The inter-rater reliability of the Risk Instrument for Screening in the Community (RISC) before and after training

Elizabeth Weathers*[1,2], Rónán O'Caoimh[1,2,3], Ronan O'Sullivan[1], Constança Paúl[4], Frances Orfilia[5], Roger Clarnette[6], Carol Fitzgerald[1], Anton Svendrovski[7], Nicola Cornally[1,8], Patricia Leahy-Warren[8] & D. William Molloy[1,3].

[1] Centre for Gerontology and Rehabilitation, University College Cork, St Finbarrs Hospital, Douglas Rd, Cork City, Ireland.

[2] Health Research Board Clinical Research Facility Galway, National University of Ireland, Galway, Geata an Eolais, University Road, Galway, Ireland.

[3] COLLAGE (COLLaboration on AGEing), University College Cork, Cork City and Louth Age Friendly County Initiative, Co Louth, Ireland.

[4] ICBAS, Institute of Biomedical Sciences Abel Salazar – University Of Porto, Porto, Portugal.

[5] Institute for Research Primary Healthcare, Jordi Gol University, Barcelona, Spain.

[6] School of Medicine and Pharmacology, University of Western Australia, 35 Stirling Hwy, Crawley WA 6009, Australia.

[7] UZIK Consulting Inc., 86 Gerrard St E, Unit 12D, Toronto, ON, M5B 2J1 Canada.

[8] School of Nursing and Midwifery, University College Cork, Ireland

*Address correspondence to: Dr. Elizabeth Weathers, Centre for Gerontology and Rehabilitation, University College Cork, St Finbarr's Hospital, Douglas Road, Cork, Ireland.

E-mail: e.weathers@ucc.ie

Tel: 00353-21-4923310

Abstract

Predicting risk of adverse healthcare outcomes is important to enable targeted delivery of interventions. The Risk Instrument for Screening in the Community (RISC), designed for use by public health nurses (PHNs), measures the one-year risk of hospitalisation, institutionalisation and death in community-dwelling older adults according to a five-point global risk score: from low (score 1,2), medium (3) and high (4,5). We examined the inter-rater reliability (IRR) of the RISC between student PHNs (n=32) and expert raters using six cases (two low, medium and high-risk), scored before and after RISC training. Correlations increased for each adverse outcome, statistically significantly for institutionalisation (r=0.72 to 0.80,p=0.04) and hospitalisation, (r=0.51 to 0.71,p<0.01) but not death. Training improved accuracy for low-risk but not all high-risk cases. Overall, the RISC showed good IRR, which increased after RISC training. That reliability reduced for some high-risk cases suggests that the training programme requires adjustment to further improve IRR.

(Abstract word count: 150 words**)**

Key words: Screening, frailty, risk, adverse outcomes, inter-rater reliability

Introduction

More people with multiple co-morbidities and complex care needs are living longer in the community, increasing the demand for limited healthcare services [Rechel]. Frail older adults are at increased risk of adverse healthcare outcomes such as transfer to nursing home (institutionalisation), hospitalisation, and death. Frailty is a state of increased vulnerability to stressors [McGee]. In the European Union, approximately 30% of people >65 years are frail and almost 60% are in a pre-frail state [Rothman]. Older frail people account for the highest healthcare costs in developed countries [Comans]. This is important for clinicians and policy makers. The association between frailty, functional decline and adverse healthcare outcomes is well documented [Kansagara],[Fugate Woods][Stuck][Brock]. Frailty may be reversed when it is independent of disease and disability [Gill]. A proactive, integrated and community-based response to frailty is required.

Risk assessment utilizing risk-prediction models is increasingly being used in healthcare to measure the chance of adverse outcomes. A variety of different tools have attempted to identify older adults at risk of adverse healthcare outcomes [de Vries]. Most are too long, have poor predictive ability [O'Caoimh_Maturitas], do not adequately stratify risk or assess the ability of older persons' caregiver networks to manage risk. To accurately determine the requirement for appropriate interventions, it is essential that we stratify and comprehensively assess older adults, taking into account their caregiver network. In conjunction with community nurses (public health nurses - PHNs) O'Caoimh et al. developed a short screening and assessment tool, based upon a risk matrix, called the Risk Instrument for Screening in the Community (RISC)[O'Caoimh-2012][O'Caoimh-2013][O'Caoimh-2014][O'Caoimh-2015][O'Caoimh-2015]. The RISC can be used to screen large numbers of patients to

identify those at greatest risk of three adverse healthcare outcomes (i.e. institutionalisation, hospitalisation and death), who can then be triaged for further assessment, investigation and treatment. The RISC tool uses a subjective, global score of risk based upon a five-point Likert scale measured from 1 (minimal-rare risk) to 5 (extreme-certain). This may result in different scores by healthcare workers depending on age, clinical experience etc. For example, younger practitioners with less experience may score higher because they are worried about the patients' prognosis i.e. they may be risk adverse. On the other hand it could be argued that if they are not experienced with some problems they might underestimate risk. There is therefore a need to establish the inter-rater reliability (IRR) of the RISC tool. It is also necessary to examine the effectiveness of the proposed training programme. The aim of this study was to examine the IRR of the RISC before and after training. It was hypothesised that IRR would be higher after implementation of the short training programme in the use of the RISC.

Methods

Participants

Thirty two student PHNs attending lectures in the School of Nursing at University College Cork, Ireland, were invited to participate as raters. All were undertaking the RISC training programme as part of their PHN postgraduate curriculum; all were naïve to scoring the RISC. Prior to IRR testing, they had not received any formal training on how to score the instrument. No information was provided in advance apart from the session title.

The Risk Instrument for Screening in the Community (RISC)

The RISC is a screening and assessment risk-prediction instrument that was developed as part of the COLLaboration on AGEing (COLLAGE) [Sweeney],[O'Caoimh_European Geriatric Med], Irelands three star reference site for active and healthy ageing, to rapidly screen and stratify community-dwelling older adults attending PHN centres according to their risk level. It measures the risk of three adverse outcomes namely, institutionalisation, hospitalisation and death, occurring in the next year. In this case, institutionalisation is defined as admission to a nursing home or other long-term care institution. Hospitalisation is defined as an acute, non-elective admission to hospital with an overnight stay.

The instrument records demographic data, the presence (yes/no response) and magnitude (mild, moderate, severe) of concern in three domains: mental state, activities of daily living (ADL) and medical state. The caregiver networks' ability to manage each domain is then scored using a five-point Likert scale from one ('can manage') to five ('absent or a liability'). Finally, based upon the information collected, the rater reaches a subjective *global risk score* for each of the three adverse healthcare outcomes (institutionalisation, hospitalisation and death), scored on a five-point Likert scale, from 1 (minimal-rare risk) to 5 (extreme-certain). The RISC takes 2–5 minutes to complete and has been validated in samples of community-dwelling older adults in Ireland [O'Caoimh_2012 x2,2013, 2014, 2015, 2016],[O'Caoimh-book chapter], Spain and Portugal [Paul]. A more detailed version called the Community Assessment of Risk Instrument, a mini-Comprehensive Geriatric Assessment has been validated in Australia[Clarnette-2015]..

The RISC Training programme

A 90-minute training programme on the RISC was originally developed in Ireland [O'Caoimh_2012] and has been adapted for use in other cultures and languages [Paul][Leahy-Warren_ Int.Journal of research in nursing]. The content of this programme focuses on:

- Context (healthcare in the specified country, allocating limited resources, community healthcare),
- Frailty (conceptualisation, measurement, challenges of managing frail community-dwelling older adults),
- Association between frailty and risk of adverse outcomes (hospitalisation, institutionalisation, and death),
- The RISC tool (domains, *global risk score*, comparison with other frailty scales, validity and reliability evidence to date, practical scoring, benefits).

The training programme has been adapted and delivered internationally including in Spain, Portugal, and Australia. The session stands in isolation and no follow-up session is routinely provided once nurses have achieved

Design

A descriptive correlational design was used. Twelve standardised cases that reflected varying levels of risk for hospitalisation, institutionalisation and death, were developed i.e. four low-risk, four medium-risk and four high-risk cases. Each of these cases were constructed to reflect the level of risk and scored *a priori* by a panel of experts (ROC, DWM, NC, EW, PLW). Participants were asked to score six of these cases (two low, medium and high cases) before receiving the RISC training programme. Next, the 90-minute training programme was delivered and participants

were asked to score six new cases (two low, medium and high) when they had completed the training (see Appendix 1 for an example of a high-risk case).

Analysis

Correlational analysis of PHN scores and expert scores for the same cases, before and after training was conducted. Correlation analysis was measured using Pearson's or Spearman correlation if parametric or non-parametric data respectively, a recommended, reliable statistical method to analysing such data [Göktas].This was used to determine which items in the three domains correlated with the estimation of risk of institutionalisation, hospitalisation and death, by the raters (expert and novice i.e. IRR). Each measure is represented by a value between -1 and +1, where +1 indicates perfect (strongest possible) level of agreement between two raters. An average of four measures was also calculated to assess the overall reliability of an item and this number was also used to rank the items (least reliable/most reliable). In addition, mean scores for raters, in all categories, within each of the domains were calculated. Statistical significance was tested at the 0.05 level. To facilitate analysis, RISC scores were grouped as either low (scores 1 or 2), medium (score 3) and high (scores 4 or 5) or dichotomised as minimum (scores 1 or 2) and maximum (scores 3-5) for each outcome.

Results

The sample comprised of 32 student PHNs (see Table 1). All participants were female (n=32) and most (59%) were aged under 30 years (n=19). All were Registered General Nurses, although some participants had dual registration including Registered Children's Nursing and Registered Psychiatric Nursing. In terms of highest level of education achieved, half of participants had a degree in nursing (n=16) and over a third had a postgraduate diploma (n=11). The mean number of years' experience working with older adults was 6.4 and ranged from 0 to 19 years. The mean number of years' experience working in the community was 2.8 and ranged from 0 to 19 years.

INSERT TABLE 1

Table 2 shows the correlations between the PHN and expert RISC scores before and after training. There was a statistically significant improvement in the degree of correlation, pre and post training, between PHN RISC scores and expert RISC scores for risk of institutionalisation (r =0.72 to 0.80 p=0.04) and hospitalisation (r =0.51 to 0.71 p<0.01). There was also an increase in the correlation between PHNs and expert opinion (r =0.59 to 0.65) for risk of death, although it was not statistically significant (p=0.15).

INSERT TABLE 2

Table 3 describes the proportion of matches (presented as decimals) between PHNs and experts, indicating the accuracy of assessments performed by nurse participants. When all patient cases were combined (i.e. low, medium and high-risk), there was an increase in accuracy for all three RISC domains. Risk of hospitalisation (p=0.01) and death (p<0.01) were statistically significantly increased. Results for the patient cases categorised individually by risk level were then examined. For low-risk cases, the

accuracy of scores increased significantly ($p<0.001$) for all domains (i.e. hospitalisation, institutionalisation and death). For medium risk patients, the accuracy of scores increased significantly for risk of institutionalisation ($p=0.04$) and death ($p=0.02$). However, there was no change in accuracy for risk of hospitalisation in the medium-risk cases. For the high-risk cases, there was a significant reduction in accuracy in predicting risk of institutionalisation ($p=0.01$) and hospitalisation ($p=0.02$) but not for death ($p=0.8$). When risk levels were combined to provide a dichotomous result (i.e. minimum or maximum),there was a statistically significant increase in the proportion of matches for all three adverse healthcare outcomes for low risk cases ($P<0.001$). For the maximum risk cases however, agreement only increased for predicting risk of death, albeit from a low baseline, but was not statistically significant (from 35% to 48% agreement, $p=0.08$).

INSERT TABLE 3

Table 4 illustrates the number of PHN scores that corresponded with expert scores in each domain of the RISC. A paired-samples design (comparing pre-training and post-training scores) was used. Given that each PHN scored 6 cases, with three global risk scores for each adverse outcome, there were 18-paired results for each of the 32 nurse-expert rater dyads. For all patient cases combined together there was a significant improvement in agreement between PHNs and expert raters for risk of hospitalisation ($p=0.03$), risk of death ($p<0.01$) and total/overall score ($p<0.01$) pre and post training. However, there was no significant improvement in matched scores for risk of institutionalisation ($p=0.12$). Similar to earlier findings, a statistically significant decline in matched scores was observed among high-risk patients for institutionalisation (1.84/2 =92% versus 1.5/2 =75%, $p=0.01$) and hospitalisation (1.75/2 =88% versus 1.41/2 =71%, $p=0.01$). ***INSERT TABLE 4***

Discussion

This study presents the results of IRR testing of the RISC tool between student PHNs and an expert panel, consisting of the developers of the CARTS programme, using a series of risk-stratified case studies. The results show that student PHNs, recently trained to score the RISC, had moderate to strong correlation with these expert raters after only one session. This suggests that nurses with background knowledge and experience, can quickly learn to risk-rate older patients for common adverse healthcare outcomes. The results also support the hypothesis that the training programme increases IRR with correlation coefficients increasing post training for all three outcomes measured by the RISC, albeit this was only significant for risk of institutionalisation and hospitalisation, with the correlation improving from moderate to strong. Correlations for death, while increasing, remained moderate and were not statistically significantly different post training. When the results of all cases were combined the proportion of matches between the student PHNs and experts, indicating the agreement of their assessment (i.e. correct interpretation), increased for all three RISC domains although only hospitalisation and death were statistically significant; no significant increase was found for risk of institutionalisation.

Grouping cases into minimum and maximum risk, consistent with the orginal validation of the RISC [O'Caoimh-2015-BMC-Geriatrics], showed that training improved agreement and hence accuracy of predictions for all minimum risk cases. More modest (non-statistically significant) or no increases were seen for maximum risk cases. When risk levels were further analysed (i.e. divided into low, medium and high-risk), the proportion of matches varied according to risk level, with the number of correct matches between student PHNs and expert raters increasing for all low-risk and most medium-risk case studies apart from hospitalisation. The increase in the

proportion of correct matches was highest for institutionalisation for low-risk cases. However, when high-risk cases were examined individually, it was found that training actually reduced agreement (the proportion of matches between expert raters and student PHNs) for risk of hospitalisation and institutionalisation. This suggests that the training programme may have affected risk tolerance, increasing or decreasing it, reducing the level of agreement. As risk assessment is subjective, training, particularly for the high-risk cases, may have caused student PHNs to question their 'gut' instinct leading to fluctuations in their scoring. One current understanding of decision-making processes called the dual-process theory describes two systems whereby we make decisions: the intuitive System 1 and the hypothetico-deductive System 2. Evidence suggests that the accuracy of System 1, 'gut feeling', applied by nurses in clinical practice, compares well (sensitivity of 80%) with the deliberate methodological System 2 approach [Cabrera et al., 2015]. Likewise, while it is often considered that risk tolerance increases with knowledge and experience, there is little evidence to support this in clinical practice [Considine]. Little is known about the effect of attitudes to risk on nurse decision making [O'Cathain 2004] although it is suggested that there is no difference between nurses with a community versus a hospital care background or between those with difference levels of experience [O'Cathain 2007]. Further, given the short duration of the session nurses had less time to weigh up and reconcile their 'risk-compass'. This highlights the challenges of using a subjective global risk assessment in clinical practice and the need to modifiy the training further to improve rater agreement particularly for high-risk cases where decisions and estimations of likely outcomes is most challenging. The results also mirror those of the initial validation of the RISC which showed modest agreement in predicting the actual outcomes of 'real life' high-risk patients at one year [O'Caoimh

BMC Geriatrics-2015]. This said, risk by its very nature is an intangible concept and the RISC, performed better than a range of individual assessment instruments including those that briefly measure cognition (abbreviated mental test score), activities of daily living (Barthel Index) and frailty (Clinical Frailty Scale [Rockwood 2005]). Further, the RISC is a brief screening instrument designed to identify patients that require more comprehensive assessment i.e. for triaging patients for often limited healthcare resources, and is not designed to replace more detailed assessment.

This study has a number of limitations. The training programme, while providing an overview of risk training is based upon theoretical cases rather than actual patients. The time available for training was restricted to 90 minutes of education due to logistical reasons, possibly limiting the student PHNs ability to appreciate concepts that were new to them. That said, the increases in correlations for most of the cases (particularly low-risk cases) suggest that the training, albeit limited, improves their ability to score the instrument. As said, the results showed that IRR reduced for some cases, particularly high-risk cases suggesting that the short duration of training may have influenced the nurses' judgment. The participants, while all qualified and experienced registered nurses, were student PHNs and had only limited experience with managing patients in 'real life' community practice. Finally, no qualitative data were collected that would have provided a better understanding of baseline risk tolerance among the nurses. Further study measuring IRR between PHNs of differing levels of experience and other healthcare professionals as well as a questionnaire such as the five item Grol instrument used to measure risk-taking behaviours [Grol et al., 1990] is now planned along with adjustment of the scoring cases and the duration and content of the RISC training programme including the provision of reading materials in advance and a booster session at one month.

In summary, this study shows that nurses training in public health nursing had moderate to strong correlation with expert trainers in scoring community-based older adults (case vignettes) according to their risk rating (using the RISC) for important adverse healthcare outcomes (institutionalisation, hospitalisation and death) at one year. The proportion of matches between PHNs and expert raters as a marker of accuracy or agreement increased for all three risk outcomes: institutionalisation, hospitalisation and death, and although some variation was noted in the post-training scoring for cases deemed high-risk, the study suggests that even a limited period of training in risk assessment improves IRR. Further study with an enhanced training programme, to improve IRR, is now planned.

References

Rechel B, Grundy E, Robine JM et al. Ageing in the European Union. Lancet 2013 ;381(9874):1312-22.

McGee HM, O'Hanlon A, Barker M et al. Vulnerable Older People in the Community: Relationship Between the Vulnerable Elders Survey and Health Service Use. Journal of the American Geriatrics Society 2008; 56: 8–15.

Rothman MD, Leo-Summers L, Gill TM. Prognostic Significance of Potential Frailty Criteria. Journal of the American Geriatrics Society 2008; 56: 2211–2216.

Comans TA, Peel NM, Hubbard RE, Mulligan AD, Gray LC, Scuffham PA. The increase in healthcare costs associated with frailty in older people discharged to a post-acute transition care program. Age and Ageing. 2016 Jan 13:afv196.

Kansagara D, Englander H, SalanitroA et al. Risk Prediction Models for Hospital Readmission: A Systematic Review. JAMA 2011; 306(15):1688-1698.

Fugate Woods N, LaCroix AZ, Gray SL et al. Frailty: emergence and consequences in women aged 65 and older in the Women's Health Initiative Observational Study. Journal of the American Geriatrics Society 2005; 53(8):1321-1330.

Stuck AE, Walthert JM, Nikolaus T, Büla CJ, Hohmann C, Beck JC. Risk factors for functional status decline in community-living elderly people: A systematic literature review. Social Science & Medicine 1999; 48(4):445-469.

Brock AM, O'Sullivan P. A study to determine what variables predict institutionalization of elderly people. Journal of Advanced Nursing 1985; 10: 533–537.

Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006 Feb 27;166(4):418-23.

de Vries NM, Staal JB, van Ravensberg CD et al. Outcome instruments to measure frailty: A systematic review. Ageing Research Reviews 2011; 10:104–114.11.

O'Caoimh R, Cornally N, Weathers E O'Sullivan R, Fitzgerald C, Orfila F, Clarnette R, Paúl C, Molloy DW. Risk prediction in the community: A systematic review of case- finding instruments that predict adverse healthcare outcomes in community-dwelling older adults. Maturitas September 2015, 82; (1):3–21.

O'Caoimh R, Healy E, O Connell E, Gao Y, Molloy DW. The Community Assessment of Risk Tool, (CART): Investigation of Inter-Rater Reliability for a New Instrument measuring risk of Adverse Outcomes in Community Dwelling Older Adults. Irish Journal of Medical Science 2012; 181 (7): 227.

O'Caoimh R, Gao Y, Healy E, O'Connell E, O'Keeffe G, Molloy DW. Screening for Markers of Frailty and Percieved Risk of Adverse Outcomes Using The Community Assessment of Risk Tool. Irish Journal of Medical Science 2013; 182 (6):230.

O'Caoimh R, Gao Y, Svendrovski A, Healy E, O'Connell E, O'Keeffe G, Cronin U,

O'Herlihy E, Cornally N, Molloy DW. Screening for markers of frailty and perceived risk of adverse outcomes using the Risk Instrument for Screening in the Community (RISC). BMC Geriatrics, 2014;14:104 doi: 10.1186/1471-2318-14-104.

O'Caoimh R, FitzGerald C, Cronin U, Svendrovski A, Gao Y, Healy E, O'Connell E, O'Keeffe G, O'Herlihy E, Weathers E, Cornally N, Leahy-Warren P, Orfila F, Paúl C, Clarnette R, Molloy DW. Which part of a short, global risk assessment, the Risk Instrument for Screening in the Community (RISC), predicts adverse healthcare outcomes? Journal of Aging Research 2015, Article ID 256414, 7 pages, 2015. doi:10.1155/2015/256414

O'Caoimh R, Gao Y, Svendrovski A, Healy E, O'Connell E, O'Keeffe G, Leahy-Warren P, Cronin U, O'Herlihy E, Cornally N, Molloy DW. The Risk Instrument for Screening in the Community (RISC): A New Instrument for Predicting Risk of Adverse Outcomes in Community Dwelling Older Adults. BMC Geriatrics, 2015 Jul 30;15:92. doi: 10.1186/s12877-015-0095-z.

O'Caoimh R, Cornally N, Svendrovski A, Weathers E, FitzGerald C, Healy E, O'Connell E, O'Keeffe G, O'Herlihy E, Gao Y, O'Donnell R, O'Sullivan R, Leahy-Warren P, Orfila F, Paúl C, Clarnette R, Molloy DW. Measuring the effect of carers on patients' risk of adverse healthcare outcomes using the caregiver network score. Journal of Frailty and Aging, 2016 http://dx.doi.org/10.14283/jfa.2016.86

O'Caoimh R, Weathers E, O'Donnell R, O' Sullivan R, FitzGerald C, Cornally N, et al. The Community Assessment of Risk Screening and Treatment Strategies (CARTS) – An Integrated Care Pathway to Manage Frailty and Functional Decline in Community Dwelling Older Adults. In: Helfert M et al. (Eds) ICT4AgeingWell, CCIS 578, Springer International Publishing, Switzerland, pp. 1–16, DOI:10.1007/978-3-319-27695-3_1

Sweeney C, Molloy DW, O'Caoimh R et al. European Innovation Partnership on Active and Healthy Ageing: Ireland and the COLLAGE experience. Irish Journal of Medical Science 2013; 182 (6): 278-279.

O'Caoimh R, Sweeney C, Hynes H, McGlade C, Cornally N, Daly E et al. COLLaboration on AGEing-COLLAGE: Ireland's three star reference site for the European Innovation Partnership on Active and Healthy Ageing (EIP on AHA). European Geriatric Medicine 2015 Volume 6, Issue 5; 505-511 DOI: 10.1159/000433432.

Paúl C, Teixeira L, Azevedo MJ, Alves S, Duarte M, O'Caoimh R, Molloy W. Perceived risk of mental health problems in primary care. Front. Aging Neurosci. 2015, 7:212. doi: 10.3389/fnagi.2015.00212

Clarnette RM, Ryan JP, O' Herlihy E, Svendrovski A, Cornally N, O'Caoimh R, Leahy-Warren P, Paul C, Molloy DW. The Community Assessment of Risk Instrument: Investigation of Inter-rater Reliability of an Instrument Measuring Risk of Adverse Outcomes. J Frailty Aging 2015;4(2):80-89.

Leahy-Warren P, O'Caoimh R, Fitzgerald C, Cochrane A, Svendrovski A, Cronin U, O'Herlihy E, Cornally N, FitzGerald C, Gao Y, Healy E, O'Connell E, O'Keeffe G, Coveney S, McGlynn J, Clarnette R, Molloy DW. Components of the Risk Instrument for Screening in the Community (RISC) that predict Public Health Nurse perception of risk. Journal of Frailty & Aging 2015, 2015;4(3):149-154.

Leahy-Warren P, Weathers E, Lupari M, Campbell S, Clarnette R, Orfila F, Fitzgerald C, Paúl C, O'Herlihy E, Cornally N, O'Caoimh R, Day MR, Mulcahy H, Molloy DW. Risk Instrument for Screening Older People in the Community (RISC): Cross Cultural Perspectives. International Journal of Research in Nursing, 2015, DOI: 10.3844/ijrnsp.2015.

Cabrera, D, Thomas, JF, Wiswell, JL, Walston, JM, Anderson, JR, Hess, EP & Bellolio, MF 2015, 'Accuracy of 'my gut feeling: ' comparing system 1 to system 2 decision-making for acuity prediction, disposition and diagnosis in an academic emergency department' Western Journal of Emergency Medicine, vol 16, no. 5, pp. 653-657

Considine J, Botti M, Thomas S. Do knowledge and experience have specific roles in triage decision-making? Acad Emerg Med. 2007 Aug;14(8):722-6.

O'Cathain A, Nicholl J, Sampson F, Walters S, McDonnell A, Munro J. Do different types of nurses give different triage decisions in NHS Direct? A mixed methods study. J Health Serv Res Policy. 2004 Oct;9(4):226-33.

O'Cathain A, Munro J, Armstrong I, O'Donnell C, Heaney D. The effect of attitude to risk on decisions made by nurses using computerised decision support software in telephone clinical assessment: an observational study. BMC medical informatics and decision making. 2007 Nov 29;7(1):1.

Göktas A, Içi Ö. A comparison of the most commonly used measures of association for doubly ordered square contingency tables via simulation. Metodološki zvezki. 2011 Jan 1;8(1):17-37.

Rockwood K, Song X, MacKnight C et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005; 173(5): 489-495.

Grol R, Whitfield M, De Maeseneer J, Mokkink H: Attitudes to risk taking in medical decision making among British, Dutch and Belgian general practitioners. Br J Gen Pract. 1990, 40: 134-136.

Tables

Table 1. Demographic characteristics of raters including in the inter-rater reliability testing of the Risk Instrument for Screening in the Community (RISC).

Variable	**Categories**	***n (%)***
Gender	Male	0 (0)
	Female	32 (100)
Age	Under 30	13 (40.6)
	31-40	10 (31.2)
	41-50	9 (28.1)
	51-60	0 (0)
Nursing registration	Registered General Nurse	32 (100)
	Registered Midwife	6 (18.7)
	Registered Psychiatric Nurse	1 (3.1)
	Registered Children's Nurse	1 (3.1)
Highest level of education	Certificate in Nursing	2 (6.2)
	Diploma in Nursing	1 (3.1)
	Degree in Nursing	16 (50.0)
	Postgraduate Certificate	1 (3.1)
	Postgraduate Diploma	11 (34.4)
	Masters	1 (3.1)
	Doctorate	1 (3.1)
Gerontology qualification	Yes	2 (6.2)
	No	30 (93.7)

Table 2. Correlations between nurse and expert Risk Instrument for Screening in the Community (RISC) scores.

	Pre-training	Post-training	Difference between correlations[1]
Low, Medium and High risk patients combined			
RISC Institutionalisation	0.72 (0.63 - 0.79)	0.80 (0.73 - 0.85)	$z = 1.79$, $p = 0.04$
RISC Hospitalisation	0.51 (0.40 - 0.62)	0.71 (0.62 - 0.78)	$z = 3.09$, $p < 0.01$
RISC Death	0.59 (0.48 - 0.68)	0.65 (0.55 - 0.73)	$z = 1.02$, $p = 0.15$

Note: reported values are Spearman correlation coefficients and 95% confidence intervals

[1] One-tailed p-value for z-test comparing two dependent correlations

Table 3. Proportions (expressed as a decimal) of matches between nurse and expert Risk Instrument for Screening in the Community (RISC) scores/categories.

	Pre-training	Post-training	Difference between proportions[1]
Low, Medium and High risk cases combined			
RISC Institutionalisation	0.64 (0.58 - 0.71)	0.71 (0.65 - 0.78)	$z = 1.42$, $p = 0.08$
RISC Hospitalisation	0.57 (0.50 - 0.64)	0.69 (0.62 - 0.75)	$z = 2.35$, $p = 0.01$
RISC Death	0.53 (0.46 - 0.60)	0.72 (0.66 - 0.79)	$z = 1.02$, $p < 0.01$
Low risk patients			
RISC Institutionalisation	0.76 (0.65 - 0.86)	0.95 (0.90 - 1.00)	$z = 3.16$, $p < 0.001$
RISC Hospitalisation	0.36 (0.25 - 0.48)	0.86 (0.77 - 0.94)	$z = 5.79$, $p < 0.001$
RISC Death	0.70 (0.59 - 0.81)	0.98 (0.95 - 1.00)	$z = 4.45$, $p < 0.001$
Medium risk patients			
RISC Institutionalisation	0.27 (0.17 - 0.38)	0.42 (0.30 - 0.54)	$z = 1.79$, $p = 0.04$
RISC Hospitalisation	0.48 (0.36 - 0.61)	0.48 (0.36 - 0.61)	$z = 0.01$, $p = 0.50$
RISC Death	0.53 (0.41 - 0.65)	0.70 (0.59 - 0.82)	$z = 2.02$, $p = 0.02$
High risk patients			
RISC Institutionalisation	0.91 (0.84 - 0.98)	0.76 (0.66 - 0.87)	$z = -2.23$, $p = 0.01$
RISC Hospitalisation	0.86 (0.78 - 0.95)	0.71 (0.60 - 0.83)	$z = -2.08$, $p = 0.02$
RISC Death	0.35 (0.24 - 0.47)	0.48 (0.35 - 0.60)	$z = 1.40$, $p = 0.08$
Minimum risk (RISC scores 1 and 2) [2]			
RISC Institutionalisation	0.76 (0.65 - 0.86)	0.95 (0.90 - 1.00)	$z = 3.16$, $p < 0.001$
RISC Hospitalisation	0.34 (0.21 - 0.47)	0.74 (0.64 - 0.83)	$z = 4.61$, $p < 0.001$
RISC Death	0.61 (0.53 - 0.70)	0.84 (0.78 - 0.91)	$z = 4.16$, $p < 0.001$
Maximum risk (RISC scores 3, 4 and 5) [2]			
RISC Institutionalisation	0.59 (0.50 - 0.67)	0.59 (0.51 - 0.68)	$z = 0.05$, $p = 0.48$
RISC Hospitalisation	0.66 (0.58 - 0.73)	0.64 (0.55 - 0.74)	$z = -0.17$, $p = 0.43$
RISC Death	0.35 (0.24 - 0.47)	0.48 (0.35 - 0.60)	$z = 1.40$, $p = 0.08$

Note: reported values are proportions and 95% confidence intervals

[1] One-tailed p-value for z-test comparing two proportions

[2] RISC score of expert was used for selecting patients

Table 4. Mean number of matches between nurse and expert Risk Instrument for Screening in the Community (RISC) scores/categories, (n = 32).

	Pre-training	Post-training	Difference between means[1]
Low, Medium and High-risk cases combined			
RISC Institutionalisation (0-6)	3.91 ± 1.17	4.25 ± 1.16	$t(31) = 1.20$, $p = 0.12$
RISC Hospitalisation (0-6)	3.44 ± 1.13	4.09 ± 1.33	$t(31) = 1.93$, $p = 0.03$
RISC Death (0-6)	3.13 ± 1.62	4.31 ± 1.03	$t(31) = 3.92$, $p < 0.01$
Total/overall score (0-18)	10.47 ± 2.68	12.66 ± 2.23	$t(31) = 3.63$, $p < 0.01$
Low-risk patients			
RISC Institutionalisation (0-2)	1.50 ± 0.72	1.91 ± 0.30	$t(31) = 3.23$, $p < 0.01$
RISC Hospitalisation (0-2)	0.72 ± 0.77	1.72 ± 0.52	$t(31) = 5.75$, $p < 0.001$
RISC Death (0-2)	1.38 ± 0.66	1.97 ± 0.18	$t(31) = 4.72$, $p < 0.001$
Total/overall score (0-6)	3.59 ± 1.76	5.59 ± 0.71	$t(31) = 5.70$, $p < 0.001$
Medium-risk patients			
RISC Institutionalisation (0-2)	0.56 ± 0.67	0.84 ± 0.77	$t(31) = 1.79$, $p = 0.04$
RISC Hospitalisation (0-2)	0.97 ± 0.70	0.97 ± 0.74	$t(31) = 0.00$, $p = 0.50$
RISC Death (0-2)	1.03 ± 0.74	1.41 ± 0.67	$t(31) = 2.34$, $p = 0.01$
Total/overall score (0-6)	2.56 ± 1.22	3.22 ± 1.07	$t(31) = 2.38$, $p = 0.01$
High-risk patients			
RISC Institutionalisation (0-2)	1.84 ± .45	1.50 ± 0.57	$t(31) = -2.61$, $p = 0.01$
RISC Hospitalisation (0-2)	1.75 ± .51	1.41 ± 0.67	$t(31) = -2.47$, $p = 0.01$
RISC Death (0-2)	0.72 ± .68	0.94 ± 0.72	$t(31) = 1.27$, $p = 0.11$
Total/overall score (0-6)	4.31 ± .90	3.84 ± 1.39	$t(31) = -1.69$, $p > 0.05$

Note: reported values are mean ± standard deviation

[1] One-tailed p-value for paired samples t-test comparing two means

Appendix 1.
Case study: High-risk case

Background: You have been asked to review Mr J, an 88 year old man who was found wandering on the road at night, looking for his wife.

Caregiver Network: A widower, who lives alone, after his wife died three months ago. His only son lives abroad. His next door neighbor, calls over to check on him and makes sure he takes his evening medications but is otherwise not involved. J had previously refused home help after a hospital discharge. There is no primary caregiver.

Domain 1: Mental State: Mr J was diagnosed with dementia 4 years ago and his last SMMSE was 12/30. He has a past history of depression and was admitted to a psychiatric unit 7 years ago. Mr J is generally a quiet man but gets agitated when people visit. He has very poor insight into his memory loss or care needs, saying he is fine and doesn't understand what all the fuss is about. He recognizes his son and his next door neighbor, but is very suspicious of strangers. He has been found wandering out on the road by the neighbor before, again looking for his wife. He can be found talking to her and will lash out with the stick when confronted or told she is not around. Living on a busy road, on a dangerous bend, he often leaves the door wide open at night. He is occasionally tearful and will often spend all day in bed. He has very poor personal hygiene and there is evidence in the house that he has been drinking heavily.

Domain 2: ADL's: Mr J lives in a two story house in the city center. He is incontinent of urine but there is no evidence of faecal incontinence. He has been using a bucket in his bedroom as a commode. He can transfer out of bed independently and is mobile with a stick. He insists on sleeping upstairs and walks up and down several times a day. He can usually dress himself with assistance, but often wears the same cloths day after day. He has not been showering. He hasn't got a telephone. J walks to the local shop for groceries, but appears not to be eating well. He can make tea for himself but he is not cooking. His house is untidy and the neighbor says he has seen rats in the kitchen. Js` wife previously did all of his housework. His wife had managed his own finances up until she died and it is unclear if anyone is doing this now. Medications are dispensed in daily blister packs but he doesn't take them.

Domain 3: Medical State: Mr J attended accident and emergency twice over the last three months, each time brought in by his neighbour with increased agitation at home. He was discharged from A&E each time. It is not known if he has fallen, but there are bruises on his arms and his face which suggest he may be falling in the house. His gait appears abnormal, possibly suggesting a sensory neuropathy. He has no difficulty hearing but wears glasses which correct his vision. No swallowing difficulties are evident. His speech is slurred. He is treated with Donepezil 10mg, trazadone 150mg, Escitalopram 10mg. The house is poor condition with a leaking roof and cats (at least 10) roaming around the house.

Currently: Mr Js` son has called asking you to review him. He is worried about his father since the death of his mother and wonders now whether his father should stay at home. His son has come home to try to deal with the problem.