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Embracing Agile Health Analytics: A Use Case for Stroke Registry

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Abstract

Electronic health records and health information exchange fuel exponential data growth in healthcare organizations. However, more data doesn't necessarily lead to more information unless you have an efficient tool to translate massive data into actionable insights in real time andcost-effective manner. Traditional IT-driven business intelligence and data warehouse often struggle in delivering benefits on schedule, within budget and are inefficient and not flexible in response to change of business. Lack of timely and efficient BI remains a key barrier to improvement of value in healthcare. This paper introduces agile health analytics and its value as an emerging differentiator to deliver user-driven analytics for improving operational efficiency, clinical quality and financial effectiveness. We also present a use case of applying agile analytics for a stroke registry project. Initial results are promising and indicate the agile concept can be successfully applied in solution development and project management through collaborative efforts. The stroke registry and analytics reporting tool are delivered timely and cost-effectively by leveraging flexible and scalable collaborative information management platform. Thorough user evaluation with subject matter experts will be conducted in future steps. Additional advanced analytics including predictive modeling and integration with data governance will be evaluated in further development.

Keywords: Agile health analytics, Business intelligence, Data discovery, Visual analytics, Stroke registry

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1 Introduction

The healthcare industry in the United States has become increasingly complex with rising cost. The U.S. spends more money per person on healthcare than any other nation in the world [1]. However, the U.S. ranks only 46th out of 48 countries in measure of overall healthcare efficiency in a recent study [2]. In order to provide patients with quality care at a lower cost, the healthcare industry is in the process of transforming from a fee-for-service to a pay-for-performance payment model. Health information technology (HIT) is a critical enabler in health care transformation. As part of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009, the federal government allocated billions of dollars for an incentive program to encourage doctors and hospitals to adopt electronic health records systems (EHRs) [3]. Healthcare is an information-based science [4]. Digitalization of health records fuels exponential data growth. However, more data doesn't necessarily lead to more insight. The deployment of EHR, will not, by itself, have a significant impact on the quality or cost of healthcare. The return of investment (ROI) will not be realized until the healthcare industry invests in enterprise data warehousing and commits culturally to the exploitation of data [5, 6].

Business intelligence (BI) is a set of tools, technologies and processes required to turn data into information and information into knowledge that optimizes business actions. Although BI has been deployed in healthcare to support clinical decision support, healthcare organizations often struggle to find a cost-effective solution and implement in reasonable timeframe with traditional BI. In fact, a recent survey of healthcare administrative executives identifies a lack of timely and effective BI as one of the key barriers to improvement of value in healthcare [7]. Healthcare providers need a new efficient approach to translate massive data into meaningful, actionable insight in real time and in a cost effective manner to support improvement of care outcomes and quality.

In this paper, we describe the business challenges and need for an efficient health analytics tool for healthcare organizations in Section 2. Then we introduce the emerging agile health analytics in Section 3. We then discuss a use case of applying agile health analytics for stroke registry project at a large healthcare provider organization in Section 4. The paper concludes in Section 5 with a discussion of the next step for further thorough user evaluation and advanced analytics feature enhancement in the future.

2 Business Challenges

A review of previous research literature indicates that many BI projects often fail to deliver expected benefits and sometimes the project is even considered to be a failure in itself[8, 9]. The major pitfalls of traditional BI project failure are summarized into two broad categories: technology and project management [10]. The technological obstacles include insufficient data intelligence capability, inconvenient interaction of data discovery, architecture and workflow support. Traditional BI is quite a lengthy process including data extract/transform/load (ETL), data modeling, and building Online Analytical Process (OLAP) cubes. However, such OLAP cubes are built only to answer pre-defined questions. Every new analytical request, not originally anticipated, requires a lengthy development process that cannot keep pace with today's ever-changing business demand for fast and agile analytics, huge data volume and diverse data sources [11, 12]. From a project management perspective, lack of enough business involvement, lack of

cooperation between IT and business end users are typical obstacles causing the project failure. If BI solutions can only be mastered by a few highly-skilled IT users, they will not generate widespread insights or better decision making. It is important to choose a solution that supports the skill sets of the organization and is easily accessible to all end users. Today's traditional BI implementations are typically led and driven by IT departments. More often the IT department becomes a bottleneck in the process flow. When IT departments have to generate ad-hoc reports for end users, the business value of BI project has been severely compromised.

3 Agile Health Analytics

According to Gartner research [9], businesses are shifting their BI emphasis away from traditional IT-driven, reporting-centric platform toward business-use-led analytics, and they will make data discovery as their prime business intelligence solution. In the healthcare industry, the new era of health analytics differs from the traditional BI solutions that are utilized by hospitals to perform retrospective analysis [13, 14]. The new breed of health analytics deploysa more holistic approach to combine clinical data from EHR with financial administrative information and other external data sources so that a more well-rounded view of quality, outcomes and efficiency of patient care is presented for enhanced strategic decision-making. The new analytics solutions include progressive real-time and predictive techniques that aggregate disparate data across diverse settings and the continuum of care.

Agile is a reserved word to describe a software development style. It refers to the ability to be flexible and adaptable. The core value of Agile is summarized in the Agile Manifesto which was introduced in 2001 [15]:

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- Individuals and interactions *over* processes and tools
- Working software *over* comprehensive documentation
- Customer collaboration *over* contract negotiation
- Responding to change *over* following a plan

That is, while there is value in the items on the right, we value the items on the left more."

Although the concept of Agile originated from software development community, it has been adopted in other business and industry. The business intelligence projects especially require a flexible approach with room to adapt to new requirements or changes in business needs. In 2009, Inmon [16] statesthat using the "big-bang" approach in the analytical environment raises the risk factors for a data warehouse failure by an order of magnitude.Inmon argues for an alternate approach to the "waterfall" method, which he describes as the iterative process or the spiral development approach. Data warehouse development is done in short fast increments. Kimball [17] refers to this method as "agile" approach, which he describes as emphasizing frequent releases and mid-course corrections. Both of them emphasize the role of the end users in this agile approach. Analytical end users operate in a mode of discovery which is a fundamentally different mode than the user of operational systems.

According to Collier [18], Agile Analytics is a style of data analysis that uses quick, repeated experimentation with granular data, usually with tools designed for this style.

Agile analytics include practices for project planning, management, and monitoring; for effective collaboration with business customers and management stakeholders; and for ensuring technical excellence by the delivery team. Table 1 highlights the key characteristics of agile analytics.

Table 1: Key Characteristics of Agile Analytics [18]

Characteristics	Description
Iterative, incremental, evolutionary	Work in short iterations typically 1-3 weeks; build system in small increments of user-valued functionality; evolve working system by adapting to frequent user feedback
Value-driven development	Every iteration must produce at least one new user-valued feature
Production quality	Each newly developed feature must be of production quality, and fully tested during the development iteration
Barely sufficient process	Emphasize a sufficient amount of project ceremony to meet the practical needs of the project but nothing more
Automation, automation, automation	Automate as many routine processes as possible to help focus on developing user features rather than manually repeating non-value added process
Collaboration	Establish a collaborative team workspace is an essential ingredient of successful project; frequent collaboration between the technical and user communities is critical
Self-organizing, self-managing team	Enable and empower team member; facilitate a high degree of collaboration with users and other members of project community

The healthcare transformation introduces a new care delivery and payment model that requires care providers to accomplish the Triple Aim of simultaneously improving population health, improving the experience of care and reducing the per capita cost of care [19]. This demands care providers to develop capability of integrating data from disparate sources and providing a holistic view of patient clinical, financial, demographic information across the continuum of care. Instilling Agile Analytics principles into healthcare brings a new efficient approach – Agile Health Analytics to help achieve the goals.

4 Use Case of Stroke Registry

In this section, we provide a use case of applying Agile Health Analytics concepts for a stroke registry and analytics reporting project at one of the largest healthcare providers in the U.S.

4.1 Integrated Stroke Registry

According to the American Heart Associate Report 2014 Update [20], about 795,000 Americans each year suffer a new or recurrent stroke, and about 137,000 people are killed each year by stroke. Stroke is the fourth leading cause of death in America and is a leading cause of more serious long-term disability. It costs the United States an estimated $36.5 billion each year.

In an effort to reduce the burden of stroke by improving the quality of care delivered to stroke patients, the American Heart Association and American Stroke Association developed Get With The Guidelines (GWTG) – Stroke, a performance improvement program for hospitals to measure and track acute stroke care. As one of the largest public healthcare organizations in the U.S., this provider has multiple designed Primary Stroke Centers at its acute care hospitals. Each hospital participates and submits performance data to the GWTG-Stroke program. Stroke patients at this provider organization typically suffer from hypertension, diabetes, hyperlipidemia, cigarette smoking, and heart disease. Researchers in this provider organization launched an integrated stroke registry initiative in 2012 for the purpose of developing the first processes required to establish an important disease-specific collaboration across hospitals that will ultimately lead to important epidemiological and observational studies as well as a network for clinical trials. By consolidating acute stroke data into a centralized registry and integrating data from EMR across multiple facilities, the provider will be able to determine key demographic characteristics of stroke patients and identify high risk populations for further risk factor management strategies. The provider establishes an executive committee of physicians, combining expertise in emergency medicine and vascular neurology as well as other work groups to address specific aspects of this project. In addition, the provider also creates a committee structure of nurses/physician assistants, support staff to begin collaborative best practice and research training across hospitals.

4.2 Agile IT Infrastructure

IT infrastructure plays a critical role in the healthcare transformation. Yesterday's legacy systems are not up to the task of managing tomorrow's health data and workflow processes. The focus of health analytics is shifting from IT-driven business intelligence to end user driven self-service business data discovery. The end users demand the ability to explore data without a pre-determined end point in mind. Any tool or process that artificially restricts the conclusions cannot be tolerated. Agile IT infrastructure should enable and facilitate timely and cost-effective solution development and implementation for the business; and to be flexible and respond quickly to any unexpected change of business need.

In our use case of the integrated stroke registry, Microsoft SQL Server is selected as the back-end database. Stroke patient visit data and medical records are extracted from multiple EMR Oracle data warehouse instances and consolidated into a centralized Microsoft SQL Server database.

Microsoft SharePoint Server is selected as the front-end presentation platform. SharePoint is a web-based enterprise collaboration and information management platform that organizations use to build solutions for a wide variety of business problems [21]. Since SharePoint has already been deployed across all facilities of this provider, we leverage the existing SharePoint platform to help deliver timely and cost-effective analytics solutions.

This makes sharing business insights easier. We use SharePoint Designer data connection services and data view web part to aggregate data from external database sources. Then Excel Services is used to create a performance analytics dashboard for the stroke registry. Excel Services is a component of the SharePoint Server. It helps increase productivity by delivering familiar functionalities with the same intuitive user interface as Microsoft Excel. Powerful self-service analytic capabilities within Microsoft Excel empowers end users to uncover patterns, slice through large amounts of data, and quickly find answers. In addition, the SharePoint Server is running on a virtual machine environment, making it scalable and flexible to fit the business growth.

4.3 Results and Discussion

Agile principle and guidelines are applied throughout project management, solution development, collaboration, and communication. Agile health analytics is delivered through the SharePoint platform that facilitates collaboration and information sharing. During this project, we learn from first-hand experience that agile analytics is not simply chunking tasks into two-week iterations, holding a 15-minute daily gathering meeting, or retitling the project manager a "scrum master". Agile analytics balances the right amount of flexibility with a constant focus on building working solution that meets user's need.
Figure 1 illustrates a sample dashboard for the stroke visit population analytics at one of the care facilities. It presents rich information visualization of stroke patient demographic statistics, making the patterns and trends easily visible.

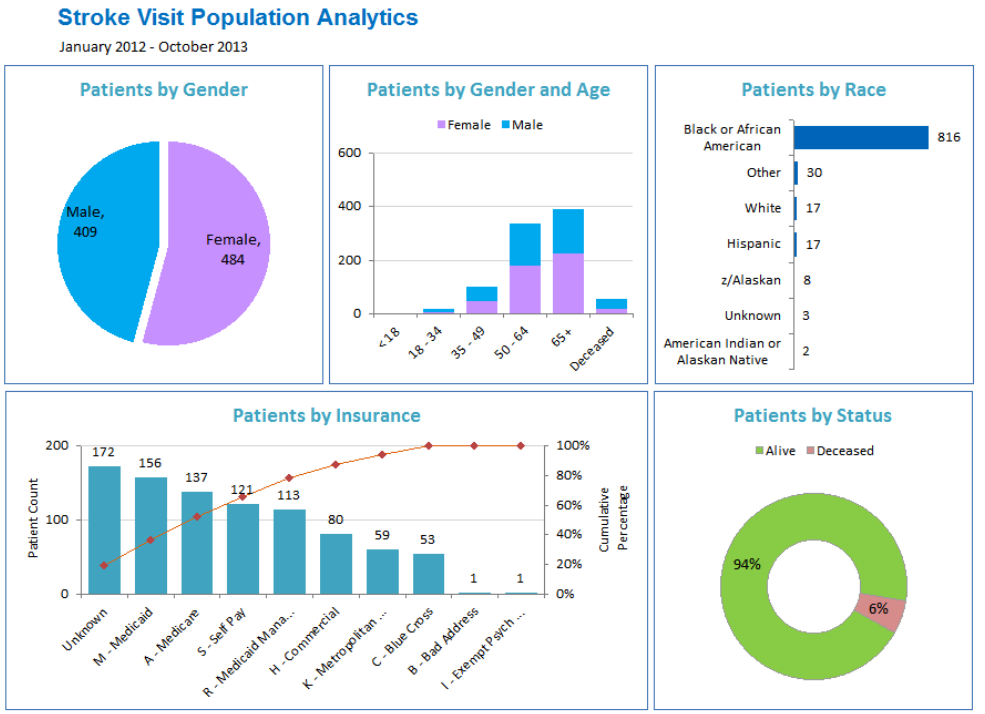

Figure 1: Stroke Visit Population Analytics Dashboard

The stroke registry analytic reporting tool also provides performance measure dashboards. Figure 2 is an example of stroke visit quality measure metrics dashboard which illustrates

how stroke patients get treated at the facility.

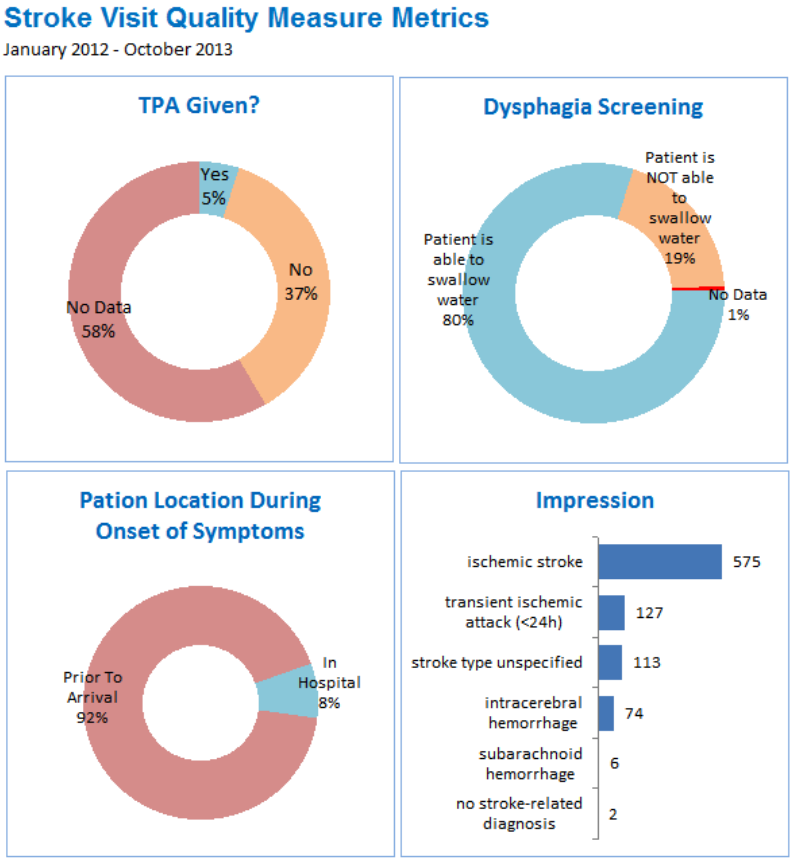

Figure 2: Stroke Visit Quality Measure Metrics Dashboard

Drill-down to individual stroke visit level and patient level are also supported to examine more detail treatment information and patient medical records. Figure 3 provides a stroke visit level list at one of the care facilities.

Hospital

Number of stroke related visits (Jan 2012 - Oct 2013): 863

Visit ID	Gender	Race	Age	Admission Date	Discharge Date	LOS (days)
19473645	Male	Black or African American	61	9/13/2013 2:00 PM	9/20/2013 3:31 PM	7.04
19471539	Female	Black or African American	92	9/13/2013 4:12 PM	9/23/2013 9:15 AM	9.71
19471363	Male	Black or African American	54	9/13/2013 1:36 AM	10/17/2013 6:15 PM	34.71
19471281	Male	Black or African American	58	9/13/2013 12:48 AM	9/14/2013 4:30 PM	1.67
19469668	Female	Black or African American	76	9/12/2013 12:18 PM	9/20/2013 4:42 AM	7.67
19467716	Male	Black or African American	74	9/12/2013 12:43 AM	9/18/2013 2:21 PM	6.58
19467045	Female	Black or African American	61	9/12/2013 12:15 AM	9/13/2013 2:50 PM	1.58
19466502	Female	Black or African American	70	9/12/2013 6:03 AM	9/16/2013 5:10 PM	4.46
19463433	Female	Black or African American	64	9/11/2013 11:27 AM	9/12/2013 8:30 PM	1.38
19463416	Female	Black or African American	67	9/11/2013 2:02 AM	10/2/2013 8:33 PM	21.75
19462830	Female	Black or African American	56	9/10/2013 9:52 PM	9/12/2013 3:12 PM	1.75
19459384	Female	Black or African American	69	9/10/2013 1:53 AM	9/13/2013 3:50 PM	3.58
19455402	Female	Black or African American	67	9/9/2013 6:57 AM	9/11/2013 12:20 PM	2.25
19454288	Female	Black or African American	74	9/7/2013 11:06 AM	9/11/2013 4:37 AM	3.71
19454137	Female	Black or African American	81	9/7/2013 4:28 PM	9/11/2013 3:24 PM	3.96
19451694	Male	Black or African American	85	9/6/2013 3:03 PM	9/8/2013 7:45 PM	2.17
19450762	Female	Black or African American	50	9/6/2013 9:22 AM	9/18/2013 2:30 PM	12.21
19448070	Male	Black or African American	59	9/5/2013 12:32 PM	9/6/2013 11:59 PM	1.46
19442252	Male	Black or African American	72	9/4/2013 8:23 AM	9/7/2013 4:20 AM	2.83
19441822	Male	Black or African American	44	9/3/2013 11:48 PM	9/6/2013 3:41 PM	2.67

Figure 3: Drillable List of Stroke Patient Visits

The stroke registry analytic reporting tool can provide either de-identified non-PHI (protected health information) records for clinical research purpose or including PHI records in support of operations, depending on the login user's privilege authorization, which is defined and managed by the SharePoint user access control.

5 Conclusion

This paper introduces the emerging agile health analytics and its value in transforming massive data into valuable insights for improving population health, clinical outcome, and financial effectiveness. We present a use case of successfully applying agile analytics approach for a stroke registry project at a large healthcare provider organization. Positive feedback is received from the user community. By consolidating acute stroke visit data from multiple facilities into a centralized registry and providing the capability of user-driven data aggregation, visual analytics on demand, clinicians are empowered with intuitive, interactive self-service data discovery and analytics reporting experience. They will be able to identify high risk patients for further risk factor management strategies.

The journey of agile health analytics to drive health transformation just gets started. While the initial results are promising, additional thorough user evaluation with subject matter experts is needed and will be conducted in future steps. Additional advanced analytics including predictive modeling and integrating with enterprise data governance will be evaluated in further development.

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