Effective Health Care

Risk Prediction to Reduce 30-day Hospital Readmission

Results of Topic Selection Process & Next Steps

The nominator is interested in using a new systematic review about various risk prediction models to reduce hospital readmissions.

We identified a recent systematic review covering the scope of the key questions, therefore, a new review would be duplicative of an existing product. No further activity on this topic will be undertaken by the Effective Health Care (EHC) Program.

Topic Brief

Topic Name: Risk Prediction to Prevent Hospital Readmissions

Nomination Date: 7/27/2017

Topic Brief Date: 10/18/2017

Authors: Suchitra Iyer

Conflict of Interest: None

Summary of Key Findings

Appropriateness and importance: There is great interest among hospitals and health systems in selecting valid risk prediction models that have good predictive ability, that are applicable to large populations, use data that are easily and reliably obtained and validated in populations that closely match their own patients. Therefore, a systematic review that synthesizes the available published literature on validated models of hospital readmission risk prediction, describe their performance and assess their clinical utility is highly desirable.

Duplication: An AHRQ systematic review on the topic would be duplicative. A systematic review, that included literature until 2015 was published in 2016. This review, conducted by an academic group in Australia, updates an earlier review conducted by the Evidence Synthesis Group at the VA in 2011.

Table of Contents

Introduction

The Medicare Hospital Readmissions and Reduction Program (HRRP) was created under The Affordable Care Act of 2012. The program, implemented by CMS, holds hospitals accountable for quality of care that it provides; it penalizes hospitals by reducing Medicare payment if the calculated readmission rate is higher than the national average. In 2013, the first year of implementation, the penalty was a 1% reduction in payment and has now increased to the maximum 3%. The HRRP defines a readmission as a patient being readmitted to a hospital within 30 days of discharge.[1]

Hospital readmission rates are now an accepted indicator of quality of care and considered as a component of a measure that is used to rank hospitals. It is calculated individually for each hospital, risk adjusted as needed and compared against the national average. Initially, the HRRP focused on medical conditions – heart failure, myocardial infarctions, and pneumonia – but has been expanded to include surgical procedures – total hip arthroplasty, total knee arthroplasty, and coronary artery bypass graft surgery (CABG).[2, 3]

Topic nomination was received on 7/27/2017. The topic Predictive Analytics in Healthcare was nominated by the Health Management Academy. The nominator clarified that several if not all health systems under their membership are incentivized by the CMS initiative. They would be interest in a compilation of evidence on the predictive value of validated instruments that can identify patients at high risk of readmission. Once identified accurately patients who are at high risk of rehospitalization. The next step would be to direct greater effort and care towards these patients to reduce that risk of 30-day hospital readmission. The key questions for this nomination are:

Key Question 1. What is the predictive value of existing models in assessing risk of 30 day re-hospitalization?

Key Question 2. What is the evidence of the correlation between the input variables used to construct the model and the calculated risk scores (C-statistic, area under the curve, sensitivity, specificity, predictive value) in accurately predicting 30 day re-hospitalization?

To define the inclusion criteria for the key questions we specify the population, interventions, comparators, and outcomes of interest. See Table 1.

Table 1. Key Question and PICOS

Key Questions	Key Question 1. What is the predictive value of existing models in assessing risk of 30 day re-hospitalization?	Key Question 2. What is the evidence of the correlation between the input variables used to construct the model and the calculated risk scores (C-statistic, area under the curve, sensitivity, specificity, predictive value, etc.) in accurately predicting 30 day re-hospitalization?
Population	Medical, administrative or survey data collected prospectively or retrospectively from patients of various age ranges and disease severities who have received care inpatient or ED care. Including the following conditions: Older Adults Pediatric population *Specific chronic disease conditions:* Pneumonia COPD CVD (HF, AMI, surgery-PCI, stent) Those with psychiatric diagnoses Obese Diabetic Joint replacement surgery Other conditions	The various Risk prediction models.
Interventions	• LACE Index • HOSPITAL • Charlson score • Elixhauser co-morbidity index • The ACC Admission and Discharge Models • SQLape® • American Society of Anesthesiologists (ASA) physical status classification system • Injury Severity Score • Acute Physiology and Chronic Health Evaluation (APACHE)	Demographic factors (age, gender, sex, ethnicity) Socioeconomic factors Medical history (mental health, substance use, existing conditions) Procedure (surgery) during index hospitalization Number of lab tests conducted Vitals measured at index admission Number and types of medications Length of hospital stay Discharge location (home, rehab, etc.) Resource utilization (Number of admissions within past year, ED admission within 30 days, number of consultations) Hospital characteristics Other information that doesn't fall into the above categories.
Comparators	Other risk models	Compare with any permutation or combination of variables.
Outcomes	30 day re-admission risk as measured by C-statistic, area under the curve, sensitivity, specificity, positive and negative predictive value	C-statistic, area under the curve, sensitivity, specificity, positive and negative predictive value

Abbreviations: ACC=American College of Cardiology; COPD=Chronic obstructive pulmonary disease; CVD=cardiovascular disease; ED=emergency department; HF=heart failure; PCI=percutaneous coronary intervention

Methods

To assess this topic nomination for priority for a systematic review or other AHRQ EHC report, we used a hierarchical process using on established criteria. Each step in our assessment determined the need for further evaluation. See Appendix A.

1. Determine the *appropriateness* of the nominated topic for inclusion in the EHC program.
2. Establish the overall *importance* of a potential topic as representing a health or healthcare issue in the United States.
3. Determine the *desirability of new evidence review* by examining whether a new systematic review or other AHRQ product would be duplicative.
4. Assess the *potential impact* a new systematic review or other AHRQ product.
5. Assess whether the *current state of the evidence* allows for a systematic review or other AHRQ product (feasibility).
6. Determine the *potential value* of a new systematic review or other AHRQ product.

Appropriateness and Importance

We assessed the nomination for appropriateness and importance.

Desirability of New Review/Duplication

We searched for high-quality, completed or in-process evidence reviews published in the last three years on the nomination's key questions.

Compilation of Findings

We constructed a table outlining the selection criteria for this nomination (see Appendix A).

Results

Appropriateness and Importance

Hospital readmission rates are highly variable across hospitals, even after adjusting for patient risk. Many readmissions are preventable and high hospital readmission rates are thought to reflect poor quality of care. Patient safety events and postoperative complications are often considered to be the result of poor-quality care, and lead to unplanned readmissions. Reducing unnecessary readmission can therefore reduce resource utilization and costs.

Hospitals are now incentivized to reduce unnecessary readmission through The Medicare Hospital Readmissions Reduction Program (HRRP) by withholding a percentage of the payment. One of the strategies to that many healthcare systems use to reduce unplanned hospitalizations rate is the application of predictive models to identify patients at high risk for readmission so that appropriate interventions may be targeted towards them.

There is great interest among hospitals and health systems in selecting valid risk prediction models that have good predictive ability, are applicable to large populations, use data that are easily and reliably obtained and validated in populations that closely match their own patients. Therefore, a systematic review that synthesizes the available published literature on validated models of hospital readmission risk prediction, describe their performance and assess their clinical utility is highly desirable.

Desirability of New Review/Duplication

A new evidence review examining Risk Prediction Models to reduce 30 day Readmission would be duplicative of pre-existing systematic reviews. A systematic review published in 2011 by Kansagara et al. (for the VA Evidence Based Synthesis Program) included 30 studies with 26 predictive models and focused on re-hospitalization rates in adult medical patients. Studies of pediatric patients, adult psychiatric and surgical patients were excluded. The review concluded that the overall performance of included models was poor. While most models incorporated medical comorbidity and prior utilization variables, few considered variables related to overall health, function, illness severity or social determinants of health.[4]

An Australian group updated the report in 2016, expanded the scope to include patients with surgical and mental health conditions. This study by Zhou et al., 2016 identified 60 studies with 73 unique risk predictive models. The authors found inconsistent performance in models for all-cause readmission, cardiovascular disease related readmission and surgery-related readmissions. However, performance of most of the predictive models for general-medical conditions related readmissions were moderate to good.[5]

Table 2. Key question with the identified corresponding evidence reviews

Key Question	Duplication (Completed or In-Process Evidence Reviews)
Key Question 1. What is the predictive value of existing models in assessing risk of 30 day re-hospitalization?	Total number of completed or in-process evidence reviews: • 2 systematic reviews completed. • 1 in 2016[5] • 1 in 2011[4]
Key Question 2. What is the evidence of the correlation between the input variables used to construct the model and the calculated risk scores (C-statistic, area under the curve, sensitivity, specificity, predictive value) in accurately predicting 30 day re-hospitalization?	Total number of completed or in-process evidence reviews: • 2 systematic reviews completed. • 1 in 2016[5] • 1 in 2011[4]

Summary of Findings

- Appropriateness and importance: The nomination is both appropriate and important.
- Duplication: An AHRQ systematic review on the topic would be duplicative. A systematic review has been published in 2016, which includes literature published until 2015. This review by Zhou et al. includes patients with surgical and mental health conditions. Findings from 60 studies with 73 unique risk predictive models are reported. The authors found inconsistent performance in models for all-cause readmission, cardiovascular disease related readmission and surgery-related readmissions. However, performance of most of the predictive models for general-medical conditions related readmissions were moderate to good.

We followed up with the nominator and at their suggestion spoke with one of their members, (Unity Point Health, a small healthcare system) who would be a benefactor of an AHRQ evidence review. We shared our findings from the literature search and asked whether it would satisfy their need for a comprehensive list of evidence based risk models to predict 30 day hospital readmissions. The nominator confirmed that indeed, several health care delivery (and payer) organizations have already started developing risk prediction models based on the validated models published in the literature. The models are then tweaked and customized to improve model performance when applied to their patient population. The resulting proprietary

models, we are told, have good predictive capability, but the issue of clinical utility is less clear. The uncertainty lies in determining what interventions should the identified high-risk patients receive in order to reduce the risk of unplanned hospital readmission.

References

1. Readmissions Reduction Program Centers for Medicare & Medicaid Services, USA. http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Page last Modified: 04/18/2016 5:08 PM).
2. Krumholz HM, Lin Z, Keenan PS, et al. Relationship between hospital readmission and mortality rates for patients hospitalized with acute myocardial infarction, heart failure, or pneumonia. JAMA. 2013 Feb 13;309(6):587-93. PubMed PMID: 23403683; PubMed Central PMCID: PMC3621028
3. Glance LG, Li Y, Dick AW. Impact on hospital ranking of basing readmission measures on a composite endpoint of death or readmission versus readmissions alone. BMC Health Serv Res. 2017 May 5;17(1):327. PubMed PMID: 28476128; PubMed Central PMCID: PMC5420148.
4. Kansagara D, Englander H, Salanitro A, et al. Risk Prediction Models for Hospital Readmission: A Systematic Review [Internet]. Washington (DC): Department of Veterans Affairs (US); 2011 Oct. Available from http://www.ncbi.nlm.nih.gov/books/NBK82578/ PubMed PMID: 22206113.
5. Zhou H, Della PR, Roberts P, et al. Utility of models to predict 28-day or 30-day unplanned hospital readmissions: an updated systematic review. BMJ Open. 2016 Jun 27;6(6):e011060. doi: 10.1136/bmjopen-2016-011060. PubMed PMID: 27354072; PubMed Central PMCID: PMC4932323.

Appendix A. Selection Criteria Summary

Selection Criteria	Supporting Data
1. Appropriateness	
1a. Does the nomination represent a health care drug, intervention, device, technology, or health care system/setting available (or soon to be available) in the U.S.?	Yes. CMS is holding hospitals accountable for poor quality care and is transitioning away from paying simply for the volume of care (i.e. fee-for-service) to pay for the outcomes or quality of care.
1b. Is the nomination a request for a systematic review?	Yes
1c. Is the focus on effectiveness or comparative effectiveness?	The focus will be on both effectiveness and comparative effectiveness
1d. Is the nomination focus supported by a logic model or biologic plausibility? Is it consistent or coherent with what is known about the topic?	Yes
2. Importance	
2a. Represents a significant disease burden; large proportion of the population	Yes
2b. Is of high public interest; affects health care decision making, outcomes, or costs for a large proportion of the US population or for a vulnerable population	Yes.
2c. Represents important uncertainty for decision makers	Yes. Several predictions models are currently utilized that variably consider the contribution of patient and health system variables. There is also interest in knowing whether incorporation of local population data or socioeconomic status data will improve model performance.
2d. Incorporates issues around both clinical benefits and potential clinical harms	n/a. since this is not really an intervention applied to a patient.
2e. Represents high costs due to common use, high unit costs, or high associated costs to consumers, to patients, to health care systems, or to payers	Yes. Nearly 20% of Medicare patients are readmitted after hospital discharge with an estimated annual cost of $26 billion. Hospital readmission rates are highly variable across hospitals, even after adjusting for patient risk. Many readmissions are preventable and high hospital readmission rates are thought to reflect poor quality of care. Patient safety events and postoperative complications are often considered to be the result of poor-quality care, and lead to unplanned readmissions. Reducing unnecessary readmission can therefore reduce resource utilization and costs.
3. Desirability of a New Evidence Review/Duplication	
3. Would not be redundant (i.e., the proposed topic is not already covered by available or soon-to-be available high-quality systematic review by AHRQ or others)	No. There are two existing systematic reviews that cover the literature published through 2015.