Cover Page

Applicant Organization: Children's Medical Center Dallas
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Menu Item: **Children's Computerized Provider Order Entry**

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

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

Executive Summary

Children's Medical Center Dallas established clinical pathways and standardized order sets through its electronic health record's (EHR) computerized physician order entry (CPOE) capability. The goal was to ensure consistent, high quality care and outcomes in patient populations. One year after implementation of the PD Catheter order set, the key metric's compliance rate (IV antibiotic prior to incision) has risen from 16 to almost 100 percent, and the organization has achieved an almost 300 percent improvement in infection-prevention.

Prior to the development of order sets through CPOE, there was a lack of consistency in workflows—an example of which was clinical variation related to three specific pre-operative preparation measures for peritoneal dialysis (PD) catheter placement. Through the collaboration of the organization's Nephrology faculty physicians, as well as multiple clinical stakeholders, the Clinical Informatics team was able to develop and deploy clinical pathways and incorporate them into clinical workflows. This process also served as a template for creation of new pathways that have yielded clinical, financial, patient safety, and clinical decision support improvements.

Background, Local Problem Being Addressed and Intended Improvement

Prior to deploying the EHR's CPOE functionality, Children's had processes and workflows that relied on paper documentation, which resulted in a lack of standardization across the continuum of care. Multiple departments and workflows benefitted from Children's deployment of the EHR's CPOE capability. An early example was the standardization of the process for a patient's pre-operative preparation for a surgical peritoneal dialysis (PD) catheter placement for end stage renal disease (ESRD) patients, whose diagnosis is more commonly known as "kidney failure."

Children's is a member of the Children's Hospital Association alliance (CHA), which at the time was known as the National Association of Children's Hospitals and Related Institutions (NACHRI). One of the three NACHRI quality bundles to which Children's had subscribed was to reduce the incidence of peritonitis (a form of preventable infection) after insertion of PD catheter. Simultaneously, the organization's higher than average infection rates reached the attention of the Executive Vice President level, which resulted in pressure to design and deliver a solution *post haste*.

By the fall of 2011 and into the spring of 2012, Children's was experiencing about 20% more frequent than average cases of peritonitis in ESRD patients. The consequences of infection at the site of surgery can be devastating to the patient and costly to manage, often requiring readmission to hospital. Surgical site infections account for 14 percent of all healthcare acquired infections.[1]

The Nephrology faculty physicians, including a senior Nephrologist (the Nephrology physician champion), were especially concerned that patients were not all receiving consistent, evidence-based practice-driven care across all points where care is delivered. Specifically, there was inconsistency on three pre-operative interventions that are known to be 'best practice' to reduce the risk of post-operative infection and complications:

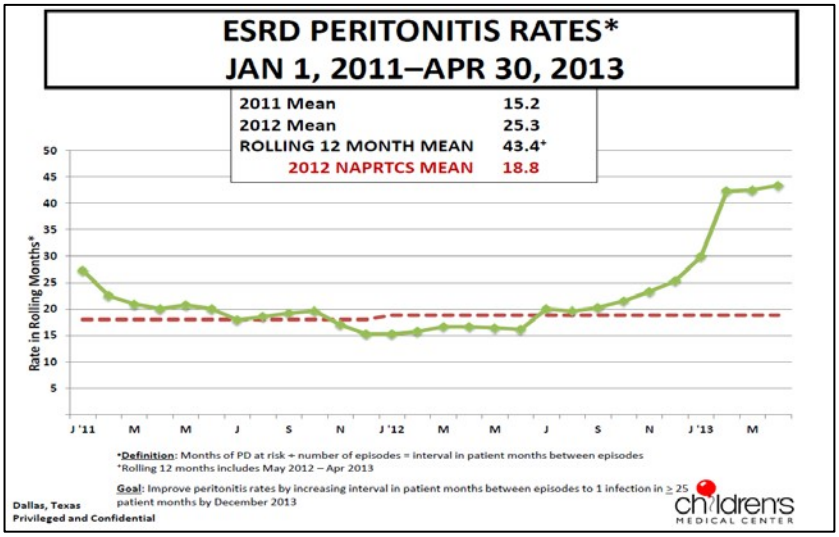


Figure 1 *-The higher the value of the green line, the better. Since the mid-2012 implementation of the CPOE order set and real-time checklist, there has been a continuous improvement in the number of consecutive months elapsed without infection, to the point that Children's is now approximately 2.3 times superior to the mean of our peer institutions.*

1. The primary matter of concern was the timely administration of the appropriate IV antibiotic. Expert Infection Control physician guidance states that the antibiotic should be administered within a particular window pre-operatively (no earlier than 60 minutes prior to the surgical incision but no later than the time of the surgical incision) in order to be of maximum benefit to the patient and also in order to be counted as *compliant.*
2. The use of Hibiclens® wipes/cleansing of the skin of the patient's trunk prior to surgery.
3. Prompt initiation of "bowel cleanout" or "bowel prep" to reduce the amount of fecal matter in the intestines at the time of surgery, as both a practical and precautionary measure for the surgeon.

[1] Smyth ET, McIlvenny G, Enstone JE, Emmerson AM, Humphreys H, Fitzpatrick F, et al. Four country healthcare associated infection prevalence survey 2006: overview of the results. *Journal of Hospital Infection*; 2008; 69:230-48

The orders for IV antibiotics, Hibiclens®, and bowel preparation were often placed at different times in the days of paper charting (increasing the nursing time spent searching the chart for orders and/or clarification, as they were ordered differently by different Nephrology faculty when written by hand). CPOE provided an opportunity to alleviate this major source of frustration for nursing and physician staff by standardizing and clarifying the provider's intent, especially around timing, since all three of these pre-op interventions have specific windows against which they are judged to be compliant.

Based on clinical workflow findings, a Health IT tool was needed to positively impact the core compliance measures for this patient cohort. The tool would also be a "template" for other clinical procedures lacking consistent flow from the point of ordering downstream, to ensure consistent documentation and processes.

Specific goals included a CPOE solution that would promote:

- 100% compliance with timely administration of pre-Op antibiotic
- 100% compliance with pre-Op Hibiclens®
- 100% compliance with pre-Op bowel preparation

Design and Implementation

In the spring of 2012, a high-priority, high-visibility organizational objective was handed to the Children's Clinical Informatics team to help coordinate the Health IT efforts to improve pre-procedural compliance for patients undergoing the placement of a PD catheter. The solution was implemented in the EHR production environment on June 6, 2012.

The Clinical Informatics team was engaged as a clinician-to-technical resource bridge to help implement a CPOE-driven solution for the ongoing care delivery struggle: inconsistency in compliance, due to lack of a consistent ordering process and corresponding checklists. To meet the needs of the organization's patients and clinical staff, Clinical Informatics consulted with the Nephrologist physician champion and conducted a needs assessment with clinical nurses and physicians from Nephrology, Surgery, Anesthesia, Intensive Care Services, the Nephrology Ambulatory Clinic, and Infection Prevention and Control. The purpose of these meetings was to engage stakeholders in the design of the optimal CPOE tool to improve pre-operative care compliance measures and to ensure that they could and would operationalize it if built and deployed.

The following were the stakeholders' final design requirements for the CPOE tools:

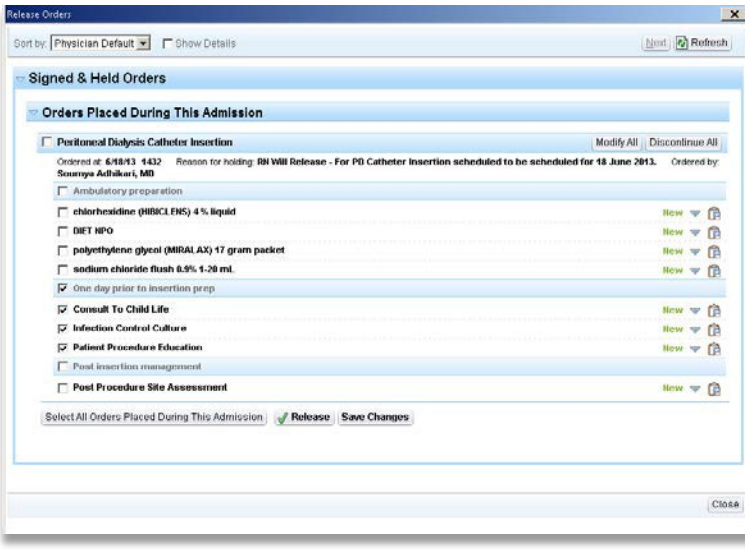
1) Ensuring only Nephrology service physicians could access the Order Set, while still allowing authorized rotating Residents to access and place orders when approved by an Attending or Fellow Physician.
2) Presenting the CPOE order in such a way that it would:
    a. provide a "one stop shop" for order entry for Nephrologists and Intensivists for all care settings.
    b. be highly intuitive (the order placement and timing is critical, but is only used a few dozen times per year, which creates a risk for a usability trap if the CPOE Order Set is not intuitively presented to the user).
    c. trigger downstream events in a prescribed sequence and time.
3) Integrating clinical decision support tools into the CPOE that would increase patient safety by automatically substituting an appropriate alternate IV antibiotic if a penicillin-class allergy is in the patient's EHR.
4) Automatically populating the Patient Education activity to be addressed with the patient and family by nursing prior to the procedure. The topics include: PD Catheter Placement Indications, PD Education Materials, Surgery Instructions, Diet, Medication Prior to Surgery, Bowel Prep Overview, Pre-

procedure Bath, and Complications & Actions.

5) Providing real-time notification to PD Nurse Manager and Case Coordinator via e-mail, pager, and InBasket messaging within the EHR whenever an insertion order is placed.
6) Providing a CPOE- and documentation-driven, real-time Pre-Op Checklist *without* increasing the degree of input / data capture by clinicians.
7) Ability to capture/document the patient's checklist at any point in time via a clinical progress note.
8) Designing a mechanism to reduce repetitive manual chart audit of the patient record for compliance.

Informatics leveraged analyst resources from Information Services to brainstorm avenues and options to deliver the customer-facing requirements within the backend abilities of the EHR's core build. These I.S. teams were key to the effort: Clinical Documentation, Inpatient Orders, Orders Transmittal, and the Ambulatory analyst assigned to the Nephrology clinic (who accomplished the proof of concept and final build).

Upon the electronic sign and hold of the Order Set, which is the workflow for scheduling Ambulatory patients (Figure 2), the Nephrologist uses EHR-delivered fields to enter comments (Figure 3). And when fully signed, a message is sent to the relevant parties via email, pager and to the EHR's InBasket for Nephrology staff awareness and tracking.



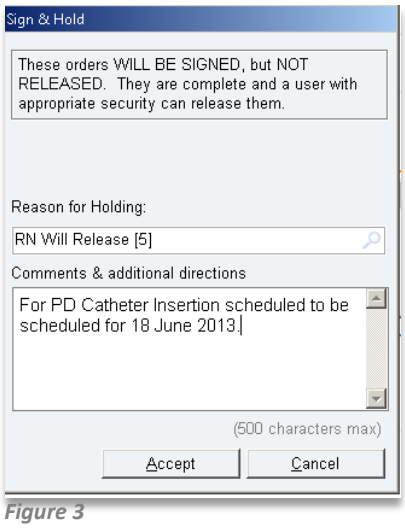


Figure 3

Figure 2-The view for a nursing user choosing orders to release and act upon at the appropriate time

Implementation was accomplished by following standard Change Management practices. The Order Set was moved and validated in each development environment, starting with Proof of Concept, continuing on to the test environment, and finally migrating into the production environment on June 6, 2012. As part of the Change Management process, an Interchange Notice was provided to describe the new tool, users impacted, benefits of change, and contact information for clinical and technical owners.

Affected physician users received additional peer-to-peer training on the Order Set and the accompanying real-time checklist. Before bringing the Order Set into production, it had been approved by the EHR's governance bodies, including the Physician Advisory Council and the Clinical Decision Support Committee.

Ultimately, the sponsoring Nephrologists and oversight bodies agreed that minimum training would be required upon implementation because of the straightforward nature of the Order Set design. Nevertheless, training on Order Sets was and is accomplished via the Physician champion teaching his colleague Attending Physicians as well as the Fellow Physicians on the Nephrology service. The Fellow

Physician, in turn, ensures that rotating residents understand the expectations when utilizing this Order Set. Physician end users described use of the checklist as "intuitive" in the period after go-live as it was placed in the very next line after the Order Set as clinicians work from top-to-bottom in the EHR.

How was Health IT Utilized?

The implementation of an intuitive, multi-faceted CPOE Order Set for PD Catheter Insertion was vital to streamlining care delivery, as well as increasing compliance with the quality bundle. Children's Physician champion reflects, "Placing the orders using CPOE is very straight forward. The real impact of this project is the tight integration with a real-time checklist…preferably one that does not introduce double documentation for any clinician, be they physician or nurse. This coordination of the orders with the checklist can be generalized across the organization for future quality improvement projects."

Clinician design requirements were accomplished by leveraging the EHR's strengths (such as being able to pass on order information via pager, e-mail, and InBasket messaging) while overcoming areas of relative weakness (for example, a lack of any out-of-the-box solution that reflects evidence-based care for pediatric clinical conditions).

The CPOE order set was designed so that appearance of the Peritoneal Dialysis activity tab was restricted to providers whose provider records reflected specialty as 'Nephrology' or physician users who login to the PRO NEPHROLOGY department. Only these users see the 'Peritoneal Dialysis' activity on the left side of their screen. The real-time pre-op checklist, however, is more effective with more eyes on it. Accordingly, access to that documentation-driven, read-only document was made available to all clinical staff accessing the patient's record.

The EHR enabled Children's to embed logic to substitute medications within an order set for specified allergies at the point of order entry—this capability was used to meet clinical requirements and increase safety margin for the patient. In the context of PD Catheter insertion, the preferred antibiotic is contraindicated for patients with a penicillin-family allergy or sensitivity, which is relatively common in the general population. For these patients, clindamycin is automatically substituted for the physician to confirm in the CPOE interface.

The checklist required data from disparate modules of the chart to inform the Surgeon, Anesthesiologist, and Pre-Op Nursing staff of the patient's readiness for surgery, as well as the laboratory results for the Infection Control culture, and Patient Education documentation, to name a few. For those providers interested in capturing a snapshot of a moment in time to be part of the patient's permanent medical record, instructions were provided on how to invoke a SmartText to populate a progress note with the exact checklist contents.

Components of the Real-time Checklist

Health IT was used to design a complement report to work hand-in-hand with the CPOE order set for PD Catheter placement (Figure 5).

The real-time checklist provides a dynamic report of the patient's:

1. Past Medical History
2. Past Surgical History
3. Results on the Infection Control Culture (which Infection Prevention & Control requests be collected on each of these patients); specifically, they determine the patient's MSRA status
4. Education status (the completion of patient education by nursing triggers a consult to Child Life services to assist in preparing the patient for surgery)

5. Status of the Child Life consult order
6. NPO status
7. Physical Pre-Op Preparation
   a. Hibiclens® bath status
   b. Date/time bowel preparation started
   c. Time patient last voided
8. Last Antibiotic Administration (searches the MAR and displays last administrations of any medication whose therapeutic class is 'antibiotic' in the EHR' electronic medication record)

The concept of phases of care within the user-facing CPOE is key to ensuring that orders are acted upon and medication is delivered to the patient's location in a timely or time-appropriate manner; for example, orders in the CPOE environment can be signed & held by the Nephrology physician with instructions to nursing staff to release/activate the orders upon the patient's arrival for a planned surgery. This reflects the operational workflow of an ESRD patient being scheduled at an Ambulatory Nephrology clinic visit for a future surgery, allowing the physician to write the orders that will be carried out in the future at a different location by a different set of staff (*i.e.,* Perioperative staff).

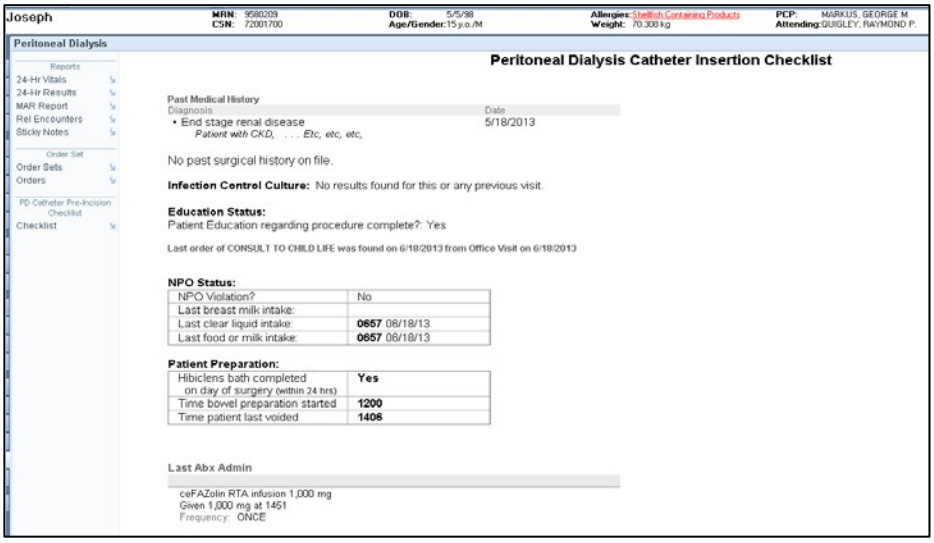
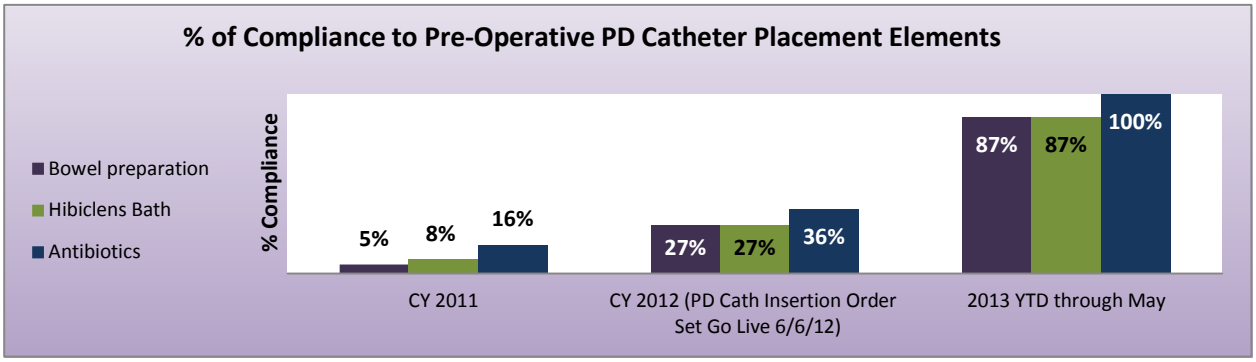


Figure 4-The real-time checklist for a demo patient - Note this patient data is readily available based on pre-operative patient information collected in the standard workflow and does not require "double documentation" on the part of clinicians.

Value Derived/Outcomes

In the 2011 calendar year, IV antibiotic administration during the 60-minute window before surgical incision time was a mere 16 percent. Moreover, only 8 percent and 5 percent of patients received Hibiclens® bathing and bowel preparation before surgery, respectively. At the time of implementation of the CPOE order set and real-time Checklist, Children's had an incident of an end stage renal disease patient developing an infection (peritonitis) every 15 months, based on a rolling monthly average.



One year after the order set implementation, the 16 percent has climbed to 100 percent (based on 2013 YTD data). Hibiclens® bathing and bowel preparation is at 87 percent, and the rolling average

of infection has improved to 44 months—an almost 300 percent improvement in infection prevention.

Physicians were highly receptive to a solution that provides ordering flexibility for both Inpatient and Outpatient populations inside a single order set, especially with the inclusion of order panels, such as the peripheral IV order panel, which is embedded for 'one-click' physician selection within the order set. This promotes more efficient care by allowing the Peri-Op nursing staff to place a patient's IV upon arrival, for example.

CPOE has increased safety margin through a reduction in verbal order utilization. It is estimated that verbal orders within the organization are roughly half of what they were when orders were processed on paper. Direct entry of orders by providers has the potential to reduce miscommunication or transcription errors.

Notable CPOE Outcomes

- $2M in annual Pharmacy savings due to optimized cart runs and the "awareness" possible through EHR/CPOE and the every 2 hour pharmacy cart delivery and retrieval process.
- Clinical stakeholders are able to combine relevant order sets and standardize their workflows and ordering practices across service lines, while also embedding order panels for added convenience.

Patient Safety Outcomes

- In addition to adding clarity to the intended timing of the CPOE orders, the organization uses the EHR to present pertinent clinical information for prescribers (*e.g.,* there is a brief explanation/reminder to "Avoid use of vancomycin to prevent resistant microorganisms").
- Children's CPOE implementation enabled automatic drug-drug, drug-food, and drug-other allergy alerting; these alerts are displayed to Clinical Pharmacists as well as the ordering provider. By design, Pharmacists see more of the EHR alerts. In order to maintain their engagement with the CPOE interface and to minimize disruptions to workflow, ordering providers only see the higher priority alerts, such as exceeding recommended maximum single or daily dose or contraindication of drug therapy.
- Increased safety margin through a reduction in verbal order utilization.

Care Coordination and Clinical Decision Support

- Improved nursing satisfaction on Children's primary Inpatient Renal floor due to less time spent trying to contact physicians for missing order. Also, there is an increased level of confidence that all appropriate orders will be available to act on earlier as a result of the standardized CPOE order set, which allows for nursing to provide better "bundling" of patient care (completing more tasks when interacting with patient/family, with fewer trips in and out of the room, which raises patient satisfaction).
- Increased care coordination via the In Basket messages and paging through the EHR.
- Enhanced ability to incorporate Clinical Decision Support tools into CPOE based on age, gender, and allergy information, wherever possible.
- Faster laboratory turnaround times, especially on STAT labs from the Emergency Department; CPOE has helped unify disparate EHR and lab systems such that post-CPOE implementation, all orders (including lab orders) may be placed prior to collection.
- Improved Clinical Decision Support (CDS) tools through the use of the EHR's background logic help the clinician arrive at the correct order set and orderables within the order set.
- Streamlined efficiency of placing blood orders in the Intraoperative setting.

- Patient Education topics are *automatically* added for nursing to address once the CPOE order set is signed for an Inpatient or Ambulatory patient.

Lessons Learned

Consulting with a clinical-to-technical liaison/bridge early in the process expedites design and the user's sense that their needs are being heard and addressed. This includes providing an explanation of any limitations (and why) and even estimates of the likelihood of having the desired functionality in the future. Children's I.S. analysts have access to the EHR vendor's Technical Support team—and the vendor has been transparent about their development plans, priorities, best practice recommendations, and strategies used by other organizations to overcome overlapping issues.

Manual chart audits are sped greatly in cases where a clinician has invoked the SmartText just prior to the start of the surgery. However, even in the absence of a filed checklist, the data is available for retrospective auditing until the point the patient is discharged, as it is set to look back up to 24 hours for the relevant documentation.

CPOE design or optimization should not occur in a vacuum. Especially within a large hospital, change truly is the only constant. Bright minds are often tugging along different courses. Even when an organization chooses to implement one strategy or design for risk mitigation when planning or deploying an EHR, there is no good reason it should feel beholden to that decision at a later point when more information is available. If it is necessary to change the design of an EHR, even at the expense of precious time and resources, then it is incumbent upon an organization which values safety and quality to do so.

Financial Considerations

Avoidance of infection is morally and ethically compulsory for health care professionals; it also saves the organization from the costs of providing the non-reimbursed care associated with any hospital-acquired infection. The cost in dollars, human suffering, and extended length of stay due to infection after surgery are well-documented in literature. Specific to abdominal surgical site infections (SSI), development of SSI extended the average hospitalization by 17.6 days and increased the average healthcare expenditure by $6,624 in a multi-center study[2] conducted in Japan, where healthcare costs are lower. An American study finds: "When all sources of direct medical costs were combined, SSIs recognized after discharge were associated with $3,382 in excess costs over those without SSI. This difference was significant after preexisting conditions and index surgery duration were controlled for."[3] Additionally, Children's Nephrology physician champion indicates that an ESRD patient who develops peritonitis may subsequently require hemodialysis, at a cost of two to three times that of peritoneal dialysis, aside from increased stress and patient/family suffering (cost figures based on estimate by expert Nephrology physician champion).

There were no additional capital expenditures required for this CPOE design and implementation, which went live in late 2009. The only costs were related to fixed operational costs, which were rolled into the overall EHR deployment. Information Services provided the analyst resources, and time associated with workgroup members was absorbed by their various cost centers. A significant set of those participating are salaried by Children's or UT Southwestern Medical Center.

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[2] Kusachi S, Kashimura N, Konishi T, Shimizu J, et al. Length of stay and cost for surgical site infection after abdominal and cardiac surgery in Japanese hospitals: multi-center surveillance. Surgical Infections; 2012 Aug;13(4):257-65

[3] Perencevich E., Sands K., Cosgrove S., Guadagnoli E., Meara E., and Platt R. Health and Economic Impact of Surgical Site Infections Diagnosed after Hospital Discharge. *Emerging Infectious Diseases;* February 2003; 9(2): 196–203.