Use of the MMRI-R prognostic tool for older patients discharged to nursing homes from hospital: a prospective cohort study

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Abstract

Background: the Minimum Dataset Mortality Risk Index—Revised (MMRI-R) is a prognostic score predicting 6-month mortality in US nursing homes. It has not been validated in the UK nor at the hospital–nursing home interface.

Methods: prospective cohort study of consecutive patients discharged from hospital or intermediate care to nursing homes from January 2012 to January 2014. MMRI-R scoring was done prior to discharge and subsequent deaths were ascertained. Calibration plots, receiver operative characteristic curves with area under the curve (AUC) and an optimal cutpoint were obtained. Kaplan–Meier curves were plotted with scores stratified by the cutpoint.

Results: a total of 183 patients were followed up for a median of 230 days. Median age was 87 years and 55.7% were female. Median MMRI-R score was 55. By the end of follow-up, 99 patients (54.1%) were dead. The Hosmer–Lemeshow test showed P-values of 0.4406 for 3-month and 0.8904 for 6-month mortality. The AUC was 0.70 (95% CI: 0.622–0.777) for 3-month death prediction and 0.723 (95% CI: 0.649–0.797) for death at 6 months. Of patients with MMRI-R scores >48 (the cutpoint), 43.6% were dead at 3 months and 53.6% by 6 months. The corresponding figures for scores <48 were 9.6 and 16.4% (P < 0.001, log-rank test).

Conclusion: the MMRI-R can be used at the acute hospital/nursing home interface, and can help predict 3-month and 6-month mortality. The finding of an MMRI-R score of ≥48 should trigger end-of-life discussions.

Keywords: older people, end-of-life care, risk stratification, nursing homes

Introduction

In the UK, care homes provided accommodation for ~460,000 people aged 65 or over in 2011 and this figure is set to increase with population ageing [1]. Age- and sex-adjusted mortality is approximately four times higher in nursing homes than in the community [2]. Studies in the UK show that 26–56% of nursing home residents die within 1 year of admission [2, 3]. In many frail older people, an acute illness requiring hospital admission leads to nursing home placement. A proportion of such patients will be in the last few months of life. National recommendations suggest that people approaching the end of life should have an agreed care plan [4]. This includes decisions about the preferred place of death, avoidance of inappropriate admissions to hospital and commencement of palliative care. The hospital–nursing home interface thus provides a unique opportunity to assess prognosis and institute appropriate care planning.

Prognostication can be difficult and a validated tool to predict mortality would be useful. Several non-disease-specific prognostic tools for hospitalised older patients exist [5–7]. These estimate 1- to 2-year mortality, and are not specific to patients discharged to nursing homes [5–7]. Several candidate prognostic scores for nursing home residents are also available [8–11]. The Minimum Data Set (MDS) Mortality Risk
Index—Revised (MMRI-R), a simplification of the original MDS Mortality Risk Index (MMRI), was designed, and validated in the USA using information from the MDS, a clinical and administrative database designed to monitor quality of care in Medicare and Medicaid registered nursing homes [10, 11]. It predicts 6-month mortality in US nursing home residents, and has not been formally validated in the UK [10]. The modifications made to the original MMRI score were designed to enable its use outside USA using information available from standard comprehensive geriatric assessment [10].

We hypothesised that a nursing home prognostic indicator could be used at the interface between hospital and nursing home, and aimed to assess the performance of the MMRI-R in a pilot study of patients discharged to nursing homes in Worcestershire, UK following an acute hospital episode. We theorised that the MMRI-R score could predict 6-month and possibly 3-month mortality, and that an ‘optimal’ cutpoint could prove useful.

Methods

Study design, setting and patient population
A prospective cohort study was conducted, which involved consecutive patients discharged to nursing homes from four settings following an acute inpatient episode. These sites included a community hospital, a hospital geriatric rehabilitation ward, an acute hospital medical admission unit and a community-based intermediate care unit where medical input was provided by the investigators. A geriatrician with a special interest in end of life care prospectively identified patients who were discharged to more than 30 local nursing homes between 1st January 2012 and 31st January 2014. The selection criteria were broad, and all patients discharged to nursing homes from these four sites were eligible. The only patients excluded were people clearly in the last few days of life, and patients sent to nursing homes temporarily, for example, non-weight-bearing fractures and people requiring adaptations to their homes.

The score and data collection
The MMRI-R tool is a 10-item score sheet with yes/no options, weighted points for each item and scoring guidance [10]. It uses easily available clinical data, which are a standard part of hospital clinical assessment. The first eight items are admission to nursing home in the last 3 months, unintentional weight loss, renal failure, chronic heart failure, poor appetite, male sex, dehydration and shortness of breath [10]. The last two items are derived from the interaction effects of variables, that is, derived from more than one variable (age with the presence of cancer and cognitive impairment with functional abilities). The item scores are added up to produce a total numerical score (range 0–85) with a corresponding percentage (4–100%) risk of dying at 6 months for each patient [10]. Two clinicians collected the relevant data from clinical information on each patient prior to nursing home discharge.

Data collected included all the items in the MMRI-R score and diagnosis.

Follow-up
One clinician subsequently scrutinised the county’s electronic NHS portal to establish if the patients were alive at the end of follow-up and if not, to determine the date of death. This portal indexes patients by their NHS numbers, and records demographic data, clinical episodes and deaths occurring anywhere in the county. Patients were followed up for at least 6 months.

Ethics approval
An outline of the study was reviewed by the local research network and was classed as service development. Formal ethics approval and patient consent were not deemed necessary. All the data collected were derived from information collected as part of standard clinical assessment. No additional procedures or subsequent patient contact were necessary as part of the study.

Statistical analysis
We assessed the calibration (observed versus predicted event rates for groups of patients) of the MMRI-R score for 3- and 6-month mortality using calibration plots along with the Hosmer–Lemeshow test [12]. Discrimination (how well it distinguished between patients who did or did not have the outcome event) of the MMRI-R for 3- and 6-month mortality was assessed by receiver operating characteristics (ROC) curves with area under the curve (AUC or c statistic) [12]. We determined an optimal threshold value for the MMRI-R scores using the Youden Index [13]. We then dichotomised the MMRI-R scores into a high-risk group with scores at or above the cut-off and a low/medium risk group with scores below the cut-off. Kaplan–Meier curves were obtained for the two levels of the score and the log-rank test was used to assess if there was a statistically significant difference between the two groups. The open source statistical software and programming environment ‘R’ was used for data analysis [14].

Results
Between January 2012 and January 2014, 183 patients were discharged to nursing homes from our four participating hospital and intermediate care settings. Median age was 87 years (range 54–104). One hundred and two (55.7%) were female. Diagnoses on discharge included a large number of acute problems such as sepsis, acute kidney injury, delirium, dementia, falls, fragility fractures and stroke. Median MMRI-R score for all patients was 55 (range 20–77). Follow-up was for a median of 230 days (inter-quartile range 63.5–409). By the end of the study, 99 patients (54.1%) had died. Of the 99 who died, 55 (55.6%) were dead by 3 months and 71 (77.8%) had died by 6 months.
Figure 1 shows calibration plots (predicted versus observed mortality) for the MMRI-R score for deaths at 3 and 6 months, respectively. These showed better calibration for death at 6 months than at 3 months. The Hosmer–Lemeshow goodness-of-fit statistic, however, showed non-significant $P$-values for both death at 3 months ($P = 0.4406$) and 6 months ($P = 0.8904$), suggesting good calibration or fit for both sets of predictions.

The area under the curve (AUC) or c statistic was 0.70 (95% CI: 0.622–0.777) for prediction of deaths at 3 months and 0.723 (95% CI: 0.649–0.797) for deaths at 6 months. Both these values suggest acceptable discriminatory values. The optimal cut-off MMRI-R score as determined by the Youden index method was 48, which gave a sensitivity of 87.2% and a specificity of 51.6%. The MMRI-R scores were dichotomised to ‘high risk’ (scores $\geq 48$) or ‘low–medium risk’ (scores <48).

Figure 2 shows a Kaplan–Meier curve of survival in the two risk groups of MMRI-R scores. In the high-risk group, 43.6% of the patients were dead at 3 months and 53.6% were dead at 6 months. The corresponding figures for the low/medium risk group were 9.6 and 16.4%. The difference in survival across the two risk categories was highly significant by the log-rank test, $P < 0.0001$.

**Discussion**

Our study, the first to validate the MMRI-R in the UK, showed that the MMRI-R can be used to assess 3- and 6-month prognosis for patients discharged to nursing homes from hospital or intermediate care. The tool showed good calibration and discrimination when applied to our dataset. The AUC of 0.723 for death at 6 months compares with the value of 0.76 in the original MMRI-R validation study [10] and 0.59 in another US validation study [15].

MMRI-R scoring involves no special training, and takes about 15 min to complete. It may be difficult to apply to patients with strokes with dysphasia or those with percutaneous endoscopic gastrostomy (PEG) tubes. The score attaches a high weight to admissions within the preceding 3 months to nursing homes. It was not originally designed for patients at the transition from hospital to nursing home. In the UK, many patients are admitted to nursing homes after acute episodes in the secondary care. To reflect this, the MMRI-R score in this study was based on information gathered prior to admission to the nursing home following an acute inpatient episode.

Advance Care planning documentation is being introduced across Worcestershire to aid decision-making around
end-of-life care. Patients thought to have a prognosis of less than 3 months are eligible to be considered for health-funded care. Our study showed that the MMRI-R was useful in predicting 3-month as well as 6-month mortality in our patient cohort, although some predictive power was lost as the score was originally designed to predict 6-month mortality. A cut-point for the score has not been used before. Using a cut-off of ≥48 points for the MMRI-R score increased its usefulness; 43.6% of patients with a high-risk score were dead by 3 months and 53.6% by 6 months. A much smaller proportion of patients with lower scores died in our study.

Our study has limitations; the sample size was small, and could be considered a convenience sample. However, we have no reason to suspect that our case mix would be any different when compared with other UK healthcare settings. The median age of our patients was 87 years, and included patients with a wide range of common acute problems such as sepsis, acute kidney injury, delirium, dementia, falls, fragility fractures and stroke. The proportion of females in our cohort (55.7%) was lower than in many nursing home cohorts [10, 11, 16] but was not dissimilar to some reported acute hospital populations [17, 18]. Patients, in our study, were discharged to nursing home from four diverse ward settings (hospital and intermediate care), thus improving its generalisability. It was a prospective study and every effort was made to identify consecutive patients discharged from these settings. The study’s other strengths include the fact that no data were missing nor were any patients lost to follow-up.

In conclusion, the MMRI-R shows promise as a useful tool for predicting death in patients discharged to nursing homes after an acute inpatient episode. It is useful in predicting 3-month as well as 6-month mortality. Using a cut-off score of ≥48 increases its usefulness. The finding of an MMRI-R score of 48 or greater should be a trigger to initiate end-of-life discussions to put in place appropriate care plans.

Key points

- The MMRI-R is a prognostic score predicting 6-month mortality in nursing home patients, which has not been evaluated in the UK
- This study assessed the MMRI-R score at the hospital-nursing home interface
- The score predicted both 3- and 6-month mortality

Conflicts of interest

None declared.

References


