Risk of Death Scale: A Death Prediction Model Based on US Nursing Home Admissions in 2011 and 2012

John N Morris
Hebrew SeniorLife Institute for Aging Research

Elizabeth Howard (✉ e.howard@neu.edu)
Northeastern University School of Nursing  https://orcid.org/0000-0002-6282-7551

Sabrina Egge
Hannover Re

Erez Schachter
Profility, Inc.

Fredrik Sjostrand
Karolinska Institutet

Research article

Keywords: risk of death, death rate, death risk factors, nursing home admissions, MDS 3.0, interRAI

Posted Date: October 14th, 2019

DOI: https://doi.org/10.21203/rs.2.15997/v1

License: ☺️ ☛️ This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

Background: Care planning has become more complex as nursing homes now are serving an ever more complex patient population. The primary purpose of this project is to identify, among persons admitted to and remaining up to 12 months, in a long-term care setting, those at more imminent risk of death, revealing the relevant risk factors and summarizing these factors within a Risk of Death Scale.

Design: Longitudinal analysis of a national cohort of nursing home admissions from all United States facilities during years 2011 and 2012.

Setting and Participants: Cohort included 1,536,842 admissions (764,002 for 2011, 772,840 for 2012). Repeated assessments are required every 90 days, with an additional assessment at discharge. Follow-up data over three years were examined.

Methods: The Risk of Death Scale is based on two sub-scales. One included five very high risk of death measures. The second was composed of an additional eighteen risk factors. The dependent variable against which these models were developed was death by 365 days. Death rates are described from one-month post-admission to three years post-admission.

Results: The Risk of Death Scale has twelve graded levels. The lowest four categories of the scale (0-3) represent approximately half the cohort and have one-year death rates that range from 3% to 15.5%, whereas the mean of the whole cohort is 24.2% at one year. The top four categories represent about 7% of the cohort and have one-year death rates ranging from 55.8% to 90.5%. The death rates increased steadily across the scale scores, a pattern that held through the three-year post admission period.

Conclusions/Implications: The Risk of Death Scale for new admissions to nursing homes rests on a broad spectrum of 23 independent variables – including measures of prognosis, treatments, diagnoses, clinical status, function, cognitive status, and age. Almost 10% of the sample (n=149,073) had a risk score of 7 or greater and the average one-year mortality for this group was 68.6% (range of 47.5-90.5%).

Introduction

Nursing homes serve an ever more complex patient population. Many residents will spend their last days in a nursing home, especially those with dementia. The increased number of assisted living beds and the availability of services in the community has resulted in a decrease of nursing home beds for less complex, lower need residents. With change in case-mix, nursing home care planning has become more complicated.

Miller and Weissett reported that death in a nursing home was more prevalent in the presence of poor functional performance, illness severity, and prior hospitalizations. In a national study of nursing home residents with dementia using 2002 data, Mitchell and colleagues identified 12 predictor variables, including age, sex, length of stay, dyspnea, pressure ulcers, body mass index, weight loss, and congestive
heart failure. A subsequent, prospective study examined ongoing complications of residents as death approached and revealed a more limited risk set, including pneumonia, febrile episodes, and eating problems. Chen and colleagues assessed how residents with dementia approached death in contrast to persons with cancer or heart failure, and their work indicated ADL changes in the last year of life was greatest for the terminal cancer group.

Two additional studies predicting death in the nursing home are noteworthy. Examining these same issues for a Michigan population of persons with dementia in nursing homes and home care identified the following factors as key for an increased death risk: hospice care, an assessed life expectancy of less than 6 months, advance directives in place, pain, shortness of breath, and oxygen therapy. Cohen-Mansfield and colleagues reported on an eleven-year death follow-up for 399 long-term care residents. Relevant risk factors included being male, a variety of medical diagnoses, manifestation of physically agitated behaviors, cognitive impairment, older age, ADL impairment, and screaming behavior. Others have examined the predictive validity of the Mortality Risk Index for MDS 3.0 using select samples and various time frames.

The research described in this paper was designed to further understanding of the death trajectory of persons entering and remaining in nursing homes, using one of the largest data sets ever analyzed, employing a broad set of independent variables that align with the reported literature. Here, we brought together a subset of these independent measures in a logistic equation to predict death at 365 days following admission into the long-term care institution. Subsequently, we selected from among the most important of these measures to produce a risk of death scale for clinical decision-making at or near the end of life, allocating resources, end of life planning, and governmental monitoring for facilities with higher than expected death rates.

**Methods**

**Sample and Data**

This paper is based on secondary analyses of data from a national cohort of nursing home admissions from all United States facilities for the years 2011 and 2012. Excluded were persons discharged from the nursing home for reasons other than death and in particular, those receiving short-term skilled (post-acute) care. In total, the cohort included 1,536,842 admissions; 764,002 for 2011 and 772,840 for 2012. Follow-up assessments were scheduled every 90 days, with additional assessment at discharge. Data were available for three years.

All de-identified assessments were completed by clinical professionals, largely nurses trained in use of the MDS 3 instrument. The reliability of such assessments has been established, and we expect the reliability of these data to be excellent, consistent with values reported previously. The geriatric assessment used in US nursing homes is the MDS 3.0, an instrument jointly owned by CMS and interRAI. MDS is designed to record a comprehensive assessment of resident status, ultimately resulting in the
creation of a wide-ranging plan of care. As MDS 3.0 includes a broad depth and breadth of key measures, in the preliminary analyses we considered 101 independent variables.

Our dependent death measure also came from MDS 3.0. Mandated follow-up assessments contain information on date and site of discharge. Included among the later are death, acute hospitalization, transfer to another nursing home, and return to the home. Primary model development was based on death on or before day 365 after admission. The contrast sample included residents in the admission cohort who were still in a nursing home 365 days post admission. For persons discharged alive prior to day 365, we have no information on whether or not they died within the year. A series of analyses are presented to describe cases lost to follow-up to determine if this sample is different from those who remained in residency. Finally, we looked at the efficacy of the baseline death-risk model in understanding 3-year death rates.

**Analysis**

Secondary analyses were performed on data generated from MDS assessments for new admissions to chronic long-term care facilities in the US. Independent variables were drawn from the baseline assessment. The dependent measure was taken from the last known assessment in the following 3-year period.

The first set of analyses identified the individual baseline independent variables that best predicted 365-day follow-up measure of living status—either died within 365 days or was alive 365 days into the stay. Because of the sample size, a wide variety of items (with very low measures of association) were significantly related to the dependent measure, even at very low levels (e.g., <.01). The best possible dichotomous form (or forms) were identified, and a minimal univariate odds ratio of 1.5 was set as a requirement. These variables were assessed in the logistic model.

The first of two stepwise logistic regressions included the identification of the personal baseline characteristics for residents who died within 365 days of admission. Identified items were next assigned to one of two categories: those more directly related to death (a univariate odds ratio of 5.0 or higher) and all others. Next, the remaining measures were subjected to a second logistic model to identify the final sub-set of measures used in construction of a death-risk scale.

All measures in the higher set were placed into an immediate risk scale, while the most powerful subset of measures that entered the second logistic equation were aggregated into a secondary risk scale. The two preliminary scales were then compared and the mean death rates identified for the resultant two-way table. Based on this pattern of death rates, the items were used to generate levels in the final Risk of Death Scale.

**Results**
Descriptive Characteristics

The cohort included a diverse array of residents. Demographically, the majority were female (62%), 29.7% were married, 40.1% widowed, 12.3% divorced, 1.5% separated, and 16.4% never married. The average age at admission was 76.3 years, 14.2% were under 60 and 17.1% were 90 years of age or older. Most residents came into the facility from a hospital (76.5%) while 15.2% came directly from home and 5.5% from another nursing home.

Review of all MDS cognitive items revealed about three-quarters had a memory problem, but only about 4% could not be understood and 3% could not understand others. The Cognitive Performance Scale (CPS) indicated that 10% were free of cognitive deficits, while 19.8% had moderate or more impaired cognitive status. The functional performance of the residents can best be described by their status on two summary scales—the ADL Long Form (which summarizes seven ADLs) and the Nursing Home Frailty Scale. On the 28-point ADL scale, where a higher score indicates a more impaired resident, the mean value was 16.7, or about 60% along the continuum, whereas 13.1% of residents had a score from 0 to 10. At the frail end of the scale, 11.6% of persons had a score of 23 or higher. A similar result emerged on the 15-point Frailty Scale.

Death Rate and Construction of the Logistic Prediction Model

Table 1 displays selected parameters for the variables that entered the final logistic model. Of the thirty-five independent variables that entered the multivariate model, 5 suggested an imminent risk of death. The prevalence rates of the 5 were relatively low, with a range of 0.3–8.4%. The remaining 30 variables fall into the following categories: treatments, diagnoses, clinical conditions, cognition and communication, function, and age. No one subset of these measures overwhelms the model. Generally, if one exhibits one or more of these baseline conditions, one's risk of death was somewhat higher.

The four treatment measures in this set, oxygen therapy, parenteral/IV feeding, chemotherapy, and respite care, depict residents who were seriously compromised. For the last three of these measures, very few of the residents received the treatment but the associated risk of death ranged from 34.8% to 43.8%. Oxygen therapy, however, was given to several residents (18.4%), and the associated risk of death was 38.1%.

Three diagnoses entered the logistic model: cirrhosis, heart failure, and malnutrition. Of these measures, the aspect of nutritional status was present in 7 of the 12 clinical measures. Included were measures of unintended weight loss and low BMI, as well as a series of more symptomatic indicators—dehydrated, poor appetite, and three swallowing related indicators. Other clinical risk factors included incontinence, unhealed pressure ulcers, and shortness of breath.
Four indicators suggested more advanced cognitive loss: having a moderate or more severe Cognitive Performance Scale score (the equivalent of a Mini Status Scale Score of less than 10); only able to understand at best simple, direct communication with others; lethargic or difficult to keep aroused during the interview; and difficulty focusing attention during the interview.

While all functional activities of daily living measures had significant positive univariate odds ratio with death by day 365, only 4 entered the final model. Two measures—locomotion off the unit and bathing—referenced persons who were totally dependent in ADLs.

The 2 remaining ADLs in the logistic model referenced persons who received any physical help from others. These ADLs are eating and toilet use. Eating is the last of the ADLs in which one typically requires support, here only 31.8% received any help, and when defined in this way, 34.2% died by day 365 (a univariate odds ratio of 2.2). Toilet use, unlike eating, is an area in which large numbers of residents received assistance. Here, death rate by day 365 was 25.6%, compared to 13% among those who were independent. The final measures in the initial multivariate logistic model were three dichotomous age variables.

The next step in the analysis was to identify variables in the first logistic model that should be selected to create a system for assigning persons into discrete risk of death categories. Two subscales were created—in each case adding together the dichotomous scores for the selected items and thus, depending on the person's scores on these two subscales, a death-risk assignment was made. The first subscale was based on a count of the 5, very high risk variables, and had a possible score range of 0 to 5.

The second subscale was based on a subset of the variables in the remaining set that first entered a second logistic model, excluding the 5 very high risk measures. The first 18 variables to enter this second logistic equation were selected to form the second subscale. These variables are noted by a “**” in Table 1, and this subscale has a range of 0 to 18. Variables represent 6 domains: two treatments, two diagnoses, six clinical, two cognitive, three functional, and three demographics. Table 2 presents the assignment rules using the 2 subscales. For example, the 4 lower risk categories all have a score of zero on the very high risk subscale and scores of 0 to 5 on the remaining variable subscale.

Figure 1 displays both the distribution of cases across the categories of the Risk of Death Scale (those for whom a day 365 alive or dead determination was possible) and the percent who died in each of these scale categories by day 365. The majority of persons in the cohort are in the 4 lowest scores on the scale (53.1%), while 19.6% are in the 6 higher categories of the 12-point scale. The death rate by day 365 rose linearly from category “0” (3%) to category “11” (90.5%). The death rate reached one-third by category “6” and exceeded 50% by category “8.” In line with the linear progression of rates, the eta measure of association was reasonably high at .449.
Figure 2 presents the death rate profiles when the time period extends from 30 days to 3 years after admission. At 30 days post admission, only persons with risk of death scale scores of 9 through 11 had a death rate of 10% or higher—12%, 22%, and 36% respectively [note—this is the follow-up with the highest case count where it was possible to say whether the members of the cohort were alive or dead at the end of the period—90%, see materials below for sample discussion]. All 3 of the groups (scale scores of 9,10 and 11) experienced a distinct increase in death rates by three and six months post admission, with the death rates at six months being 52%, 69%, and 84% respectively. No other group reached the point where 50% or more of the residents died until group 8 at one year—56% died by this point in time.

At the other death extreme, risk group “0” had death rates of 3% or lower up to the end of the first year, a death rate level corresponding to the general US population. These rates rose to only 5% and 7% at years 2 and 3 post admission. Groups “1” thru “3” had rates that were only slightly higher than group “0”. All were less than 1% at 30 days, less than 7% at 6 months, and 6% to 16% at one year. By the end of year 3, the rates had taken a step up to 25%, 36% and 47% respectively. At these later dates, it is clear that group “3” was distinct from groups “1” and “2”. The more mid-range Death-Risk groups, categories “4” thru “8”, displayed stepped risks over time. At 6 months, the death rates ranged from 10% to 38%, at one year, the rates ranged from 22% to 56%, and finally at 3 years, the rates ranged from 55% to 84%. When viewing the full range of Risk of Death categories, there was a steady increase in death rates at all time periods, with higher rates of death by days 30 and 90 post admission. The very lowest rates were found for categories “0” and “1”. Rates at about the study population average occurred for categories “4” and “5,” and categories with rates at about double the average death rate or higher were “7” thru “11”.

For all persons, we have a baseline and discharge assessment. If the person remained in the facility up to a given date or died at that date or earlier, we can track their death status. But some persons were discharged alive prior to the end of a given follow-up period. When that occurred the resident could not be entered into the equation that determined the time-specific death rate.

To provide insight on these cases, we looked at both the rate at which persons left the nursing home for other sites and a comparison of the Death-Risk Scale profile of categories for persons who left and did not leave the facility by day 365. Figure 3 displays the rate at which persons left the nursing home (and did not return), by the destination site. Here, case loss is steady over time with the exception of those residents who returned home. For these residents, there is a higher rate of discharge in the months closer to the baseline assessment. Supplemental file presents a summary table comparing demographic and study variables and vulnerability items not used in the scale for those with follow-up data at year 1 and those lost to follow-up.

Among the 30 items compared, only one, age in years, had an eta value of 0.15 or higher. There were no major differences between the study sample and the group lost to follow-up for the other items.
Figure 4 displays the baseline Risk of Death Scale scores for persons without follow-up data at day 365, persons with follow-up data at day 365, those discharged home, those discharged to an acute hospital, and those discharged to another nursing home. Of note, those without follow-up data at day 365 had a Risk of Death Scale score profile that differed little from those for whom we could calculate whether they had died prior to day 365 or were alive at that time. In total, the two distributions of Death-Risk Scale scores were about the same.

Discussion

Based on a review of the literature and the extensive available item set in the MDS 3.0, we reviewed and utilized a wide variety items to develop a Risk of Death Scale for persons entering nursing homes. Of the more than 100 variables assessed as potentially relevant to one's risk of death within 365 days, thirty-five had univariate odds ratios of 1.5 or higher and entered the initial logistic equation.

Five of the variables had higher odds ratios of at least 5.0. They included discrete indications that death was near—admitted from a hospice program, in a hospice program, receiving radiation therapy, had a cancer diagnosis, and assessed by the clinician as having a projected life expectancy of less than 6 months. Several of these variables have been reported in other models, including the measures of cancer, hospice care, and assessed life expectancy, \textsuperscript{5,7,8,18} what is distinctive in this paper is our bringing together of the 5 elements as jointly putting these newly admitted residents within a higher risk of death grouping.

The remaining 30 independent variables identified in the first logistic model (all of which had a univariate odds ratio of at least 1.5, fell into a series of categories, including treatments, diagnoses, clinical conditions, cognition and communication, function, and age. The second logistic model identified eighteen unique measures that fell into the second risk subscale. Included were treatments such as chemotherapy, the diagnoses of heart failure (CHF), clinical factors that emphasized malnutrition and shortness of breath, poor cognition, impaired function, and age. While the resulting model includes items that may be associated with facility characteristics such as hospice and chemotherapy, they reflect a broad-spectrum approach to the prediction of death.

Using the 2 subscales, a 12-category risk scale was created, with one-year death rates progressing linearly from 3% to 90.5%. The first 4 scale categories, representing about 50% of the cohort, had an average one year-death rate less than 9%. This can be compared to survival statistics on a general US population from 2011 that showed that 2.9% and 4.1% of 76-year-old (age-matched to this study population) women and men respectively were expected to die within one year. These data correspond to the mortality rates seen for the Risk of Death Scale “0”. The last four categories of the scale, representing about 7% of the cohort, had one-year death rates of 55% or higher.

When the death rates are extended to 3 years post-admission, we observed a steady increase in death rates across all categories of the Risk of Death Scale. Categories “0” and “1” had the lowest death rates
at all points in time—staying at about 20%, even at 3 years post-admission. Categories “4” and “5” on the Death-Risk Scale had death rates at about the population average at all follow-up time points. Finally, categories “7” and “11” have death rates at about double the cohort average across all follow-up time periods.

Conducting a secondary analysis has inherent limitations in that an existing data set was used without opportunity to select a desirable set of variables or scales. The MDS 3.0 enables a comprehensive geriatric assessment but the resulting predictive scale is applicable only to residents in long-term care and not those receiving skilled nursing care for a limited time, nor older adults in other settings. Finally, the large number of cases lost to follow-up was a concern, but our analyses suggest that, exclusive of age, the cases do not differ in their risk-profile from those for whom 1-year follow-death data were available.

Conclusion/relevance

Death following admission to a long-term care bed in a nursing home was shown related to two sets of predictive variables drawn from CMS and interRAI assessment instruments. With the availability of an extensive array of elements, a complex model was created that incorporated measures of treatments, diagnoses, death prognosis, clinical status, function, cognition, and age. The Risk of Death Scale based on these elements differentiates across the categories by our earliest follow-up point (30 days) and continues to the last of our follow-up points at 3 years. In addition to the apparent clinical utility, the scale may be useful to states monitoring for possible excess death rates in suboptimal facilities, insurance companies for providing coverage upon entry, and as the basis for a length of life quality indicator.

Declarations

Human Subjects Involvement

The secondary MDS 3.0 data for residents in US nursing homes were provided pursuant to an agreement with CMS in the United States. The data were anonymized before coming to the analytic team. The analyses are covered by an approval from the Hebrew Senior Life, Institute for Aging Research, Institutional Review Board, and the analyses were completed using SPSS version 20 and 22.

Availability of Data and Material

As the data analyzed in this paper were provided by CMS pursuant to a specific request by our research team they are not publically available through us for analysis by others. Others can, however, submit a request to CMS to access and analyze their MDS data holdings. CMS considers such requests on a case-by-case basis and will put appropriate restrictions on their use.
Conflicts of Interest

JNM, EH, FS are members of interRAI.

ES is a full-time salaried employee of Profility.

FS, SE are salaried employees of Hannover Re

Disclosure

Mr. Erez Schachter has a financial interest in Profility, a company that provides software tools and services to support health care planning. The company’s solutions benefit from health patterns and knowledge collected by data analysis created from patients’ populations. The knowledge and patterns captured in this study are published in order for any party, including but not limited to Profility to benefit from. Erez Schachter’s interests were reviewed and are managed by Hebrew SeniorLife in accordance with their conflict of interest policies.”

Funding

Partial support for this study was provided by Profility through a contract with Hannover Re, by the Marcus Institute for Aging Research (at HebrewSenior Life), and by interRAI (an international nonprofit organization).

Authors’ contributions

JNM led the study design, analysis and interpretation of data, and preparation of the manuscript. EH, FS and SE provided bibliographic support for the manuscript and collaborated in project conceptualization, the interpretation of data and revision of the manuscript. The final version of the manuscript was revised and approved by all authors.

Acknowledgements

None

References

1 Mitchell, S. L., Teno, J. M., Miller, S. C., Mor, V. (2005). A national study of the location of death for older persons with dementia. *Pain and Symptom Management, 53 (2):299–305.*

2 Grabowski, D., Stevenson, D. G., Cornell, PO. Y. (2019) Assisted living and the market for nursing home care. *Health Services Research, 47(6):2296–2315.*
Thomas, K. S., Mor, V. (2012) The relationship between older American act itle III state expenditures and prevalence of low-care nursing home resident. *Health Services Research, 48*(3):1215–1226.

Segelman, M., Intrator, O., Yue, L., Mukamel, D., Veazie, P., Temkin-Greener, H. (2017) HCBS spending and nursing home admissions for 1915-c waiver enrollees. *Journal of Aging & Social Policy, 29*(5):395–412.

Miller, E. A. & Weissert, G. W. (2000). Predicting elderly people's risk for nursing home placement, hospitalization, functional impairment, and mortality: a synthesis. *Medical Care Research and Review 57, pp-pp.*

Mitchell, S. L., Miller, S. C., Teno, J. M., Davis, R. B., Shaffer, Michele. (2010). The advanced dementia prognostic tool: a risk score to estimate survival in nursing home residents with advanced dementia. *Journal of Pain and Symptom Management, 40* (5):639–652.

Mitchell S. L., Teno, J. M., Kiely, D. K., Shaffer, M. L., Jones, R. N., Prigerson, H. G., Volicer, L., Givens, J. L., Hamel, M. B. (2009). The clinical course of advanced dementia. *New England Journal of Medicine, October 15 361:1529–1538.*

Chen, J. H., Kiely, D. K., Morris, J. N., Mitchell, S. L. (2007). Terminal trajectories of functional decline in the long-term care setting. *J Gerontol A Biol Sci Med, 62:*531–536.

Mitchell, S. L., Morris, J. N., Park, P. S., Fries, B. E. (2004). Terminal care for persons with advanced dementia in the nursing home and home care settings. *Palliative Care, 7* (6).

Cohen-Mansfield, J., Marx, M. S., Lipson, S., Merner, P. (1999). Predictors of mortality in nursing home residents. *Journal of Clinical Epidemiology. 52*(4):273–280.

Niznik, J. D., Zhang, S., Mor, M. K., Zhao, X., Ersek, M., Aspinall, S. L., Thorpe, C. T. (2018). Adaptation and initial validation of minimum data set (MDS) mortality risk index to MDS version 3.0. *Journal of the American Geriatrics Society, 66*(12), 2353–2359.

Pocock, D, Parker-Oliver, D., Petroski, G. F., Rantz, M. (2010). The MDS mortality risk index: the evolution of a method for predicting 6-month mortality in nursing home residents. *BMC Research Notes, 16*; 3. 200.

Hirdes, J. P., Ljunggren,G., Morris, J. N., D.HM, Soveri, H. F., Gray, L., Bjorkgren, M., Gilgen, R. (2008). Reliability of the interRAI suite of assessment instruments: a 12-country study of an integrated health information system. *BMC Health Services Research, 8.*277.

Morris, J. N., Fries, B. E., Mehr, D. R., Hawes, C., Phillips, C., Mor, V., Lipsitz, L. A. (1994).

Minimum data set cognitive performance scale. *Journal of Gerontology, 49*(4), M174-M182.doi: 10.1093/geronj/49.4.M174
15 Morris, J. N., Fries, B. E., Morris, S. A. (1999). Scaling adls within the MDS. *Journal of Gerontology, 54*(11):M546-M553.

16 Howard, E., Morris, J., (2018). Frailty and recovery in the nursing home setting. *Innov Aging, 2*(Supple 1):717–718. Do1: 10.1093/geroni/igy023.2656.

17 US Social Security Administration. Actuarial Life Table, Period Life Table, 2011. SSA website. [https://www.ssa.gov/oact/STATS/table4c6_2011.html](https://www.ssa.gov/oact/STATS/table4c6_2011.html). Accessed February 2, 2019.

18 Lau, Fr., Cloutier-Fisher, D., Kuziemsky, C., Black, F., Downing, M., Borycki, E., Ho, F. (2007). Systematic review of prognostic tools for estimating survival time in palliative care. *Journal of Palliative Care, 23*(2).

### Tables

**Table 1. Logistic Regression: variables suggesting two levels of Risk of Death: Very High Risks (univariate OR >5.0) and High Risks (univariate OR 1.5-4.9)**
| Variable                                | Baseline Response Related to Higher Risk of Death | Percent of Sample in Indicated Risk Category (n) | Univariate Odds Ratio | Percent Who Died by Day 365 (Population percent who died – 23.4%) | Multivariate Odds Ratio in Logistic Model |
|----------------------------------------|--------------------------------------------------|-------------------------------------------------|-----------------------|--------------------------------------------------------------------|------------------------------------------|
| **Very High Risk Variables**           |                                                  |                                                 |                       |                                                                    |                                          |
| Hospice care                           | Yes                                              | 6.4 (63,461)                                    | 15.2                  | 79.6                                                              | 5.2                                      |
| Entered from hospice                    | (7) Yes                                          | 0.8 (7548)                                      | 10.6                  | 76.7                                                              | 1.3                                      |
| Life expectancy judgment – less than 6 months | Yes                                              | 4.6 (45,607)                                    | 13.2                  | 78.4                                                              | 2.0                                      |
| Cancer                                 | Yes                                              | 8.4 (84,278)                                    | 5.0                   | 57.1                                                              | 3.7                                      |
| Radiation treatment                    | Yes                                              | 0.3 (2527)                                      | 7.3                   | 69.9                                                              | 4.3                                      |
| **High Risk Variables**                |                                                  |                                                 |                       |                                                                    |                                          |
| **TREATMENTS**                         |                                                  |                                                 |                       |                                                                    |                                          |
| Oxygen therapy **                      | (1) Yes                                          | 18.4 (183,579)                                  | 2.3                   | 38.1                                                              | 1.5                                      |
| Parenteral/IV feeding                  | (1) Yes                                          | 1.2 (12,300)                                    | 1.7                   | 34.8                                                              | 1.2                                      |
| Chemotherapy **                        | (1) Yes                                          | 0.4 (4258)                                      | 2.5                   | 43.8                                                              | 1.2                                      |
| Respite care                           | (1) Yes                                          | 0.8 (6852)                                      | 1.5                   | 32.0                                                              | 1.5                                      |
| **DIAGNOSIS**                          |                                                  |                                                 |                       |                                                                    |                                          |
| Heart failure (e.g., CHF) **           | (1) Yes                                          | 17.9 (178,511)                                  | 1.6                   | 31.4                                                              | 1.4                                      |
| Malnutrition                           | (1) Yes                                          | 3.3 (32,513)                                    | 1.9                   | 37.1                                                              | 1.2                                      |
| Cirrhosis **                           | (1) Yes                                          | 0.9 (9091)                                      | 2.3                   | 42.3                                                              | 2.9                                      |
| **CLINICAL**                           |                                                  |                                                 |                       |                                                                    |                                          |
| Shortness of breath – with exertion ** | (1) Yes                                          | 12.7 (126,945)                                  | 1.8                   | 34.9                                                              | 1.2                                      |
| Shortness of breath – sitting **       | (1) Yes                                          | 4.6 (46,129)                                    | 2.7                   | 45.0                                                              | 1.3                                      |
| Dehydrated                             | (1) Yes                                          | 0.4 (3953)                                      | 3.0                   | 49.0                                                              | 1.4                                      |
| Swallow – hold food in mouth after meal| (1) Yes                                          | 1.5 (14,772)                                    | 2.1                   | 39.5                                                              | 1.2                                      |
| Swallow – loss liquids/solids from mouth when eating/drinking | (1) Yes | 0.8 (7981)                                      | 2.3                   | 41.7                                                              | 1.2                                      |
| Cough, choke during meals              | (1) Yes                                          | 2.6 (26,291)                                    | 2.1                   | 38.6                                                              | 1.3                                      |
| Poor appetite **                       | (1) Yes                                          | 19.9 (198,547)                                  | 2.0                   | 34.9                                                              | 1.4                                      |
| Unintended weight loss **              | (1) Yes                                          | 5.8 (58,311)                                    | 1.9                   | 36.6                                                              | 1.3                                      |
| Low BMI **                             | (1) 18 or lower                                  | 11.0 (109,762)                                  | 2.0                   | 36.9                                                              | 1.5                                      |
| Unhealed pressure ulcer **             | (2) Yes                                          | 15.4 (154,068)                                  | 1.8                   | 34.3                                                              | 1.3                                      |
| Urinary incontinence **                | (3+) Yes                                         | 24.3 (242,307)                                  | 2.0                   | 34.0                                                              | 1.2                                      |
| always | Physically aggressive | (1-2) Yes | 4.5 (44,731) | 1.8 | 35.3 | 1.5 |
| --- | --- | --- | --- | --- | --- | --- |
| **COGNITION and COMMUNICATION** | Cognitive performance scale – moderate severe or worse ** | (4+) Yes | **15.6** (232,984) | 2.2 | 37.4 | 1.5 |
| Delirium – altered level of consciousness ** | (1-2) Yes | 4.8 (47,132) | 3.6 | 51.1 | 1.6 |
| Delirium – inattention | (1-2) Yes | 17.1 (170,858) | 1.7 | 32.2 | 1.7 |
| Understand others – sometimes or never | (2,3) Yes | 14.5 (142,953) | 2.1 | 36.7 | 1.2 |
| **FUNCTION** | Locomotion off unit – totally dependent ** | (4) Yes | 35.9 (358,487) | 1.9 | 31.9 | 1.2 |
| Bathing – totally dependent ** | (4) Yes | 29.9 (298,503) | 1.8 | 32.3 | 1.2 |
| Eating – receives help ** | (2+) Yes | 31.8 (317,349) | 2.2 | 34.2 | 1.4 |
| Toilet use – receives help | (2+) Yes | 88.5 (884,197) | 2.3 | 25.6 | 1.3 |
| **DEMOGRAPHICS** | 60 or older ** | (1) Yes | 89.7 (895,551) | 1.9 | 25.2 | 1.5 |
| 80 or older ** | (1) Yes | 47.0 (573,488) | 1.8 | 28.6 | 1.6 |
| 90 or older ** | (1) yes | 20.2 (201,852) | 1.8 | 33.7 | 1.5 |

**Table 2. Risk of Death Model Based on a Cross Walk of the Sum of the Variables Identified in the two subscales**

- Columns = “Very High Risk Variables;” rows = “High Risk Variables”
- Numbers in cells indicate assigned value on Risk of Death Model, from low to high
  
  Further details in Figure 1.

- Note – there is an age adjustment to the Risk of Death scale. If the person is less than 60 years of age and the Risk of Death scale score is greater than “6” a value of one is added to the Risk of Death Scale (this accounts for the fact that such persons are less likely to have the conditions included in the remaining variable subscale).
| Number of variables | 0 Very High Risk Variables | 1 | 2 | 3 + |
|--------------------|-----------------------------|---|---|-----|
| 0 High Risk Variables | 0                           | 4 | 9 | 10 |
| 1                  | 0                           | 4 | 9 | 10 |
| 2                  | 1                           | 4 | 9 | 10 |
| 3                  | 2                           | 5 | 9 | 10 |
| 4                  | 3                           | 6 | 9 | 10 |
| 5                  | 4                           | 7 | 9 | 11 |
| 6                  | 5                           | 8 | 10| 11 |
| 7                  | 6                           | 9 | 10| 11 |
| 8                  | 6                           | 9 | 10| 11 |
| 9                  | 7                           | 10| 11| 11 |
| 10                 | 8                           | 11| 11| 11 |
| 11+                | 8                           | 11| 11| 11 |

**Figures**
Figure 1

Risk of Death Scale vs. % Of Persons in Each Level of the Scale AND % Who Died by Day 365 in Each Level of Scale (Overall % who died = 24.2)
Figure 2

Death by Time Period and Death-Risk Scale

Figure 3

Loss of Sample Over One Year
Figure 4

Percent of Residents in the 12 Categories of the Death-Risk Scale as Function of Status at One Year