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Menu Item: Revolutionizing Perioperative Services with Discoverable Data Analytics

Executive Summary

To support Mercy’s strategic goals related to cost, service and quality, and help Mercy pioneer a new model of care while balancing financial pressures due to changes in reimbursement, perioperative leaders set out to find new ways of monitoring, measuring, comparing and improving the cost and delivery of surgical procedures while increasing patient satisfaction and creating an exceptional experience.

The focus for this case study is Mercy’s cost per case perioperative dashboard which provided the greatest opportunity for the organization, surgeons and patients. Using key cost and outcomes data related to surgical procedures across Mercy, we achieved $9.42 million in cost reduction, eliminated or minimized the use of certain surgical products, reduced variation, established best practices across perioperative departments and ensured quality post-operative outcomes for patients.

Background knowledge

With Mercy’s high volume of surgical procedures – approximately 210,000 annually – our second leading driver of cost was coming from surgical supplies and implants. Add to that an opportunity to impact quality and patient experience, and Mercy recognized the need for a revolutionary approach to reduce surgical costs, streamline processes and ensure surgical patients get the best care.

Mercy’s perioperative team partnered with Mercy’s IT team, Mercy Technology Services (MTS), to create a set of custom dashboards launched through an information portal for one-stop access to high level metrics, reports and data exploration tools for immediate answers, faster decisions and more agile process improvements. The interactive dashboards leverage cutting-edge technology to provide a holistic view, consolidating large sets of diverse clinical, operational and financial data into a single platform. This method gives us visibility to compare surgical procedure costs and outcome data between all Mercy hospital locations and surgeons. Now, Mercy can easily identify best practices, reduce variation, decrease procedure costs and enhance the quality of Mercy’s surgical practices.

This project is one example of how Mercy’s hospitals and clinics have been working together to leverage resources and improve care. In March, their work was recognized by Truven as one of the top five large health systems in the U.S., as part of the 2016 Truven Health Analytics 15 Top Systems study. This study annually ranks the top 15 health systems – five large, five medium and five small – based on independent research and publicly reported data of system-wide performance in health care quality, patient satisfaction, coordination of care, cost of care and
operational efficiency. The hospitals chosen represent the highest national standards in hospital care and management reducing overall expense year over year while improving patient outcomes. These are exactly the results that the entire industry hopes to attain.

**Local Problem being Addressed and Intended Improvement**

Prior to 2012, determining surgical costs at Mercy was an unstructured, manual process. At the time, surgeon preference cards and product contracts (which contain supply cost) were the only methods available to determine the cost of surgical procedures. Without data as evidence, there were varying opinions as to the best practice, price and product for a given procedure. As a result, there were significant variations in the cost per surgical case across Mercy.

For example, from July 2012 to July 2013, Mercy’s surgeons performed 2,231 total knee procedures. The median cost per case before we started the solution was $7,045 with an interquartile range of $1,999. To better manage these costs, in 2014, we set a 3% cost per case reduction goal for all locations performing total knee replacements. Resource Optimization & Innovation (ROI), Mercy’s group purchasing organization, set up a capitation pricing model where all products have uniform pricing to support the goal of 3% cost per case reduction.

Yet, perioperative leadership quickly realized setting goals and capitation pricing alone wouldn’t get sustainable, systemic results. Our manual process lacked standardization and a unified approach. Capitation of pricing was just one of the methods used to achieve our case cost savings. We needed to find a new, reliable methodology that would accurately calculate cost per case and help facilitate standardization. With a goal of transparency across Mercy, we sought out a solution that is integrated and automated, with many levels of visibility into key perioperative performance indicators, so Mercy would be better positioned to reduce variation in product selection, cost and surgical practices.

**Design and Implementation**

Mercy’s first challenge in designing the perioperative dashboards was to decide which metrics made the most sense to gather and report. Our Perioperative Leadership Committee (PLC) (See Figure #1) established a charter and governance structure to facilitate these decisions, and manage the design and development of the perioperative dashboard. The governance structure included a perioperative governance chairperson, perioperative leaders (nurses), business managers from each surgical location and a core development team consisting of a business solution analyst, data architect, health care analyst and application developer.

**Figure #1- Perioperative Leadership Committee Structure**
It took the leadership team eight months and a total of 150 hours to develop the overall dashboard metrics. Within this timeframe, each metric and definition was approved by the governance committee and brought back to PLC for review and support. A road map was built for each metric so Mercy has comparable, national data points and analytics. As each metric was developed, designated perioperative leaders in each community were assigned one metric to follow and track on the dashboard and on manual spreadsheets to compare for accuracy. This was an important step in building confidence in our dashboard information, and it made it easy to see and then correct differences in data input in the EHR between locations, which ensured quality and consistency in the output of the dashboard.

**Design Through Storyboards**
Based on the governance chairperson’s requirements, the data team used an agile development approach and created the vision using a storyboard. From start to finish, a story board concept takes six to 12 months to complete, but completed sets of functionality are delivered along the way, with final approval required by the governance committee before development begins. Storyboards help Mercy determine and align project timeframes to each storyboard concept. (See the section “How Health IT Was Utilized” for more detail).

**Designed for Drill Down**
Because information is consumed in varying ways based on the audience, Mercy’s perioperative
dashboard is designed with that area’s audience in mind, accommodating the unique needs of three levels of users to provide the right view of the data to the right person. For administration there is a 30,000 feet view (See Figure #2), for the department director there’s a 20,000 feet view (See Figure #3) and for surgeons there is an “on scene view.” This provides multiple levels of leadership a summary view specific to their needs, while enabling frontline leadership the ability to drill down to improvement opportunities.

**Figure #2 – Periop Dashboard (the 30,000 feet, summary view)**

![Periop Dashboard](image1)

**Figure #3 – Periop Intra-op Case Cost Dashboard (the 20,000 feet view of cost per case)**

![Periop Intra-op Case Cost](image2)

As for the type of information that would be displayed, the committee decided on specific metrics that told the most compelling story about cost generation and quality outcomes. To this end, the perioperative dashboards were designed with the ability to drill down to more detailed dashboards containing these key performance metrics:
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- **Cost per case.** Provides leadership and surgeons a transparent view of surgical cost per case across each Mercy location - by community, by service, by specialty and by procedure.

- **On-time starts.** Provides a visualized display of both staff and individual surgeon results related to surgical procedure on-time starts.

- **Operating room turnover times.** Visualizes turnover times relative to each hospital’s size, giving leadership the ability to benchmark and find like opportunities.

- **Block utilization.** Provides measures on the use of each operating room, as well as facilitates the surgeon’s scheduled procedure time in the operating room.

The dashboards include a self-discovery tool called Explorer, which gives leadership the ability to interact with over 40 million records spanning several years in near, real-time. In fact, Explorer is designed so that anyone in the health system can approach the data with questions and get answers as their questions arise, making analysis immediate, intuitive and evidence-based. In the moment they need it, Mercy’s leadership team and surgeons can filter their view to find the best opportunity for the organization. An additional design benefit of the Explorer tool gives leadership the ability to export the data so the information can be presented in any venue (See Figure #4).

**Figure #4 – Dashboard Explorer - (the on-scene view of cost per case)**

*Each dashboard can be explored in detail*
To make these complex and extremely large data sets easy to find and always available, we built dashboards that could be accessed through Mercy’s intranet, integrating the information into the workflow with a simple click of a button.

**Governance Process**

We used a governance process at the organization level and at the business unit level, including key stakeholders such as COOs, CFOs and other Mercy leaders. We worked collaboratively to develop requirements and used agile methodologies for an iterative review of the product throughout development.

Mercy’s Perioperative Dashboard Governance Committee
(See Figure #5 and #6):

- Requests for dashboard changes (new functionality and enhancements) are submitted via a support ticket in Mercy’s service management tool.
- Governance reviews each request, responds with feedback to the requestor and organizes approved changes with a storyboard using agile methodology. Given a high volume of requests, the committee is continuously prioritizing.
- Perioperative governance chairperson manages the data team’s assignments based on the availability of each team member.
- The business solution analyst creates a test report; perioperative directors, business managers and executive leadership review the accuracy of the data and verify the functionality of the test report.
- Feedback from the test report is presented and functionality is revised and approved by the perioperative governance committee.
- Once the report is approved, it’s passed to the application developer who creates and transitions the report into a functioning automated dashboard.
- Testing and validation is conducted during the build of each dashboard.

**Figure #5- Perioperative Dashboard Governance Committee**
Figure #6 – Perioperative dashboard governance process

Training. The perioperative governance committee scheduled an initial four-hour training course for directors, managers, and business leaders so users received an optimal experience with
the tool. Additional training sessions were held for the entire enterprise over the course of six months, and continue to be ongoing as training is requested or when there is a change in procedure. Training includes a review of basic functionality and how to navigate the dashboards, how to identify opportunities for patient and location benefit and how leaders can use the data to develop action plans for improvement. Currently, there are 14 overall dashboards generated from the organization’s information portal which is accessed daily, one which is the perioperative dashboard. Since in production, the Perioperative Dashboard has been accessed 15,814 times in FY16.

How Health IT Was Utilized

Using IT Tools for Storyboards
As a tool, the storyboard is used to facilitate an agile project management methodology, and help organize and prioritize development work (See Figure #7). Once necessary modifications to the dashboard have been identified by the business, it goes into the storyboard (in the “None” column). This column provides an easy list view of business requests for the PLC and governance committee. This list of requests is reviewed by the governance committee, and prioritized work progresses left-to-right through the storyboard and its respective stage of development. It provides clear visibility to all dashboard project work.

Figure #7- Story Board Prioritization- Work that has not started

As the stories or tasks are addressed, they are moved to the next column by the assigned person, which enables the team to see progress or where there may be road blocks (See Figure #8).

Figure #8- Storyboard Process in the Development Life Cycle
The user is able to click on each story to get to the detail of the story or task (See Figure #9).

**Figure #9- Sample of story detail**

**Data Architecture Built for Aggregating**

To address performance and reduce waste, Mercy needed analytical tools that look at clinical and financial data together to fully understand costs and outcomes. That means combining Epic’s EHR data with data from enterprise resource planning (ERP) software and other internal and external sources (See Figure #10). Mercy uses Epic’s EHR to capture patient information, and
perioperative departments document all surgical procedures in Epic’s OpTime module, while surgical information is stored in Epic’s Clarity Data Warehouse. Cost data is generated from Mercy’s ERP systems, which are refreshed nightly through a daily batch job.

**Figure #10 – Perioperative Data Flow**

Once the diverse source data is collected, the challenge becomes organizing the data so that it is uncluttered and can answer specific questions about a particular service line, making it meaningful to the audience consuming it. Mercy uses a strategy of service line “data marts” to organize large amounts of data into a structured, insightful view into Mercy’s operations through performance dashboards, which includes the perioperative dashboard (See Figure #11).

**Figure #11 – Perioperative Data Mart and Data Access**

Mercy created a perioperative data mart that combines all of the relevant data from its respective source system and then stores it on the SAP® HANA platform. For efficient processing of large volumes of data and to support advanced analytical processing and high-performing data self-
service, Mercy uses SAP HANA, an application server that includes an in-memory, column-oriented analytical database management system.

Mercy uses the SAP® BusinessObjects™ BI solutions, and SAP BusinessObjects Explorer® software to develop integrated dashboards and Explorer spaces. This allows the organization to manage data in a format that is appropriate for the specific department (See Figure #12).

**Figure #12 - Perioperative dashboard representing many integrated data sources**

All metrics are documented in Mercy’s information portfolio, a wiki-based collaboration space and information repository. By providing standard definitions around perioperative performance, perioperative leaders establish a common language and set of rules they manage and update themselves, further minimizing variation across Mercy’s perioperative departments. The definitions and detail around perioperative metrics can be accessed from any screen within the perioperative dashboards by selecting the “information” icon (See Figure #13).

**Figure #13 – Periop Case Cost Information Portfolio Page**
Value Derived/Outcomes

Before launching the analytics dashboard initiative in 2013, Mercy perioperative service line had been analyzing data using many sources, and manually combining the information in spreadsheets or other forms. Key performance indicators would take weeks, sometimes months, to gather.

Today, the data provided in the perioperative dashboard is automatic and takes just seconds, saving Mercy’s perioperative services team approximately 2,300 man-hours a month for each of Mercy’s locations – a total estimated to be around 30,000 hours a year of manual effort saved. What used to take 2,300 man hours a month, now takes 10 minutes.

With analytics at our fingertips, and needing only minutes to identify expense and get all the comparative details to eliminate variance, improve quality and lower cost, Mercy achieved a total savings of $9.42 million across perioperative departments for all surgical procedures as calculated through January 2016.

For example, Mercy’s median cost per case for total knee surgery dropped from $7,045 with an interquartile range of $1,999 in 2014 - to a median cost per case of $5,527 and interquartile range of $901 in 2016. As the surgeon usage of the dashboard increased, the costs dropped dramatically (See Figure #14).

Post-dashboard implementation (indicated with a red line), there was a significant drop in costs of intraoperative implants and supplies per case related to total knee arthroplasty (See Figure #14).

**Figure #14** - Trend in Median Medical Services CPI Adjusted Intraoperative Supply Cost per Case in Total Knee Arthroplasty at Mercy, May 2012-Jan 2016 (n=11,834)
Monitoring and Improving Processes and Performance at a Macro-level

As illustrated by the total knee surgery savings highlighted in this case study, the dashboard made it simple to monitor performance and spot necessary process changes for optimal cost, quality and surgical services across Mercy’s perioperative departments. Perioperative leaders used the intuitive data to identify rising costs in Mercy’s total knee replacement procedures. The detailed and drillable data helped leadership see increasing costs were the result of using a certain type of knee implant technology. After using the dashboard to compare knee cases across surgeons and against all of Mercy’s surgical communities, leadership noticed others were using a less expensive implant technology with similar outcomes. With this comparison data, leadership could make an informed decision to implement the use of a new, lower cost implant technology. Additionally, contracting of that implant would be based on usage patterns (another data point provided through the dashboard), so Mercy is purchasing products more efficiently and being better stewards of its resources. These process changes reduced the cost of total knee replacement surgeries, yet clinical outcomes stayed the same or improved, and front line clinical user satisfaction increased thanks to better availability of high quality implant technology.

Mercy’s group purchasing organization (GPO) provides a contracting strategy that offers various products. The product review within the GPO sets the standard to provide quality products overall.

Because the dashboard data is intuitive and delivered in real-time, operational leaders can easily see how perioperative departments are performing from day to day. They can see every surgical community across Mercy at a glance. Having this visibility makes it a breeze to spot operational...
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lags and set actions plans to implement change to improve performance as soon as the next day. For example, perioperative operational leaders used dashboard data to identify ‘First Case On-time Starts’ – that is, surgical cases started as scheduled in a specific operating room. For cases that didn’t start on time, leaders can drill down to discover the reasons for delay – e.g. surgeon or anesthesiologist arrival time, patient required further pre-operative testing, instrument trays not ready and any other patient condition or delay. From there, leaders determine a solution and implement change for the next day’s surgeries, and continue to monitor on-time starts for improvement.

**Impacting Performance at the Micro-level**

Mercy’s surgeon scorecard is an example of dashboard data intended for users (e.g. Mercy’s surgeons) to identify and implement individual performance improvement. For example, a surgeon can see at a glance her average cost per case and her cost ranking among her peers. She can click on the cost per case tile to review detail for all her cases; compare her cases against every surgeons’ cases in Mercy and against national data. She can click on a specific case for even greater detail related to supply cost. The surgeon scorecards have not only created visibility, but facilitated a culture shift toward transparency and friendly competition, spurring surgeons to make changes to lower case costs and ensure the best outcomes. The scorecard has also helped drive standardization across surgical departments, for systemic change across Mercy. (See Figure #15).

**Figure #15- Surgeon Scorecard**
**Figure #16** – Boxplot Medical Services CPI Adjusted Intraoperative Supply Cost per Case in Total Knee Arthroplasty at Mercy by Intervention Status, May 2012-Jan 2016 (n=11,834)
Cost and outcomes analysis helped us identify and either eliminate or minimize the use of certain surgical products, while ensuring the best clinical outcomes for Mercy’s total knee replacement patients. For example, we were able to:

- Eliminate the use of blood auto transfusion drains, which reduced the risk of post-operative infection in patients.
- Reduce the use of the ultrasonic devices, a surgical technology used to minimize intraoperative blood loss. Where there was no clinical evidence of its benefit, Mercy was able to steward resources and pass on cost savings to surgical patients.
- The cost of bone cement is a major driver of cost in total knee replacements, but there is conflicting medical literature on its effectiveness. Mercy was able to minimize the use of antibiotic bone cement on total knee procedures using comparative data as evidence. Compared to regular cement, antibiotic cement did not affect the occurrence of post-operative infections for patients - with the exception of diabetic patient populations due to slower metabolic rates. Therefore, regular cement could be used for all non-diabetic patients as effectively at a lower cost.

Other outcomes include:

- An increase in on-time starts for surgeries from 49% to 65% on-time starts, resulting in more satisfied surgical patients.
- Room turnover reduced from 33 minutes to 22 minutes.
- Physician turnover is now 30 minutes, down from 46 minutes.
- Improved culture in the Surgeon’s Specialty Council meetings with the new ability to look at up-to-date dashboard information instead of months-behind information.
- Increased physician engagement by providing the ability for surgeons to see their cost down to the product level.
- Facilitated teamwork between the Orthopedic Specialty Council and ROi, our supply chain organization, enabling easy reviews of pricing contracts to achieve cost savings.
- Quality measures: Infection rates remained very low with no significant change post-cost savings interventions (See Figure #17).
Lessons Learned

- **Focus on cost reduction without Triple Aim compromise.** Focusing on cost reduction strategies with our providers redirected us to the Triple Aim. Quality, Service and Cost cannot be considered in a vacuum. Cost reductions in the OR, along with quality metrics and bundled payments, have better positioned Mercy for a new model of care.

- **Establish governance.** We recognized early in the design the need to create a governance committee, as well as designate the role of chairperson to centrally manage and oversee dashboard metrics and development for all Mercy’s perioperative departments.

- **Avoid scope creep.** The original business plan outlined the scope of practice for dashboard metrics. However, scope creep had to be managed. Scope creep required the committee to create an intake and output process and prioritize requests.

- **Assign super users.** The governance committee set up initial training, education and orientation for the end users. For greater adoption and support, a super user (business
manager) would be elected at each location to answer questions, educate and champion the perioperative dashboard.

- **Establish closer to real-time communication structure.** We learned communication was more effective in-the-moment to provide feedback. Because the governance committee and core team have other responsibilities in the organization, immediate feedback wasn’t always possible. The dashboard committee decided to meet more often than was originally planned, which provided the necessary communication structure.

- **Validate data at the local level.** The opportunity to validate data with influential locations within Mercy is now managed on a location-by-location basis. The committee made the assumption that the data was accurate because the source was Mercy’s EHR. However, we learned there are opportunities to correct input from the contracting system and the pages requiring adjustments at each location, such as the inventory supply screen within Mercy’s supply chain application. (See Figure #12 & #18)

**Figure #18 - PeriOp Supply Management by Average Cost per Case by Product Category**

- **Frontline reporting is needed.** We discovered perioperative frontline managers needed the ability to see their own data, which helps them manage the data quality, resolve duplication and reconcile any variances. These reports include data quality implant reports, implant overstatement reports, and duplication reports.
Financial Considerations

**Figure #19- Cost Benefit Analysis**

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<th>Year 2013 (US$)</th>
<th>Year 2014 (US$)</th>
<th>Year 2015 (US$)</th>
<th>Year 2016 (US$)</th>
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| Benefits                    |                 |                 |                 |                 |                 |                   |
| Implant Standardization and Volume Consolidation | $ - | $ - | $ - | $ - | $ - | $ - |
| Supply usage and removal of waste | $ - | $ - | $ - | $ - | $ - | $ - |
| Custom Pack Standardization | $ - | $ - | $ - | $ - | $ - | $ - |
| Soft ROI: Resources for manually running reports | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Cost Savings          | $ 10,942,262.00 | $ - | $ - | $ - | $ - | $ - |

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