Advisory Board | Health Care IT Advisor

Building a Prescriptive Analytics Model

How Jewish General Hospital Used Predictive and Prescriptive Analytics to Improve Patient Access, Costs, and Quality of Care

Health Care IT Advisor

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Executive Summary

Background

The Sir Mortimer B. Davis Jewish General Hospital (JGH) is a 647-bed teaching hospital associated with McGill University in Montreal, Quebec, Canada. The facility faced several pressures—including an influx of patients presenting at the facility from outside their traditional catchment area and a fixed budget—that forced administrators to take action to improve access and quality of care while limiting the associated costs. In response to these pressures, JGH administrators decided to build a computer model of the hospital.

Solution and Results

JGH entered into a proof-of-concept engagement with River Logic, Inc. and CGI Group to build the model. Facility leaders identified the need for a thoughtful and data-driven approach to address the facility's budget and capacity issues with the end goal to improve access and quality of care and minimize costs. The model mapped how resources are consumed as a patient with a specific DRG[1] flows through the hospital. This allows one to fully understand specific impacts to cost, quality, and access across the entire facility, rather than within a specific department. Administrators held workshops with clinical and departmental leaders to define a short list of policy and process-change scenarios that focused on four key areas: the oncology, surgery, medical, and emergency departments. Once the model was built and all data streams were in place—no small feat—JGH conducted iterative what-if analyses to optimize patient flow through the hospital. The model revealed that 24 acute beds could be closed with an estimated savings of $2.3M CAD[2]. Ultimately, JGH closed all 24 beds.

Lessons Learned

Even though JGH was piloting advanced analytics capabilities, many of the problems were the same as a full-fledged implementation. It is imperative to allocate enough time and resources to obtain clean data and establish effective data governance. Use the expertise of health data analysts to define consistent and trusted definitions of terms (e.g., episode or care, frequent flier). Additionally, success hinges on clinician involvement as project champions and great sources of ideas for possible scenarios. Strong senior leadership involvement is vital to maintain project momentum. External pressures coupled with the right vendors with good analytical tools can lead to data-driven, meaningful change.

Next Steps

Legislation in the spring of 2015 initiated a merger of JGH with nine other health and social services institutions. As a result, JGH was not able to implement any of the proposed scenarios beyond closing 24 acute care beds; however, a second, more complex model will be built to simulate the entire network with the same goals of improving access and quality while reducing costs at the network level. Senior network leadership is particularly interested to model how patients move around the network to identify inefficiencies such as readmissions, duplicative care, and patient stays in the incorrect care setting.

[1] DRG = diagnosis-related group.
[2] CAD = Canadian dollars.

Background

The Sir Mortimer B. Davis Jewish General Hospital (JGH) is a 647-bed teaching hospital associated with McGill University in Montreal, Quebec, Canada. It is now part of the Integrated Health and Social Services University Network (CIUSSS[3]) for West-Central Montreal. JGH has provided acute care health services to patients throughout the Canadian province of Quebec since 1934. Dr. Lawrence Rosenberg currently leads the CIUSSS for West-Central Montreal and previously served as the Executive Director for JGH.

Several financial pressures pushed JGH to pursue predictive and prescriptive analytics capabilities: a fixed $350M CAD budget based on historical data, an increase in the number of patients flowing through oncology services and the emergency department (ED), and the Canadian Ministry of Health's announcement of additional budget cuts to extract any remaining savings through efficiencies. Facility innovations and improvements coupled with a great reputation across the province for emergency and cancer care have led to an increase in the number of patients who present at JGH.

As a result, administrators decided to build a computer model of the hospital. The scope of the initial project was limited to the JGH acute care facility.

Goals and Objectives

Dr. Rosenberg identified the need for a thoughtful and data-driven approach to address the facility's budget and capacity issues. The ability to model how resources are consumed as a patient with a specific DRG flows through the hospital allows one to fully understand specific impacts to cost, quality, and access to care across the entire facility, rather than within a specific department.

Administrators wanted to see this end-to-end, holistic view of hospital-based processes, not just a departmental view, in order to fully understand the upstream and downstream implications of any proposed clinical, policy, or process changes. The model would serve as an objective decision-making tool to identify the changes that would improve access, patient throughput, and quality without increasing costs. JGH focused on using the model to find opportunities to optimize patient flow through the hospital given the facility's particular operational constraints, such as bed and discharge blockages and an inability to turn away patients.

The Solution: River Logic and CGI Partnership

JGH entered into an proof-of-concept engagement with River Logic, a prescriptive analytics and performance management firm with years of prescriptive analytics experience in manufacturing, oil and gas, and other industries; and CGI Group, an IT and business process services company, to develop the model. The project was led by a team of personnel assembled from River Logic, CGI, and JGH analytics leadership and consisted of three main phases: discovery, modeling and validation, and scenario analysis and planning.

[3] CUISSS = French language acronym for Centre intégré universitaire de santé et de services sociaux.

Discovery Phase

The discovery phase aimed to identify the scenarios and data requirements for the model. Administrators held a series of on-site workshops with departmental and clinical leaders to solicit their input and generate ideas of what JGH can do differently, both clinically and operationally. Many participants came to the table with definite ideas for change. Together, the scenario ideas were whittled down to a short list to analyze. Table 1 shows a sample list of these scenarios. Next, administrators held individual one-hour sessions with the department and clinician leaders to identify several required inputs: the necessary variables; what operational, financial, and clinical data are required and available; and how to precisely model the environment. JGH then defined how they will measure the impacts of any changes and what these impacts mean for the province of Quebec in terms of access, quality, and cost of care as outlined in Table 2.

Table 1: Sample of Jewish General Hospital Program Scenarios for Analysis

Scenario	Description
Discharge Improvement Programs	• Introduce an inpatient discharge policy based on the Ministry of Health and Social Services End of Active Care guidelines[4] • Implement a discharge planning system
Appropriate Oncology Orders in ED	• Implement oncology order sets that can be ordered in the ED
Directed Outreach for ED "Frequent Fliers"	• Implement a program to divert frequent flyer patients to another care provider so as to provide better and more cost-effective care
Oncology Partnership with Local Hospitals	• Implement a program with local hospitals so that JGH serves only patients in its catchment area and patients from anywhere that can fit into a clinical trial • Increase number of patients in a clinical trial
Reduce Oncology Volumes	• Partner with community hospitals so standard oncology treatments can be provided in the community
Weekend Oncology Clinic	• Open a weekend oncology drop-in clinic for Segal Cancer Centre patients who use the ED on the weekend
Geriatric Outreach to Nursing Facilities	• Educate Long Term Care (LTC) staff and provide an on-call team to treat patient in LTC and prevent admissions to hospital • Reduce the time it takes for an inpatient to receive their PICC[5] lines and allow them to be discharged sooner
Bed Turnover Process Improvement	• Implement a program to improve the time it takes to make a bed available to a patient once the previous patient has been discharged
End of Active Care and Elective Procedures	• Implement multiple scenarios such that the benefits of one scenario can be utilized to implement additional program improvements of another scenario • The impact of implementing an End of Active Care policy and optimizing the One Day Surgery and Inpatient elective procedures

[4] End of Active Care guidelines require that elderly patients who no longer need acute care services be assigned and transferred to a lower level acuity setting within the network—such as long term care, rehab, or social services facilities--within 8 days or they will incur a fine of $984 per patient per day.

[5] PICC = peripherally-inserted central catheter.

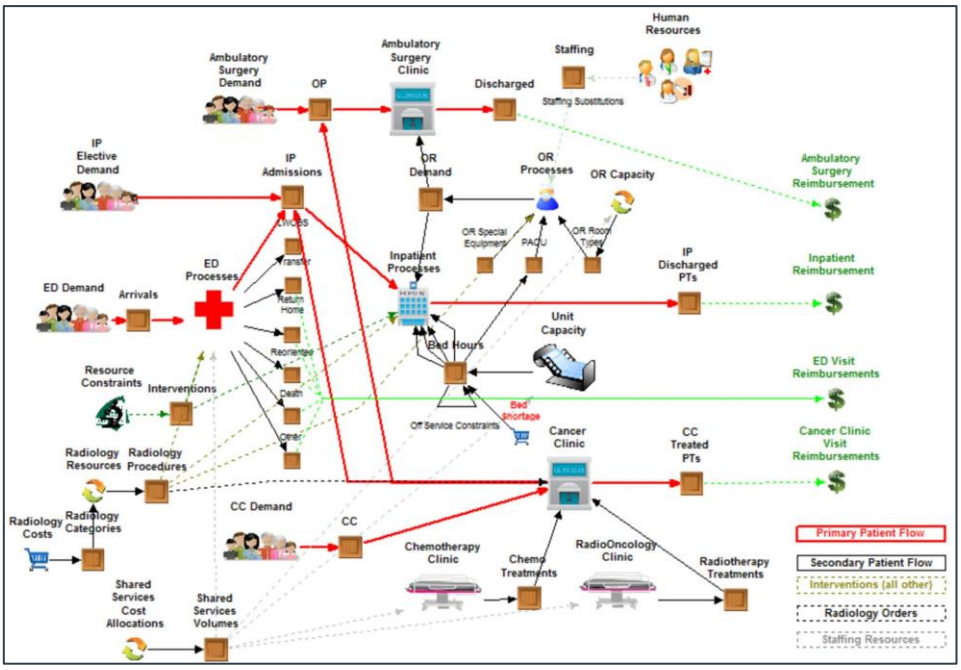
Table 2: How Jewish General Hospital Measured Results

Area of Impact	How It Was Measured
Access to Care	• Number of beds that become available per year • Increased access for clinical trial/study patients • Reduction in wait-list for procedures
Quality of Care	• Fewer days in the hospital • Fewer trips to the ED for geriatric patients • Fewer cancer patients visiting the ED on the weekends • Fewer unnecessary procedures
Cost Savings	• Number of beds that can be closed • Reduced lengths of stay • Reduced costs in the ED • Net dollar savings across the system

Modeling and Validation Phase

In the modeling and validation phase, JGH focused on the processes within four main departments including the oncology, surgery, medical, and emergency departments. This covered about 80% of all the facility services. To capture the relationship between the processes and resource consumption within the hospital, the model mapped them to their impact on resource consumption from supporting services such as the radiology department, radiation oncology, labs, pharmacy, nutrition, and the laundry within River Logic's Enterprise Optimizer tool. An example model is shown below. The model also allowed administrators to tie in detailed financial data to capture any financial constraints and predict the overall monetary impact of changes. As one might expect, a significant percentage of the total implementation time was dedicated to data identification, collection, and validation/cleansing.

Figure 1: Example of River Logic Enterprise Optimizer Health Care Process Model



Scenario Analysis and Planning Phase

During the scenario analysis and planning stage, analysts used the model to conduct a series of iterative "what-if" analyses on the various scenarios described in Table 1 with the goal to optimize patient flow through the hospital and minimize costs. The model and what-if analyses provided specific impacts for the measurements listed in Table 2. Then, a team of clinical and departmental leaders evaluated these scenarios and assigned a relative value of positive, medium, or negative impact. For JGH, four scenarios were estimated to have an end-positive impact and three as having a negative impact on overall access, cost, and quality of care. The remaining scenarios were assigned a medium, though still positive, level of impact. The results were presented back to the clinicians. This process solidified an understanding of the hospital-wide impact of certain policy or procedure changes.

Moving forward, JGH plans to reevaluate the model on a yearly basis.

Results

The model was able to simulate the complex hospital environment. Across all JGH scenarios analyzed, the model revealed that 24 acute beds could be closed, equating to about $2.3M CAD in savings. Ultimately, JGH closed all 24 acute care beds.

The project identified the best scenarios to improve access, quality, and cost of care. Several of the program scenarios were assumed to have a positive impact on the hospital; however, the model also identified situations in which a new program or change would have little-to-no positive impact if implemented. Such was the case with opening a weekend oncology drop-in clinic to reduce the number of ED visits by Segal Cancer Centre patients. The model revealed that it would result in only 100 fewer visits and ultimately was not worth the costs to start and operate the weekend drop-in clinic.

Below is a summary of potential results from the model in the three key areas of interest:

- **Access to Care**: Up to 84 additional beds becoming available or 1,000 additional elective procedures performed annually
- **Quality**: 2,000 fewer patient visits to the ED, earlier surgeries, 200 fewer unnecessary CT scans, and 500 fewer unnecessary inpatient admissions annually
- **Costs**: Annual savings of $1M–$2M CAD through redirection of geriatric patients away from the ED; annual savings of close to $250,000 CAD by avoided acute care admissions.

While many of the initiatives analyzed during the process were identified as net-positive changes, none have been fully implemented to date due to unforeseen legislation that merged JGH with nine other institutions, forming the CIUSSS in 2015. This has led to a second phase of the project in which the nine other facilities in the network will be modeled and optimized at the network level.

Additionally, physicians began to think more holistically. Working through the various clinical scenarios via the predictive and prescriptive capabilities of the model made it a concrete reality to clinicians that policy and process changes in their own departments actually have hospital-wide impacts.

Related Business Intelligence Resources

The Business Intelligence Maturity Model

An Introduction to Prescriptive Analytics

Challenges

Though the project was deemed an overall success, it was not without challenges. As with many analytics projects, data collection and data quality were major hurdles. Project leaders estimate that approximately 50%–60% of the implementation time was devoted to data investigation and preparation. JGH data-related challenges included:

- Finding gaps in financial, clinical, and operational data
- Locating and extracting all required data streams
- Relating data to episodes of care
- Linking clinician scenario proposals to available data
- Resolving data inconsistency issues across departments
- Determining costs—budget data was used as substitute

The importance of health data analysts, not just data analysts, also surfaced. For example, how does one define a frequent flier, an episode of care, or a lifetime of care? Which diagnosis should be used to determine how to identify an ED frequent flier: the patient's initial complaint, the triage diagnosis, the ED physician diagnosis, or the admitting diagnosis? Experienced health data analysts were used to guide the definition of these terms and to validate any assumptions with clinicians and operational or financial staff. Additionally, it was difficult to determine how JGH would measure outcomes.

Unexpected Outcomes

This project brought individuals out of their siloed thinking by illuminating just how interconnected individual department operations are. Dr. Rosenberg notes the shift in conversations from finding localized efficiencies in clinicians' own departments to the relationship of the changes and how they impact other parts of the system. Prior to the project, no one truly understood how everything worked, and being able to model the interdependencies was imperative to understanding the facility system as a whole. Administrators gained valuable insight from seeing upstream and downstream effects of processes, policies, and changes.

Lessons Learned

- Even though JGH was piloting advanced analytics capabilities, many of the problems were the same as a full-fledged implementation.
- Data-focused projects will inevitably take longer than anticipated; it is imperative to allocate enough time and resources to obtain clean data. This process is time intensive, but is attainable through the establishment of strong data governance.
- Establish a forum to determine a consistent and trusted definition of terms (e.g., episode or care, frequent flier), leveraging the expertise of health data analysts.
- Success hinges on clinician involvement for project champions and as great sources of ideas for possible scenarios. Clinicians are also vital to help validate the clinical assumptions in the model and outcomes. Gather ideas that this group generates

and test them, reporting back the results to gain trust and buy-in to the model and its capabilities.

- "Gut feel" is not a good way to evaluate changes since the results from the modeling were very different from what was assumed or anticipated for several scenarios.
- Validate the model thoroughly. Be intellectually critical of the model's outputs.
- Strong senior leadership involvement is vital for maintaining project momentum.
- Combined with a desire to change and vendors with expertise, good analytical tools can lead to data-driven, meaningful change.

Next Steps: The Network Model

Background

On April 1, 2015, Bill 10 transformed health care within the province of Quebec, essentially merging JGH with nine other institutions into the CIUSSS and placing Dr. Rosenberg at the helm. The new network has an annual budget of about $700M CAD and now includes multiple acute care facilities, ambulatory clinics, rehabilitation services, post-acute care, elder care, and social services. As a result, JGH did not implement any of the proposed scenarios described above; rather, a second more complex model will be built to simulate the entire network with the same goals of improving access and quality while reducing costs. The new network model will have a proposed timeline of six months.

New Model Objectives

This second model will serve several purposes:

- Use the new model to consider the entire health ecosystem
- Examine individual patient data to understand the needs of the population through data mining and business intelligence, particularly in how the population's needs transition over time and what the network should do to plan for services
- Change data collection efforts to fill in the gaps the first model revealed and to standardize data elements across the network members
- Understand how patients move around the system, identifying if patients linger too long in one setting, in an effort to reduce readmissions, duplicative care, etc.

The New Network-Level Model

The CIUSSS will continue to work with River Logic and CGI to build the network-level model. They held a kick-off meeting to narrow the focus to a few clinical conditions. Dr. Rosenberg is most interested in modeling how patients move around the network to identify if patients are readmitted, receiving duplicative services, or staying too long in a higher-acuity-than-necessary care setting. The model will emphasize four things:

- The impact of all government-mandated services at all institutions

- The physical resources and financial resources required
- The optimal operational level
- The costs to coordinate with other nearby networks to determine where care is most appropriate, whether it be within the CIUSSS or in another network

Analysis will be ongoing and as the data is refined, the network will fine tune its decision-making process. Ultimately, CIUSSS will work toward a live data stream through the model; the River Logic tool does have this capability.

Expected Challenges

Project leaders expect many of the same challenges for the construction of the new model. First, obtaining data may be a bigger challenge than with the first model. For example, data will be needed to determine:

- Expected demand for each type of health care service
- The resources needed to provide each type of health care service
- The resources available at each institution
- Standardized outcome measurements of each type of activity provided at each institution

Data cleansing will likely require a lot of time and effort, as some of the same data availability and consistency issues are expected also to be present within the other institutions, if not be a bigger issue. An overarching goal for the second model is to standardize data collection and ensure each institution collects all required data pieces moving forward.

Previously, cost analysis was hampered by a lack of cost-accounting data at JGH. While not all network institutions have costing data, some do have activity-based costing in place. Additionally, CIUSSS will need to rethink how to define an episode of care for the network; health data analysts are expected to play a major role here again.

Advisors to Our Work

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