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# Emergency department intervention for high-risk elders: identification strategy and randomised controlled trial to reduce hospitalisation and institutionalisation

## Key Messages

1. A six-item self-reported screening questionnaire — Hong Kong identification of seniors at risk (HK-ISAR) — was developed for elders attending the emergency department (ED) deemed to be at increased risk of adverse health outcomes.
2. The HK-ISAR is the first validated screening tool for use in an ED setting in Hong Kong. It addressed health outcomes such as activities of daily living, dependence, history of hospitalisation, and polypharmacy.
3. Among the six questions in the HK-ISAR, attendance at a hospital ED during the past month was the most important predictor of poor subsequent health outcome.
4. The sensitivity and specificity of the HK-ISAR for predicting a poor health outcome was 68.3% and 49.4%, respectively, with an area under the receiver operating characteristic curve of 0.621.
5. A randomised controlled trial of a community-based structured interventional programme found no difference in the 6-month outcomes of patients screened positive (receiving the intervention) or negative (receiving usual care) according to the HK-ISAR.

## Introduction

Ageing populations are a problem of worldwide concern. In 2003, 12.5% of the population in Hong Kong was aged over 65 years. It is estimated that by 2033 the proportion of such elderly will increase to 25%.<sup>1</sup> An ageing population has a huge impact on the health care system, including emergency department (ED) service utilisation. Moreover, EDs are a common point of contact for geriatric patients. Elderly ED patients are at increased risk of hospital admissions, intensive-care unit admission, and return ED visits, compared to younger cohorts.<sup>2,3</sup> The ED plays an important role in identification of higher-risk elders.

Identification of seniors at risk (ISAR) was a six-question screening tool (derived from the original 27-item ISAR questionnaire) developed and validated in a Canadian population for ED administration for elderly patients. It predicts adverse health outcomes (death, long-term care admission, or functional decline), acute care hospital utilisation, and identifies patients with high utilisation of ED services during the 6-month period after the index ED visit.<sup>4,5</sup> Using a cut-off score of two or more of the six questions, the ISAR tool predicted adverse health outcomes and high rates of hospital utilisation with a sensitivity of 73% and a specificity of 51%; the area under the receiver operating characteristic (ROC) curve was 0.68.<sup>4</sup> Similar studies have not been performed in Hong Kong, despite the huge geriatric population expected in the future.

This study aimed to (1) derive a Hong Kong (HK) version of the ISAR, (2) validate it in the local population, (3) compare the performance of HK-ISAR with the original ISAR, and (4) use the validated HK-ISAR to identify high-risk elderly patients and study the effects of a structured ED intervention and targeted referral process on hospitalisation and institutionalisation over the next 6 months.

## Methods

This multicentre study was conducted from July 2007 to October 2009 in two phases in three EDs in Hong Kong: the Prince of Wales Hospital, the Pamela Youde Nethersole Eastern Hospital, and the United Christian Hospital.

### Phase 1

This was conducted between July 2007 and July 2008. Patients aged  $\geq 65$  years and who were about to be discharged from the ED were recruited. The original 27-item ISAR was completed. Patients were followed up by telephone interview 6 months after the ED visit. The composite primary outcome measure was to identify any of the following adverse outcomes: (1) institutionalisation, defined as admission to a nursing home or chronic/acute care hospital for  $\geq 3$  months, (2) admission to an acute care general hospital during the first month after the index ED visit, (3) early return visit or frequent ED visits (one return visit within one month or three or more visits during the 6 months following the index ED visit), and (4) death.

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Multiple logistic regression analysis was performed on the 27 ISAR screening questions to identify the six most significant variables with the highest adjusted odds ratios (OR) to derive the HK-ISAR. This was then validated.

### Phase 2

This was conducted between September 2008 and October 2009. High-risk elderly patients (identified using the validated HK-ISAR) who were to be discharged from the ED were recruited into a prospective randomised controlled clinical trial. Outcomes were compared in patients receiving an ED-based intervention (which specifically targeted and maximised timely referrals to community-based geriatric support and medical and social services) and those who received routine ED care. The ED-based intervention included a brief standardised assessment of functional status, mental state, and relevant social factors (using the Barthel index, short Geriatric Depression Scale, and Mini Mental State Examination). The focus was on identifying new and unresolved old problems that required medical intervention, a new or increased level of home care or community-based service. Referrals to a range of clinics and agencies were arranged according to the individual's needs and standardised cut-off points for the study instruments.

## Results

### Phase 1

Of 2130 patients screened, 1820 were eligible and successfully followed up (Table 1). The eligible patients were randomised into derivation and validation groups. The derivation group comprised 915 patients (50% male) with a mean age of 74.5 years (standard deviation [SD], 6.23 years). After entering all patients' responses into the model, 32 had not answered the questions clearly and were excluded. Six questions highly predictive of poor outcome were identified from the 27 ISAR items. They were (1) Before the illness or injury that brought you to the emergency department, did you have any health problems that required you to limit your activities? (OR, 1.604; 95% confidence interval [CI], 1.171-2.198); (2) Have you visited a hospital emergency department during the past month? (OR, 2.458; 95% CI 1.725-3.503); (3) Have you been hospitalised for one or more nights during the past 6 months? (OR, 2.242; 95% CI, 1.568-3.204); (4) Do you take more than two different medications every day? (OR, 1.534; 95% CI, 1.126-2.090); (5) In case of need, can you count on someone close to you? (OR, 1.711; 95% CI, 1.078-2.716); and (6) Do you usually have enough income to meet your daily needs? (OR, 1.446; 95% CI, 1.047-1.996)

**Table 1. Baseline characteristics of recruited patients**

Characteristic	No. (%) of patients	
No. of male:female	910:910	
Age (years)		
65-74	975 (53.6)	
75-84	727 (39.9)	
≥85	118 (6.5)	
No. of co-morbidities		
0	297 (16.3)	
1	418 (23.0)	
2	409 (22.5)	
3	329 (18.1)	
>4	367 (20.2)	
Median Barthel index score	11.5	
Median Geriatric Depression Scale score	7.5	
Short version of identification of seniors at risk (C-ISAR) score		
0	230 (12.6)	
1	520 (28.6)	
2	564 (31.0)	
3	312 (17.1)	
4	136 (7.5)	
5	50 (2.7)	
6	8 (0.4)	
Adverse outcomes	Present	Absent
Institutionalisation	11 (0.8)	1809 (99.2)
Admission to acute care general hospital	506 (27.8)	1314 (72.2)
Early or frequent emergency department visit	392 (21.5)	1428 (78.5)
Death	55 (3.0)	1765 (97)
Primary composite outcome	698 (38.4)	1120 (61.6)
Canadian ISAR score of those with adverse outcomes		
0	62 (8.9)	
1	165 (23.6)	
2	229 (32.8)	
3	138 (19.8)	
4	71 (10.2)	
5	28 (4.0)	
6	5 (0.7)	

Using the cut-off of two or more out of 6 possible positive answers, the sensitivity and specificity of HK-ISAR for predicting poor outcomes were 68.3% and 49.4%, respectively, with an area under the ROC curve of 0.621. The validation group comprised 905 patients, of which 25 were excluded because of missing data. This yielded a sensitivity and specificity of HK-ISAR for predicting poor outcome of 76.1% and 33.3%, respectively, with an area under the ROC curve of 0.592.

The Hong Kong version of ISAR comprised six questions that differed slightly from the short version of the original ISAR (C-ISAR). Evaluation of the ability of C-ISAR to identify high-risk patients in the Hong Kong Chinese population was performed.

Of the 1820 patients recruited, 698 (38.3%) had two or more positive responses to the C-ISAR. The C-ISAR correctly identified 471 (67.5%) of the 698 positive cases, and 523 (46.6%) of the 1122 negative cases (Fisher's exact test,  $P < 0.0001$ ), yielding a correct classification rate of

994/1820 (54.6%). The HK-ISAR correctly identified 535 (77%) of the 698 positive cases, and 366 (33%) of the 1121 negative cases (Fisher's exact test,  $P < 0.0001$ ), yielding a correct classification rate of 910/1820 (49.5%). In the Hong Kong population, the HK-ISAR identified 9% more seniors at risk than the C-ISAR.

### Phase 2

At their index visit, 1279 patients were randomised into the control group (333 males and 309 females; mean age, 75 [SD, 6.8] years) and the intervention group (277 males and 360 females; mean age 76.3 [SD, 6.8] years) [Table 2]. In all, 224 controls and 255 patients in the intervention group had a positive composite outcome ( $P = 0.299$ ). There was no significant difference between the groups for institutionalisation (7 [1.1%] vs 6 [0.9%],  $P = 0.791$ ), admission to an acute care general hospital (174 [27.1%] vs 198 [31.1%],  $P = 0.117$ ), early return or frequent ED visits (120 [18.7%] vs 124 [19.5%],  $P = 0.724$ ), or death (12 vs 12,  $P = 0.985$ ). Use of the HK-ISAR and structured interventional programme made no difference to the 6-month outcomes.

**Table 2. Baseline characteristics of patients in randomised controlled trial**

Characteristic	No. (%) of patients		P value
	Control	Intervention	
No. of male:female	333:309	277:360	0.003
Age (years)			0.005
65-74	326 (50.8)	266 (41.8)	
75-84	251 (39.1)	298 (46.8)	
$\geq 85$	65 (10.1)	73 (11.5)	
No. of co-morbidities at recruitment			0.0001
0	158 (24.6)	85 (13.3)	
1	170 (26.5)	155 (24.3)	
2	134 (20.9)	180 (28.3)	
3	100 (15.6)	115 (18.1)	
>3	80 (12.5)	102 (16.0)	
No. of co-morbidities at follow-up			0.0001
0	133 (20.7)	64 (10.0)	
1	150 (23.4)	122 (19.2)	
2	125 (19.5)	182 (28.6)	
3	124 (19.3)	114 (17.9)	
>3	100 (15.6)	144 (22.6)	
Median Barthel Index score			
At recruitment	18.54	18.46	0.149
At follow-up	18.89	18.85	0.121
Median Geriatric Depression Scale score			
At recruitment	5.30	5.06	0.178
At follow-up	6.48	4.45	0.0001
Hong Kong identification of seniors at risk (HK-ISAR) score at recruitment			0.0001
0	-	-	
1	-	-	
2	213 (33.2)	309 (48.5)	
3	251 (39.1)	194 (30.5)	
4	131 (20.4)	91 (14.3)	
5	41 (6.4)	38 (6.0)	
6	6 (0.9)	5 (0.8)	
HK-ISAR score at follow-up			0.0001
0	7 (1.1)	3 (0.5)	
1	43 (6.7)	63 (9.9)	
2	144 (22.4)	181 (28.4)	
3	226 (35.2)	159 (25.0)	
4	82 (12.8)	89 (14.0)	
5	29 (4.5)	17 (2.7)	
6	-	5 (0.8)	

## Discussion

This study resulted in the development of a six-item self-reported screening questionnaire (HK-ISAR) for elders attending the ED to identify those at increased risk of adverse health outcomes. It is the first validated screening tool for use in an ED setting in Hong Kong. The HK-ISAR is a brief, general screening tool, suitable for an ED setting to enable clinical resources for the care of elders to be rapidly deployed and focused on patients with unmet care needs currently or in the near future. The items included in the HK-ISAR are well-known risk factors for adverse health outcomes among elders. They include activities of daily living, dependence, history of hospitalisation, and polypharmacy. The HK-ISAR has similar sensitivity and specificity to the original Canadian short version (C-ISAR) but is more applicable to the local population; it identified 9% more seniors at risk. Among the six questions in the HK-ISAR, attendance at a hospital ED during the past month is the most important predictor of subsequent poor health outcome. The C-ISAR does not include this item as one of the screening questions. This indicates a difference in the Hong Kong and Canadian geriatric populations in terms of utilisation of ED services. The ED is an important contact point for the high-risk elderly with high utilisation of health care resources, for whom effective interventions are necessary. The intervention was community based, with referrals to a range of clinics and agencies according to individual patient needs and standardised cut-off points used for the study instruments. All the referrals were arranged within 6 months of the ED visits but made no difference

to the 6-month outcomes. A main reason for failure of intervention was lack of a coordinated effort among the referred parties. Nevertheless, the HK-ISAR is a useful first step to be implemented in the ED to trigger subsequent interventions in high-risk elders. Further study is necessary to explore other strategies to reduce the occurrence of adverse health outcomes.

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