ReInforcedCare™

Readmission Predictive Modeling

Risk Models to Improve Patient Care

Why Use Readmission Risk Models?

Since readmission reductions can benefit a hospital in so many ways—from helping achieve patient care goals, to enhancing a hospital's reputation, to improving a hospital's bottom line by reducing CMS penalties, – a low-cost analytic technique for identifying patients' degree of readmission risk holds great promise. Like so many other hospital staff members, nurses and case managers are often overworked, to the point where a hospital can only devote certain focused interventions to a fraction of its patients. When this is the case, it's important to identify readmission risk in order to selectively deliver services to help those most in need. Reinforced Care's readmission risk models help hospitals accomplish this, thereby improving patient outcomes and increasing the overall efficiency and utilization of employee training and talent.

Few hospitals possess sufficient in-house resources to build effective risk scoring models, and many rely on outside analytic companies such as ReInforced Care. Our team of analytical experts combines an understanding of the readmission problem; of wider hospital needs and realities; and of the fine points of large-scale statistical modeling. We partner with hospitals to support patient well-being post-discharge and provide detailed analytics. We build customized statistical models of readmission risk, drawing on a variety of sophisticated techniques including **logistic regression**, **discriminant analysis**, **random forests**, **chi-squared automated interaction detection**, and **neural networks**.   We are adept at testing our statistical models through cross-validation so you can be assured of their predictive power when relying on us to help inform your patient-care decisions.

> **"Even limited ability to identify a proportion of patients at risk for future high-cost medical services use can increase the cost-effectiveness of [interventions]."**
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> **Devan Kansagara, M.D., et al., Risk Prediction Models for Hospital Readmission (*JAMA*, 306:15, Oct. 2011, 1696).**

Which Data Elements Matter?

The predictive power of any model depends on the breadth and quality of the data on which it rests. We have the greatest ability to produce high-performing hospital-specific models when hospitals provide us with a broad range of data on patients' demographic variables; their health history and current health; physiological measures; social supports and behavioral/mental health; and hospital admission assessments. In all of our engagements, we consult with clients to help them determine the best array of data to provide and the best format and timeframe in which to do so.

When Should Risk Scores Be Assigned?

ReInforced Care can provide clients with risk scores based typically on one of three timeframes: at admission, at discharge, and post-discharge. A hospital may need to limit the data fed into the modeling process to those variables known at admission. This will support decisions and interventions made during the inpatient stay. Such variables might inform more intensive patient education, teach-backs, or discharge planning. A risk score based on such data acts as a double-check to be sure that hospitals attend to high risk patients that might be overlooked otherwise.
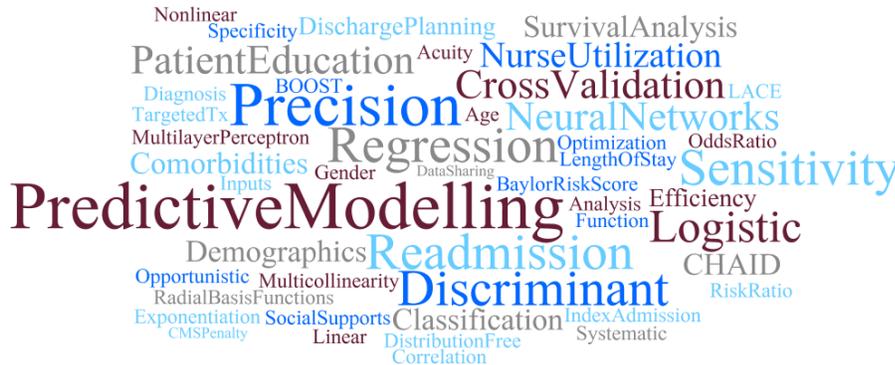
Alternatively, a hospital may want to include all relevant variables available at discharge, to inform the level or timing of post-discharge care.

Finally, our clients will occasionally ask, for those patients included in our PM360™ Full Cycle Post-Discharge Management program, that we include data we collect as part of our early phone contact. This can yield useful information about the way the patient, care team, and other supports are responding to his/her post-discharge needs.

There are benefits to each of these options. The first allows for the most timely intervention; the second and third have greater predictive power, while limiting the hospital's window in which to act based on the scores. The choice will depend on available hospital resources and care delivery models. Whatever the timeframe you choose for data collection, we will work with you to make results conveniently available to your hospital staff via our secure online portal.

How to Use Risk Scores: Stratifying Patients

Once our analysts have developed an equation to automatically compute each patient's predicted readmission risk on a scale from 0% to 100%, our next step can take a couple of forms.

- We can simply divide patients into low-risk and high-risk categories; this would facilitate your establishment of Intervention and Non-Intervention groups.

- We can assign ten categories or deciles of risk: the lowest 10%, the next-highest, and so on. This facilitates reporting of results via certain standard, intuitive formats, including gain charts and lift charts. These would show, for example, how many actual readmissions are accounted for by the highest decile of predicted risk, the second-highest, and so on.

Predicted vs. Actual Risk
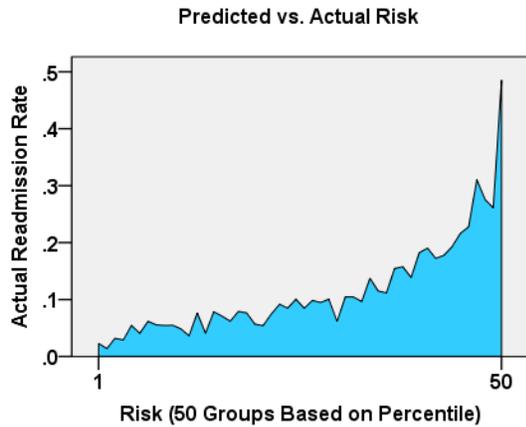
A more fine-grained version of this arrangement is shown in the chart at left, which plots, for one of our client hospitals, the actual readmission rate of patients at each of 50 levels of predicted risk, based on variables available *at admission*. The fact that actual readmission rate rises so consistently with predicted risk attests to the practical utility of the model.

How to Evaluate the Model's Performance

Although we use specialized statistical methods, we strive to make their predictive power transparent. We typically report multiple, commonly-accepted measures of model performance, such as:

- Concordance, or the *C*-statistic. This is equivalent to the Area Under an ROC curve, as seen in the chart to the right. In the literature, most efforts to predict readmission yield *C*-statistics in the range of .60 - .75. Models built on behalf of CMS and used to assign readmission-based penalties nationwide have had *C*-Statistics of about .60. In comparison, our recent models have produced figures of .63 - .77.[1]

- Pseudo *R*-squared, or the percent of variation in the outcome that is explained by the model. The CMS models cited above have had pseudo-*R*-squareds of .03 - .07; ours, .03 - .12.
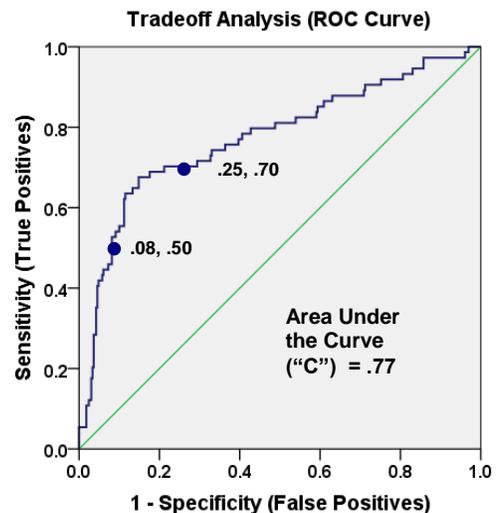
As we conduct this modeling, we will work in collaboration with you to ensure that, for your unique context, you can best manage the tradeoff between sensitivity (ensuring that those truly at risk are identified) and specificity (avoiding false positives and thus inefficiency). In the example displayed, one could choose a risk cutoff score that allowed intervention with 70% of patients otherwise headed for readmission, while including only 25% of the rest.

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[1] "*C* = .77" means that, if pairs of patients were randomly chosen – one who readmitted and one who did not – the former would have the higher predicted risk 77% of the time.

Beyond Risk Modeling

Predicting readmission risk for individual patients constitutes one strand of the analytical work ReInforced Care performs for hospitals. Much of our analytic work is explanatory rather than predictive. Using current and long-term hospital-specific data, we use statistical methods to help uncover the factors that best explain readmission status and the subgroups that most deserve increased attention. We also offer in-depth examinations of the feedback offered by the patients we support post-discharge, to shed light on their post-discharge experiences and the services that might need to be coordinated by the hospital.

Our analyses allow you to prioritize your interventions and fine-tune your processes to enhance patient care, while also limiting financial penalties imposed by CMS and other bodies. Finally, analytics themselves are just one component of our suite of services. These include post-discharge support for patient health, satisfaction and loyalty, support which itself helps to reduce preventable readmissions.

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