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*Data Rich, Analytics Poor:*

# Predicting and Avoiding Preventable 30-Day Re-hospitalizations

## Now Evolving Rapidly, Readmission Risk Tools Help Hospitals and Health Systems to Reduce Admissions that Negatively Affect Reimbursements and Quality

***Summary:*** The era of intensified scrutiny of 30-day readmissions for same or related DRG has arrived. Based on data collected in 2012, hospitals can no longer depend on all admissions as a source of revenue, especially readmissions deemed preventable. Analytic tools that provide an accurate prediction of a patient's readmission risk are in active development and are guiding health systems in reducing these avoidable occurrences. The best predictive tools use regression analyses of large-scale databases that generate weighted drivers of risk that can predict likelihood of readmission for individual patients. Risk scores guide providers to revise and enhance inpatient care and post-discharge plans for at-risk patients.

- "Patient A" underwent cardiac angioplasty and stent placement within a single coronary artery. A few week later, the patient again developed acute chest pain while at work, the result of a coronary vessel blockage not addressed in the prior admission. A co-worker brought the patient to the Emergency Room, and the patient was immediately readmitted.

- Requiring a broader-spectrum, more-powerful antibiotic, "Patient B" began to experience fevers again from her pneumonia, just ten days following hospital discharge to her assisted-living facility. Her primary-care physician transferred her back to the hospital for readmission.

- A home health nurse found "Patient C" at home with severe hypoxia, just short of one month after the patient's treatment in the hospital for congestive heart failure. The nurse diagnosed "fluid overload," the result of inadequate fluid maintenance in the patient, and called an ambulance. The patient was readmitted to the hospital.

These patient scenarios are typical of real-world cases impacting hospitals across the U.S. – and they are the types of readmissions that hospitals are working more and more vigorously to prevent, driven now not only by quality of care considerations, but based on new, potential financial penalties that may be significant. Hospitals across the country are now paying especially increased attention to preventable 30-day readmissions, based both on their looming ties to reimbursement and to their role as an indicator of quality.

But how can a hospital systematically identify "at-risk" inpatients during an initial hospitalization, a requirement for altering a patient's post-discharge risk of readmission? Relying on physicians and other clinical staff to dependably and consistently predict patient short-term readmission risk based on clinical experience is unrealistic. Hospitals need a predictive, actionable, accurate tool that individualizes a score for 30-day readmission risk for each patient, in an automated system that is integrated into daily inpatient care.

## What prompted this overdue attention to preventable 30-day readmissions?

Payers long ago set the precedent of deciding what they will and will not pay for, be that through a set schedule for a portion of incurred care costs or no payment at all (such as in the recently introduced nonpayment for entirely preventable "never events").

Today, all payers, on the heels of CMS, are turning their attention to early post-discharge hospital readmissions, signaling an end to the days when hospitals could simply view all readmissions as additions to the revenue stream. In the immediate future, many early related readmissions will in fact represent a loss of revenue.

Payers and quality raters continue to examine post-discharge costs and events, with Medicare leading the way and commercial payers likely to follow. Most hospitals are expected to experience a reduction in payments as a result of this new form of cost cutting and quality improvement.

The U.S. Department of Health & Human Services' *Hospital Compare* site publicly reports 30-day readmission rates for individual hospitals based on a risk-adjusted ratio to a national average. Controversy remains regarding the validity of quality determination based on readmission comparisons between hospitals, but still, most hospitals internally generate limited "after-the-fact" (retrospective) readmission-rate data based on their clinical information solutions. The best of these systems permits hospitals and networks to evaluate readmission rates for specific cohorts, such as organization sub-unites (nursing units, for example), inpatient diagnosis, or clinician.

Both payers and providers would agree on a subpopulation of shorter-term (30-90 day) readmissions that are clinically unavoidable or minimally avoidable or even expected (for example, an anticipated and required wound-closure surgery following resolution of a wound site infection). Payers and providers are focused instead on the inpatient subgroup that represents "unnecessary" or "preventable" readmissions. Regulators currently define this group as patients readmitted within 30 days *for reasons related to the clinical condition that resulted in the initial hospital admission.*

The presumption is that within this group of "preventable readmissions" is a concentration of patients who are readmitted as a result of errors or omissions in care during the initial hospitalization or inadequate post-discharge care. While an imperfect surrogate for such a patient subset – because the group includes patients readmitted due to uncommon or chance medical occurrences as well as patients whose unpreventable or unpredictable actions result in readmission – the criterion is useful in large part due to its availability in hospital data to those determining reimbursement.

### The Readmission Problem

Hospital readmissions, including short-term and preventable readmissions, are prevalent and costly. Readmissions are estimated to absorb tens of billions of dollars annually. And, their rates have not improved in recent years, according to the Dartmouth Atlas Project. (Goodman)

Roughly one in six Medicare patients are readmitted to the hospital within one month of initial discharge. (Ibid) And the variation in readmission rates across health care facilities and between similar populations is dramatic, indicating a failure to provide consistent quality and coordination of care.

The analytics challenge comes not in retrospectively tabulating the numbers of short-term readmissions relative to original admission DRG but in *predicting the likelihood of an individual inpatient's 30-day readmission during an initial hospitalization.*

"A lot of organizations – including medical centers and systems, payers and vendors – are now working to create better ways to predict preventable readmissions," notes Diane Hemphill, Project Manager at Elsevier/MEDai.

While hospitals today are frantically calculating the predicted financial losses resulting from preventable readmissions, the sought-after ideal is to incorporate, as soon as possible, a solution to prospectively determine risk of short-term readmission for inpatients, thus creating the potential to reduce that risk. Despite the availability of statistical models for predicting readmission, these tools have yet to become routine in the delivery of inpatient care for a number of reasons, including their failure to:

- Accurately stratify inpatients into risk categories;
- Present predictive risk in forms understandable or meaningful to users;
- And guide providers in reduction of identified risk in the inpatient and post-discharge settings.

Evidence demonstrating the effectiveness of targeted inpatient and post-discharge interventions for reducing readmissions has begun to grow in recent years. (Hasan) Implementing care activities guided by a readmission-risk score has the potential to result in higher quality, lower-cost proactive, rather than reactive, patient care. Academic research and industry experience has demonstrated that high risk of readmission can be detected early in the inpatient course for many patients. (Ibid)

Calculations starting from the day of admission can identify patients who would likely benefit from additional or modified care. Such accurate, actionable readmission risk assessment allows patients and families to more deeply engage in the patient's care, supports increased primary-care involvement, and guides care activities of physicians, nurses and nurse practitioners, care managers, case workers, social workers, nurse call center staff, and home health personnel.

## Absorbing Possible Medicare Adjustments First, for Avoidable Readmissions

Medicare is taking the lead in decreasing facility reimbursement for preventable readmissions. In the first phase of this strategy, CMS will use the information already obtained and process in enrollment and claims data for Medicare Fee-For-Service inpatients harboring a principal diagnosis of acute myocardial infarction, heart failure or pneumonia. Based on data compiled from October 2012 forward, the higher a hospital's predicted 30-day readmission rate (relative to expected readmission for the hospital's particular inpatient case mix) the higher its calculated " adjusted readmission rate." CMS will apply penalties for hospitals with "excessive readmissions" – penalties for all Medicare payments, not just payments associated with excessive-readmission DRGs.

Reimbursement adjustments begin in 2013, based on clinical outcomes monitored in federal fiscal year 2012. In fiscal year 2013, hospitals face a penalty equal to as much as one percent of their total Medicare billings; penalties rise to as much as two percent in 2014 and three percent in 2015.

## What is the current state and potential of these tools?

Nationwide, health organizations are looking at patients "bouncing back" to their inpatient facilities and are recognizing the urgent need to address this issue with predictive capabilities. Progress in reducing preventable readmission requires valid, effective readmission risk analytics, and it is becoming clear that possessing electronic patient/clinical data is just the first step.

A 2011 JAMA retrospective analysis of predictive models concluded that nearly all performed poorly in predicting which inpatients were at high or low risk for readmission. (Kansagara) Only a handful of models in the analysis reported a *C statistic* above 0.7, a minimum value for indicating even a modest ability to discriminate risk. (As a measure of how well a clinical prediction rule can correctly rank-order subjects, a C statistic is a method to evaluate concordance achieved by a logistic regression model.)

Unfortunately, only one of the studies analyzed in the JAMA review focused on preventable readmissions, the critical focus for which newer algorithms are showing greater predictive success. Such tools are already proving useful in health systems and producing significant reductions in hospital readmissions.To date, the strongest generic predictors of a patient's short-term hospital readmission include:

- History of prior hospitalizations and emergency department visits;
- Certain prior conditions or the presence of multiple co-morbid illnesses; and
- Hospital length of stay

Many other clinically-related factors, such as specific lab results, vital signs, drug status, and other data available within a hospital information system or electronic medical record (EMR) further strengthen the prediction.

Given the nationwide drive for valid readmission-risk solutions, it is not surprising that there is currently significant activity among some of the best analytics teams, supported by a variety of funding and research and development sources, driving the continued effort to refine and improve readmission models and predictive tools.

These activities, however, are extremely resource and personnel intensive, making the tool-development process prohibitive to perform internally for most health systems. This is true even as the very information that would allow health care facilities to avoid preventable readmissions pours into those facilities' data systems from the moment a patient presents for admission, throughout that inpatient's evolving hospital course, and concluding with the patient's discharge.

Quality issues revealed by preventable 30-day readmission analysis should be the greater concern – and should be a concern regardless of the financial implications.

### A Question of Definitions

Not all 30-day readmissions can or should be avoided, just as not all are a result of sub-optimal care. Unfortunately, current 30-day readmission risk predictors are not primarily designed to provide clinical guidance regarding the driving factors for short-term readmission risk, bus simply to generate a risk score and provide the statistical drivers behind that score. Comparison of DRG for initial and subsequent readmission is currently the sole determinant in defining readmission preventability.

A parallel function of identifying real-time clinically actionable risk factors is a feature of any predictive solution that aims to reduce risk during and following hospitalization. Eventually, solutions will more fully mesh readmission-risk and such clinical action functions.

## Preventing the preventable: What a readmission-risk tool should do

So what characteristics should a 30-day readmission risk predictor possess? First, such a solution is predicated on the availability of the required data elements within the health care organization's systems. The goal is to take advantage of these valuable assets every day to help define the changing likelihood of readmission for all hospital inpatients.

On the facility side, this challenge requires a hospital culture in which staff input factors (clinical and clinically-related data) critical to predicting readmission risk, starting from initial admission and continuing throughout hospitalization. The tool itself should have analytics pathways that automatically perform intelligent clean-up as needed of the data entered by the providers.

In the risk stratification model, risk should be determined by weighted risk drivers that are based on a regression analysis of a large database of patient information. Variables within the data set covering a variety of factors, from blood values to medications to nutritional status to co-morbidities, should be assigned relative values based on their power for predicting readmission. Patient data for each of these weighted risk drivers determines the individual's risk score for readmission.

Processing this day days or weeks after inpatient discharge – at which time the patient may already be readmitted – is clearly not effective. The earlier in the course of hospitalization that readmission risk can be calculated and presented, the greater the opportunity to impact that risk. Such calculation should begin with generating of a risk score based on the day of admission.

While the score may well change during the course of hospitalization, this early prediction affords the clinical team increased opportunity to respond to high-risk patients. The risk score for preventable readmission should recalculate as new data arrives (labs, etc.), providing near-real-time risk prediction.

The tool should also highlight the risk drivers that form the basis of each patient's risk score, providing guidance to potential clinical activities (both inpatient and post-discharge) with the possibility of reducing readmission risk. Presentation of risk drivers compliments, rather than duplicates, concurrently running alerts provided by clinical protocols, EMRs, or care analytics systems.

Finally, the provider of the predictive solution should continually expand the data set on which the risk drivers are based. As more total data on patient populations accumulates, risk drivers and their relative weights should adjust, enhancing the predictive capability of the model.

An added benefit of a pre-admission risk score is reduction of unwanted events prior to discharge, prompting specific steps that improve outcomes for the hospitalization itself.

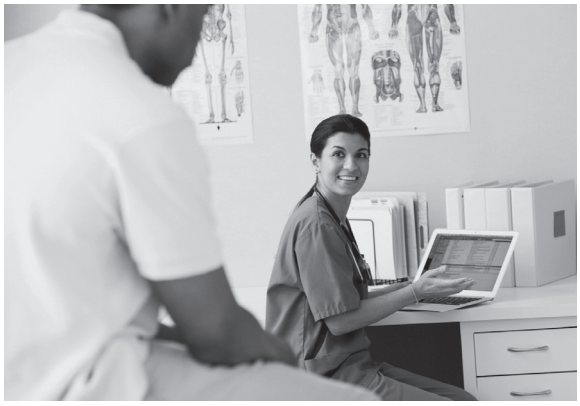
## An example: Pinpoint *Review*®

Elsevier/MEDai's highly regarded clinical analytics solution, Pinpoint *Review*, predicts a patient needs and provides staff alerts to help avoid adverse events. In this role, it also provides users with a carefully developed prediction for patient readmissions.

"There's no doubt that some past predictors in the field have not done as well," says Dr. Peter Edelstein, M.D., Chief Medical Officer for Elsevier/MEDai. "We set out to improve on that with this tool."

Elsevier/MEDai used its large repository of client patient data to determine the risk drivers in its own regression analysis. "We wanted to originate this risk-scoring model to empirically identify for ourselves the strong drivers of preventable readmissions," says Dr. Anton Berisha, Clinical Product Manager for the solution.

To facilitate its ranking ability, the model that the team developed uses a preventability logic that breaks outcomes into levels for how the dependent variable is computed (no readmission, non-preventable readmission, likely non-preventable readmission; possibly preventable readmission, likely preventable readmission; definite preventable readmit) based on the DRG relationship of the original admission to a readmission.



Working in the background, the relationship of drivers to predict these levels permits the solution to provide the user a risk-level prediction score of 1-5 (with 1 the least risk and 5 the highest risk) for each patient.

To apply the resulting predictor function to this hosted, web-based tool, Elsevier/MEDai uploads a hospital's data on admitted patients. Data scrubbing includes content validation, in which descriptions are translated to coding standards.

Users can query risk of readmission and preventable readmit for patients with confidence in the discriminating value of the result. Unlike most models used to date, Elsevier/MEDai's preventable readmission analysis has produced a good C-statistic of greater than 0.75. Pinpoint *Review* offers a high level of modeling accuracy in predicting which patients will not be readmitted, but also significant success in the more difficult task of identifying those likely to be readmitted.

The more predictions the solution makes, the better the predictions should become, based on a repository of results that steadily improves the modeling.

In most recent analyses, it accurately predicts more than a third of patients to be readmitted in 30 days, more than half to be readmitted in 30-90 days, and more than a third of preventable readmits in the 30-90 day period. (Similarly, Pinpoint *Review* also offers accurate prediction of severity, length of stay, and risk for hospital-acquired conditions.)

In addition, Pinpoint *Review* enhances the model for certain patient statuses such as "newborn," "delivery" and "prior admissions," to create weighted clusters that better predict readmission for patients in these categories. Using such "hierarchical clusters-based model ensembles," the model helps identify patients with particular combinations of factors that are predictors of readmission in these groups.

Pinpoint *Review* also provides the basis of each readmission risk score, which usually supplies a direct or indirect indication of clinical adjustments that can be made. Clients may choose to further parse the analysis to see readmission risk per facility, physician, floor, or diagnosis, with associated drivers.

"Most of our clients run the tool once per day or at the start of shift changes," explains Hemphill. "The risk score may change, of course, as labs and other data come in, and typically a case manager will take scores that need attention to the attending physician. The first day's scoring is most important in terms of having the best opportunity to drive down the readmission risk during the stay."

## A readmission risk predictor delivers business intelligence but also makes hospital care better

Reducing early-related re-hospitalizations across the health care system will take long-term innovation and quality standardization, but medical centers are already focusing on areas of most rapid pay-off. They know that if they want, they can apply equal attention and resources to all patients, but such an approach doesn't make sense.

Instead, providers acknowledge that they must direct strategies to patients with the highest preventable readmission risk, especially when it comes to resources around discharge and post-discharge care (and particularly now for certain DRGs).

Readmission risk scores can have important effects on medical and nursing steps, including in the area of patient education. Such scoring should be a supportive, not punitive, tool for the staff, with the results pushed out to decision makers early and often, including across platforms such as smart phones, laptops, tablets and other personal devices.

Pinpoint *Review*'s readmission risk prediction accuracy is high, with most patients receiving a correct readmission prediction. In what amounts to near-real-time clinical surveillance and forecasting, the tool gives clinical staffs the information needed to prevent costly negative post-discharge outcomes that hospitals want to manage more effectively because of their effect on cost and quality.

Even for patients discharged directly from the emergency room, risk communication must carry over to the case manager and any institutions to which high-risk patients proceed. Scores for risk of short-term readmission can:

- Provide guidance to the individual's primary caregivers and generate more follow-up from them;
- Prompt optimal use of the network's home care services or available home care resources;
- And make individuals and families more adept at managing their own post-discharge health and more responsible for participation in it.

The more integrated, accountable, or patient-centered a network is, the easier time it will have in taking advantage of such analytic tools to achieve these goals.

Meanwhile, readmission risk tools will only improve, including as they:

- Gain more data on risk drivers and include new variable in important areas such as patient functional status and psychosocial factors;
- Use condition-specific variables in more cluster analysis, as Elsevier/MEDai's Pinpoint *Review* has begun to do;
- And adjust the algorithms for risk drivers that are stronger or weaker at specific hospitals or other patient populations.

The tools will also want to be designed with better suggestions on risk-reduction interventions for clinicians.

Providers can thrive amidst value-based reimbursements, and a comprehensive system for readmission risk assessment is a critical means to that end. It opens the clinical process to more of the power of computing and of vast data repositories, to make care more modern, deliberate, intelligent and effective.

Health systems working on preventable readmissions will reap better partnerships with all parties paying the health costs of individuals, whether those entities are the patient or family, the government, private insurers or employers. Preventable readmissions can't be eliminated, but they can be minimized – a step that will help to close long-standing gaps in health care. Hospitals so engaged will improve quality and achieve fiscally sustainable admission patterns.

30-day readmission risk tools are in an active state of development to make them more rigorous, accurate and actionable.

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