

A Health Analytics Framework

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ABSTRACT

As the big data wave continues to magnify in the healthcare industry, health data available to organizations are becoming richer and more diverse. Whether it is financial, clinical, or mobile health data, the sheer amount of data surfacing across payer and provider groups alike is remarkable. In fact, McKinsey & Company predicts that the value of big data in healthcare could reach \$300 billion by the year 2020.

Through the midst of this growth, and the continued pressure to improve the quality of care while reducing costs, healthcare organizations are grappling to make sense of the immense amount of information generated each day. As information technology tools become increasingly powerful, the opportunities to operationalize analytics to better understand this data and improve the practice of medicine are becoming greater and richer.

New advancements in data management and advanced analytics have created opportunities for enterprise-wide capabilities in the field of healthcare analytics. The new health economy, centered on improving patient outcomes and creating value throughout the system, requires that these capabilities are leveraged. Real-time data and analysis that is now made possible through advancements in big data and IT can provide stakeholders across the health care spectrum the information they need to achieve the goals of today's health system.

INTRODUCTION

Establishing a health analytics framework (HAF) within a healthcare organization can transform the way clinical and business decisions are made which directly impact the cost, quality and effectiveness of care. Additionally, a HAF can assist in facilitating the shift from a fee-for-service model to one of pay-for-value. A HAF is a single platform that can harness all of the disparate health information that exists within internal systems as well as those outside of an organization, cleanse, enrich, integrate, link, the information across the various systems, and ultimately analyze these huge data sets rapidly while providing insights across the entire health care ecosystem. The HAF is flexible and scalable, providing connectivity and sharing of data across multiple users. New-generation IT, such as in-memory computing and cloud analytics make the HAF a powerful platform for health care decision making.

The HAF takes health care organizations beyond transactional analyses and traditional approaches to analytics, to more complex and novel analytics methods, such as predictive analysis, optimization and forecasting. These tools allow organizations to address important health care initiatives such as value-based payment, accountable care, all-payer claims databases, bio-surveillance, Medicaid/Medicare management, and population health. More specifically, use cases for the HAF can span across multiple clinical, financial, and operational activities such as:

- Planning care for individuals and populations, including predictive disease management.
- Defining and applying best practices to reduce readmission rates.
- Determining best practices for addressing specific chronic conditions, such as diabetes.
- Better managing pharmacy costs and outcomes.
- Strengthening reimbursement models, with a focus on paying for outcomes.
- Implementing integrated care models across all physical and mental health service points
- Better understanding the impactful relationship between healthcare and non-healthcare data
- Identifying the best ways to engage with patients and improving the patient experience.

Establishing a health analytics framework can begin with just a single type of data and expand with virtually infinite types and sizes. For example, utilizing claims data as a foundation, and taking in large amounts of claims data from multiple legacy systems and existing databases can give health plans and providers a starting point for establishing a broader framework. A Health Analytics Framework covers a broad set of analytic initiatives including:

- Claims data analysis
- Clinical data analysis
- Mental health analysis
- Episodes of care construction and analysis
- Population health analysis

CLAIMS ANALYSIS

Health care claims data, while not novel in nature, are becoming increasingly important for decision makers. Recent federal support for healthcare modernization efforts involving claims data include: State Innovation Model Grants, State Innovation Waivers, 1115 Demonstration Waivers and other Medicaid/Medicare reform efforts. These federal support instruments, whether focused on government payers or commercial health care payers, have direct and profound effects on the entire healthcare system. Since much of the same healthcare system which serves the government program population (and benefits from portions of this funding), serves the non-government population as well, these funding mechanisms do ultimately benefit the entire health system and have a heavy focus on the ability to extract insight from claims data. In fact, several reform initiatives (much of which are partially funded through the federal funding), such as ACO models, episodic care, reducing hospital readmissions, and all payer claims databases (APCDs) rely on claims data as the primary fuel for analyses. Traditionally, however, claims data have acted as transactional systems to support billing and eligibility. For instance, State Medicaid programs operate Medicaid Management Information Systems (MMIS) for business processes and billing, and are not typically designed to generate actionable data analysis to help practices or other entities profile patients, understand utilization and spending patterns, target efforts to improve care, or measure performance.ⁱ Now with new enabling technologies that allow a single platform for big data and analytics, claims data are increasingly becoming an opportune data source for analysis.

Healthcare claims data is the most accessible, structured type of health data in the US, and offers the broadest view of how health care services were delivered. It includes many elements that are valuable in understanding health care delivery. For example, some of the elements aside from the amounts billed and paid that are particularly useful provide information on Primary diagnosis (and co-diagnoses) codes (ICD-9 and 10), Procedure code (CPT), Site of Service, patient and provider demographics, inpatient info and more.

Claims data include many other components as well. The combinations of these various elements and the types of analyses that can be done are virtually infinite. Further, because of the structure of claims data, it can be a foundation for linking other health data and developing a more extensive health analytics framework over time. A robust HAF contains the necessary technology to support advanced claims data analytic initiatives and assist in mitigating total cost of care, enhancing quality of care, and providing better access to care.

The following are some examples of how a health analytics framework can be leveraged for claims analysis.

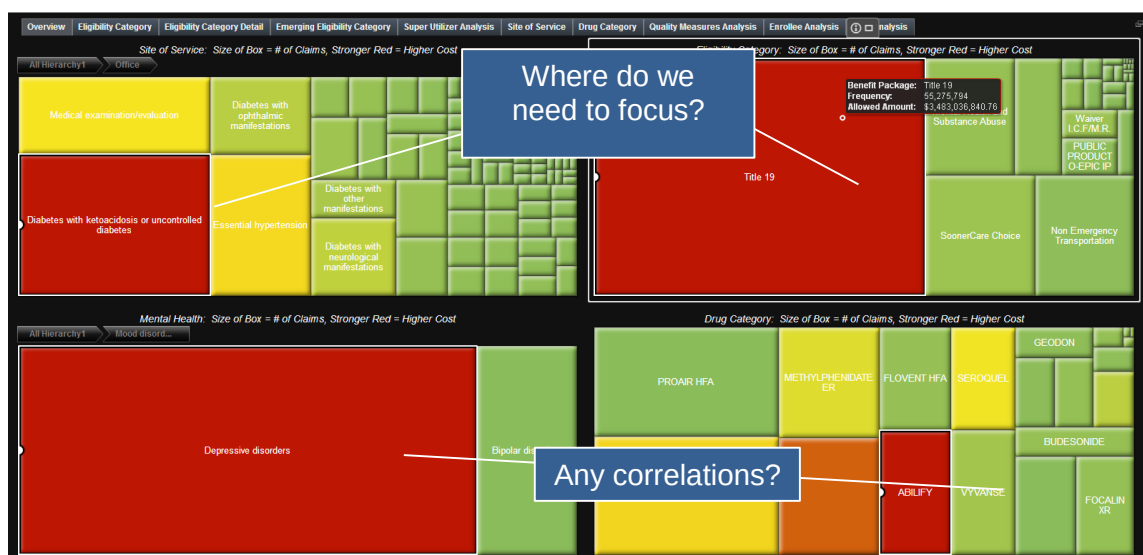


Figure 1. Health Analytics Dashboard - High-level analyses of a population

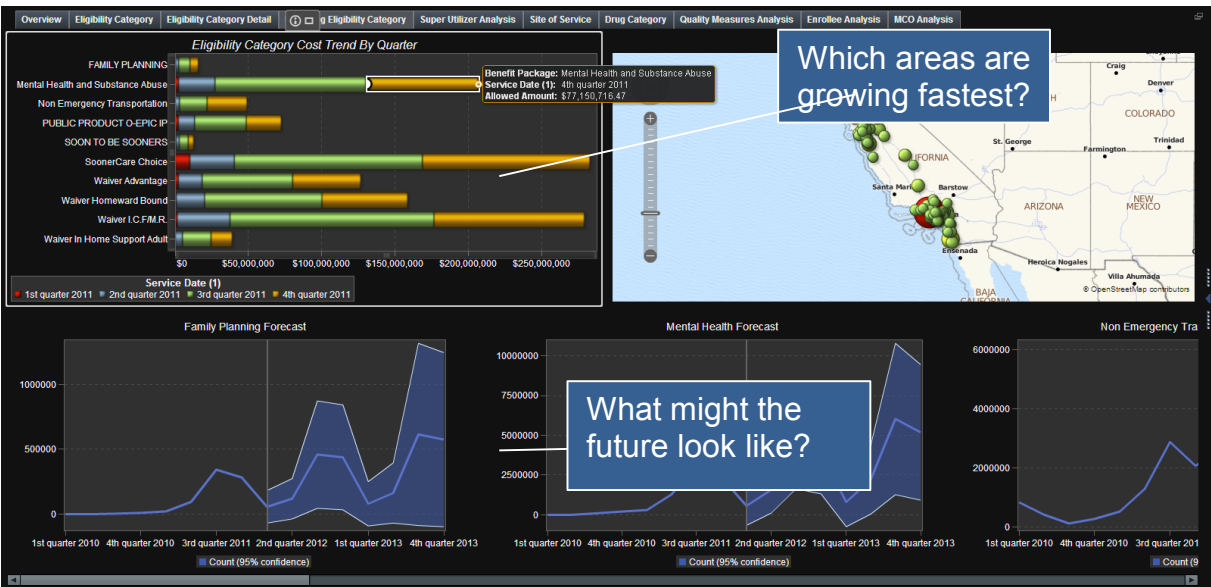


Figure 2. Identify trends in population categories (i.e. Medicaid program eligibility)

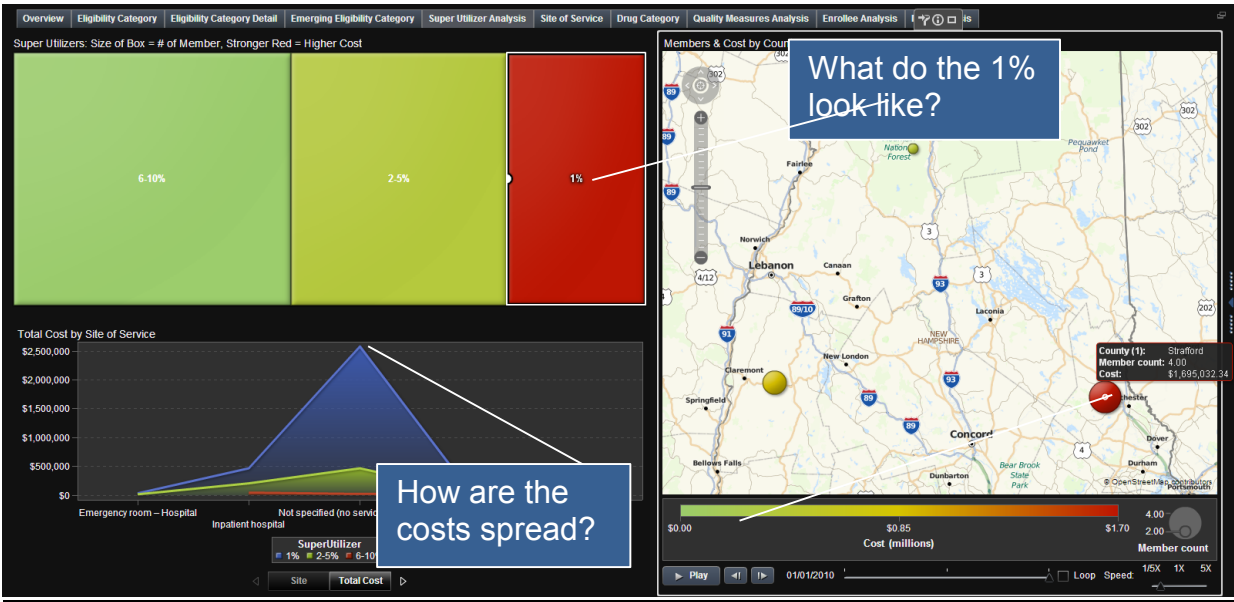


Figure 3. Super Utilizer analysis across an entire population (using APCD data)

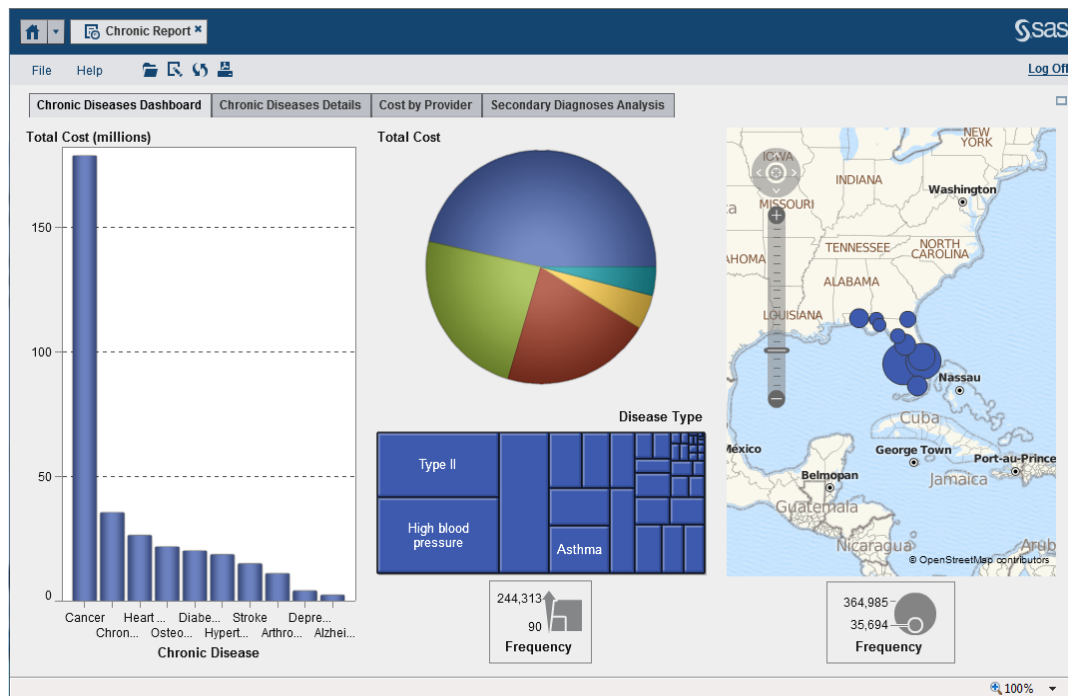


Figure 4. Chronic disease analysis across an entire population (using APCD data)

CLINICAL DATA ANALYSIS

A Health Analytics framework can also provide modern technological approaches to analyzing clinical data such as those data from Electronic Medical Records (EMR) systems, clinical trial data and others. Clinical data, like claims data, possess a variety of useful data elements, such as lab results/interpretations, clinical notes, vital signs and more. One of the more prominent challenges with clinical data is the saturation of clinical data systems across the healthcare continuum. There exists hundreds of various clinical data systems, each with their own approach to clinical data management. Further complicating matters is the lack of a true data standard across the industry to assist in interoperability and cross system data integration and analysis efforts. As a contrast, claims data follows adherence to national standards and HIPAA transaction formats for insurance purposes, making the ability to integrate and analyze cross insurance data less complex. Consequently, the ability to collect, cleanse, link, report and analyze clinical data is of critical importance to the success of integrated care initiatives that are vastly growing around the nation and rely on access to clinical data from individual and blended multi-organization systems. Some of the broader clinical based data initiatives include: ACO (and other community level systems of care) Health Information Exchanges, (HIE) , Health Registries, Clinical trial sharing/transparency and more. The HAF provides enterprise wide enabling technology to support these clinical data initiatives as well as analytics at the point of care.



Figure 5. Understand clinical quality measures and drill down to patient-/provider-/transaction-level detail

MENTAL HEALTH ANALYSIS

The impact of mental health on individuals and our society as a whole is both costly and tragic and generates a social impacts that effect virtually every aspect of communities. As of 2012 it was estimated that 1 in every 5, or approximately 44 million adults in the US, aged 18 or older were living with any mental illnessⁱⁱ. In addition, US employers lose almost \$22 billion dollars annually from a decline in productivity due to the impacts of mental illness.ⁱⁱⁱ While successful initiatives have been launched to increase this awareness and address mental health in a more comprehensive and effective manner (such as accountable care organizations, patient-centered medical homes, telemedicine, etc.), many more technology opportunities exist to support and affect positive change across mental health.

The push towards integrated care (which combines social services with medical services) is a primary driving force behind the need for better and broader use of data and analytics. Consequently, modernizing a mental health infrastructure necessitates a robust data driven approach, capable of integrating, linking, cleansing, reporting and analyzing data, across all organizations including physical and mental health services. Taking this type of data-driven analytic approach can lead to improvements in mental health through: better understanding and implementation of integrated care payment methodologies, better understanding service utilization, identifying and implementing evidence based treatment plans, targeted education campaigns, risk stratification across multiple variables, predictive modeling and more. Ultimately this approach can lead to improving quality, cost, and effectiveness of mental health care in addition to physical and social health.



Figure 6. Analysis of mental health super utilizers and associated physical health costs

EPISODE ANALYSIS

Health care systems' performance incentives have historically been driven by the volume of services provided to patients and not the coordination of patient care, particularly when multiple providers are involved. But incentives are changing drastically, creating opportunities to gain a more patient-centric focus on value. As commercial and government payers move away from a pay-for-volume system toward pay-for-value, financial risk is transferred to the provider(s) managing care. This changes incentives across the board for care and reimbursement as providers must focus on better patient outcomes. It means that providers must seek to improve entire episodes of care, rather than just single events.

An episode of care is defined as a series of temporally contiguous health care services related to the treatment of a given spell of illness or provided in response to a specific request by the patient or other relevant entity.⁶ In simpler terms, it is a collection of care provided to treat a particular condition for a given length of time. Episodes of care are the foundation for any assessment of efficiency and are necessary in determining if a delivery system is achieving its intended purpose. Subsequently, well-constructed episodes of care are instrumental to understanding and managing both cost and quality.

WHAT CONSTITUTES AN EPISODE OF CARE?

Episode construction is a complex, multistep process in which many thousands of clinical rules must work together to identify what constitutes an episode. The construction of an episode is initiated by a trigger event, such as an inpatient hospital admission or a diagnosis, which signals that a patient has a condition or procedure taking place. Utilizing a patient's claim and service-level data, all of the claims that are relevant to a particular episode are then grouped together. This grouping is done with clinical rules that identify a defined time period to capture all of the events that are related to the episode. While each episode of care has unique rules for associating relevant events, there are some standards that exist. For example, chronic conditions, once triggered, do not terminate. Procedures, like a knee replacement, are triggered by the procedure itself and have a look-back and look-forward period. Finally, acute medical events, like a heart attack, start with the event (typically a hospitalization) and then look forward 30 days post-discharge.

Let's use the example of John Doe's knee replacement to illustrate episode construction.

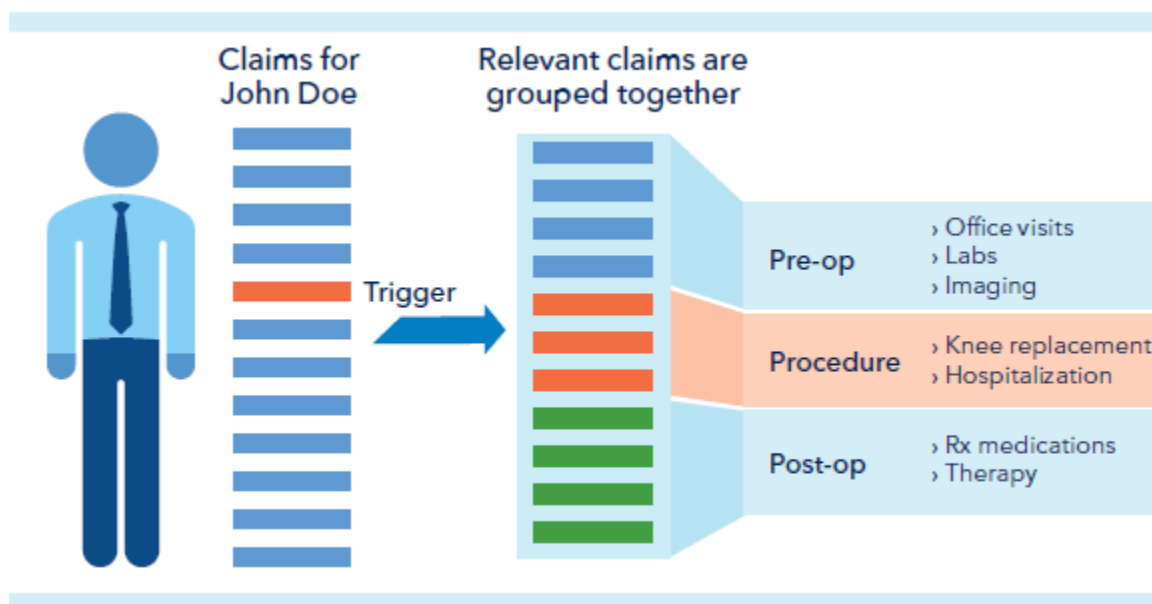


Figure 7. Example of constructing a knee replacement episode

In Figure 7 we see a trigger in John's claim data that lets us know that a knee replacement episode has begun. Subsequently, all of the events related to the knee replacement are grouped together. Identifying which events are relevant entails three time periods. First, there is the period leading up to the procedure – which can be referred to as the pre-operative (pre-op) or look-back period. The lookback period for a knee replacement is 30 days, and for John's knee replacement, this period may include events such as office visits, lab work and some imaging. Then there is the procedure itself bounded by an inpatient or overnight stay. This includes the hospitalization and all professional services during that stay. Finally, upon discharge, the postoperative (post-op) period begins and it concludes when the patient has fully recovered and no longer needs treatment. For knee replacements, we look forward 90 days. In this stage of John's episode, there may be prescription medications, therapy and more office visits.

Calculating the Cost of an Episode The next step is to calculate the cost of the knee replacement episode by identifying which costs gets allocated to the "bundle." Costs are broken up into categories: typical, potentially avoidable and unrelated. All of John's aforementioned events, such as the labs, office visits and therapy can be clinically categorized as "typical" costs – because they are typical in treating this procedure. Within the group of claims, there may also be claims for other events that were not actually relevant to his knee replacement. In other words, John may have had other services that were not expected. For example, John has pain and swelling, goes to the emergency room, and gets admitted and treated for a wound infection. These events are unexpected, and clinically, infections are considered preventable with good clinical practice and follow-up care. Thus, these events are included in the total cost, but are differentiated as "potentially avoidable costs" (PACs). Finally, during the time period of John's knee replacement episode, other services may have occurred, such as a primary care visit for a cold. These services might be related to a different episode or simply other services unrelated to this procedure. These costs do not get assigned to the cost of the knee replacement and are simply identified as "unrelated" costs.

PATIENT AND POPULATION: ANALYZING COSTS AND OUTCOMES

This methodology of episode construction and cost allocation lets us see the entirety of patient treatment as reflected in their claims data. Further, it provides an accurate measurement of total cost of care, as cost must be measured at the condition or procedural level, not at the individual service level, for optimal accuracy. And because value for the patient is created by providers' combined efforts over the full cycle of care, it structures patient data to allow us to track patient costs and outcomes across this full cycle

Once this data is captured in claims, based on episode creation we can analyze a variety of factors across a patient population and can facilitate bundled payment models, measurement of variation in care and the increase of efficiencies amongst providers. For example, looking at the output represented in Figure 8 we can identify what clinical groups are represented in the patient population and how efficiently they are being treated.

This report shows the total cost of treating a variety of episodes across a patient population. The top left pie chart shows total cost divided into the five classes of episodes – acute, procedural, chronic, system-related failures and other. Meanwhile the other two graphs display the total cost of each episode across the population and the collective, potentially avoidable costs for each episode. Another view of the total cost of conditions can be seen in Figure 9, with the ability to view again by condition class.

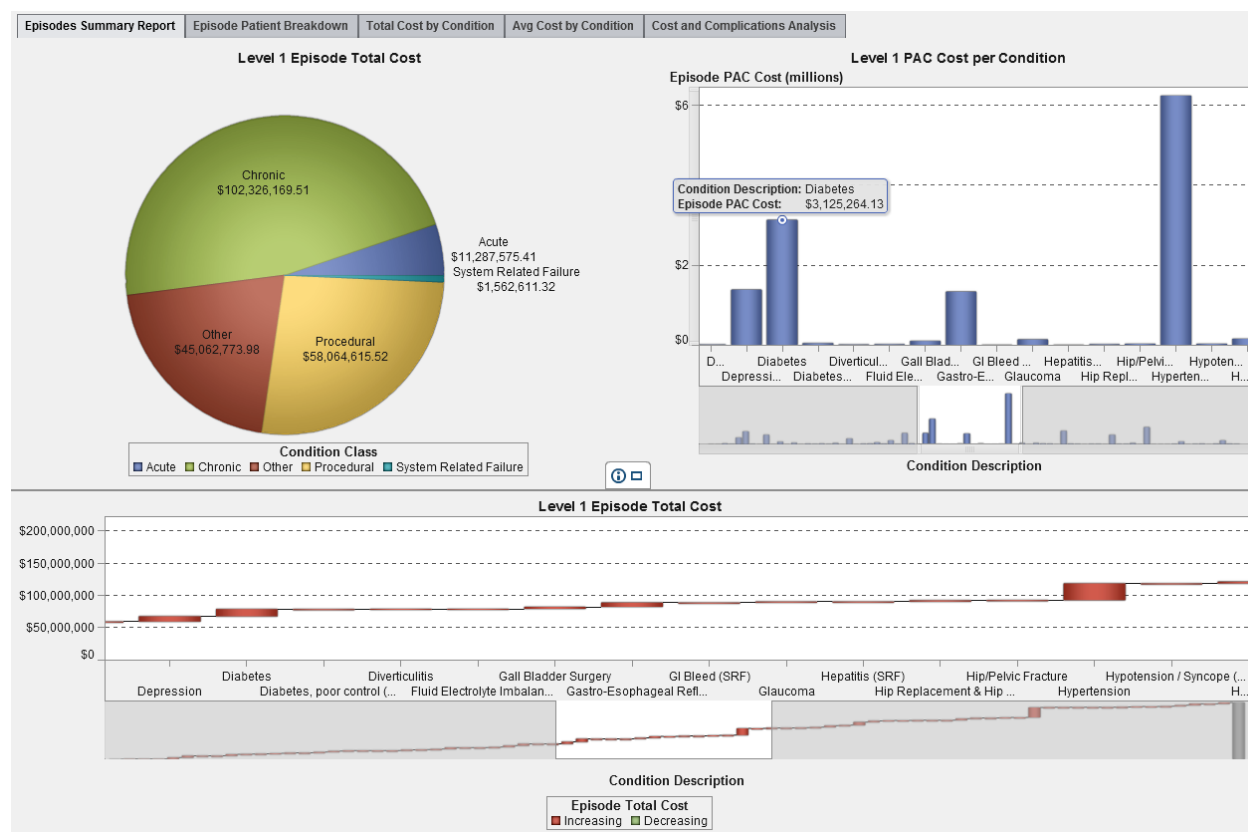


Figure 8. Episode summary report

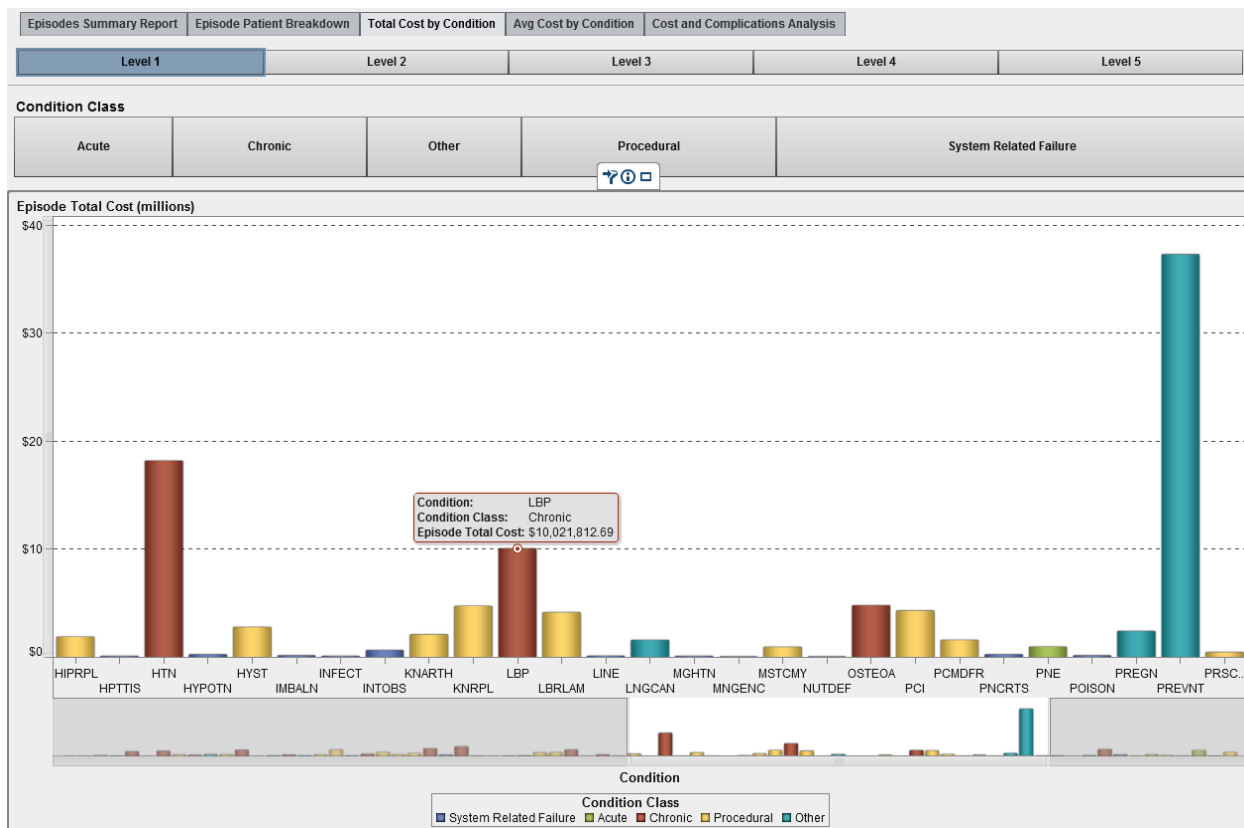


Figure 9. Total cost by condition

CONCLUSION

The Centers for Medicare and Medicaid Services, as well as state government and commercial health entities continue to push for and understand the enormous value of providing team-based, evidence-informed care to the entire population in a pay-for-value system. To support this type of advanced system, data must be available, integrated, and analyzed across the many points of care a patient can interact with and is key to providing holistic management of healthcare. An enterprise approach to health analytics, such as a Health Analytics Framework, has introduced an enormous opportunity to support a value-based system and utilize sophisticated analytic tools to generate necessary insights and foresights across the delivery of services. As additional data becomes available such as clinical data, patient generated data, mobile health data, and public health data, a Health Analytics Framework can be an ideal platform for capturing these various data sources. Using superior enterprise wide analytics within a single environment provides the ability to understand the complex interdependencies that drive medical outcomes and costs, giving users across the health spectrum the information they need to improve healthcare and provide a more systemic and comprehensive approach to patient care.

REFERENCES

- <http://kff.org/medicaid/issue-brief/data-analytics-in-medicare-spotlight-on-colorados-accountable-carecollaborative/>

² http://www.nimh.nih.gov/statistics/1ANYDIS_ADULT.shtml

³ <http://www.aha.org/research/reports/tw/12jan-tw-behavhealth.pdf>

RECOMMENDED READING

Data Visualization in Health Care: Optimizing the Utility of Claims Data through Visual Analysis

<http://support.sas.com/resources/papers/proceedings14/SAS176-2014.pdf>

All-Payer Claims Databases: A Platform for Transparency and Innovation

http://www.sas.com/en_us/whitepapers/all-payer-claims-database-106671.html

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