Planning for a Healthier Future

How analytics can help overcome challenges facing the Canadian healthcare system

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Introduction

The transition from a reactive to a proactive approach to healthcare management

The purpose of this paper is to describe the prevailing conditions facing today's healthcare administrators, examine current issues in strategic planning for large health agencies and propose an exemplary framework for migration to a predictive analytics capability.

The nature of the job

A perennial concern among healthcare managers is the reactive nature of their role. Immediacy and urgency tend to characterize issues that arise in healthcare; the corresponding tendency toward a reactive management style is prevalent. Coupled with the tendency of available information to be limited and historical in nature, it dictates a style of management that tries to solve tomorrow's challenges with yesterday's information.

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The nature of the data

Early information systems offered some relief to the manager through first-generation basic statistical tabulations produced by report generators. Later, the introduction of second-generation data handling and reporting tools in the 1990s offered significant improvements in timeliness and relevance of management information.

This early online analytical processing (OLAP)/cube technology helped bring valuable information to the frontline manager through reports, drill-down capability and query analyses. While certainly a step up from legacy report-generator output, the main limitation of these reports and online dashboards was that they were based, again, on retrospective data. Although they offered only a rear-view mirror perspective on past events, they were considered adequate for monitoring departmental budgets and reporting on operational metrics.

As managers' information needs became more sophisticated, some limitations of this early business intelligence technology became evident. Plans were developed and performance monitored mainly on the basis of historical behaviors of the health system rather than on insight into future needs.

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Above and beyond: Challenges to traditional approaches

Managers began to demand forward-looking information that would provide them the flexibility to adapt to contingent events such as pandemics and respond proactively to material shifts in consumer needs and demographics.

Healthcare managers greeted the new millennium facing funding shortfalls and national public concern over declining healthcare service levels. These, among other factors, applied pressure for improvements in health system performance. Government agendas addressed ways of resolving management accountability problems, poor fiscal control and consumer dissatisfaction. The process brought to light inadequacies of existing management information and furthered managers' demands for more sophisticated information tools to enable better forward planning and performance monitoring.

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At this time larger and more complex health agencies were being created through health reforms in all provinces. Radically improved management information tools would be essential to running these new large-scale integrated health services amalgamates. Further, government bodies and health agency boards exerted their stewardship responsibilities more rigorously, requiring these newly formed amalgamated agencies to meet formal accountability criteria defined in accountability contracts.

It became evident that new management information tools would also be essential for performance-based compliance reporting; "second-generation" business intelligence tools would prove inadequate for effective planning and control in this demanding future business environment.

Lessons from the private sector

The questions confronting health system planners and executives were not unlike those facing private sector business strategists some five to 10 years before, for example: "How do we find out what changes are taking place in the needs of our consumer population? What if these trends continue? What might happen next? What might be the best choice from a range of feasible strategies?"

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Clearly these questions could not be answered using statistics based solely on historical data. Software solutions began to evolve from R&D investments into advanced statistical techniques in the late 1990s, emerging as predictive analytics. These techniques surpassed the second-generation OLAP/cube technologies by introducing enterprise data architectures, simulating consumer behaviour and using operations research methods to identify optimal business strategies.

Private-sector organizations have already demonstrated success using predictive analytics for several years. Enterprises upgraded from legacy retrospective planning models to predictive models to achieve enhanced corporate performance and competitive advantage. Many business success stories speak to companies making this transition.[1]

Could similar approaches be applied to healthcare planning to improve performance and consumer satisfaction? Indeed, lessons learned from private-sector modeling have proved particularly instructive in the area of predictive planning to simulate relationships between service capacity and consumer needs.

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Toward a holistic, predictive approach

New methodologies cannot be adopted overnight; information management infrastructure and skills must mature to effect a successful transition to the desired future state. Nevertheless, health authorities that adopt an analytics-based approach to executing their mandates are better positioned to deliver needs-based, quality care today and to anticipate and meet needs that are likely to arise tomorrow.

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Canada's health system

Unlike the user-pay, private health-insurance system employed by the United States, Canada offers a basic foundation of universal-access healthcare. The system aims to include those who would otherwise find themselves, due to financial barriers, ineligible for health protection. However, it is vulnerable to two traditional pitfalls faced by government-run entities:

a) Resources are allocated to satisfy political ends rather than to meet the explicit health needs of a particular population.

b) Resources are scarce, which takes its toll on the standard of care a particular health authority is able to meet.

The healthcare administrator needs to make decisions well before the existence of precedents. The incidence of SARS in the early part of this century served as a wake-up call to the reality of what had previously been largely textbook knowledge of pandemics. A key lesson was that centralized healthcare is vulnerable to decisions made on relatively sparse information. Instead, healthcare managers must probe the data they do have by asking complex "what-if" questions and use any resource available to them to find creative, long-term solutions.

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1 Thomas H. Davenport and Jeanne G. Harris, *Competing on Analytics*, Harvard Business School Press, 2007.

Healthcare leaders across Canada are ultimately responsible to the Ministry of Health in their particular province or territory. Ministries have a broad responsibility to guard the multifaceted well-being of all its constituents. That means creating and implementing legislation beyond the immediate and day-to-day concerns faced in a hospital. For instance, it means examining data and deciding to ban smoking in public areas; to argue for seatbelt legislation and alcohol-free driving. It means finding the more subtle connections between diet and health and, for example, legislating against trans fats, as in New York City. The ministry needs to be able to see steps beyond descriptive data and effect change in very specific ways. The Health Council of Canada, for instance, reports to the government on the overall health status of the population. It employs complex models to assess the comprehensiveness, continuity and coordination of care, and the resultant consumers' perceived quality of care and confidence in care.

The complete picture combines electronic medical records (EMR) data from specific agencies to create electronic health records (EHR): complete, cross-institutional client-centered data. The integration of EMR and EHR data more consistently and effectively with the plans of healthcare leaders, combined with the use of more sophisticated data management tools, is essential to creating a proactive healthcare environment. The demand for complex-system analysis has never been greater to assist healthcare management professionals, at all levels, to provide evidence-based, forward-looking healthcare delivery.

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Drivers for change

Healthcare has been described as the "most complex of all industries."[2] Early behavioral scientists commented even in the 1970s on the complexity of managing the array of loosely interdependent functions that comprise major hospitals. This was long before the advent of the even larger multibillion-dollar healthcare delivery mega-agencies that we now see emerging across Canada. Early planning for health reform recognized the complex nature of the system as exhibiting "mutual causality, emergent outcomes and probabilistic, uncertain and somewhat non-predictable outcomes."[3] It is fair to say that the health system has grown larger and significantly more complex over time. The following table provides a snapshot of the current system's human and financial resource investment.

2 Robert C. Townsend, *Up the Organization*, published 1970.
3 Globerman, Zimmerman, *Complicated and Complex Systems: What Would Successful Reform of Medicare Look Like?* ISBN 0-662-32778-0

Canadian Health System Metrics 2007	
Licensed Physicians	65,000
Registered Nurses	110,000
Pharmacists	24,000
Physiotherapists	9,000
Hospitals	400
Annual Expenditures	$148 billion

Value for money and quality of care dominate public and political agendas. Over and over again, a dearth of reliable information has hampered attempts to effectively evaluate respective arguments. For example, the Health Council of Canada in its 2007 report on wait times noted, "… the information needed to paint a cross-Canada picture – information that allows Canadians to see changes over time and to compare wait times data from different parts of the country – is not available from all jurisdictions, despite widespread recognition that it should be."[4]

Consumer demand for service improvements continues to mount. According to an Ipsos Reid survey, a majority of Canadian adults rank a patient wait-times guarantee as more important than any other of the government's priorities; 42 percent said that "a patient wait-time guarantee that would reduce wait times for key health services" was the most important to them personally. In January 2007, a similar survey concluded that 78 percent of Canadians believed healthcare wait times cost Canada money.[5]

Following the period between 2000 and 2004, health system governors at federal and provincial levels initiated three specific interventions that precipitated systemwide renewal and reorientation. Each has had significant implications for information management.

4 Health Council of Canada: *Wading through Wait Times: What Do Meaningful Reductions and Guarantees Mean? An Update on Wait Times for Healthcare*. June 2007 ISBN 978 1 897463 30 7

5 Ipsos Reid Survey, *The Cost of Waiting: Eight In Ten (78%) Canadians Believe Healthcare Wait Times 'Cost Canada Money'*: January 2008.

Organizational restructuring

Provincial governments commenced organizational restructuring of their health systems with the aim of improving service delivery and governance. Newly centralized models led to the emergence of large integrated health service delivery networks. Numerous smaller health delivery agencies were amalgamated under the leadership of regional health authorities.

One of the most challenging restructuring issues has been creating a central planning function within each of the new organizations. A recurrent challenge is the absence of relevant data, poor data quality and limited standards compliance, making it difficult to assemble a true enterprise data architecture. Another problem has been the scarcity of statistical analysis staff who have planning experience in large, complex organizations. As a result, many of the regional health authorities are now striving to fast-track upgrading of their planning and evaluation functions and their attendant information management capabilities.

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Performance initiatives

In response to consumer dissatisfaction over timely access to health services, the federal government began a review of health system renewal.[6] This resulted in some $41.3 billion of additional federal funding being committed to systemwide healthcare improvement initiatives, of which $612 million is to be used to help accelerate the implementation of patient wait-times guarantees. One key goal of this accord was that “Canadians see their healthcare system as efficient, responsive and adapting to their changing needs, and those of their families and communities now, and in the future.” This funding has launched numerous studies into wait times for emergency room service as well as for key surgical procedures and diagnostic tests. These studies make extensive use of analytics, integrating performance data from local institutions with national data from sources such as CIHI analyzed by SAS®.

In this demanding and complex milieu, it is important that healthcare managers use the best possible strategic planning practices to meet an ever-changing public need for health services and, equally important, to demonstrate the extent to which planned service goals have been met.

6 *First Ministers’ (FMM) Accord on Healthcare Renewal 2004 FMM 10-Year Action Plan to Strengthen Healthcare.*

In the context of a knowledge-based organization such as a hospital, Peter Drucker was among the first to insist that measurement be tied to organizational goals.[7] In addition to dealing with funding challenges, the healthcare industry is also confronted with severe operating difficulties including human resource shortages, escalating pharmaceutical costs and the disruptive consequences of organizational realignments. As a result, managers are confronted with demands for significantly higher levels of performance, coupled with an urgent need to drive operational improvements throughout the health system. They are increasingly expected to achieve these measures in ways that ensure ongoing sustainability.

What emerges is a picture of a large national industry: a complex and adaptive system to manage, answerable to many masters and accountable to a public with burgeoning expectations for service. It is a daunting management challenge in any terms.

Imperatives to Look to the Future

To date, strategic planning for the Canadian healthcare system has been based on studies of demand for services. However, many argue that planning based on studies of need is more appropriate. The shift to a need-centered approach promises to meet the requirements of consumers and facilitate superior outcomes.

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Demand-based planning relies heavily on forecasting future trends by analyzing historical patterns of health-service consumption. There is a surfeit of demand-based health information available to policymakers and planners, readily obtainable from health-industry databases including physician insurance claims, pharmaceutical prescriptions and hospital stays. Demand-based analyses have been useful in developing broad assumptions about the aggregate past health service consumption patterns of a population. However, the usefulness of this data as an accurate predictor of future needs is questionable. Using historical demand data for future planning is akin to navigating the road ahead by looking only at the rear-view mirror. Organizations cannot respond well to a changing reality by relying solely on information based on past events.

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Needs-based planning, on the other hand, relies on normative judgments about the services that would affect a change in the health status of an individual or a peer group. Information on health needs is scarce because it must usually be acquired directly from the person or group. This makes it more onerous, time-consuming and costly to collect than mining demand-based data from large-scale industry databases.

7 N. Seeman and A. D. Brown, "Remembering Peter Drucker: Inspiring the Quality Revolution in Healthcare," *Healthcare Quarterly*, 9(1) 2006: 50-54.

In recent years there have been some very successful examples of planners being able to identify health needs from data collected directly from consumers, e.g. the BC Chronic Disease Network[8] and the diabetes program at Puget Sound Group Health Cooperative in Seattle.[9] In addressing the complex problem of diabetes among its population, the Puget Sound program took a step beyond considering those cases diagnosed by physicians and went in search of data that indicated undiagnosed cases. This is an example of a top-down, proactive approach to addressing pre-symptomatic illness. Further, the parameters of the investigation introduced treatment protocols specific to the type of diabetes and provided for personalized treatment.

In both cases above, planners identified consumer needs and used them as the basis for planning. They evaluated alternative strategies and developed targeted tactical plans around a preferred optimal solution. Evaluation of these initiatives has been positive. Consumer satisfaction and outcomes have improved. Costs have been reduced, and physician effectiveness has been enhanced.

In truth, most health organizations tend to use a combination of these two planning modalities. Many find themselves heavily invested in a weighty legacy of past demand-based planning data and practices, while recognizing the need to make greater use of needs-based planning.

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Some of the current pressures that underline the need to review and upgrade strategic planning practices to a more consumer needs-based approach include the following:

Pressure point: expenditure escalation

Over the past 10 years, total annual healthcare spending in Canada has increased from $80 billion to $148 billion, outpacing inflation and population growth during every year in that stretch.[10] Even when adjusted for inflation, this escalation in mainly public expenditures cannot fail to attract the attention of taxpayers and consumers alike.[11]

Current estimates show that Canada's healthcare spending continues to increase as a share of Canada's gross domestic product (GDP). In 1975, healthcare spending accounted for 7 percent of the GDP. Health Canada estimated that total national spending on healthcare would reach $142 billion in 2005 and $148 billion in 2006 – approximately $4,400 per capita – and may reach close to 11 percent of the GDP.

8 http://www.health.gov.bc.ca/cdm
9 http://www.liebertonline.com/doi/abs/10.1089/109350704322918998?cookieSet=1&journalCode=dis
10 Graham W. S. Scott, C.M., Q.C., Chairman of the Board, CIHI, 2006.
11 *CIHI Report on Healthcare Spending, December 5, 2006.*

Pressure point: transparent accountability

The Canadian government has on several occasions expressed concern over funding increases allocated to healthcare that have failed to result in a measurable improvement in public health. A consequence of this concern, across federal and provincial jurisdictions alike, has been a growing interest in performance accountability – not just in healthcare, but across the public sector as a whole. As healthcare costs mount, so do attendant expectations for improvements in planning, delivery and evaluation of health services. This has resulted in the emergence of performance contracts as an instrument for governing agencies to more closely link funding with outcomes. Executives responsible for healthcare agencies are coming under increasing pressure to plan more effectively and to monitor more closely the population health outcomes arising from the services they provide.

Pressure point: technology and data constraints

In the face of pressures for cost control and accountability, boards and senior executives of health agencies are compelled to become better-informed about how their organization is fulfilling its mandate. In response, executives have called for substantial improvements in planning capabilities, i.e. improving the availability and appropriateness of data and enhancing the power of technology-based tools to provide more appropriate analyses. The vice president of planning and the CIO may often find themselves jointly challenged to meet these executive expectations.

Unfortunately, many organizations find themselves unable to meet their executives' needs. Data resources are often fragmented and inconsistent with significant data quality problems, unresolved anomalies among data sets and poor conformance to standards. In addition, much of this data is historical and only supports demand-based planning. The software tools used to analyze the data tend to be very much second-generation, using primarily desktop software for routine reporting, query and drill-down. Corporate enterprise analytical solutions are rare.

Pressure point: the service capacity gap

Ida Goodreau, CEO of the Vancouver Coastal Health Authority (VCH), published a thought-provoking paper about her experiences running a very large, complex health authority.[12] The paper discussed challenges of treatment equity across a continuum of care and outlined some of the business intelligence solutions that her health authority uses to assist in planning resource allocation. Even having exhausted all opportunities for efficiencies through redesign and best practices, she found:

"… the reality for most public health providers is that demand for services still outstrips the capacity to deliver. Therefore, decisions must be made regarding how and where to allocate funds and resources more effectively."

12 I. Goodreau, *Balancing Equity Issues in Health Systems: Example of Vancouver Coastal Health. Longwoods*. http://www.longwoods.com/product.php?productid=19220&cat=508&page=1

She notes that priority guidance on resource allocation is not the role of federal or provincial governments and should not be expected. Ultimately, resolution of resource allocation choices lies within the mandate of the health authority.

It is worth noting the first element of the VCH continuum-of-care strategy: *"A focus on health outcomes by providing the most appropriate services and treatments designed to ensure optimal quality of life and longevity."*

What is significant here is that the words "appropriate" and "optimal" imply normative judgment against a standard, correlated presumably to a result, i.e. the "outcome." The implications in these three words for the informatics and analytics professional are fairly clear. They imply the requirement for an organization to have knowledge of its consumers' needs. This knowledge should drive decision making and become a key part of the organization's intellectual capital.

Also, this closer attention to consumer interests is a core value of the Institute for Healthcare Improvement (IHI).[13] Many of its members use analytics to derive important strategic direction from patient satisfaction and patient experience surveys. These, along with focus groups, will continue to be used to gauge how well the healthcare system serves patients. These analytics tools are also being rapidly improved. For example, trustees and executive leaders across North America are increasingly learning from and about patients through contemporary analytics.

In summary, situational factors suggest that the future information expectations of health service executives are less likely to be met from analysis of past events and more likely through predictive planning solutions. For today's manager to successfully administer a health agency in the current business climate, he/she will need to possess:

- A health-needs profile of their consumer population.
- A demographic profile of the consumer population that goes beyond age and gender and includes key influencers of health such as genomic, cultural, social and economic factors.
- A forward-looking strategic approach to health services planning based on constituents' needs and demographic profiles and the ability to translate those patterns into service requirements.
- The capability to apply alternate resource-allocation scenarios and assess optimal-outcome solutions.
- An understanding of the impact of shifts in population dynamics and the ability to make timely corrections to resource allocation and priorities.
- A steady stream of coherent, reliable feedback information and the analytical tools to enable continuous quality improvement.

The following sections examine how recent advances in predictive analytics can help the industry overcome data management and analysis obstacles and make speedy progress toward achieving its needs-based planning goals.

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13 IHI.org

Planning the Transition to Analytics

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Leadership

Strong leadership with committed corporate support will be essential to introducing analytics successfully to any organization. The leader will need to create an innovative new function that presents complex information to a wide variety of audiences, such as data driven analyses, reports, and other results based on outcomes evaluations and industry trends to senior management. He/she will lead and oversee the evaluation of clinical, behavioral and utilization outcomes, and conduct economic impact/return on investment (ROI) analyses for program interventions.

Health data architecture

This element addresses the improvement of the quality of information across the board, derived from a range of financial and clinical source systems, encoded to common standards that support integration and comparison. Factors to consider include:

Data quality

Most health delivery and governance agencies in Canada have achieved a mature state with their information holdings; they may have some 20 years of data holdings from a wide variety of source systems.

There are common limitations: (i) originating source systems may have been decommissioned; (ii) many data holdings may be the collapsed remains of organizational amalgamation, with their source systems having been replaced long ago; (iii) data may be episodic and patient-focused and some may be cumulative over time, entities and populations.

Data standards

Data elements and coding strategies vary among clinical specialties, such as LOINC for coding laboratory results and ICD-9CM for coding diagnoses and reimbursement. One challenge is to reconcile and cleanse all of this incompatible data, much less reap useful intelligence from it. Fortunately, Canada Health Infoway has established a national health information standards initiative that provides a forum for collaboration and alignment among vendors and consumers alike. While this is not expected to resolve legacy standards issues, it will help to avoid a recurrence of past problems.

Data architecture

Knowledge-based organizations recognize the value of good-quality information and many have already invested in major overhauls of their data holdings. The objective has been to resolve quality anomalies and establish data holdings as a trusted corporate asset. The results include "architecture" that is well documented, managed proactively and that contributes significantly to the organization's intellectual capital. The role of a data architect, for instance, may be the acquisition, cleansing and quality assurance, organization, storage and maintenance of information. The criteria for quality data are:

- Correct
- Complete
- Current
- Consistent
- Context
- Controlled

Analytical skills

This element requires the development of a competent analytics skills base by recruiting a leader and key staff with skills or aptitude in predictive modeling, survey research, advanced analytics and knowledge discovery. The team must be capable of delivering analytic solutions and expert consultation to provide new insights, drive strategic decisions and produce measurable results. Recruiting experience of some health authorities has demonstrated the right staff hard to find and hard to recruit. For some health agencies with only modest prior investment in these skill sets, it may be necessary to re-engineer the whole corporate analytics function.

Information structure

This element pertains to improving the applications and technology layer that provides the physical means of data management, data acquisition and interoperability between analytical applications and end users. Factors to consider in migrating to an effective corporate information structure include:

Selecting analytics software

Since this will be a key determinant of corporate performance, it is of critical importance to make the right choice. Functions would include:

- Data acquisition and quality assurance
- Transformation and loading
- Reporting and visualization tools
- Model building
- Simulation
- Optimization

Enterprisewide data management

Throughout its life cycle, data must be integrated effectively into the larger picture, from the time of its creation to its being archived or destroyed.

Leveraged alignment with Canada Health Infoway

This will be an essential long-term corporate commitment that contributes to, and benefits from, national initiatives such as standardization, data sharing, technology assets development and preferred solution programs.

Analytics culture

Building a corporate culture founded in knowledge-based values, inspiring users to visualize capabilities beyond basic reporting and query functions to include statistical analysis (what's happening?), forecasting (what happens next if this condition prevails?), predictive modeling (what happens to our plan if one or more variables change?) and optimization (what's the best possible solution we can expect?).

Approaching the Analytics Milieu

For most organizations, the process of establishing an analytics capability may not be as straightforward as it initially seems. It is important to look upon it as a planned transition from present state to future state. The process will require committed sponsorship to bring about some significant enhancements to data management practices, analytical skills, technology and corporate culture. It will be valuable to take stock of where an organization sits in readiness for this transition and examine key elements of an implementation plan.

For most organizations, the process of establishing an analytics capability may not be as straightforward as it initially seems. It is important to look upon it as a planned transition from present state to future state.

Current state assessment

There are several key questions that an organization may want to ask as it contemplates a potential analytics path to mastery of its strategic information resources. For example, does your organization need analytics? Is your organization ready for analytics? And, is your organization's vision for analytics realistic?

Does your organization need analytics?

- The organization is plagued by missing or poor-quality data, multiple definitions of its data and poorly integrated systems.
- The organization collects transaction data efficiently but often lacks the right data to answer executive decision-making questions.
- The organization has a proliferation of second-generation business intelligence tools and data marts, but much of the data remains only partially integrated, nonstandardized and difficult to access.

Is your organization ready for analytics?

- Executives have stressed that information must be relevant to their decision-making role.
- Planners have begun to focus on what could happen rather than what has happened but are concerned that supporting data may not be accessible or available.
- Managers want their dashboards to answer “why?” and “what if?”
- Line departments are asking to hire their own analytical staff.

What is your organization’s vision for analytics?

- The CEO is a passionate sponsor of analytics.
- Strategic planning is conducted on the basis of consumer need and optimal choice from alternative futures.
- Senior levels of management enjoy deep strategic insights, supporting continuous renewal and improvement.
- Highly skilled staff with specialist analytical competencies are centralized and highly motivated.
- The organization has a knowledge-centered, learning-based culture.
- There is a supporting enterprisewide technology infrastructure.

APPENDIX I

Common definitions in healthcare analytics

The following are some very generic definitions of terms found in healthcare analytics.

- **Healthcare-specific analytics** enable non-statisticians to surface meaningful intelligence from vast amounts of information about patients, populations, providers, procedures and risks.
- **Predictive analytics** based on consumer needs and expert analyses deliver more accurate forecasts, evidence-based service planning and improved patient outcomes.
- **Query, reporting and visualization tools** give various types of users the highest quality of information, where and when needed, via multiple platforms and channels, including detailed analysis and trend forecasting.
- **Structured analysis** enables you to evaluate a parameter or hypothesis, such as analyzing reimbursement trends for a diagnostic code or length of stay for a particular condition or procedure.
- **Unstructured analysis** reveals hidden patterns in large volumes of data without having a predetermined idea or hypothesis about what the pattern may be. For example, predicting the response to changes in treatment protocols for ventilator patients. With the ability to drill down or roll up through various dimensions in a very large database applying sophisticated models and algorithms in the process, it is possible to uncover important patterns and help identify best practices.
- **Text mining** is a very powerful tool used to scan vast amounts of unstructured textual data. By scanning for inferential patterns in EHR text, for instance, it can expose otherwise unknown relationships between diseases and treatments. Its ability to carry out these kinds of exploratory analyses on vast amounts of text means that more concrete data can be acquired to support further research.

APPENDIX II

Examples of analytics in healthcare

Since its inception in 1976, SAS has been widely embraced by the health industry. It has been deployed across a broad range of solutions including strategic planning and policy development, through to research, clinical trials analysis and patient care optimization.

The following general list gives examples of cases where SAS Analytics have been deployed in healthcare.

Large-scale data analysis for effective strategic planning and policy development

How might we use SAS to derive reliable broad indicators for strategic decision making and policy evaluation by executives and health system governors?

SAS solutions provide the power to analyze vast amounts of data to:

- Provide in-depth analyses of national healthcare data aggregated from across Canada to support legislative policy and industry directions.
- Highlight key trends in the changing pattern of service needs of the health consumer population that will guide strategic planning decisions.
- Monitor the quality of care from analysis of broad outcome patterns that will help determine optimal health policy decisions.
- Determine systemwide accountability criteria.
- Conduct research into the determinants of good healthcare practice.

Examples

The Canadian Institute for Health Information (CIHI) chose SAS as the tool for its large-scale utilization analysis of the Canadian healthcare system.

> *"SAS has credibility in the research community and is the de facto standard in my experience."*
>
> **Bob Cote, Manager of Analytical Systems, CIHI**

The Manitoba Centre for Health Policy chose SAS as its research data analysis tool. The centre works collaboratively with Manitoba Health on research studies that include disease trends, service use and quality indicators over time in the population. SAS is also used by other research and policy groups such as the BC-based Centre for Health Service Policy Research.

> *"The research done at MCHP is an integral part of how healthcare is delivered in the province. We work collaboratively with Manitoba Health on our research studies."*
>
> **Heather Prior, Data Analyst, MCHP**

Utilization analysis and reporting

What if you could clearly understand the demand for health services at various times and under various conditions?

SAS solutions give you the ability to assemble highly sophisticated predictive models that can analyze and predict such utilization variables as:

- Demand for future services by geography, medical need and disease classification.
- When future need will likely occur (including time of day and, more importantly, the point in time during the patient's health history).
- How future encounters will take place (emergency, routine visit, hospital admission/readmission, etc.).
- Financial expenditure/revenue projections, budget forecasting, etc.

By forecasting better, you can improve your planning capabilities across the board. You can size service offerings and determine where to locate them, keeping both patient satisfaction and revenue high. This information can be used to support:

- **Cost prediction** – Placing the right resources in the right place at the right time and uncovering where wasteful expenditures may occur.
- I**nvestment decision support** – Making evidence-based decisions, such as type and location of facilities, type and amount of equipment, etc.
- **Knowledge management** – Understanding the characteristics of the anticipated patient population.
- **Human capital management** – Skills and manpower forecasting to support recruiting decisions, staff development decisions, training program content, etc.

Examples

Alberta Health selected SAS as its enterprise intelligence platform, delivering an end-to-end solution that includes business intelligence, predictive analytics, forecasting, data quality and data integration.

Nova Scotia Department of Health uses SAS in continuing care to extract and analyze data for planning, program evaluation, policy development and performance management activities. SAS software was a key part of the development and validation of a fairly sophisticated population- and frailty-based bed-allocation methodology that integrated data from many different sources.

> *"I needed to analyze a lot of data quickly, and SAS was used to calculate many key components of the model including wait times, demand drivers, population projections, and the pattern of frailty in seniors across the province."*
>
> **Kevin Druhan, Research and Statistical Officer, Nova Scotia Department of Health**

Monitoring and quality improvement

What if you could improve your care processes by analyzing and predicting variances in care?

SAS supports both analysis for variance identification (e.g., predicting the response to changes in treatment protocols for ventilator patients) and structured analysis (e.g., analyzing readmission rates by DRGs). SAS Analytics uses unstructured methodologies to discover hidden patterns without a predetermined idea or hypothesis about what the pattern may be. From desktop applications that support clinical quality teams to sophisticated enterprise-wide performance management systems, SAS Analytics supports all levels of sophistication, enabling users to:

- Uncover unexpected patterns or rules for use in effecting evidence-based improvement in clinical and support operations.
- Use analysis of variance to demonstrate compliance with professional standards of practice, accreditation requirements and the documentation of patient satisfaction.
- Identify and investigate key drivers of deviations in standards of care delivery across care settings.
- Analyze trends and patterns in clinical errors. Identify and eliminate patient care processes that lead to sentinel events.
- Monitor patient satisfaction trends in response to evidence-based process interventions.

Creating a true evidence-based culture requires healthcare providers to empower management and staff with analytic and knowledge-management capabilities for strategic decision making that will lead to:

- Increased patient safety.
- Improved quality of care.
- More effective risk-management practices.
- Better application of best practices for care protocols.

Examples

Joseph Brant Memorial Hospital (Ontario) uses SAS to integrate data from multiple sources and deliver performance management metric reports needed to support hospital funding decisions. It plans to expand the use of SAS to bring the hospital up to standard on performance management and business intelligence via the Data Integration for Hospitals project.

> *"Data integration is our single most difficult challenge. We need a solution that pulls together all the information in one place. Our hospital sees SAS as a leader in this area."*
>
> **Mark Morreale, Manager, Decision Support, Joseph Brant Hospital**

Bridgepoint Health, Canada's first healthcare organization dedicated solely to the prevention and management of complex chronic disease, chose SAS as its business intelligence software to help transform the way managers solve problems and make more informed decisions about the patients they serve. Employing business intelligence and predictive modelling, the University of Toronto-affiliated teaching hospital will help its managers use their time more effectively by providing the right information at their fingertips, allowing them to respond to the demands of their patient base promptly with the power to make better-informed critical decisions.

> *"Prior to using SAS for business intelligence, we were data-rich but information-poor ... now we are in a position to turn this data into knowledge and empower our managers, clinicians and researchers to make more informed decisions about the patients that they serve."*
>
> **Steve Banyai, Vice President and CIO, Information Services, Bridgepoint Health**

Maine Medical Centre chose SAS as its enterprise scorecard solution to understand how it performs against key patient care metrics. The scorecard has been adopted as a multi-disciplinary patient centric tool, helping the hospital ensure that over 85 percent of patients admitted with heart failure receive all evidence-supported care, and increased the likelihood that patients were given appropriate medication counseling at discharge. Using SAS, the hospital has been able to develop scorecards that measure everything from staff hand-washing compliance, to whether a patient admitted with pneumonia is actually offered a flu vaccination. The hospital also uses the SAS scorecard to carefully track whether its staff is taking additional teaching programs to stay current on the latest protocols for managing diseases, like stroke and heart attack. The scorecard also incorporates national guidelines issued by the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) and CMS.

> *"The way SAS helps us is that we can push out critical information – which we know drives improvement – to the frontline staff. The scorecards are our way of communicating our strategic priorities."*
>
> **Doug Salvador, Associate Chief Medical Officer, Maine Medical Centre**

Discovery research

What if you could overcome the problems of analyzing massive amounts of complex data from a wide range of sources so that discoveries from such analysis would lead to groundbreaking advances in medical science?

Using the analytical mining powers of SAS, you can find hidden meaning in massive data sources and make progress toward being able to:

- Determine patient risk levels in order to optimally prioritize resource allocation.
- Predict future health outcomes based on past behavior and environmental factors.
- Investigate the genetic factors contributing to the development of infectious and autoimmune diseases.
- Analyze text-based medical records and healthcare reporting practices to derive hidden cross-relationships between disease, treatment and outcome.

Examples

Brock University Department of Community Health Services chose SAS to study the incidence and distribution of diseases and ways to control and prevent them. For instance, they used SAS software to study the connection between a high level of cholesterol in childhood and the risk of adult cardiovascular problems. It typically requires massive amounts of data from a variety of sources, including nutrition databases, as well as healthcare and community demographic information.

> *"The beauty of SAS is that it can be used at differing levels, from basic homework assignments for a second-year university student to heavy-duty, PhD-level research and beyond."*
>
> **Dr. Jian (Jason) Liu, Assistant Professor, Department of Community Health Sciences, Brock University**

Clinical trials

What if you could gain new insights into the results of introducing pharmaceutical and clinical treatment therapies across national and global geographies?

SAS' powerful integrative capabilities enable you to amalgamate clinical trials information from a wide range of disparate clinical information systems, technology platforms and across national and international environments. Using the power of SAS to analyze the resulting massive trials databases, you could then:

- Determine the results of pharmaceutical trials faster and with greater accuracy and sensitivity than before.
- Unearth more penetrating clinical insights previously buried in mountains of data.
- Utilize a much broader range of information resources by overcoming many of the differences in data standards that previously constrained the size of clinical trials populations.
- Utilize new methods of signal detection in large-scale populations, supporting the emerging needs of pharmacovigilance practices.

Examples

Pharmaceutical companies worldwide use SAS for research into drug trial results and drug-utilization patterns. Analytic processing, particularly to create complex analyses and reports, is complemented by a suite of other SAS solutions – including SAS Data Integration, which allows researchers to consistently integrate disparate data sources into industry-standard data structures (e.g., E2B, CDISC, IHE and HL7); and SAS Drug Development, which provides a standard, compliant environment to store, retrieve, analyze and report data that unlocks the power of signal detection – companies and researchers can enable the emerging practice of proactive pharmacovigilance.

SAS and the Clinical Data Interchange Standards Consortium (CDISC)

With a deep commitment to the development and implementation of data standards in life sciences, SAS has been a member and ardent supporter of CDISC since 2000. CDISC standards can be effectively implemented in solutions like SAS Drug Development and SAS Data Integration Studio. The consulting services group within the SAS Health and Life Sciences division offers CDISC implementation services using Base SAS®, data management and SAS Drug Development. Services include business consulting, assessment, integration, and delivery. SAS is also a registered solution provider for CDISC. Approved CDISC solutions providers are qualified consultants, system integrators and subject matter experts believed by CDISC to have sufficient knowledge and experience implementing the various CDISC standards.

Harm reduction, patient safety and quality of care

What if you could effectively manage quality of care and drive sustainable improvements?

The delivery of quality care to patients is the core business of healthcare provider organizations. However, a lack of integrated legacy practices and poorly-coordinated workflows, exacerbated by staffing shortages, can result in deviations from quality standards in the delivery of care to patients.

Consequences may include:

- Unfavorable clinical outcomes.
- Increased cost of care.
- Unnecessary readmissions.
- Inappropriate use of resources.
- Loss of accreditation.

SAS can help you effectively manage quality of care and drive sustainable improvements by measuring and viewing clinical performance, resource utilization, cost-effectiveness, pathway development and evidence-based decision making.

Examples

The National Patient Safety Agency (UK) chose SAS for storage, manipulation and analysis of data from 1.6 million patient safety incidents describing what happened, including patient outcomes. Since the inception of the national database in 2003, the NPSA has used SAS to store, manipulate and analyze this data.

The US Centers for Disease Control and Prevention chose SAS to provide information to enhance health decisions. The CDC develops disease prevention and control programs, environmental health policies and health promotion and education activities. By using SAS software, several CDC departments are making public health data more accessible to the people most directly affected. Most recently SAS was used to help the National Center for Injury Prevention and Control (NCIPC), which extended SAS software's powerful data retrieval and analysis functionality to its consumers.

> *"SAS has been a great tool for helping SDMB to eliminate steps in the daily data management and unitization process….With STDNet, people – even those without any SAS knowledge – can access information on their own."*
>
> **Sharon Clanton, Developer, US Centers for Disease Control and Prevention**

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