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BI APPLICATION: DASHBOARD FOR HEALTHCARE

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ABSTRACT
Business intelligence allows information to be incorporated into care provisioning, clinical research, organization, compensation and decisions making scenarios. There is an urgent need for providers to get useful information in a timely manner to improve care and business intelligence is the key. The purpose of this paper is to provide an overview on BI benefits in healthcare and the data visualization technology in delivering information to healthcare professionals. We contribute to the literature in the following areas: 1) overview the BI application areas in healthcare; 2) discuss BI application areas in healthcare; 3) provide several examples and use Xcelsius as a tool to illustrate dashboards design.

Keywords
Business intelligence, healthcare, data visualization, dashboards.

INTRODUCTION
Gartner reports that the market for Business Intelligence (BI) platforms will continue to be one of the fastest growing software markets despite slow economic recovery and many organizations rely on BI to make business operations and management more agile and efficient (Sallam et al. 2011). BI delivers the right information to the right people in the right format at the right time. BI systems are used to support better decisions. The predictive analytics capabilities in BI has a great potential for both healthcare and non-healthcare organizations.

In healthcare, business intelligence has received increasing attention and players in the healthcare industry seek BI as a tool to become more competitive. Various areas of healthcare are challenged with operational and managerial issues. Technologies such as the electronic medical record, clinical decision support system, clinical data warehouse and business intelligence improve health operations, data capture and communication. Glaser and Foley (2008) recommend that long-term IT strategy in health should consider customer relationship management, clinical decision support, business intelligence, and interorganizational systems. Business intelligence allows information to be incorporated into care provisioning, clinical research, organization, compensation and decisions making scenarios. There is an urgent need for providers to get useful information in a timely manner to improve care quality. The useful and relevant information derived from business intelligence satisfy provider’s information needs, resulting in better and informed decisions in patients’ care.

Making informed decisions is imperative in healthcare because decisions could be related to patients’ life and impact patients’ health. There are many areas of healthcare that BI can contribute to deliver desired benefits. The purpose of this paper is to provide an overview on BI benefits in healthcare and the data visualization technology in delivering information to healthcare professionals. We contribute to the literature in the following areas: 1) overview the BI application areas in healthcare; 2) discuss BI application areas in healthcare; 3) provide several examples and use Xcelsius as a tool to illustrate dashboards design.

BUSINESS INTELLIGENCE AND HEALTHCARE
“Business Intelligence systems combine data gathering, data storage, and knowledge management with analytic tools to present complex internal and competitive information to planners and decision makers” (Negash, 2004, p. 178). The concept of Business Intelligence contains a broad meaning referring to the processes, software and technologies for capturing, storing, processing, and distributing information in the right format to users for better decision-making. Giving the important role that healthcare plays in our economy and the ongoing changes in healthcare industry, business intelligence is recognized and increasingly become useful in healthcare.

Numerous researchers and practitioners recognize the benefits of BI in healthcare. BI supports evidence-based clinical decision-making and assists the search for clinical evidence to support diagnoses, care plans development and outcomes evaluation for patients (Wanless 2005). Healthcare entities such as hospitals, clinics, pharmacies, labs, and other medical
facilities have been slow in adopting technology, healthcare professionals have realized the benefits of BI and are willing to use BI as a tool to stay ahead of the competition (Shams, 2001). Larow (2007) reports that BI helps, healthcare entities such as healthcare agencies, payers and hospitals to develop better business solutions and make better decisions, resulting in increased competitive advantage. In addition, BI can offer valuable business analytical capabilities for labor management, revenue cycle management, or service line analysis. In addition, BI allows users to monitor business performance and conduct advanced data analysis (Hennen 2009).

**BI DASHBOARD**

BI dashboards are data visualization technologies that are used to display metrics and key performance indicators (KPIs) for organizations. Dashboard solutions were available a decade ago but technology advancement and data integration have made dashboards solutions popular recently. Today, executives and business users consider corporate dashboards as the “must have” business intelligence technology.

An effective business dashboard needs to balance the visual appeal of dashboards icons, structure of visual icons, amount of information, usefulness and relevancy of information for the decision makers. The design of dashboards could be more challenging than it might be because a small visual area is used to display business information.

Dashboards can be designed for users at different levels: operational, tactical and strategic. They take many forms from simple reports to strategic business scorecards. The key in developing dashboards is to understand users’ information needs, their responsibilities and roles on a daily/weekly basis from decision making perspectives and ensure dashboards provide relevant and actionable information needed for decision making.

**Key Performance Indicators (KPIs)**

When designing a dashboard, defining and understanding KPIs is of most important. A KPI is defined as a measure that is used to assess performance in relationship to a target goal. For instance, KPI could be cost per unit, weekly sales, or number of patients encounters in outpatient facilities. KPIs capture business performance measures and these measures are useful for decision makers to do self-evaluation and set or reset targets. KPIs must be relevant to business operations and practices. KPIs build the foundation and context for the information that will be presented visually within the dashboard. The following shows some examples of KPIs.

- Percent of in-patient commercial revenue
- Percent of in-patient Medicaid revenue
- Percent of in-patient revenue
- Percent of in-patient self-pay revenue
- Percent of out-patient Medicaid revenue
- Percent of out-patient revenue
- Patients given aspirin at arrival
- Patients given ACE or ARB for left ventricular systolic dysfunction
- Patients given fibrinolytic medication within 30 minutes of arrival
- Patients given PCI within 90 minutes of arrival
- Patients given aspirin at discharge
- Patients given beta blocker at discharge

**Application of BI in Healthcare**

BI can be applied in many areas of healthcare. For example, Wanless (2005) discusses the patient registry system, a BI application, which can be used for chronic care management, disease management programs, case management, quality measurement and patient volume analysis. Other examples include patient care analysis, using operation-level clinical data to prioritize surgeries, analyzing aggregated clinical data for unrecognized disease patterns discovery, identifying at-risk patients, conducting predictive modeling and pattern analysis, and evaluating physicians performance. In addition, BI is used to demand and revenue forecasting, patient outcomes prediction, labor and service line analysis, and risk prediction (Wanless 2005, Hennen 2009). Furthermore, BI used in medication therapy helps to effectively manage patients, medications and doses in larger volume due to the fact that medication therapy is challenged with increasingly complicated and sophisticated medication therapy.

**Dashboards Examples - Xcelsius**

Business Objects is a leading vendor in the BI market. We used its product Xcelsius to design dashboards. Xcelsius provides user-friendly interface and allow the quick and fast development of dashboards. Its design functions include various charts,
containers, selectors, single values, maps, text, art and backgrounds etc. The following chart uses container which consists of tabs and users view the dashboards by clicking on the tab. We used a hypothetical hospital called “Goodwill Hospital” to show care measures for patients and patients’ feedback on service quality.

Figure 1 displays the heart attack measures and performances. The heart attack tab shows care quality measures for heart attack. This chart has seven KPIs and it compare Goodwill’s performance with the state averages. This comparison helps decision makers to quickly make sense of data and get a detailed information at operational level about its performance vs the state averages. Figure 2 contains patients satisfaction assessment. The satisfaction tab shows customers’ evaluation on service quality. Six KPIs are used. When making decisions to improve service quality, decision makers know which KPI is underperformed and which is doing better than the state averages.

![Figure 1. Heart Attack Quality Measures](image1)

![Figure 2. Patients Satisfaction](image2)
Drilldown Examples

Drilldown chart allows decision makers to view the big picture first and provides detailed information on any subcategories. Figure 3 has two charts: a pie and a column. The pie chart contains the relatively contribution in revenues in each categories. If the users are interested in getting detailed information based on quarter, clicking a slice of the pie triggers the changes in the content of column chart.

![Pie Chart and Column Chart](image.png)

Figure 3. Drilldown Analysis on Revenue

Sensitivity Analysis

Sensitivity analysis focuses on the impact of the change of input on the output in mathematical models. Figure 4 shows an example of change of lab revenues based on the changes of different tests performed. It contains a gauge and a bar chart. When users click the gauge to change the units, the associated bar chart changes so users see how many changes in the units are needed in order to reach a particular goal.

![Gauge and Bar Chart](image.png)

Goodwill Hospital
Lab Tests Revenue

- Glucose
- Complete blood count
- Urinalysis
- Drug screen
- Men's screen
- Women's screen

![Gauge and Bar Chart](image.png)
CONCLUSION

BI can be used to gather, access, and analyze data about the activities of an organization. BI is helpful for healthcare organizations in managing their data to enhance financial and operational performance and patient care quality. The focus of this paper is on the benefits of BI and provides several examples of dashboards. The dashboards examples used in this paper are related to revenue distribution, heart attack quality measures, lab, and patient satisfaction. It is easy to transfer the designs and dashboard ideas to other areas of the healthcare such as healthcare marketing, research or management, clinical trials etc.

REFERENCES