment, with a greater risk of ED return visits, hospitalization and death<sup>5</sup>.

A geriatric evaluation of every older patient accessing the ED is not possible, because of time constraint and workload. However, an appropriate screening and decision-making tool may help emergency physicians to prevent adverse outcomes (early mortality, hospitalization, ED readmission, institutionalization, etc.)<sup>5</sup> and to assess the need and priority of a geriatric evaluation. The latter can be identified through the InterRAI ED Screener, available as an application on smartphone, easy and quick to use<sup>10</sup>.

Pua and Matchar<sup>14</sup> showed the usefulness of the Short Physical Performance Battery (SPPB) in predicting falls and mobility limitations in the elderly who access ED due to a fall. Regarding SPPB recently<sup>15</sup> it has been found to be predictive in acute care wards of length-of-stay, in-hospital and postdischarge death.

Instead, in our study, the elderly subjects were enrolled regardless of clinical reason of ED access, therefore we considered it more appropriate to use tools with a broader outcome prediction such as ISAR and TRST in accordance with the American guidelines<sup>16</sup>.

Certainly, prevalent disability plays a role in determining outcomes. In our study, a high percentage of the 421 enrolled subjects had at least one functional disability (65.6% IADL and 63.9% BADL).

Conflicting results are available for the predictive capacity of ISAR<sup>17,18,22</sup>.

In our study the ISAR positivity at the ED admission was 72.4%, which appears in line with the literature, although a variability is observed from 52.1 to 81.5%<sup>17-22</sup>.

**Table I.** Characteristics of the study population.

	<b>Whole population (n = 421)</b>	<b>Male (n = 186)</b>	<b>Female (n = 235)</b>	
	<b>Median (IR)</b>	<b>Median (IR)</b>	<b>Median (IR)</b>	<b>Mann Whitney</b>
<b>Age, years</b>	77 (71-83)	76 (71-83)	78 (72-84)	0.10
<b>Waiting time (minutes)</b>	58 (18-122.25)	48 (31.16-65.84)	68 (52.99-92.03)	<b>0.0295</b>
<b>Length of stay (minutes)</b>	237 (154.75-317.25)	233 (149-316)	238 (158.25-317.75)	0.45
<b>BADL</b>	10 (7-12)	11 (8-12)	9(6-12)	<b>0.0005</b>
<b>IADL</b>	5 (1-8)	5 (2-8)	5(1-8)	0.17
<b>ISAR</b>	3 (2-4)	2 (1-3)	3(2-4)	<b>0.003</b>
<b>TRST</b>	2 (1-2)	1 (1-2)	2(1-3)	<b>0.04</b>
<b>InterRAI ED Screener</b>	3 (1-6)	3 (1-6)	5(1-6)	<b>0.02</b>
<b>BADL</b>	<b>N. (%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
< 12	269 (63.9)	107 (57.5)	162 (68.9)	<b>0.008*</b>
12	132 (31.4)	71 (38.2)	61 (26.0)	
NA	20 (4.7)	8 (4.3)	12 (5.1)	
<b>IADL</b>	<b>N. (%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
< 8	276 (65.6)	120 (64.5)	156 (66.4)	0.59*
8	125 (29.7)	58 (31.2)	67 (28.5)	
NA	20 (4.7)	8 (4.3)	12 (5.1)	
<b>Discharge</b>	<b>N. (%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
Hospitalization	226 (53.7)	109 (58.6)	117 (49.8)	0.17
Home	182 (43.2)	71 (38.2)	111 (47.2)	
Other	13 (3.1)	6 (3.3)	7 (3.0)	
<b>Caregiver</b>	<b>N. (%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
Presence	234 (55.6)	96 (51.6)	138 (58.7)	0.15
Absence	187 (44.4)	90 (48.4)	97 (41.3)	
<b>Color code at the access</b>	<b>N. (%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
Red	29 (6.9)	15 (8.1)	14 (6.0)	0.59
Yellow	296 (70.3)	133 (71.5)	163 (69.4)	
Green	92 (21.9)	37 (19.9)	55 (23.4)	
White	4 (0.9)	1 (0,5)	3 (1.3)	
<b>ISAR</b>	<b>N.(%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
Positive	305 (72.4)	131 (70.4)	174 (74.0)	0.26
Negative	116 (27.6)	55 (29.6)	61 (26.0)	
<b>TRST</b>	<b>N.(%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
Positive	211 (50.1)	86 (46.2)	125 (53.2)	0.12
Negative	210 (49.9)	100 (53.8)	110 (46.8)	
<b>InterRAI ED Screener</b>	<b>N.(%)</b>	<b>N. (%)</b>	<b>N. (%)</b>	$\chi^2$
1	116 (27.5)	61 (32.8)	55 (23.4)	0.132 <sup>§</sup>
2	12 (2.9)	3 (1.6)	9 (3.8)	
3	73 (17.3)	37 (19.9)	36 (15.3)	
4	12 (2.9)	4 (2.2)	8 (3.4)	
5	26 (6.2)	12 (6.4)	14 (6.0)	
6	163 (38.7)	62 (33.3)	101 (43.0)	
NA	19 (4.5)	7 (3.8)	12 (5.1)	

\*NA not included in  $\chi^2$ 

§InterRAI ED Screener score 1-2 vs 3-4-5-6.

IR: Interquartile range; BADL: Basic Activities of Daily Living; IADL: Instrumental Activities of Daily Living; ISAR: Identification of Seniors at Risk; TRST: Triage Risk Screening Tool; InterRAI ED Screener: International Resident Assessment Instrument Emergency Department Screener; NA: Not Applicable

**Table II.** Outcomes at 6 months.

Outcomes	N. of events at 6 months (N. 421)	N. of events at 6 months in males (N. 186)	N. of events at 6 months in females (N. 235)	$\chi^2$
<b>Exitus</b>				
Yes	42 (10.0%)	24 (12.9%)	18 (7.7%)	0.075
No	379 (90.0%)	162 (87.1%)	217 (92.3%)	
<b>ED readmission</b>				
Yes	89 (21.1%)	45 (24.2%)	44 (18.7%)	0.17
No	332 (78.9%)	141 (75.8%)	191 (81.3%)	
<b>Hospital admission</b>				
Yes	77 (18.3%)	38 (20.4%)	39 (16.6%)	0.31
No	344 (81.7%)	148 (79.6%)	196 (83.4%)	
<b>Institutionalization</b>				
Yes	10 (2.4%)	1 (0.5%)	9 (3.8%)	*
No	411 (97.6%)	185 (99.5%)	226 (96.2%)	

\* Not performed due to the low number of events  
ED: Emergency Department

**Table III.** Comparison between variables and outcomes.

Variables	Dead Median (IR)	Alive Median (IR)	Mann Whitney	Returned to ED Median (IR)	Not returned to ED Median (IR)	Mann Whitney	Hospitalized Median (IR)	Not Hospitalized Median (IR)	Mann Whitney
<b>Age</b>	81 (75-86)	76 (71-82)	<b>0.007</b>	77 (72-84)	76 (71-83)	0.56	77 (72-84)	77 (71-83)	0.7
<b>Color code</b>	2 (2-2)	2 (2-3)	<b>0.014</b>	2 (2-2)	2 (2-2)	0.87	2 (2-2)	2 (2-2)	0.75
<b>Waiting time</b>	34.5 (6-127)	62 (21.3-134.3)	0.09	53 (15-121.3)	58 (20-138)	0.73	42 (13-108.5)	66.5 (23-145.5)	<b>0.036</b>
<b>Length of stay</b>	226 (147-295)	246 (165.3-317.8)	0.54	232 (144.75-293.5)	246 (170.5-335)	0.12	232 (140.8-283.3)	246.5 (171.5-343.5)	<b>0.046</b>
<b>BADL</b>	7 (2-9)	11 (8-12)	<b>&lt; 0.0001</b>	10 (7-12)	10 (7-12)	0.8	10 (7-12)	10 (7-12)	0.99
<b>IADL</b>	1 (0-3)	6 (2-8)	<b>&lt; 0.0001</b>	5 (1-8)	5 (1-8)	0.75	4 (1-8)	6 (1-8)	0.2
<b>ISAR</b>	4 (3-5)	2 (1-4)	<b>&lt; 0.0001</b>	3 (2-4)	2 (1-4)	<b>0.040</b>	3 (2-4)	2 (1-4)	<b>0.011</b>
<b>TRST</b>	2 (1-3)	1 (1-2)	<b>0.006</b>	2 (1-3)	1 (1-2)	<b>0.047</b>	2 (1-3)	2 (1-2)	0.189
<b>InterRAI ED Screener</b>	6 (5-6)	3 (1-6)	<b>&lt; 0.0001</b>	3 (3-6)	3 (1-6)	0.35	5 (3-6)	3 (1-6)	<b>0.043</b>

IR: Interquartile Range; BADL: Basic Activities of Daily Living; IADL: Instrumental Activities of Daily Living; ISAR: Identification of Seniors at Risk; TRST: Triage Risk Screening Tool; InterRAI ED Screener: International Resident Assessment Instrument Emergency Department Screener.

This tool at Mann Whitney test was able to predict the risk of mortality, hospital admission and ED readmission ED in line with ISAR validation (excluding institutionalization not considered for the low number of subjects institutionalized – 10 of 421).

TRST positivity in our population was similar to that reported in previous studies<sup>17,21,23-27</sup>.

In the univariate analysis, TRST was a predictor of mortality and readmission but not for hospitalization. We cannot rule out that different timing for outcomes

**Table IV.** Logistic regression at 6 months.

Enter logistic regression												
Variables	Mortality				ED readmission				Hospital admission			
	OR	95% CI	P	AUC	OR	95% CI	P	AUC	OR	95% CI	P	AUC
Age	1.01	0.95-1.06	0.85	0.84	1.0	0.96-1.04	0.89	0.63	0.99	0.95-1.03	0.70	0.66
Gender	2.93	1.32-6.52	<b>0.008</b>		1.5	0.88-2.60	0.13		1.30	0.73-2.28	0.37	
Color code	0.57	0.24-1.34	0.20		0.95	0.55-1.62	0.84		1.01	0.58-1.78	0.97	
Waiting time	1.00	0.99-1.00	0.29		1.00	1.00-1.01	0.28		1.0	0.99-1.00	0.54	
Length of stay	1.00	1.00-1.001	0.29		1.00	0.99-1.00	<b>0.04</b>		1.0	1.0-1.001	0.12	
BADL	0.91	0.78-1.06	0.21		1.04	0.92-1.18	0.55		1.13	0.99-1.29	0.07	
IADL	0.79	0.61-1.02	0.08		1.08	0.91-1.29	0.37		0.98	0.82-1.18	0.85	
ISAR	1.31	0.89-1.93	0.18		1.27	0.95-1.69	0.11		1.34	0.99-1.80	0.06	
TRST	0.68	0.43-1.07	0.09		1.16	0.86-1.57	0.33		0.95	0.69-1.30	0.74	
InterRAI ED Screener	1.15	0.81-1.64	0.43		1.05	0.84-1.32	0.69		1.16	0.92-1.47	0.21	
Stepwise logistic regression												
Variables	Mortality				ED readmission				Hospital admission			
Gender	2.45	1.16-5.16	<b>0.019</b>	0.81	*	*	*	*	*	*	*	*
Length of stay	*	*	*	*	1.0	0.996-1.0	0.04	0.56	1.0	0.996-1.0	<b>0.03</b>	0.63
IADL	0.66	0.57-0.77	<b>&lt; 0.0001</b>	0.81	*	*	*	*	*	*	*	*
ISAR	*	*	*	*	*	*	*	*	1.23	1.03-1.48	<b>0.02</b>	0.63

\*Not included in the model

ED: Emergency Department; BADL: Basic Activities of Daily Living; IADL: Instrumental Activities of Daily Living; ISAR: Identification of Seniors at Risk; TRST: Triage Risk Screening Tool; InterRAI ED Screener: International Resident Assessment Instrument Emergency Department Screener; OR: Odds Ratio; CI: Confidence Interval; AUC: Area Under the Curve

evaluation may explain the difference between our study and the literature.

InterRAI ED Screener, in addition to indicating the priority for geriatric assessment, was a predictor for death and hospitalization although this tool was not validated for these outcomes. This could be related to the greater number of subjects needing an urgent geriatric examination in our study population as compared to the literature (44.9 versus 27.2 and 14.4%, respectively)<sup>24,25</sup>. However, applying stepwise logistic regression, of the three tools used, only the ISAR was a predictor for hospital admission, with a poor discriminative capacity for predicting this outcome, as evidenced by the AUC of 0.63.

In conclusion, our study showed the utility of using an instrument capable of intercepting critical issues typical of the elderly, such as the ISAR, in association with InterRAI ED Screener, as the latter can identify the need and priority of the geriatric evaluation. Future large studies are needed to confirm the results of our study.

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None.

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#### Author contributions

All the authors contributed in the development of this manuscript.

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