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The Relationship Between Elder Risk Assessment Index Score and 30-Day Readmission from the Nursing Home

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Abstract

Objective—Preventable early readmission to the hospital is costly and identification of patients at risk is an important task for healthcare providers. The objective of this study was to determine the relationship between a high score on the Elderly Risk Assessment (ERA) index and 30-day readmission to the hospital in older patients dismissed to the nursing home.

Patients—Patients over 60 years of age residing in the community on January 1, 2005 and subsequently admitted to a local nursing home following hospitalization were included. The cohort was drawn from all patients impanelled within a primary care internal medicine practice in Rochester, MN.

Methods—This was a retrospective cohort study utilizing an electronically archived administrative risk index, ERA derived from demographic and clinical factors. The primary outcome was hospital readmission within 30 days following initial admission to the nursing home. The predictor variable was the ERA score. Univariate association between the total ERA score and individual components of the ERA and 30 day re-hospitalization was determined. The ERA score cutoff with optimal sensitivity and specificity for hospital readmission was also identified.

Results—Of 12,650 in the population, 800 patients were admitted to a facility in 2005–2007. Thirty-day readmission was not higher in the group with the highest ERA score (top 10%) with a relative risk of 1.72 (95% CI 0.93–3.56), compared to the lowest scoring group. The second and third highest quartiles were significantly associated with 30-day readmissions. The individual component of the ERA with the strongest association with early readmission was dementia, with an odds ratio of 2.69 (95% CI 1.71–4.23). A cutoff score of 5 on the ERA resulted in a sensitivity of 0.81 and a specificity of 0.34.

Discussion—Residents possessing high ERA scores (in the top half) have a slightly higher risk for 30-day readmission to the hospital. While the top 10% was not significant, the remaining top

half were associated with increased risk. The ERA index can provide initial risk stratification; however, cannot by itself identify high risk patients.

Introduction

The rapid aging of the United States (US) population provides great opportunities and great challenges for hospitalists and long term care (LTC) physicians. Preventable early re-hospitalization is a current focus of quality improvement initiatives in an effort to provide stewardship of Medicare finances in the face of this growing population.^{1, 2} Patients discharged to long term care represents one high risk group.³ Approximately one-fourth of the patients will return within 30 days, with a cost to Medicare in 2006 of \$4.34 billion.⁴ Providers and healthcare leaders consider the application and utilization of electronic medical records (EMRs) important components of quality healthcare delivery.⁵ Despite this imperative, only one-third of nursing home (NH) facilities use an electronic record for medication administration documentation.⁶ One potential application of an EMR either in the hospital or LTC facility involves the identification of LTC residents at risk for re-hospitalization.

While a number of indices have been developed to predict early hospital readmission,^{3, 7–10} no prediction tool currently exists to identify general medical patients dismissing to LTC. One study identified the use of biological markers, creatine and hemoglobin, which could potentially predict readmission in LTC residents with heart failure, but they have not been tested in all patients.¹¹ There is a current need to identify patients from LTC who are at the most risk for readmission. The instrument used for identification of high risk LTC residents must be easy to use. Providers do not actively implement available tools and instruments, due to practice barriers. Nurses frequently suffer an overwhelming burden on their time; thus, the additional screening and documentation can be frustrating, causing the task to be ignored. Secondly, a screening instrument may be widely applied and may not target the population at risk; thus, significant resource will be applied with limited benefit.

The utilization of an instrument based upon administrative data and available in the EMR holds considerable promise to identify hospital patients at risk for re-hospitalization. The Elder Risk Assessment (ERA) index was developed utilizing administrative data readily available in an EMR to identify patients at risk for functional decline and in need of a higher level of care, including hospitalization. It was designed to identify patients at high risk of emergency room use or hospital admission.¹² This study evaluated the relationship between higher (ERA) index scores and 30 day re-hospitalization from LTC facilities. A second objective of this study looked at the relationship between the individual components of the ERA index and rehospitalization. To answer this question, we developed a retrospective cohort study of hospital patients dismissed to the nursing home from an academic medical hospital in 2005.

Methods

This was a retrospective cohort drawn from all community dwelling adult patients over age 60 on January 1, 2005 who were impaneled within the Division of Primary Care Internal Medicine (PCIM) at Mayo Clinic in Rochester, MN. Patients were placed within the cohort if they were admitted to a nursing home within the two years following January 1st 2005. The Mayo Clinic Institutional Review Board (IRB) reviewed and approved the protocol. The authors conducted all aspects of the research on this project in accordance with the principles of the Declaration of Helsinki with an emphasis on patient welfare and confidentiality.¹³ The investigators also adhered to the Minnesota state statute with regard to

medical record use and privacy that states subjects are allowed to refuse medical record review for research.¹⁴

Study Subjects

Inclusion criteria—The inclusion criteria consisted of adults over the age of 60 residing in the community or in an assisted living facility within Olmsted County, MN on January 1, 2005. All adults impanelled within Mayo Clinic's PCIM division, meeting the above criteria were included in the cohort from which the ERA was derived. Subjects from this larger cohort were included in this study after admission to a skilled nursing facility in the ensuing two years following January 1, 2005.

Exclusion Criteria—Patients initially residing within a skilled nursing facility on January 1, 2005 were excluded from the study. Subjects living outside of Olmsted County as their primary residence were also excluded from the study. Patients who did not give consent for medical record review were also excluded from analysis, in accordance with Minnesota state law.

Data collection

Outcomes Variable—The primary outcome was admission to the hospital within 30 days of admission to the long term care facility. Nursing home placement was defined as admission to a LTC facility. A LTC facility was defined as a Minnesota licensed nursing home with 24-hour nursing care. Readmission to the hospital was determined electronically via the EMR. Patients residing in LTC facilities in Olmsted County and impanelled within PCIM, would be admitted to one of three Mayo Clinic Rochester hospitals, ensuring full ascertainment of all hospitalizations. Personnel within health science research collected the information and were blinded to the hypothesis. Mayo Clinic maintains all EMR information within one system and all outcome and predictor variables are easily obtained.

Predictor Variables—The primary predictor variable used was the ERA index. The ERA index includes demographic information of date of birth (age), gender, number of hospital days in the prior 2 years, and marital status. Age was stratified into age categories of 60–69, 70–79, 80–89, and 90 or greater. Comorbid medical illnesses included the presence or history of diabetes mellitus, coronary artery disease (CAD), congestive heart failure (CHF), stroke, chronic obstructive pulmonary disease (COPD), and dementia. These variables were used based upon the derivation of the ERA model.¹² Hospital days in the two years prior to 2005 were collected electronically. Each distinct hospital visit was counted individually and defined as an admission to the hospital from the nursing home. The secondary outcomes included the individual predictors from the ERA instrument of a 30-day readmission. The demographic information was obtained electronically (age, gender, marital status). The comorbid medical conditions were based upon diagnostic codes within the electronic medical record. These diagnoses were made clinically by the clinical team.

Each of the individual predictor variables were weighted and scored with the ERA index. The ERA index was derived based on previous risk modeling designed to identify individuals at risk for hospitalization within two years.¹² The presence or absence of predictive risk factors yielded a risk score for each individual. The scores were then placed in 5 groups with the first 3 groups representing the bottom quartile by score, the 25–50% percentile, the 51–75%, the 76–90% percentile, and the top 10% by score for the overall cohort. For this analysis, the bottom two quartiles (bottom 50%) were combined to reflect a total of 4 groups with the comparisons in the top 10%. The index has three primary components: demographics, previous hospitalization, and comorbid health concerns. The scoring system is listed in Table 1..

Data Analysis

Health research services directly entered all information via electronic abstraction into a Microsoft Excel (version 2003, Microsoft, Redmond, WA) spreadsheet for data entry, retrieval, and analysis. The investigators analyzed the final information (both outcomes and predictor variables) using SAS 6.1.2 (Cary, NC). The analysis was undertaken in three parts. The initial analysis involved univariate analysis of different ERA scores (in four groups according to score) and a 30-day rehospitalization using the lowest two quartiles (bottom 50%) as the reference for comparison for the other three groups. The secondary analysis included unadjusted analysis of individual variables within the ERA instrument and the remaining comorbid health concerns. These predictor factors were analyzed by t-test for continuous variables or Pearson chi square test for proportional variables. Predictor variables were considered significant if the p value was less than 0.05. Based upon the individual ERA score and 30-day rehospitalization, a receiver operator curve was constructed to determine the specificity and sensitivity of ERA in predicting 30 day rehospitalization.

Results

There were a total of 12, 650 patients over 60 years in the active PCIM panel on January 1, 2005 who had given consent for medical record review. Of the 12,650 patients, 800 patients (6.3%) were admitted to a skilled care facility within 2 years of 1/1/2005. The demographics of the cohort of 800 patients are noted in Table 2. Of the 800 patients admitted to LTC facilities, 110 (13.75%) of the residents were readmitted to the hospital within 30 days (see Figure 1). The patients were placed in 4 groups based upon the ERA scores for the initial population cohort of 12,650 patients were ranked and placed into four groups.¹² Subjects in LTC in the highest group by score did not have a higher risk 30 day re-hospitalization of 12.1% compared to those who were in the bottom two quartiles with a rehospitalization rate of 7.4% (p =0.143). Please see Table 3 below. The bottom two quartiles of the initial cohort were combined to allow for adequate comparison for the other 3 groups. Overall, the bottom 50% (by score) of the cohort of 12,650 patients only represented 175 of the 800 patients (21.8%) in the nursing home cohort. The second highest group by score, did have a higher rate of readmission with 38/110 (35%) readmission rate compared to 182/690 (26%) in the non-readmission group. This resulted in an odds ratio of 2.60 (95% CI 1.34–5.06). A similar finding was found in the third highest group with an odds ratio of 2.44 (95% 1.26–4.74). Thus, there does appear to be evidence that the ERA score can help predict 30-day readmission from the nursing home.

The secondary analysis of the individual components of the ERA index reflected increased age in the readmission group (81.1 +/- 8.11 yrs), compared to the non-readmitted group (79.00 +/- 7.85 yrs), with a p value of <0.01. The highest odds ratios for 30-day readmission comparing the presence of disease in both groups was for dementia, with an odds ratio of 2.69 (95% CI 1.71–4.23). The specific percentages, significance, and odds ratios are noted in the table two below. After the initial analysis, the authors constructed a receiver operator curve (ROC), evaluating the optimal score (from <1 to 32) for 30 day readmission to the hospital. Using the ROC, the authors found an optimal score of 5 on the ERA which corresponds to a sensitivity of 0.81 with a specificity of 0.34 with an area under the curve of 0.55. The ROC curve is noted in figure two below.

Discussion

This study found that subjects living in LTC with the highest ERA score in the top 50% had a significantly higher risk 30-day rehospitalization compared to those residents with lower scores (in the bottom half of ERA scores). The 30-day rehospitalization rates were 35% and

26% in the second and third highest scoring group compared to 7.4% in those residents with a score of less than 4 for a corresponding odds ratio above 2 for both groups. Interestingly, the top group did not have a higher readmission rate compared to the lowest 50% of patients; however, the odds ratio of 1.72 (95% CI, 0.83–3.56) indicate a potential relationship that was not seen in the small number of patients within that subset. Thus, this difference between the top 10% of patients by score and the top 50% by score, may reflect an issue of numbers and power to detect a difference. It may also reflect a fundamental difference in how nursing home clinicians handle the sickest individuals. There may be an emphasis on palliative care and “do not hospitalize” orders for this subset.

Overall, these findings suggest potential utility of the ERA instrument as a method of identifying patients at high risk for 30-day rehospitalization following discharge to a nursing home. However, the ability to discriminate between the high risk frail elderly using ERA has significant limitations in this debilitated population. In the general cohort, 50% of patients have scores less than 4; however, in the nursing home population, only 22% had low scores. The primary utility of using this instrument would be to identify those patients with low scores who will not likely be readmitted to the hospital. Ideally, the clinicians would allocate additional resources or protocols to those with high scores; however, in our cohort, this would be over 78% of the patients. Clinicians often have difficulty detecting frailty at the bedside and may benefit from a screening instrument that would complement their clinical judgement.¹⁵ The ERA gives some additional assistance for identifying high risk residents; however, clinicians would need additional information with the ERA score. These findings also emphasize the need for a specific LTC instrument for readmission. The ERA was designed to help predict hospitalizations in the community; however, its ability in LTC has limitations as noted.

There are numerous potential advantages to an electronic index to identify older residents at risk for re-hospitalizations. This index incorporated common risks for hospitalizations including age, gender, previous hospitalizations, and comorbid illnesses like COPD, dementia, stroke, CAD/CHF/MI, and cancer. Many of the individual components were also individually significant for 30-day rehospitalization. The use of summary clinical information available in real time can assist medical providers in appropriately allocating discharge planning without relying upon the Gestalt method or time consuming instruments.⁵ Despite the potential advantages of such an instrument to predict 30-day readmission from the LTC facility, an instrument does not currently exist that is in routine clinical use. Thus, this instrument may provide some additional information; however it cannot be used alone. In essence, if a patient had a low score of less than 5, the risk for 30-day readmission will be low.

The most well known instrument to predict hospitalizations in older, frail community dwelling adults is the Pra.^{8, 16} The basic domains of the Pra are similar to the ERA index, but it was not tested or validated in patients residing in LTC. The authors found that previous hospitalization, over 6 doctor visits in a calendar year, age, male gender, presence of a caregiver, poor self-rated health, and comorbid illnesses of heart disease, and diabetes predicted hospitalization.¹⁷ The patients who score the highest on the Pra had the highest rates of hospitalization, with health-care claims 2.5 to 2.7 times that of the lowest risk patients.¹⁷ Many of the Pra predictor characteristics are not applicable in the nursing home environment like caregiver status or doctor visits which are both mandated by federal regulations. Furthermore, the Pra must be administered to patients rather than using an electronic index like ERA. The Pra may also suffer the lack of the ability to differentiate patients as noted with the ERA index.

A widely used instrument specific to LTC is the minimum data set (MDS). The MDS is a set of 19 quality indicators used for each nursing home admission in the United States. Validation of the MDS has shown good convergent validity and is widely used in the US for various purposes including resident assessment, quality measures, and reimbursement.¹⁸ The MDS may have utility as a screening device to detect seniors at risk for LTC admission. In fact, components of the MDS-home care instrument predicted hospitalization in older community dwelling adults and results correspond with our findings, including age and comorbid health burden. The authors also found that socioeconomic issues like living alone and functional status impacted hospitalization.¹⁹ Using certain aspects of the MDS also predicted rehospitalizations in LTC residents, with delirium being one of those factors that predict rehospitalization.²⁰ While the MDS may potentially be useful, these indicators are not widely used as a predictive instrument for clinicians and are largely unavailable to hospital providers. This limits the usefulness of MDS.

Individual predictors for 30-day rehospitalization confirm the potential usefulness of the components of the ERA index. Age predicted rehospitalization is consistent with findings in other studies.^{3, 21, 22} Marital status did not impact rehospitalization which differs from community-based studies where living with another prevents hospitalization.²³ This difference likely reflects the nursing care and functional support at LTC facilities. The number of previous hospital days also was associated with increased 30-day rehospitalizations. The highest odds of 30-day re-hospitalizations were noted with the comorbid health conditions of dementia with an odds ratio of 2.69 (95% CI, 1.71–4.23). Many comorbid medical conditions, including COPD, have well known risks for rehospitalization, higher LTC utilization, and multiple transitions.^{24, 25} Many residents in LTC have multiple diagnoses (i.e. dementia with heart failure and mild COPD); thus, the need for one encompassing instrument to predict re-hospitalization.

The ERA instrument differs from other commonly used instruments that predict hospitalization, rehospitalization, or frailty. The ERA does not include an assessment of functional status or muscle strength. Both factors figure strongly in previous work on frailty and hospitalization.²⁶ Providers and nursing staff recognize that most adults who are admitted to the hospital have a decline in functional status. Those patients who suffer decline or disability are often admitted to LTC for rehabilitation or for long term placement. Functional decline predicts frailty and this decline forms a fundamental component of the definition of frailty along with energy loss and nutritional issues.^{27, 28} The potential disadvantage of using a functional instrument in the hospital or in LTC is the variable nature of functional status. Patients often improve dramatically over a period of days to weeks; thus, an instrument using functional measures like gait speed or grip strength would require frequent administration in the hospital or LTC. Using an instrument with demographic and comorbid health issues might represent a more stable picture over time compared to functional tests. The ERA index predicts a 30-day rehospitalization, despite the lack of a functionality component, while using administrative data. Additionally, one index utilizing a measure of function found it to have very low predictive ability for avoiding rehospitalization with an OR of only 0.99.⁹

This study possesses numerous strengths including a robust data system and comprehensive electronic medical record. This system captures demographic information as well as comorbid health conditions and previous hospitalizations. There were over 800 new admissions to long term care over a 2 year period from a community dwelling population of 12,650 patients over age 60. The patients comprising the cohort represented an undifferentiated adult community internal medicine primary care practice as only patients residing within Olmsted County are permitted registration into the practice, making referral bias unlikely. Furthermore, PCIM accepts all adult patients residing in the county for

registration in the PCIM division. Most of the information within the ERA instrument can clearly be retrieved (age, gender) and the comorbid status and hospitalization status can be as well. The hospital and LTC facility records of patients impanelled within the PCIM, and making up the cohort, would be captured in the EMR utilized for this study, ensuring full ascertainment of hospital and LTC facility admissions. The ERA index is being used clinically and is updated daily for patients over 60.

There are inherent weaknesses within the study. Administrative data systems suffer weaknesses including potential missing information or miscoded information. Previous studies evaluating the accuracy of the medical records in this study estimate accuracy at 97%.^{29, 30} The second primary concern is the ability to generalize the findings of the study outside of Olmsted County, MN. The residents of Olmsted County primarily compose an ethnic mix of 90% Northern European.³¹ This may limit the utility of this instrument in different populations with different ethnic and cultural diversity. Further challenges to the generalizability of the information include differences in patient acuity at a tertiary, academic medical center. As noted above, these patients are from within primary catchment area which lowers referral bias. Despite any limitations, there is strong biological plausibility with older age, and dementia as predictors of 30-day rehospitalizations. Few studies have assessed dementia as a predictor of early hospital readmission, but a recent study readmission risks in elderly patients did find it to be an independent predictor.³²

This study suggests an association between higher ERA scores and higher 30 day re-hospitalization for hospital patients dismissed to LTC. Providers might use this index to identify those patients at the highest risk of rehospitalization either to allocate services prior to hospital discharge, or target patients in LTC for aggressive monitoring and treatment. High-risk individuals will remain high-risk throughout their stay in the facility; thus, a continuous vigilance on medical issues would be required. Further potential optimization of care would include end of life planning for many of these residents, as well as optimal nutrition and palliative care. Providing real time risk assessment continues to be the goal for many providers. While this study may provide some help, there is still work to be done for risk stratification of long-term care resident.

Conclusion

Using an administrative risk index helps predict rehospitalization in older adults who had been admitted to long term care with over a two-fold increase in rehospitalizations in the second and third highest scoring group compared to the lowest scoring group. Risk stratification allows providers to allocate resources to those at the highest risk of rehospitalization with subsequent continued functional decline. The ERA is one such administrative tool which can provide support for hospital and nursing home providers attempting to identify the highest risk individuals within the facility. While the ERA index provides valuable information as a tool for risk stratification, further refinement may help identify those LTC residents at the absolute highest risk.

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Abbreviations

ERA	Elderly at Risk Index
CI	Confidence Interval
EMR	Electronic Medical Record
US	United States
NH	Nursing Home
PCIM	Primary Care Internal Medicine
IRB	Institutional Review Board
ADL	Activities of daily living
CHF	Congestive heart failure
LTC	Long term care
MDS	Minimum data set

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Figure 1.
Development of Cohort of Adults over 60

Figure Two.
Receiver Operator Curve for ERA index's ability to Predict 30 day Rehospitalization

Table 1

Scoring System for Elderly Risk Assessment Index (ERA)

Married	-1
Age 70–79	1
Age 80–89	3
Age 90 or more	7
1–5 hosp. days in prev. 2 yrs.	5
6 or more hospital days in prev. 2 yrs.	11
History of Diabetes	2
History of CAD/MI/CHF	3
History of Stroke	2
History of COPD	5
History of Cancer	1
History of Dementia	3

Table 2

Predictor Variables with Univariate Analysis.

Variable	Overall (N=800)		No readmit (N=690)		Re-admit within 30 days (N=110)		Odds Ratio	95% CI		p-value
								Lower	Upper	
age	79.3	± 7.91	79	± 7.85	81.1	± 8.11	1.04	1.01	1.06	0.011
male, No. (%)	263	33%	225	33%	38	35%	1.09	0.71	1.67	0.688
race_white, No. (%)	785	98%	678	98%	107	97%	0.63	0.18	2.27	0.482
married, No. (%)	386	48%	335	49%	51	46%	0.92	0.61	1.37	0.670
Cancer, No. (%)	247	31%	216	31%	31	28%	0.86	0.55	1.34	0.511
Diabetes, No. (%)	221	28%	194	28%	27	25%	0.83	0.52	1.32	0.437
Dementia, No. (%)	137	17%	102	15%	35	32%	2.69	1.71	4.23	<.0001
Stroke, No. (%)	159	20%	143	21%	16	15%	0.65	0.37	1.14	0.134
COPD, No. (%)	161	20%	137	20%	24	22%	1.13	0.69	1.84	0.634
CAD/MI/CHF, No. (%)	356	45%	313	45%	43	39%	0.77	0.51	1.17	0.220

Table 3

ERA Score and 30 day Re-Hospitalization Rates in 800 residents in Long Term Care.

Score	Odds Ratio	Lower 95%	Higher 95%	P value
<4				
4-8	2.44	1.26	4.74	0.008
9-15	2.20	1.11	4.37	0.005
>16	1.72	0.83	3.56	0.143