

# Validating a Prognostic Model for Mortality of Psychogeriatric Inpatients

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**How to cite this paper:** Moebs, I., Gale, C., Abeln, E., Seifert, A. and Barak, Y. (2023) Validating a Prognostic Model for Mortality of Psychogeriatric Inpatients. *Open Journal of Psychiatry*, 13, 27-32.

<https://doi.org/10.4236/ojpsych.2023.131004>

**Received:** October 25, 2022

**Accepted:** January 7, 2023

**Published:** January 10, 2023

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## Abstract

**Background:** To validate a predictive scoring system for 1-year mortality among psychogeriatric inpatients admitted for acute psychiatric care. **Methods:** Computerized data were extracted from the District Health Board Database for a university affiliated general hospital. A geriatric risk scoring system developed in the USA was employed to validate mortality within 1-year of hospital discharge. **Results:** Among 125 psychogeriatric inpatients who were discharged in 2017, [mean age 82.8 ( $\pm 8.9$ ) years, 82 (65.6%) women] 33 died within 1-year [26.4% of the sample, mean age, 87.7 ( $\pm 11.1$ ) years, 25 (75.7%) women]. Levine's mortality index predicted death. A post hoc probit analysis found two factors significantly associated with predicted mortality: metastatic cancer (Chi-square = 5.6;  $p < 0.02$ ) and discharge to care (Chi-square = 14.1;  $p < 0.001$ ). **Conclusions:** A geriatric 1-year mortality scoring system accurately predicted mortality among psychogeriatric inpatients. Predicting psychogeriatric mortality should be considered a guideline for ensuring quality of care and appropriate discharge and advanced care planning.

## Keywords

Psychogeriatric, Mortality, Prediction

## 1. Introduction

Estimating mortality risk, is important in terms of medical decision-making and optimal management and care of older patients, especially those suffering from comorbid psychiatric illness [1].

Prognostic models for mortality of older adults have been developed for different populations [2]. A search of a Scopus database for articles identified 103 articles describing 193 models. It was concluded that models were regularly developed to help with clinical decision making but their use is premature [3].

However, to the best of our knowledge, no specific focus on the added burden of psychiatric comorbidity was tested [4].

Psychogeriatric inpatients are more frail and complex to manage than geriatric patients due to higher rates of co-morbidity, polypharmacy and the adverse effects of life-long and current psychiatric morbidity [5] [6]. A prognostic index for 1-year mortality risk in older adults discharged from a general medicine service was developed based on administrative data [2]. Risk factors independently associated with 1-year mortality included: age, length of inpatient stay, discharge to nursing home, congestive heart failure, peripheral vascular disease, renal disease, hematologic malignancy, and dementia. Administrative data validly identified high-risk mortality groups [2].

We aimed to validate a prognostic model for 1-year mortality in old-age psychiatry inpatient services.

## 2. Methods

This is a retrospective cohort audit in a general hospital inpatient psychogeriatric ward with unplanned psychiatric admissions during 2017.

Records of all patients admitted to say ward were included in the analyses. This served as a naturalistic cohort.

We collected patients' gender, age, discharge location (home or facility), length of hospital stay, and all risk factors tested by Levine *et al.* [2]. Data was collected from computerized discharge summaries.

### 2.1. Prognostic Risk Scoring System

The prognostic scoring assigned to each of the 9 final risk factors are shown in **Table 1**. A final risk score was calculated by adding the points designated for each risk factor. For example, a 90-year-old patient (2 points) with congestive heart failure (1 point) and who is discharged to a nursing home (1 point) will have a final risk score of 4 points.

### 2.2. Analysis

Age was coded as per Levine's protocol (see **Table 1**) as Zero (less than 70, One (70 to 74) and Two (75 or older). Items were collapsed to bivariate outcomes tested against survival using the chi-squared test. Any correlation from this tabulation with a  $p < 0.10$  was entered into a Probit (probability unit) regression, and a de novo model established. The significance of the correlation in toto was tested using Wald's test and post hoc testing of the significance of each coefficient using in parallel, the risk scoring system for each participant was extracted using Levine's method (see **Table 1**) and the correlation for this model was tested against survival.

Probit analysis operates like multiple regression with dependent or response variables that are binary. It enables converting data to a representation that could be viewed as a linear function. For both models, linear regression was used

**Table 1.** Mortality score sheet.

Risk factors associated with one-year mortality (From Levine <i>et al.</i> , 2007)			
Characteristic		Odds ratio	Points
Age, years	70 - 74	1.6	1
	75 - 79	2.2	2
	80 - 84	2.0	2
	85 - 89	2.9	2
	90 or over	3.0	2
Discharge to nursing home or skilled care facility	Yes	1.7	1
Length of stay five days or over	Yes	1.5	1
Comorbid condition present:	Congestive Heart Failure	1.3	1
	Peripheral Vascular Disease	1.8	1
	Dementia	1.6	1
	Renal Disease	1.7	1
	Hematologic and Solid malignancy	1.7	1
	Metastatic cancer	3.1	2

to estimate the proportion of variation attributable to the model [7].

There were no missing data nor indeterminate outcomes.

### 2.3. Ethical Approval

Ethical approval was obtained from the University of Otago Ethics Committee reference number HD19/080 and the Southland Medical Foundation Ethics Committee project number 01603.

### 3. Results

Between January 2017 and Dec 2017 there were 125 inpatient admissions to the closed psychogeriatric unit at the Dunedin Public Hospital. All 125 patients' electronic records were accessed and relevant information extracted. Mean age for the sample was 82.8 [ $\pm 8.9$ ] years, 82 (65.6%) women. Thirty-three (26.4%) [mean age, 87.7 ( $\pm 11.1$ ) years, 25 (75.7%) women] died before reaching the 1-year survival post-discharge threshold.

Deaths were ascertained by cross referencing the patients NHI (National Health Identifier) with the Ministry of Health's database of mortality. Patients were followed for 12 months or until the date of death, if that occurred before 12 months of follow-up.

Using Levine's derivation cohort 1-year mortality risk scores [2], we demonstrated that a higher score was significantly predictive of mortality within 12 months of discharge (Wald  $\chi^2 = 9.1$ ,  $df = 1$ ,  $p = 0.0026$ ). Patients who passed

away had a mean score of 5.0 compared with patients alive after 12 months whose mean score was 3.3.

Two factors were statistically different between the “alive” and “passed away” groups: discharge to a care facility (Chi-square = 14.1;  $p < 0.001$ ) and the presence of metastatic cancer (Chi-square = 5.6;  $p < 0.02$ ).

There was a no correlation of length of stay over 5 days and mortality: in part because most patients stayed longer.

Three factors correlated significantly with mortality: discharge into care, a diagnosis of cancer, and metastatic cancer. These three factors were tested against each other using probit regression, and discharge to care remained highly correlated with mortality. The three factor model had a significant correlation using the Wald test (Wald  $\chi^2 = 13.2$ , 3 df,  $p = 0.0042$ ).

## 4. Discussion

The last decade’s studying high-dimensional data has driven an increase of prediction in medicine and psychiatry [8]. We evaluated the ability of a published prognostic index for 1-year mortality of hospitalized older adults [2], using readily available standard administrative data, to predict mortality of inpatient psychogeriatric patients. The index was readily able to identify patients with a high 1-year mortality rate. Our findings are also in line with other published studies that focused on psychogeriatric dementia inpatients after unplanned acute hospital admission [9].

The present study has some major strengths and limitations. This is the first study that has evaluated predictors of mortality in a cohort of hospitalized psychogeriatric inpatients. This was a single-centre study. The clinical profile of the patients treated and cared for at psychogeriatric wards might be uneven among hospitals due to different policies dictating acute psychogeriatric services.

## 5. Conclusion

The Prognostic Risk Assessment Tool accurately predicted 1-year mortality in psychogeriatric inpatients. Further elucidation of the factors that predict mortality over time is important. A more hopeful compassionate approach to older people with an expectation of life measured in years not months may be a way forward.

## Declarations

### Ethics Approval and Informed Consent

Ethical approval was obtained from the University of Otago Ethics Committee reference number HD19/080 and the Southland Medical Foundation Ethics Committee project number 01603.

This manuscript reports human data. We hereby state that all methods were carried out in accordance with relevant guidelines and regulations.

## Informed Consent Was Not Obtained for Publication of Patient Data

This is due to the fact that all data was de-identified prior to use and the Southland Medical Foundation Ethics Committee was consulted in the preparation of the dataset.

Administrative permissions to access the raw data was granted by the Southland Medical Foundation

## Availability of Data and Materials

The datasets used and analysed during the current study available from the corresponding author on reasonable request.

## Authors' Contributions

All authors meet criteria for authorship as stated in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals.

Authors' contributions are as follows:

- Study concept and design: Yoram Barak and Isabelle Moebs.
- Acquisition of data: Esther Abeln, Annalise Seifert.
- Analysis and interpretation of data: Chris Gale, Esther Abeln.
- Drafting of the manuscript: Yoram Barak and Isabelle Moebs, Esther Abeln, Annalise Seifert, Chris Gale.
- Critical revision of the manuscript for important intellectual content: Yoram Barak and Isabelle Moebs, Esther Abeln, Annalise Seifert, Chris Gale.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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