Executive Summary
Hawai‘i Pacific Health’s electronic health record has been instrumental in the implementation of a Clinical Care Surveillance Program for the obstetrical population at Kapi‘olani Medical Center for Women & Children, an obstetric and pediatric specialty hospital performing approximately 6,000 deliveries per year. In 2009, as part of the Institute for Healthcare Improvement’s Perinatal Collaborative, a multidisciplinary team was formed to focus on improved care for patients receiving oxytocin during labor, and care related to post-partum hemorrhage. This case study demonstrates the practical application of Health Information Technology (IT) to assist clinical teams in making improvements to patient care. Significant improvements were achieved.
Background Knowledge: Hawai‘i Pacific Health is an integrated healthcare system with four hospitals and 49 outpatient centers. One of the four hospitals is Kapi‘olani Medical Center for Women & Children (KMCWC), an obstetric and pediatric specialty hospital performing approximately 6,000 deliveries per year. The John A. Burns School of Medicine Department of Obstetrics & Gynecology (OB/GYN), based at KMCWC with an accredited residency program, provides the obstetric hospitalist program and offers significant leadership for improvement efforts. In 2009, as part of the Institute for Healthcare Improvement’s (IHI) Perinatal Collaborative, a multidisciplinary team was formed to focus on improvements that positively impact patient safety. To achieve aggressive goals, the team relied heavily on the electronic health record (EHR) for clinical surveillance of specific populations to identify improvement opportunities and implement changes.

Goals:

- **Labor Management**
  - Improve care surrounding oxytocin management
  - Conduct surveillance to reduce risk of harm to the fetus during augmented labor
- **Improve the quality of nursing hand-offs**
- **Identifying and Handling Critical Events**
  - Conduct surveillance and increase identification of patients at-risk for massive hemorrhage
  - Improve coordination of care surrounding massive hemorrhage events
- **Streamline Reporting to Provide Data Feedback for Quality Improvement**
  - Provide objective data to clinicians to allow accurate evaluation of practice changes

LABOR MANAGEMENT

Local Problem and Intended Improvement: On August 9, 2007, oxytocin was designated as a high alert medication by the Institute for Safe Medication Practices (ISMP). Oxytocin is a medication frequently used to initiate or augment labor. Aggressive use of oxytocin can result in adverse outcomes so monitoring of these patients is extremely important. The use of oxytocin is significant on Labor and Delivery units across the U.S. and concerns related to perinatal harm and liability led to the development of the Institute for Healthcare Improvement (IHI) oxytocin assessment tools. KMCWC conducted an assessment using the IHI Trigger Tool in order to measure fetal and maternal harm in patients receiving oxytocin. The assessment revealed a need for improved surveillance and documentation of tachysystole (too many uterine contractions in a defined period of time), a condition that may result from oxytocin administration. The team agreed to develop an oxytocin protocol based on best-practices literature and aimed to rely heavily on the EHR to use, implement, and monitor this protocol.

Design, Implementation, Utilization of IT, and Value/Derived Outcomes: The protocol outlined a checklist which was to be used before initiating the use of oxytocin. This checklist was built into the EHR to be completed by the nurse caring for the patient. The EHR was also modified to capture incidence of tachysystole and to prompt action when tachysystole is identified (see Figure 1).
This field was built in a manner which allowed the fields to later be extracted, allowing the team to examine global trends in patient care.

There were initial concerns by some unit physicians that the oxytocin protocol changes may result with extended duration of labor. An increase in length of labor could require more vaginal exams and leave patients with longer periods of ruptured membranes and as a result an increase in the incidence of chorioamnionitis. Prolonged labor could also lead to increases in the cesarean section rate. Data from the EHR were leveraged to compare care outcomes before and after implementation. Both maternal and newborn outcomes were tracked to monitor the impact of changes made to oxytocin management. The team agreed to measure time from admission to delivery as a proxy measure for “length of labor”. Results showed no significant increase in length of labor and no increase in chorioamnionitis. The cesarean section rate for low-risk deliveries actually decreased (Figure 2), so the clinicians were reassured that the protocol did not negatively impact maternal outcomes.

Data were shared on a monthly basis with those clinicians who at first were reluctant to adopt the new protocol. This resulted in the protocol becoming more widely accepted.

The team used the EHR to measure the presence of tachysystole in two different ways. The templated charting for tachysystole was created and monitored, but there were concerns that rates
could only reflect charting and not true incidences of tachysystole. Therefore, the EHR was mined to identify the administration of the drug terbutaline for patients receiving oxytocin. This medication is sometimes given to reverse worrisome tachysystole. Examination of both graphs (Figures 3 and 4) showed significant decreases in the rates of documented tachysystole and of terbutaline administration for patients receiving oxytocin. The dissemination of these data on a regular basis increased clinician support and buy-in related to the new protocol.

![Figure 3. Rate of Tachysystole for Patients Receiving Oxytocin Before Delivery.](image1)

![Figure 4. Rate of Terbutaline Administration for Patients Receiving Oxytocin Before Delivery.](image2)

The team also monitored outcomes for babies to measure harm. There were no remarkable changes in the rate of neonatal intensive care admissions or in babies born with low pH levels in the routine cord blood gas tests. Our ability to measure harm in this routine and regular way led to confidence and standard adoption of the Oxytocin Protocol across the unit.

**HAND OFF IMPROVEMENTS**
**Local Problem and Intended Improvement**: KMCWC nursing expressed interest in improving nurse-to-nurse communication. Nursing leadership had voiced concerns surrounding the exchange of information between shifts and during other crucial hand-offs. Experienced nurses requested a tool to help nurses with less experience.

**Design, Implementation, Utilization of IT, and Value/Derived Outcomes**: Nurses were given a survey to measure perceptions surrounding handoffs. This survey was used to guide the tools created to assist with handoff improvement. Key elements were also outlined for nurse-to-nurse handoffs and a measurement tool was used as a short-term way to measure effectiveness of handoffs occurring during shift change. A summary screen (Figure 5) was also built into the EHR to make it easier for nurses to convey all important information during shift change and other handoff situations. Prior to the development of the summary screen, it was found that nurses had to go to seven different screens in the EHR to find all the information required for a complete handoff.

![Figure 5. Obstetrical Nursing Hand-Off Screen.](image)

The survey conducted to measure nurse perception revealed that most nurses report giving appropriate information more than they report receiving appropriate information from their colleagues. Observation data from handoffs ‘before’ and ‘after’ the standardized tool reflected a clear improvement in critical elements of the handoff performed at shift change (Figure 6).

Following the success with the nurse tool, a note template was also designed for Ob-Gyn Residents to use in order

![Figure 6. Pre and Post Measurement Obstetrical Nursing Hand-Off.](image)
to communicate information with each other and to communicate information back to the nurses. Although not formally assessed, anecdotal reports from the unit indicate that labor and delivery nurses regularly consult the new resident notes. Hospitalists also report that the tool has improved communication during the labor and delivery process. Both physicians and nurses report that the tool is rarely used after the patient gives birth, so it is not a useful communication tool for post-delivery patients.

IDENTIFYING AND HANDLING CRITICAL EVENTS

Local Problem and Intended Improvement: There are many components to providing care during critical massive hemorrhage events. There must be coordination with pharmacy surrounding medication orders and pharmacy response time. It is also important to have timely communication and response from the lab and blood bank. It is crucial to get blood products to the bedside as quickly as possible once an event occurs. There are also specific supplies which may not be available for day-to-day procedures, but in the event of a massive hemorrhage these tools need to be available and easily accessible. It is important for everyone in the room to know their roles and feel confident in conducting their duties. This can be challenging because most staff members do not participate in massive hemorrhage events on a regular basis. These events are not common, so most staff members do not have the opportunity to participate in multiple events. This has caused confusion and delay in the absence of clear guidelines during critical events. The team utilized the EHR as a tool to help identify at-risk patients. The EHR was also leveraged to improve consistency with managing these events.

Design, Implementation, Utilization of IT, and Value/Derived Outcomes: Initially, the team conducted an assessment which included a Massive Hemorrhage simulation drill. The results of that assessment laid the framework for improvement efforts in the management of obstetric hemorrhage. The team decided to implement a standard protocol. The designation for such events is now noted as “Code Crimson” and there is a protocol initiated every time a patient experiences an estimated blood loss greater than 1500ml. The team first addressed issues surrounding the reliable availability of medications and supplies. The team worked with:
- Pharmacy to create a massive hemorrhage medication kit
- Physicians and nurses to create 6 Massive Hemorrhage carts to centralize supplies
- Lab to coordinate blood-related orders

All of these efforts were bundled into both blood and non-blood electronic order sets. Creation of these order sets helped improve collaboration with blood bank. Non-blood-related order sets were also developed to increase efficiency during emergent situations. The team also wanted to work on identifying those patients who are at-risk for massive hemorrhage events. Efforts were made to extract heart rate and blood pressure in order to calculate a shock index for laboring patients. Work was done in the EHR to add a calculated flow sheet row for shock index that would be visible to both nurses and physicians (Figure 7).

<table>
<thead>
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<th>Vital Signs</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Temp</td>
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</tr>
<tr>
<td>Temp ser</td>
<td>Oral</td>
</tr>
<tr>
<td>Pulse</td>
<td>90</td>
</tr>
<tr>
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<td>89/60</td>
</tr>
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<td>MAP</td>
<td>63</td>
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<td>Right arm</td>
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<td>Resp</td>
<td>24</td>
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<tr>
<td>SPO2</td>
<td>98</td>
</tr>
</tbody>
</table>

Figure 7. Shock Index Flow Sheet Row.
Due to the absence of literature in the use of the shock index in obstetric patients, the team worked to understand the relationship between shock index and massive hemorrhage events for this special population. In-depth analysis was conducted for shock index data, but physicians were unable to agree on the use of a Best Practice Alert (BPA) related to shock index. Currently, the team has agreed to make the calculated field visible in the EHR and staff members were educated about concerning parameters; however BPAs do not fire for any specific thresholds. Anecdotally, it is known that staff members are paying attention to the calculated value, and have been successful in predicting events and in raising awareness of high risk patients.

After all changes were made, a post-measurement simulation drill was conducted and significant results were achieved.

![Massive Hemorrhage Simulation Event Times](image)

**Figure 8. Pre and Post Measurement Simulation Results.**

In order to increase clinician confidence, it was necessary to report data related to blood utilization during code crimson events (Figure 9). These data allowed clinicians to see that using an estimated blood loss of 1500ml to trigger an event was appropriate.

![Blood Utilization for Code Crimson Events](image)

**Figure 9. Blood Utilization for Code Crimson Events.**
Actual events are tracked on a monthly basis and the details for each specific case are reviewed by the Perinatal Improvement Team to continue to look for improvement ideas.

**ADDRESSING REPORTING CHALLENGES**

**Local Problem and Intended Improvement:** HPH previously experienced difficulties related to obstetrical reporting. Data existed in various data structures and there was a lack of standardized definitions for commonly reported fields. There were difficulties linking mother charts with corresponding newborn charts and structural guidance from the software vendor was limited (there were no offered trainings and no existing Enterprise Relational Diagrams).

**Design, Implementation, Utilization of IT, and Value/Derived Outcomes:** HPH has done extensive work to design transforms which streamline obstetrical reporting. In order to deal with reporting challenges, HPH assembled the EHR Clinical Data Reporting Team (ECDR) to build an Obstetrics Datamart. The ECDR contains Inpatient IT Charting staff members, Reporting Team members, Patient Safety and Quality Team members, Health Information Management members, and frontline clinicians (the representatives vary depending on the subject matter).

Since then, HPH has used these fields to create reports which are used by the clinical team to guide quality improvement efforts. Ongoing data reports allow the team the ability to monitor and sustain results over time. This project illustrates how HPH leveraged the EHR to make a difference to care provided at the frontline.

**6. Lessons Learned:** For all of our improvements in obstetrical care, the major challenges encountered were related to physician leadership and a general reluctance to change the practices that had been in place for many years. It is difficult to spark change without supporting data. Standardized EHR reports were not comprehensive and did not meet organizational reporting needs. HPH identified the need to create our own transforms based on definitions guided by clinicians. Data definitions were designed with direct involvement of clinical staff members and clinicians were also directly involved with the validation process. This allowed for meaningful display of the data and also allowed the clinicians to understand any nuances in the data. This trust and understanding resulted with meaningful discussions surrounding results. Ultimately, after several data presentations on the topic, enough committee members were convinced to move forward with the new changes in practice.

In addition to measuring intended benefits, it is also important to search for unintended harm. With changes in oxytocin management, there is the potential to negatively impact outcomes for the newborn. Adverse outcomes could show up as an increase in admissions to the NICU or an increase in newborns born with low cord blood gas pH levels. In regards to the Code Crimson events, some clinicians voiced concerns about wasting blood if events did not ultimately require a transfusion. Developing the capacity to measure unintended consequences allowed HPH to ensure patient safety. When data demonstrated the absence of unintended harm, it often resulted with increased clinician confidence in the new methods.
There were concerns that the tachysystole measure might be artificially skewed based on the quality of documentation. These concerns were overcome by tracking the administration of terbutaline, as a proxy measure. The team agreed that it was beneficial to measure outcomes in multiple ways. The parallel results confirmed that true improvement was achieved. This allowed the team to gain confidence in the accuracy of tachysystole measures.

Surveys related to nursing behavior were an important tool for improving hand-offs. The survey that was given asked nurses to report on their own behavior as well as their peers’ behavior. Surveys conducted to measure nurse perception revealed that most nurses report giving appropriate information more than they report receiving information from their colleagues, suggesting that information was not always communicated as intended. This highlighted the need for clearer, more consistent, hand-off practices.

The hospital was fortunate that its perinatal nurse educator was also a super user of the EHR. Her knowledge of the EHR capabilities enabled her to be creative in her approach to developing new tools. She had enrolled in the organization’s internal process improvement course and completed a quality improvement project as a part of the course. With support from the quality staff and additional permission to create and trial new processes, changes were made. This same nurse is in charge of the simulation work that is done in high risk OB events, and was able to do a before and after simulation for maternal hemorrhage that clearly demonstrated that the process needed improvement and that the new standards were working.

7. Financial Considerations: There were no additional funds used for any of these IT improvements as work was done using internal resources. Participation in the IHI Perinatal Collaborative was initially supported in 2009 by the organization’s health plan partner and the results of the improvement work met their criteria for several of their Pay for Quality projects. As a result of these demonstrated improvements, Kapi‘olani Medical Center received $75,000 from a local health plan partner in 2011.

References: