



Developing a Real-Time Predictive Model for Identifying High-Needs Patients

Atrius Health's Approach

Domain: Patient Risk Assessment
Category: Implementation and Data
Competency: PRA.3.2 Make risk assessment data available at the point of care (e.g., discrete, searchable fields and/or on the problem list in the EMR)

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BACKGROUND

Atrius Health was formed more than ten years ago, when like-minded medical groups came together to collaborate on clinical and operational processes that would enable high-quality, cost-effective care. Atrius Health quickly became a pioneer of what is now called "population health," leveraging electronic health data stretching back to 1970 and establishing an integrated data warehouse in the early 2000s to track quality, cost, and utilization. With over 80% of the organization's revenue under risk-based contracts, developing accurate tools to guide efficient resource allocation has been a priority for the organization. One crucial element of Atrius Health's data-driven population health strategy has been its ability to accurately predict population clinical and cost risk. This case study describes the development of Atrius Health's predictive risk models.

About Atrius Health

Atrius Health is a non-profit health care leader delivering a system of connected care across 30 clinical locations, 50 specialties, and 875 physicians to more than 675,000 adult and pediatric patients.

Location: Eastern Massachusetts

Website: www.atriushealth.org

VBP Activity:

- Medicare Advantage since 2000 or prior (~21k lives)
- Commercial HMO, including BCBSMA since 2000 or prior (~170k lives)
- Medicaid HMO since 2000 or prior (~31k lives)
- Pioneer ACO Jan 2012-Dec 2016 (~30k lives)
- Next Generation ACO since Jan 2017 (~30k lives)

APPROACH

The first iteration of Atrius Health's risk prediction tool focused on the Pioneer ACO's Medicare population, stratifying patients into four categories: 1) advanced illness, 2) high risk, 3) complex rising risk, and 4) risk prevention. Called the "Medicare High-Risk Model," Atrius Health developed this predictive tool in several iterations, using a point-based system to combine discrete data fields (such as prior hospitalizations) with commercially-available algorithms in order to make its electronic health record (EHR) and Medicare claims data actionable. For four years, Atrius Health used this early predictive model to drive proactive care management, providing targeted lists and rosters to individuals at the point-of-care, the outreach team, and case managers. As practices developed enhanced protocols to improve care for high-risk roster patients, the shortcomings of this primarily claims-based predictive model became apparent. Because claims data are lagged by as much as 3 months, the model often missed patients in the critical early phase of intervention. The model was also limited to Medicare patients and required some manual manipulation of the data in addition to its automated processes.

In 2016, Atrius Health deployed the second iteration of the tool: Clinical RiSk Prediction Initiative (CRISPI). In addition to pulling EHR and claims data from the integrated data warehouse, CRISPI also incorporates real-time data sources, such as patient hospital admission feeds, making it more highly predictive and reliable. CRISPI looks beyond Medicare beneficiaries to include all of Atrius Health's ambulatory adult patients who are continuously enrolled in global risk Medicare, Medicaid, and commercial contracts.

In addition to incorporating more robust, real-time data, the presentation of the CRISPI output has been carefully designed around the user experience. In creating this new tool, Atrius Health's Advanced Analytics Team sought feedback from the care teams who would be interacting with the data. The intuitive and apparent visual integration of CRISPI into the EHR has allowed staff to easily act on its prediction of high-risk patients. Identification of a high-risk patient triggers a visual cue, turning the health record header purple. Hovering over the header displays the top 10 factors recognized among the model's 150 clinical risk factors that indicate increased risk of hospitalization or readmission within the next 6 months. Making the patients' risk levels clearly visible at the point of care has helped the care teams to quickly follow enhanced triage protocols. Care managers regularly receive lists of high-risk patients identified by CRISPI, and work to schedule assessments within two days. The list is also used to determine which patients should be discussed during team-based, multidisciplinary care team reviews.

While CRISPI has been shown to perform favorably relative to commercially-available models for predicting hospitalizations, Atrius Health is constantly looking for ways to advance this work, focusing on improving the accuracy of the model and the input data and encouraging feedback from the users.

RESULTS TO DATE

In vetting the CRISPI algorithm, Atrius Health has proven its ability to identify the patients in need of enhanced access to prevent hospitalization. It has also helped create a more prioritized, accurate list to inform efficient allocation of population health management resources. CRISPI

demonstrates an accuracy (as measured by the c-statistic) of 83%, comparing favorably to similar tools while also providing greater timeliness and transparency into the factors that contribute to risk.

Early results of an enhanced access workflow using CRISPI are promising. In a review of the last two months of data, hospital admissions look better for all high-risk groups relative to controls that were defined using similar clinical criteria.

	CONTROLS	CRISPI	DIFFERENCE	% DIFFERENCE
ADMITS/1000	69.3	51.7	-17.6	-25%

In addition to these findings, anecdotally, Atrius Health physicians have confirmed that the CRISPI model more effectively identifies the “right” patients in a timely manner, and it displays that information in an actionable way. Atrius Health will continue to monitor CRISPI’s impact on actual care delivery practices.

TOOLS & VENDOR PARTNERS

CRISPI is an internally-developed, multivariable logistic regression model that pulls data from the Atrius Health enterprise data warehouse, including clinical data from the Epic EHR, ADT feeds, and payer claims. The model uses 138 variables across medical and pharmacy utilization, diagnoses, and sociodemographic factors to predict a patient’s risk of hospitalization within 6 months (low risk: <20%, moderate risk: 20-50%, and high risk: >50%).

CRISPI was developed in-house by Atrius Health’s Advanced Analytics Team, consisting of a physician medical director with advanced analytics expertise and two data analysts with public health degrees. The team’s unique combination of skills in an environment that encourages constant innovation has led to many successful tools throughout Atrius Health’s risk journey. The Advanced Analytics Team is currently deploying natural language processing, new models for predicting risk of patient mortality and premature births, and is incorporating new datasets like socioeconomic and patient-reported data.

CHALLENGES WITH IMPLEMENTATION

Two critical features of the CRISPI implementation were 1) to provide full transparency into the model development and 2) to clearly articulate the covariates with the largest impact on the hospitalization outcome. This was important for establishing model face validity for a clinical audience. It also helped engage the clinical teams in opportunities for care management redesign.

In the medical group’s experience, models available on the market may feature sophisticated machine learning algorithms that are often perceived by lay audience as a “black-box.” Atrius Health found that having CRISPI developed, tested, and implemented on internal patient data strengthened its value and utility to key stakeholders. CRISPI’s use of parameters such as demographics, medication history, utilization, helped communicate the covariates of highest impact. This includes a rough description of the c-statistic and comparisons to prior models Atrius Health developed in-house as well as obtained from third party vendors.

KEY LEARNINGS

- **Listen to the frontline** – Actively seek feedback from care teams when building models that will change workflows. Listen to the people who are doing the work; they will provide the solutions.
- **Don’t wait for perfection** – Create solutions based on the best options currently available. Allow people to use solutions and innovate around them. Apply learnings in the next iteration.
- **Build a strong team** – Recruit or develop people with unique skill combinations (e.g., data analysts with public health degrees). Leadership must then create an innovative environment.
- **Simpler is better** – Sometimes a simple solution is the best one. Know what to look for. When stratifying populations, risk of hospitalization maybe be enough.

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