HIMSS Davies Enterprise Award Submission

CPOE-Enabled Reduction in Medication Errors

Applicant Organization:	St. Clair Hospital
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Menu Item:	Safety: improve liability and eliminate errors wherever and whenever possible.

Executive Summary:

Over a multi-year period, St. Clair Hospital had continuing efforts to drive physician utilization of electronic system and to adopt CPOE. These efforts were largely successful. The benefits of CPOE are well documented, as is the potential for unintended consequences. As utilization of the EHR system grew, certain types of errors and omissions became more prevalent. A process to monitor all CPOE-entered medication errors was in place. Frequently, isolated incidents were solved through coaching or re-training for clinical users.

For other types of medication order entry errors, it became increasingly apparent that a resolution could not be achieved through training alone. These errors had no patterns or trends that showed that it was related to individual practitioners, patient care areas or nursing staff. It was apparent that these errors were beyond simply remediating end users. Characteristic of the problem, the physician would correctly select a well formed medication order, or enter the major components of a medication order (strength, dose, route, frequency), but not always indicate a start time as required by the system. As a result, medications were often not started in a timely manner, resulting in a delay in treatment, and a risk to patient safety. Prior to June of 2014, the daily rate of missing start times reported was averaging over 4.5 per day. Through carefully designed clinical decision support, the system now auto-schedules some medications. This new logic was activated in June 2014 and for the first 6 weeks the number of reported medication start time errors has decreased to less than 0.088 per day.

Background Knowledge:
St. Clair is a 328-bed independent, acute care facility that provides advanced, high quality health care to more than 480,000 residents of southwestern Pennsylvania. Our mission is to provide highly-valued, service oriented healthcare to our community across the hospital's main campus and five outpatient centers.

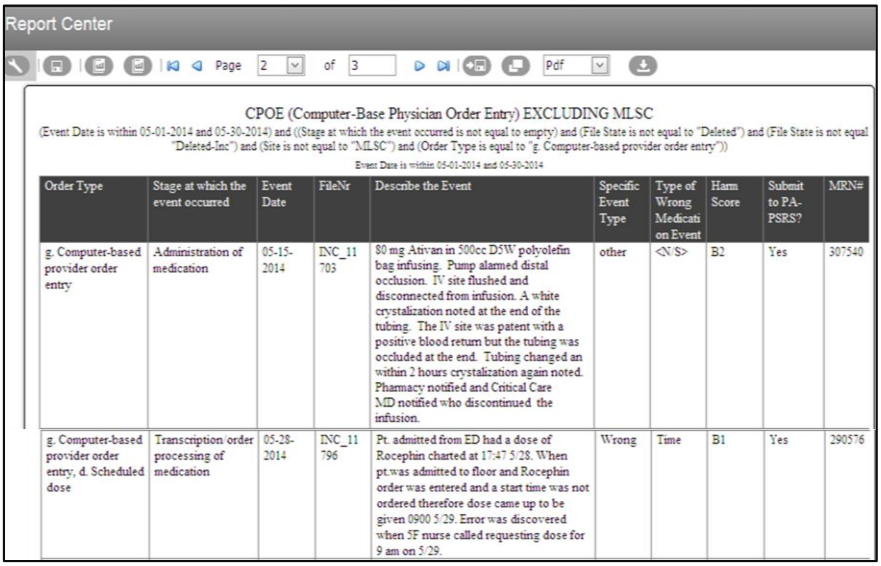
Computerized physician order entry (CPOE) has been available at St. Clair Hospital since 1990. Initially, its use was limited to those forward-thinking physicians who were interested in exploring how this technology might improve their ability to care for their patients. Over time, and as a result of new developments related to improved electronic health records, adoption grew. This had the unintended consequence of increasing the number of medication orders that required a start time and yet did not have it included in the order.

Local Problem and Intended Improvement:
Over the past years, physicians were very engaged in developing order sets and providing feedback on what was working for them. This feedback was gathered by analysts and clinical staff who were providing at-the-elbow training and support and communicated through the CMIO to the Physician Resource Information System Management committee (PRISM). PRISM membership includes Medical Executive Committee physician appointments, as well as HIS staff and analysts, Pharmacy and Medical Imaging staff, and Senior Managers. This interdisciplinary approach was a key component in providing clarification and evidence-based clinical decision support. Measures of success were designed and included such things as CPOE utilization percentages by physicians and physician extenders and the rate of CPOE-reported errors along with a subsequent review of those errors.

Medication orders entered into the system required a decision by the prescriber to identify when the medication was to start. For example, if a medication is ordered every six hours, the physician is asked whether the medication should start before the next pharmacy-defined time or just wait until the next routine time. Physicians were omitting this component for a significant number of orders, resulting in potential treatment delays for the patient. Once the medication errors were analyzed, it was revealed that the vast majority of these medications were antibiotics.

PRISM reported that physician workflow had not previously required the physician to identify the schedule and the expectation was that the nursing staff should continue to manage those issues and perfect the order. Physicians who practiced at several organizations reported that different medication administration times at different hospitals contributed to the issue. Even those who practiced exclusively at St. Clair relayed that it was nearly impossible to remember the different timing protocols and properly correlate them, on the spot, to the current time the medication order was being placed. The incident reporting system confirmed the problem.

Through our electronic, web-based Occurrence Reporting System, all frontline employees can, and are expected to, enter an occurrence as soon as it is committed or identified. The ease of entry, coupled with the organizational adoption of a "Just Culture", an environment where employees understand professional accountability, but feel safe in reporting errors without concern over being punished for making a mistake. Just Culture not only increases voluntary reporting, it fosters an approach where the underlying systems and processes can be examined and improved, rather than treating errors as a disciplinary event. When a CPOE event is entered into the occurrence system, an email is auto-generated and sent to the IT Clinical Manager, who then logs into the system to examine the event documentation. During this process of occurrence entry and reporting, it became apparent that there was a pattern of errors related to missing start times.


Report Center

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CPOE (Computer-Base Physician Order Entry) EXCLUDING MLSC

(Event Date is within 05-01-2014 and 05-30-2014) and ((Stage at which the event occurred is not equal to empty) and (File State is not equal to "Deleted") and (File State is not equal "Deleted-Inc") and (Site is not equal to "MLSC") and (Order Type is equal to "g. Computer-based provider order entry"))

Event Date is within 05-01-2014 and 05-30-2014

Order Type	Stage at which the event occurred	Event Date	FileNr	Describe the Event	Specific Event Type	Type of Wrong Medication Event	Harm Score	Submit to PA-PSRS?	MRN#
g. Computer-based provider order entry	Administration of medication	05-15-2014	INC_11703	80 mg Ativan in 500cc D5W polyolefin bag infusing. Pump alarmed distal occlusion. IV site flushed and disconnected from infusion. A white crystalization noted at the end of the tubing. The IV site was patent with a positive blood return but the tubing was occluded at the end. Tubing changed an within 2 hours crystalization again noted. Pharmacy notified and Critical Care MD notified who discontinued the infusion.	other	<N/S>	B2	Yes	307540
g. Computer-based provider order entry, d. Scheduled dose	Transcription/order processing of medication	05-28-2014	INC_11796	Pt. admitted from ED had a dose of Rocephin charted at 17:47 5/28. When pt.was admitted to floor and Rocephin order was entered and a start time was not ordered therefore dose came up to be given 0900 5/29. Error was discovered when 5F nurse called requesting dose for 9 am on 5/29.	Wrong	Time	B1	Yes	290576

Design and Implementation/How Health IT Was Utilized:

Under PRISM's guidance, a collaborative care team comprised of physicians, nursing, pharmacy and HIS was established. It was agreed that antibiotics would be the first group of medications that would be examined, due to the volume of errors reported. The team met weekly, at a minimum. A literature review related to similar errors and alert fatigue was conducted.

As mentioned previously, antibiotic start times were the most common errors and presented an unacceptable risk to the patient as a result of delayed treatment. Errors were occurring across all areas and a global solution was indicated.

Four major components were identified as potential barriers to a successful intervention. These included:

- Understanding the most frequent scenarios related to antibiotic ordering
- Identifying scenario exclusions
- Gaining consensus among physicians in order to standardize ordering practices
- Assisting the physician without the use of excessive alerts

- Managing multiple drug therapies (by class)
- Lack of documentation for administered doses

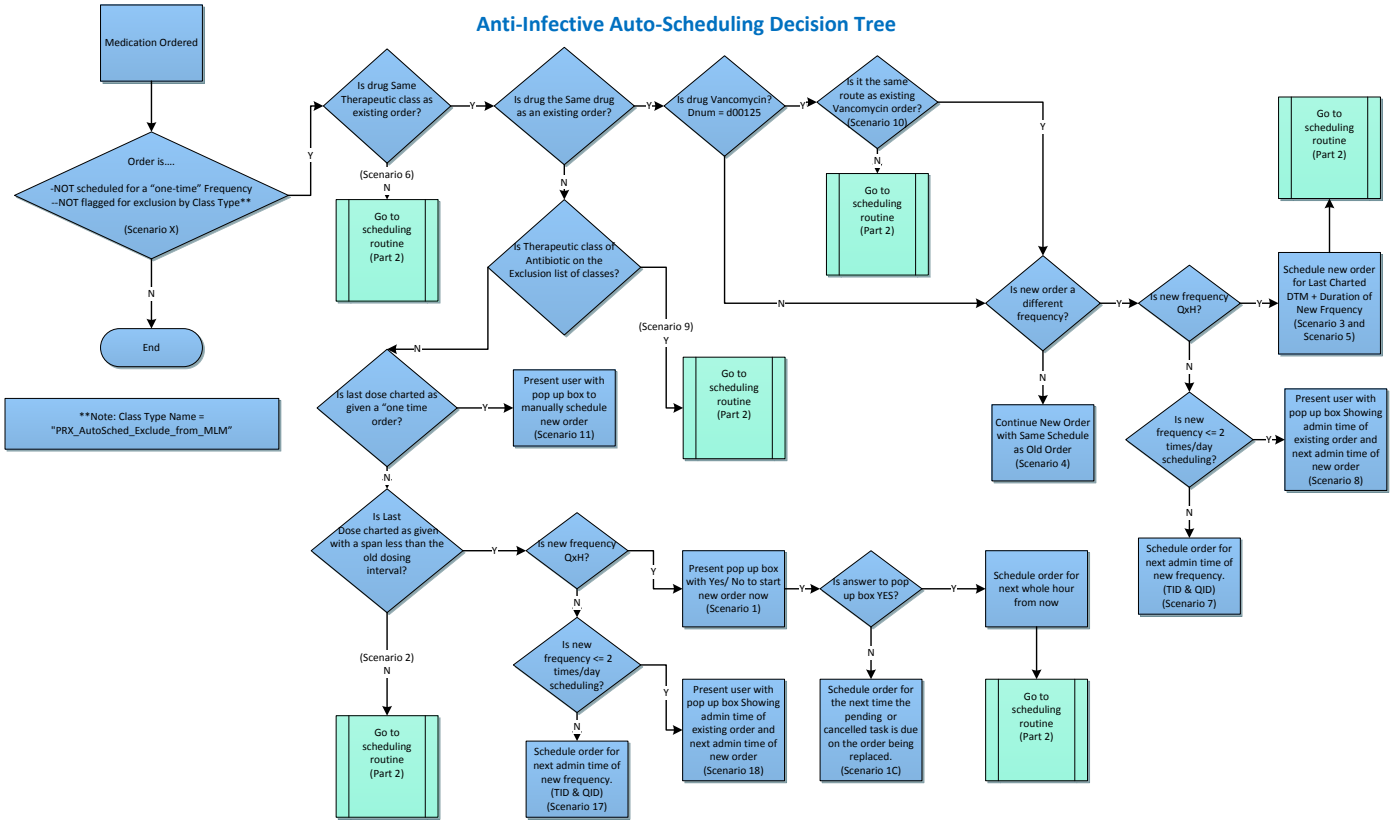
A review of reported errors was conducted and categorized into various scenarios that could be more easily managed. It soon became apparent that there were certain scenarios that could not be managed by auto-scheduling. These outliers would need to be a special training focus for clinicians in order to reduce the unintended consequence of over-reliance on the technology.

A flowchart of the logic that is needed within the ordering process was developed. The logic was separated into two subroutines. The first focused on all the decision points related to the order and what had preceded it, and the second handled the scheduled of the start time itself. To automate the scheduling task to the greatest extent the following decision points had to be embedded as conditional logic operating behind the ordering process

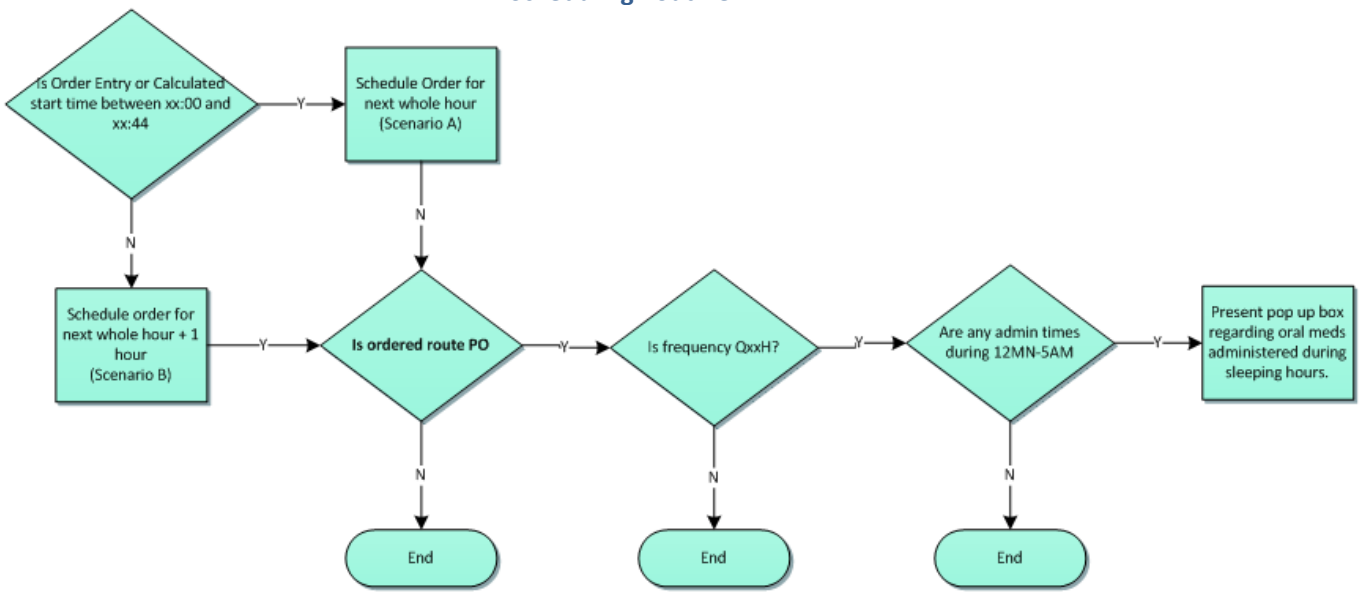
- Examine whether the order was a one-time frequency, or within an excluded class (such as an order from the ED placed in a hold session),
- Determine whether the drug being ordered was the same therapeutic class as an existing order
- Determine whether the drug was within the same drug as an existing order
- Determine whether the therapeutic class of the antibiotic is on the exclusion list of classes
- Determine whether the last dose was charted as given as a one-time
- Determine whether the last charted dose was within a time span less than the old dosing interval
- Determine whether the frequency is changing
- And so on … in total there are 18 decision points and 26 different ordering scenarios covered in the process. Once the start times and associated frequencies are determined by completing the conditional logic, flow passes to the scheduling routine.

By following the flowchart, the proper sequence of decisions and processes are shown, and can be reduced to programming logic in the EHR.

Anti-Infective Auto-Scheduling Decision Tree



Scheduling Routine



Value/Derived Outcomes:
As a result of an intense analysis of the most common errors and ordering practices, rules for future scheduling based on agreed cut-off times were established. This required ongoing discussion by team members and communication with PRISM and was, by far, the most challenging component.

In a process this complex, with many variables and many possibilities to handle, there is a tendency on the part of the analyst, to include a number of prompts to the user to collect decisions, and yet, this is exactly what needs to be avoided so that physicians don't develop click fatigue. The team wondered whether rules that are this stratified could effectively be translated into an efficient ordering process. However, by persevering through each decision point in the design process, the prompts were kept to a minimum, and through relentless testing regimens, the accuracy of the clinical decision support was validated and shown to be reliable. Below are some examples of how the auto-time scheduling works across a few of the scenarios:

Scenario 1: A new antibiotic is started and no other antibiotics within the same class are ordered or charted:

Any order entered between :00 and :44, the antibiotic will be scheduled to start on the next whole hour. Any order entered between: 45 and: 59, the antibiotic will start on the next whole hour + 1

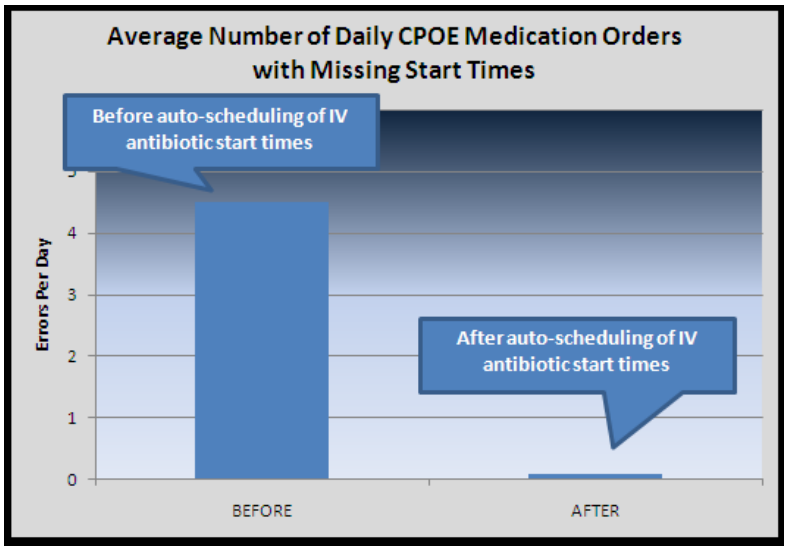
Examples:
- Order entered by physician into the system at 12:43. Antibiotic will start at 13:00.
- Order entered by physician into the system at 12:47. Antibiotic will start at 14:00.

Scenario 2: There is a change in dose or frequency of an antibiotic already charted, such as changing levaquin from 750 mg IV Q24hr to 500 mg Q48hr. The previous order may be active, discontinued, or a onetime dose within the last 48-hours:
- In order to provide future scheduling, it was necessary to search the electronic health record for the last time that the medication was charted as having been administered.
- The antibiotic will be scheduled based on the last charted dose and the new frequency ordered.

Scenario 3: An antibiotic is ordered and is in the same class as an antibiotic already charted, such as changing from ceftriaxone to cefazolin or vice versa
- The new antibiotic will be scheduled to start when the previous antibiotic was scheduled to be given. The physician is given the opportunity to choose either "Start Now" or modify the time.
- When switching from ceftriaxone to cefazolin, cefazolin will likely be started when the next ceftriaxone dose was due because the coverage is being narrowed

- When switching from cefazolin to ceftriaxone, the switch is likely necessary in order to cover additional organisms. Therefore, the physician should opt to start a dose now rather than waiting until the next cefazolin dose would have been due.

This patient safety initiative has resulted in a dramatic decrease in the number of CPOE medication errors related to missing start times. Prior to June of 2014, the daily rate of missing start times reported was averaging over 4.5 per day. Through carefully designed clinical decision support, the system now auto-schedules some medications. This new logic was activated in June 2014 and for the first 6 weeks the number of reported medication start time errors has decreased to less than 0.088 per day.



Lessons Learned:

- The impact of the historical practice by the nursing staff in the scheduling of medications was underestimated. It was incorrectly assumed that clarifications would be sought from the physician as to whether or not, for example, to start a medication now versus waiting until the next routine administration time. This practice contributed to the physician's reluctance in assuming responsibility for the schedule. In retrospect, a more thorough direct observation of workflow should have been conducted.
- There was a misunderstanding of roles and responsibilities as a result of more CPOE activities. Some nursing staff reported that they did little adjustment of orders because they were under the impression that the physician was "supposed" to do everything. As a result, concentrated electronic orders management training was provided to unit secretaries.
- Pharmacy collaboration is paramount, both in the identification of errors as well as providing the best therapeutic options in support of physicians.

- Once a challenging initiative like this is completed and successful, it generates a level of eagerness on the part of may stakeholders to take on the next phase of the work, and re-apply the successful techniques developed.
- There are so many instances where physicians are asked to step up and voluntarily take on a new task, or to spend their time to assist the Hospital on a new regulation or program. Relative to this project, the same approach was used, that is, asking the physician to be more compliant with medication start times. It isn't until there's push back from the users, or continual underperformance, that the mindset changes to look toward innovation to solve the problem. In this case, the innovation should have been pursued first, as it saves times and increases patient safety, without requiring physicians to put more effort in the order entry process.

Financial Considerations:

- No special funding was obtained for this quality improvement project.

- All of the EHR system enhancements implemented were configured through core EHR functionality and did not require any additional software purchase.

- The multidisciplinary team was comprised of existing staff. The IT Analyst hours expended on this project was 376 which represents a salary and benefit cost of $16,104.

- As a result of reducing missing start times from 4.5 per day to 0.088 per day, episodes of septicemia are reduced, along with the costs associated with these avoidable errors. According to Statistical Brief #160, Healthcare Cost and Utilization Project (HCUP), August 2013, Agency for Healthcare Research and Quality, septicemia was the most expensive condition billed to Medicare in 2011, with an average cost per case of $17,548. The elimination of missing start times and delayed administration of antibiotic therapy is just one of many components of the sepsis initiative at St. Clair, but the downward trends in the charts below indicate cost avoidance is being realized.