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 Menu Item: Business Analytics (Data Warehouse) – Population Health

Hospital National Patient Safety Goals	Select all that apply
▪ Improve accuracy of patient identification	
▪ Improve the effectiveness of communication among caregivers	
▪ Improve the safety of using medications	√
▪ Reduce the risk of healthcare associated infections	√
▪ Identify safety risks inherent in the patient population	√
▪ Prevent wrong site, wrong patient, wrong person surgery	

National Priorities Partnership Goals	Select all that apply
▪ Engage patients and families in managing health and making decisions about care	
▪ Improve health of the population	√
▪ Ensure patients receive well-coordinated care across all providers, settings and levels of care	√
▪ Safety: improve liability and eliminate errors wherever and whenever possible	√
▪ Compassionate palliative and end-of-life care	
▪ Remove waste and achieve effective, affordable care	√

Executive Summary

The Electronic Health Record (EHR) project was implemented at Children’s Hospital of Pittsburgh of UPMC (CHP) in 2002 to improve the quality of patient care by providing a centralized source of patient information.

In 2007, CHP leadership considered the next steps in how the data could be used for quality, research, and business information. Regulatory agencies require data on a variety of healthcare activities, and the process to provide the required data was onerous and expensive. There was no easy way to collect, report, and analyze data, so the data warehouse was implemented to centralize and structure the data for reporting. In addition, the need for Quality clinical reporting was needed to improve patient care and reduce errors.

Initially, CHP utilized reporting tools available from the EHR, but they found that the data could be difficult to query because of the numerous data tables and inconsistent data structures. The reporting tools did not provide automated distribution. Within three years, CHP leaders investigated Data Warehouse tools for these features. CHP invested \$400,000 in the initial phase of the data warehouse and hired two technical staff members to be the foundation of the first data warehouse solution. The initial objective was to transform raw data into useful and meaningful information.

The Business Analytics team has now grown to 9 full-time technical and clinical personnel. While the initial objective continues to be the mainstay of the work, the focus has progressed to include discovery into areas that hadn't initially been considered. The new approach to predictive reporting, clinical research and population health are projected to increase the quality of care and decrease the cost of care.

The data warehouse supplies 250 scheduled reports and over 700 additional reports that are on demand. The reports serve a variety of business and clinical areas. Approximately 30% of the reports are targeted toward clinical quality improvement. These are primarily the control reports to evaluate the results of clinical workflow and activities; however, the development of an early warning system (pediatric Rothman Index) has been a significant advancement in predictive reporting.

Predictive reporting methods are developing into tools that prevent patient decline and improve patient outcomes. Using data that is less than 60-seconds old allows the data warehouse to provide nearly real-time predictive analysis and alerting to prevent negative clinical outcomes. This is where clinicians are able to evaluate the patient's key health indicators to assist treatment decisions, prevent infections, and avoid health complications.

In addition to quality reports and predictive analysis, the data warehouse provides business intelligence reports such as work-flow monitoring, outcome reporting, security access reports and research study reports.

Background Knowledge

Renowned for its outstanding clinical services, research programs and medical education, CHP has helped establish the standards of excellence in pediatric care. From primary care, Emergency and Acute Care to Ambulatory, including Transplantation and Cardiac Care, talented and committed pediatric experts care for infants, children and adolescents who make over 1,000,000 visits to CHP each year.

CHP is the only hospital in southwestern Pennsylvania dedicated solely to the care of infants, children and adolescents. Care is provided by more than 700 board-certified pediatricians and pediatric specialists. CHP also provides primary care and specialty care at over 30 locations throughout the Pittsburgh region, as well as clinical specialty services throughout western Pennsylvania at regional health care facilities. Children's is ranked among the U.S. News & World Report's 2013-2014 Best Children's Hospitals Honor Roll and is ranked in all ten of the evaluated specialties.

CHP leads the way in advanced technology as the first pediatric hospital in the country to achieve Stage 7 Recognition from HIMSS Analytics for its electronic medical record and has been recognized by KLAS, an independent health care research organization, as the number one pediatric hospital in its use of health care information technology.

The Business Analytics team leads healthcare innovation in analytics and predictive modeling in Western Pennsylvania, targeting opportunities to improve revenue and patient care in a variety of medical

services. Analytics have played an important role in increasing quality of care and discovering opportunities for cost saving and improving revenue

Local problem being addressed and Intended Improvement

In 2007 when Business Analytics were first initiated, leadership only conceptually understood the potential of the data warehouse. When patient records were on paper, there were pieces of the records scattered throughout sub-specialty departments as well as inpatient records housed in the hospital medical records file room. It was only possible to manually review the paper records and a few disparate systems to compile information. Until the last five years, many ancillary orders and results were not available. As more orders, results, and patient information are digitized, data is more accurate and available.

With the full implementation of the EHR, there are no paper medical records available for manual review. Paper medical records and disparate tracking systems are a thing of the past, so it was necessary to provide a solution for the reporting needs.

Initially, the concept of a data warehouse was to meet the needs of clinical quality metrics and regulatory reports. The time to gather and submit required data was onerous, and data lacked completeness and accuracy due to lack of a data model. The need for actionable, real-time clinical data was identified as biomedical equipment for vitals monitoring were incorporated into the EHR.

Clinical research is a key driver at CHP. CHP has a state-of-the-art research facility, and the new ability to provide data for research electronically was a powerful motivator. Most research was previously study based by identifying study participants, then making the observations needed. While study-based data is still important, research outcomes are greatly enhanced by using de-identified EHR data for many conditions and treatment modalities.

In order to use the copious data in a meaningful way, it was necessary to standardize the data with a data model and refine the data so that it was organized. Once the data model was created, new opportunities arose to use the data to improve clinical outcomes, clinical quality, and business decisions. Each baseline and subsequent improvement is shown in the Value Derived examples below.

Design and Implementation

The Business Analytics team began with a Business Objects administrator and a report writer. The Cerner electronic health system database contains more than 4500 tables; and the CHP analytics database stores the data from more than 300 of those tables. GoldenGate is used as a tool to replicate the data from the Cerner Electronic Health Record within 60 seconds. This architecture allows CHP to take advantage of customized tables to increase performance and support unique applications.

The current data warehouse utilizes Informatica as a data quality tool and ETL (Extract, Transform, Load) to extract data from outside sources.

In year 2015, leadership plans to implement the next version of data warehouse with an anticipated budget of \$500,000 to upgrade the environment and tools.

When the data warehouse was first implemented, there were challenges when the analysts had concerns about legal, HIPAA, and data accuracy. They did not have resources for guidance and answers.

For efficiency, a multi-disciplinary team of Physicians, Clinical Informatics, Information Technology, Legal, and the HIM Director was formed as the Data Warehouse steering committee. The committee reviews all data requests and projects and assigns priorities based upon regulatory need, impact to patient care, or financial implications. In this way, they can easily assess which reports and projects are to be completed first. The requestor is required to be at the steering committee meeting to present their request and discuss the details.

How was Health IT Utilized

The EHR is the primary source of health data for the data warehouse. In the current data warehouse environment, the data warehouse has grown to accept data from 3 clinical EHR applications used throughout the UPMC hospitals and the patient registration and accounting system. The data warehouse has over 250 scheduled reports with over 700 on-demand reports.

- **Clinical Quality Reports** are used by management to monitor the safety and effectiveness of infection control and patient safety.
- **Business Analysis Reports** are used by management to monitor the activities of clinical and business functions. Key performance indicators have been identified, such as PPID (Positive Patient Identification) scores where each clinician is responsible to have 90% compliance.
- **Research Reports** are used by research faculty for the private- and government-funded studies.
- **Predictive and Preventive Analysis Reports** are used to improve patient outcomes and reduce the overall cost of healthcare.
- **Population Health reports** are a new type of report that will be used to identify trends within regions so that healthcare can be targeted to the areas with specific needs.

Each of the EHR systems shown below includes the orders and results from many ancillary systems (such as lab, radiology, EKG, pathology, etc.) and interfaced biomedical equipment. There is data from the following application sources:

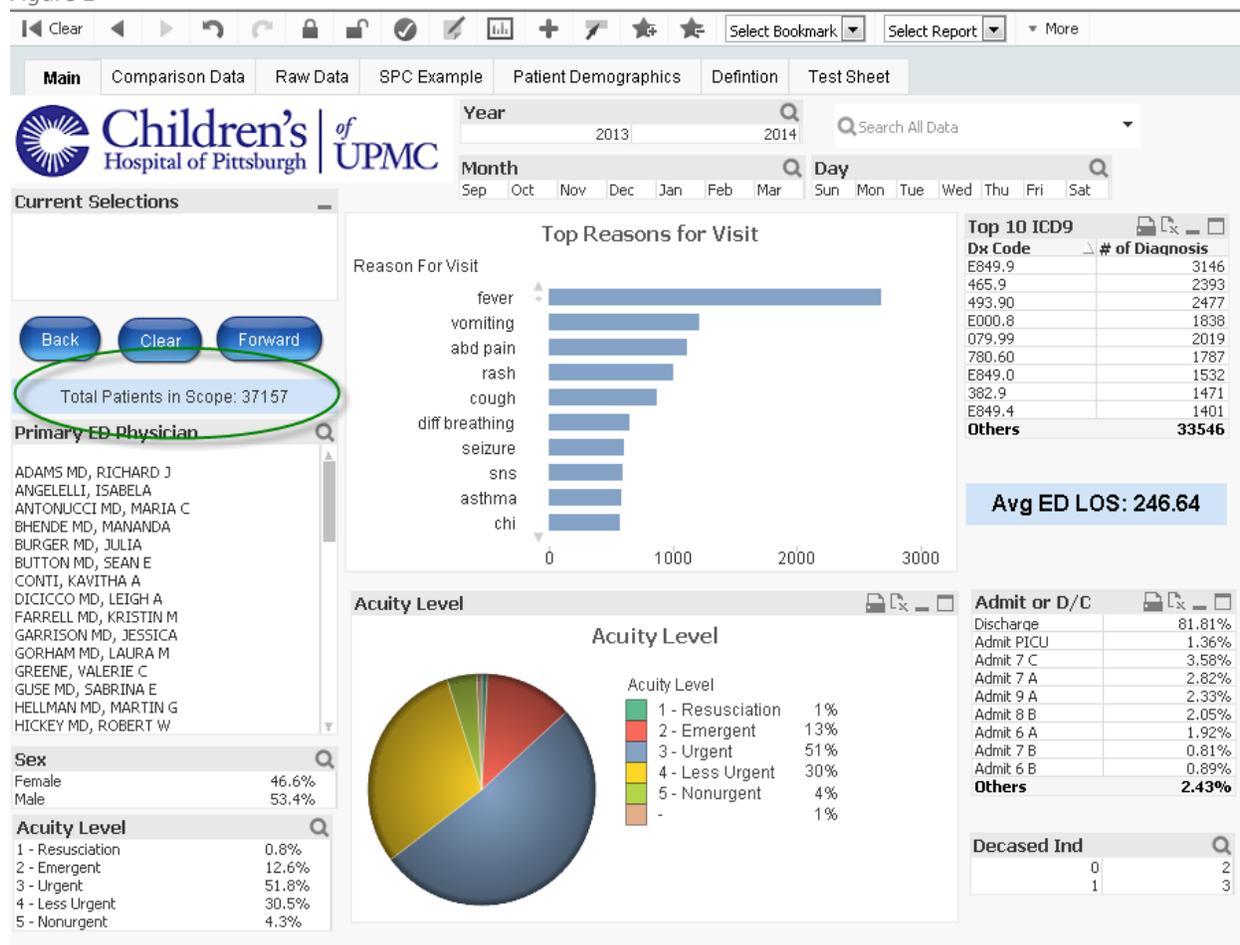
- Cerner EHR (Inpatient electronic health record)
- Cerner PowerChart Ambulatory (Outpatient ambulatory services)
- Epic (Physician offices)
- Medipac (Patient demographics, Patient Accounting)

Dashboards

QlikView is used as the tool to present dashboards for the clinical departments. In figure 1, the Emergency Department dashboard is used by the division chief and selected physician leaders for service metrics. The data is updated every 24 hours. Staff physicians have access to their own data and are able to compare their performance to the data from the whole. Researchers in the Emergency Department use the data to enhance the research studies.

QlikView allows the user to drill down into any data point on the dashboard to obtain the details. From the example below, the user can click on the one of the diagnosis bars to see the list of patients who presented with that diagnosis. Conversely, the user can click on a physician name and see performance statistics in comparison to other physicians in the same time period.

Figure 1



Requesting Data Warehouse Reports

There is a MS Sharepoint site set up to capture data warehouse requests. The submissions are then used to create the Steering Committee agenda. See Figure 2 below.

Figure 2

The screenshot shows the InfoView dashboard with the following sections:

- Navigate:** View your Inbox, Favorites, or Document Lists. Use the Help to learn more about InfoView.
 - Document List
 - My Favorites
 - My Inbox
 - Information OnDemand Services
 - Help
- Personalize:** Change your InfoView start page, viewing options, and preferences for daily tasks.
 - Preferences
- Data/Report Request Tools:** Request a report or data from the Data Warehouse Team by filling out the Request form. Use the Email Data Warehouse Team link to email the request.
 - Clinical Data/Report Request
 - Email Data Warehouse Team
- Training Material:** Access the Training Guides to help navigate your way through accessing your data/reports.
 - View User Training Guide

Figure 3

The screenshot shows a project management interface with the following elements:

- Navigation tabs: Process Documentation, Current Projects, Archive, Reference, EDIT LINKS
- Buttons: + new item or edit this list
- Filter tabs: DWSC - In Process, All Items, All Items in Queue
- Search bar: Find an item
- Table of items:

ID	Title	Requestor	Priority	Assigned To	Status	Estimated Time in Hours	Hours Completed	Date Requested	Requested By
966	Ambulatory Deficiencies	Carrie Pesce		Chris M	User Test	25	10	2/3/2015	3/3/2
993	Pulm/Allergy/Immunology: Influenza immunization	Kelly Butler		Anita	User Test	40	100	4/30/2015	9/1/2
998	Cardiology-Immunization Status	Kelly Butler		Anita	User Test	10	0	4/30/2015	9/1/2
1005	ID-Flu Education	Kelly Butler		Anita	User Test	10	50	4/30/2015	9/1/2
840	Pediatric Septic Shock Collaborative Quality Improvement Project Phase 2	Lieu Tran / Dr. Tavaréz	High	Anita	User Test	280	75	1/26/2014	2/7/2
1017	ED Data FTP	Bill Ollin	High	Chris M	User Test	10	5	6/1/2015	7/1/2

Value Derived/Outcomes

Using Data Warehouse to Create Care Standardization

Since the Data Warehouse has been implemented at CHP, the reports generated have influenced the quality of service and quality of clinical care. Once standards of care and standards of service are established, the reports give clinicians and management the ability to monitor performance to ensure the quality is upheld.

The examples below demonstrate how clinical care has changed as a result of the EHR documentation and data warehouse reports that complement the clinical changes.

MRSA and VRE Infection Rates Reports

In June 2015, it was identified that the rate of MRSA and VRE was increasing. There was a procedure created with the purpose of reducing risk of hospital acquired MRSA and VRE. The procedure provided guidance related to patients with these infections who entered the hospital.

The first step in the procedure is to identify the infection at admission. The Screened Cases report in figure 4 shows that screening compliance improved significantly since the start of the reports in August 2015. The % New Cases report in figure 5 identifies that there is a corresponding decrease in the occurrence of hospital-acquired MRSA and VRE.

Figure 4

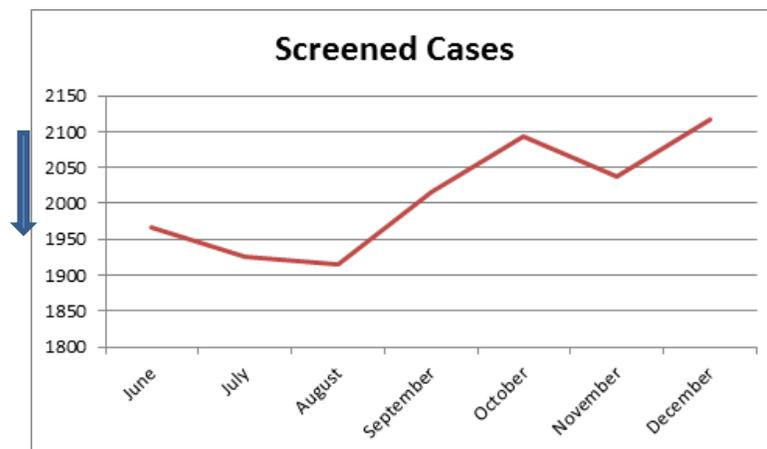
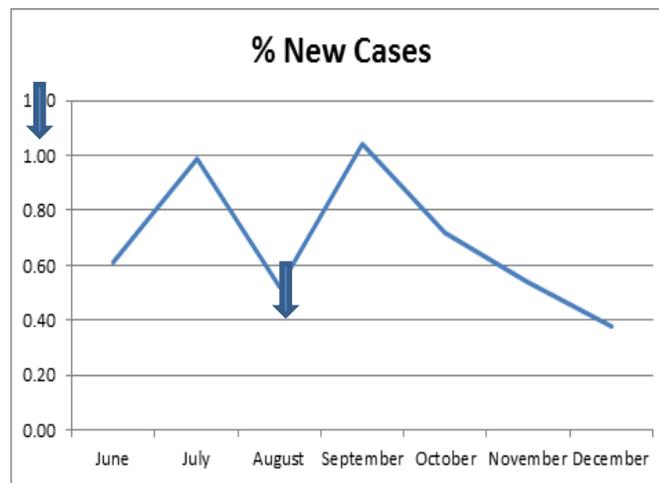


Figure 5



Central Line Bloodstream Infection Reports

Central line associated bloodstream infection (CLABSI) is one of the most deadly and expensive hospital associated infections. CLABSI increases length of stay between 7 to 10 extra days.

Central line infection leads patients to sepsis. The prognosis of a patient with CLABSI is worse than a patient with the same diagnosis who doesn't suffer from CLABSI. Therefore, it is essential to prevent development of CLABSI and is crucial to detect and treat patients who are at the early stage of infection.

CHP adopted a "care bundle" strategy to prevent CLABSI. The care bundle is a checklist that clinicians use to make sure sterile techniques have been practiced in every step of inserting the central line. Cerner uses *smart text to easily document the steps in the care bundle. Once the prevention steps were documented, there were data warehouse reports created to identify nursing compliance to the bundle steps. See Figure 6 for an example of the bundle documentation in the EHR.

**Note: Smart text is when the application will automatically interpret certain text patterns to complete the documentation. For example, when writing a date in MS-Word, the user can begin to type the current month, and the entire date will automatically populate.*

Figure 6

*Type: *Author: 

*Date: Status:

Subject:

Procedure tolerated
Well.

Complications
NONE.

Performed by
JOHNSON MD, ERIN M.
Fellow.

Informed Consent
Informed consent: verbal consent.

Pre-procedure diagnosis
Hemodynamic monitoring.
Medication delivery.
Need for venous access.

Procedure performed
>5 years old: CVC, non-tunneled 36556.

Preparation
Sedative and analgesic: as recorded on the MAR.
Sterile preparation (R): Maximum sterile barriers used, With 2% chlorhexidine, With drapes to exposed with gloves, with hand hygiene, with mask.
Vessel was identified: Anatomic landmarks / Ultrasound guided.
Monitoring during procedure: blood pressure monitoring, cardiac monitoring, continuous pulse oximetry.

Technique
Method: Modified Seldinger Technique.
Location: left internal jugular vein.

EHR uses Smart Text to easily document preparation steps

The precaution care procedures for placing the central line were standardized; however, the IV Team was dependent upon the nurse to call and notify when patients exhibited signs of CLABSI. When the biomedical device data was integrated with the EHR and the data was available in the data warehouse, it was possible to proactively report on the symptoms, identify the patient at risk, and take steps to prevent CLABSI.

The Occulted Central Line Catheters report in Figure 7 is a predictive report that provides a daily list of patients who exhibit the warning signs of central line complications such as sluggish blood return or blood leak complications for patients that can lead to CLABSI. IV nurses use the report to identify and check on patients whose indicators point to developing complications.

Figure 7

Occluded Central Line Catheter Report

Patient's Name	MRN	FIN	DOB	Current Unit	Access Device Tab	Performed Date/Time	Flagged Assesment	All Assesments
ABC DEF	6543210	123456789	*****	9B	Central Line #1 Lumen #2 Status	#####	Sluggish blood return	Heparin lock, Sluggish blood return
					Central Line #1 Lumen #2 Status	#####	Sluggish blood return	Heparin lock, Sluggish blood return

Early Warning Systems

The pediatric Rothman Index (pRI) is the new 'universal patient score' at Children's Hospital of Pittsburgh, where it identifies a patient's condition in real time with an easy-to-understand composite score. The score is universal (used across all disease categories and patient populations), simple (a number from 1-100), and automated (calculated using existing EHR data). It is a constantly updated reference that improves communications between physicians and nurses on a single shift, across multiple shifts and across multiple units and departments.

Because hospital care is primarily a Monday-Friday business, the traditional methods to alert clinicians did not effectively identify the downward trajectory of a child's condition with the diligence needed to prevent a cardiac or pulmonary event. pRI was a development effort in partnership with PeraHealth and funded by a grant. The objective is to provide a simple, effective automated early-warning system for pediatric healthcare. This system can be used with many EHR systems now that the alerts and levels have been identified at CHP.

In a baseline study of existing data from 2006 to 2011, we were able to see that there were 412 total patients with either a pulmonary event or a cardiac event and 220 (or 53%) of those patients had sufficient pre-event data that could have been used to alert caregivers to the declining conditions. If pRI had been in effect during the baseline period, it is likely that 220 patients could have identified the cardiac or pulmonary condition at least 8 hours in advance. This would have given the caregivers an opportunity to avoid a critical condition alert.

pRI uses the data that is charted in the EHR in conjunction with live data feed from the patient's continuous monitoring system. pRI generates a graph to display the patient's condition/acuity based on labs, vital signs and nursing assessments (using natural language technology). The trends update every 1, 5 and 60 minutes based on the data type. pRI graphs serve as a backup to the expert care of physicians and nurses, providing a historical context for patient care. In particular, graphs can draw attention to gradual but important health declines that can be difficult to detect when a patient is handed off between multiple physicians and nurses. By providing a clear picture of patients' health in a graphical view, it is possible to quickly implement corrective measures. Figure 8 below is an example of the analysis provided using pRI.

Figure 8

Rothman Index



Alerts provide multiple opportunities to identify and prevent a critical condition over 8 hours before a critical condition takes place. The alerts are sent to smart phones, pagers, and/or MIPT (or Spectralink) phones to nurses and physicians. Figure 9 below shows an example of the alert sent to the clinician's mobile device.

Figure 9



The system was initially developed using the baseline data, then it was run in “silent” mode to ensure that the data and alerts were consistent with the patient’s condition. pRI was then rolled out to a limited number of clinicians, and then finally, it will be implemented throughout the acute-care inpatient areas beginning August 2, 2015. During these phases, the alerts were fine-tuned with a goal to minimize clinical deterioration events and capture a cohort of patients who might otherwise suffer a cardiac or pulmonary arrest. IT worked closely with the Quality team and clinical partners to fine-tune the alerts so they were meaningful and actionable.

A new “ConditionE” alert was created to represent ‘early, EMR- based recognition of clinical deterioration.’ For the period April 2015 through July 2015, where the index and the alerts were run in silent mode, there were 128 ConditionE alerts triggered by 69 patients in acute care inpatient beds. Ultimately, 16 of the ConditionE patients were transferred to ICU with a median lead time of 8 hours and 50 min notice before a cardiac or pulmonary event. There were 53 pulmonary and cardiac conditions avoided where the patient did not experience a critical condition. pRI gave ample advance notice to begin treatment, and the child was able to improve.

pRI opens a window of opportunity to intervene before the patient arrives to a critical condition. The patient prognosis drastically improves and rate of unplanned ICU admission will decrease.

Based on studies, each *pediatric ICU admission costs \$9,150.00 per day and mean length of stay for pediatric ICU is 3.5 days. (Please see the reference below). For each patient that application helps prevent from ICU admission, hospital saves \$32,025.00. From April – July 2015, 53 conditions were avoided for a savings of \$1,697,325. Extrapolating that to an entire year, it is expected that there could be a savings of \$5,091,975.00.

Vancomycin Usage Report

Vancomycin antibiotic treats bacterial infection, and it has been prescribed widely to prevent serious infections such nosocomial infections. However, according to the U.S. National Library of Medicine, this medication may cause permanent serious side effects including damage to hearing and kidneys. CHP did

not study the frequency of side effects caused by Vancomycin in CHP patients to provide a baseline; however, studies report that these side effects are rare (.01% to .1%).

Vancomycin may commonly cause easy bleeding and bruising, fever, persistent sore throat, persistent diarrhea, and toxicity. Patients may develop resistance to treatment in some forms of bacteria.

Physicians who are concerned about the adverse effect of the medication decided to monitor the use of Vancomycin to avoid over-prescribing the antibiotics. The Vancomycin Usage Report (Figure 10) was created for management oversight.

Figure 10

Name	MRN	FIN	Age	Admit Date	Disch Date	Medical Service	Order Location	Order Status	Order
			18 years	6/20/2015	6/29/2015	Critical Care Medicine	PICU	Completed	caspofungin
							PICU	Ordered	caspofungin
							Emergency Dept Holding	Ordered	vancomycin
Vancomycin	06/24/2015					No Proven Infection	Continue	Vancomycin	For critically ill patient
Day 3 ASP Note	01:29:03 PM								
						No Proven Infection	Continue	Vancomycin	OTHER === monitor serum trough levels closely as clearance is delayed and accumulation may occur
						No Proven Infection	Continue	Vancomycin	Per approved treatment guidelines
Caspofungin	06/24/2015					No proven			
Day 3 ASP Note	01:26:10 PM								
						Use of Caspofungin alone indicated			Critically ill
						Use of Caspofungin alone indicated			Per protocol

The Vancomycin usage report increased awareness for physicians about the frequency of Vancomycin orders and the administration of the antibiotic in the hospital, especially in the Intensive Care Unit setting. Subsequently, there has been a consistent decrease in the use of Vancomycin as a result.

In 2011, the report was in production and available to clinicians. The baseline of 2225 patients ordered Vancomycin for that year was used as comparison. Since the implementation of the report, the usage of Vancomycin drastically decreased.

While it is possible that the population of patients who avoided the use of Vancomycin would not have had serious, permanent side effects, in rare cases of .01% to .1%, it is expected that one to three patients avoided permanent harm due to the avoidance of Vancomycin and a much higher number of

patients who avoided temporary side effects. There is no estimate on the cost of long-term impact; however, it is undeniable that avoiding permanent harm to kidneys and hearing is desirable.

Lessons Learned

In 2007, the first Business Analytics team began to take requests and issue reports. There was a four-year gap between 2007 and 2010 that was a learning period where the concept was less successful because the data was derived directly from the EHR databases. There were many challenges that led to the solid foundation that is the current Business Analytics team. Many of the lessons learned were business procedure challenges rather than technical challenges. It wasn't until 2010 that the data warehouse became the primary resource for reporting data. Since 2010, the team has progressively improved to meet the demands of the clinical, research, and business needs.

Now that data is readily available, all areas of the hospital are requesting reports and projects. There are more requests than time available, so it is important to prioritize the requests and act upon the requests with the most significant impact.

Knowledge and Experience: Two technical resources were initially hired as report writers. One individual had experience with the Cerner application while the second resource had experience with the technology. Neither had knowledge of the Cerner data model and both had limited clinical knowledge. These challenges meant that the resources who knew the technical requirements of how to build a report were limited in their ability to provide accurate reports.

Since 2010, the data model has been documented and the technical and clinical resources are knowledgeable about the data structure and tools. Clinical resources provide guidance on reporting clinical outcomes and clinical predictive tools. Technical resources build the reports, data structures and tables. Developer resources only have access to the development environment and do not have access to make changes to the production environment ensuring sound segregation of duties and change management processes.

Change Management was needed for changes to the data structures and the data tools as well as the technology changes. There are two change management venues used. The data changes are addressed with the Data Warehouse Steering Committee who provides knowledgeable insight into the data and the uses for the data so that the modeling is efficient. In addition, technical change controls are also utilized for server and database changes, utilizing the established CHP and UPMC change control procedures.

Outage notifications and change notifications are sent to CHP user groups as needed to inform of changes and outages.

Policies and Procedures: Initially, there were limited policies and procedures for security access to the data. There was a lack of guidance around who could receive reports and how reports are distributed. Balancing the clinical needs with HIPAA and the need to protect the patient's identity, the technical resources were ill-prepared to make judgments about who could have data.

The solution is that there is a data warehouse steering committee that includes the Director of Patient Information, research, technical resources, and quality resources. This committee reviews and approves the requests for data to determine the legal and ethical use of data and to ensure that data requests follow policies and procedures.

Understanding the Data: The CHP database size is approximately 30 Tb of uncompressed data.

Data is an expensive asset that must be protected in any organization. CHP not only has done a fine job in terms of disaster recovery, back up and replication of data but also has been able to build and modify data marts to improve performance of reporting tools in the data warehouse.

Understanding the technology to compress data, purge data, and consume data is important to the overall success and meaningful reporting. For example, if the goal is to provide a real-time clinical early warning dashboard, then a once daily data transfer from the EHR will not provide the data currency needed when real-time data is needed.

Data is purged at the front of the import process as data is imported from the source systems. Data tables that are not utilized for data reporting are not imported into the data warehouse and are purged from the system. This provides a very thin but functional data mart that is quick and easy to maintain. Data is only added when there is a demonstrated need to utilize the data for reporting.

Financial Considerations

The cost of the data warehouse solution is approximately \$400,000 in initial capital outlay. The operating costs for employee salaries (initially two employees and growing to nine employees) and maintenance costs for the technology are estimated at approximately \$1,000,000 annually.

Data Warehouse Financial Investment

The initial \$400,000 investment in the data warehouse included:

- \$ 95,000 Annual licensing fee
- \$ 55,000 Hardware
- \$250,000 Consultants and staffing

Prior to 2012, the data warehouse was not sufficiently developed to provide accurate, efficient, and timely information. After 2012, when data models, data stores, and real-time data were utilized, the data warehouse became instrumental in CHP clinical and business process.

Financial Value Component of CLABSI Prevention

*The cost of CLABSI is expected to be \$55,000 per case (reference given below).

Central Line Associated Blood Stream Infection (CLABSI) Rate per 1000 central line days

Year	Rate	Average Cost	Estimated Cost Savings or Loss
Base Year – FY 2012	1.39 (53 infections)	\$55,000	
Year 1 – FY 2013	1.47 (57 infections)	\$55,000	(165,000)
Year 2 – FY 2014	0.879 (32 infections)	\$55,000	\$1,100,000
Year 3 – FY 2015	0.84 (32 infections)	\$55,000	\$1,155,000
		Total Savings	\$2,090,000

Financial Value Component of Vancomycin Avoidance

The main total cost of antibiotic therapy per patient including drug acquisition and administration costs is \$4,703.57 for a full course of treatment.

Fiscal Year	Patients Ordered	Decrease	Per Patient Savings	Total
Baseline- 2011	2225			
2012	1578	647	\$4,704	\$3,043,210
2013	1749	476	\$4,704	\$2,238,899
2014	1528	697	\$4,704	\$3,278,388
Estimated - 2015	1618	607	\$4,704	\$2,855,067
				\$11,415,564

Financial Value of pRI

# of conditions avoided	Cost per patient	3-Month outcome (2015)	Potential 1-Year outcome (2016)
53	\$32,025.00	\$1,697,325.00	\$6,789,300.00

Data Warehouse Financial Analysis

	Initial	FY2007-2011	FY2012	FY2013	FY2014	FY2015	Totals
	Investment						
System	-400,000		-70,000	-250,000	-250,000	-250,000	-1,220,000

Costs/Maintenance							
Salaries		-1,125,000	600,000	-600,000	-750,000	-750,000	-2,625,000
					Total Expense		-3,845,000
CLABSI				-165,000	1,100,000	1,155,000	2,090,000
Vancomycin			3,043,210	2,238,899	3,278,388	2,855,067	11,415,564
pRI						1,697,325	1,697,325
					Total Savings		15,202,889
pRI Grant					333,333	333,333	666,666
					333,333	333,333	666,666
					Total Revenue		1,333,332
						Total	12,691,221

References:

CLABSI Cost

<http://www.beckershospitalreview.com/quality/how-much-does-it-cost-to-treat-pediatric-clabsi.html>

Ped-ICU Cost

<http://www.uhhospitals.org/rainbow/patients-and-visitors/billing-insurance-and-medical-records/patient-pricing-information>

ICU LOS

<http://www.ncbi.nlm.nih.gov/pubmed/22824935>