Electronic Health Record (EHR)-Embedded Care Guidelines

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Executive Summary

Since 1964, Children’s Hospital of Orange County (CHOC Children’s) has been steadfastly committed to providing the highest quality medical care to children. Affiliated with the University of California, Irvine, our regional pediatric healthcare network includes a state-of-the-art 279-bed main hospital facility in the City of Orange, and a 54-bed hospital-within-a-hospital in Mission Viejo. CHOC also offers many primary and specialty care clinics in Orange County and beyond; more than 100 additional programs and services; residency programs in Pediatrics, pharmacy and nursing; support for several fellowship programs; and four “centers of clinical excellence – The CHOC Children’s Heart, Neuroscience, Orthopedics and Hyundai Cancer Institutes” in cardiovascular care, neurosciences, orthopedics and pediatric cancer.

CHOC Children’s Hospital began its journey to a fully-implemented Cerner Millennium EMR in 2002. The Hospital’s dedication to patient safety was evident in the acronym chosen for CHOC’s EMR, “CUBS,” which stands for Connecting Users and Building Safety. Today, CHOC Children’s dedication to safety, quality, and the patient experience is supported by over fourteen ensuing years of patient-centered Healthcare IT design. These efforts led to our recognition as a Stage 7 HIMSS Analytics Inpatient awardee in 2015 and support this case study.

In 2009, CHOC Children’s determined a need to reinvigorate and significantly expand its care guidelines program. Over the next two years, the organization went from approximately five active
care guidelines to more than 20 evidence-based care guidelines. In addition, some ten “evidence-based statements” were created, for smaller pieces of clinical care that nonetheless merited evidence-based practice. Asthma, as the most common chronic condition in pediatrics and the second to third highest volume diagnosis at CHOC Children’s, was an obvious care guideline to revisit.

The Care Guidelines Committee (aka, Evidence-Based Medicine [EBM] Committee) used CHOC Children’s care guideline template (a template to standardize all guidelines at CHOC for ease and effectiveness of use) to develop a one-page view of considerations, assessment, interventions, inclusion and exclusion criteria (including criteria for PICU status), and discharge criteria and care. The guidelines are hyperlinked within the EHR through notifications, which are activated by specific order sets. For asthma admissions, the activation of the asthma order set also triggers a hard stop alert within the EHR workflow if the home management plan of care is not documented before discharge.

Since the implementation of the revised evidence-based guideline and order set for asthma, the already high use of the guideline has risen an additional 12%. Monthly usage is frequently 100% and has not fallen below 92% since 2010. Home management plan of care documentation, an essential piece of asthma continuity of care, has also steadily increased from 66% (Q3 2010 – pre-implementation of technological advance with electronic HPMC), to an average of 97% (2012 through 2015). As a result, average length of stay for asthma patients fell from 2.14 days to 1.72 days between 2010 and 2016. Asthma readmissions within 30 days also fell from an average of 1.7 per quarter (Q3 2010 through Q4 2011) to 0.7 per quarter (Q1 2012 to Q3 2015).

**Local Problem**

In 2009, leadership at CHOC Children’s decided to review and rewrite existing care guidelines, as well as develop care guidelines for previously uncovered clinical diagnoses and conditions. The hospital had a modest number of care guidelines in place, but saw an opportunity to utilize their EHR to embed clinical guidelines-and their associated order sets- directly within existing workflows and, when necessary, incorporate automated alerts. Leadership anticipated this would lead to higher use of standardized practices for identified diagnoses, reduce non-helpful variability, and increase quality of care throughout the organization.

All potential guidelines were assessed using three established criteria: 1) high volume conditions, 2) high risk conditions, or 3) high variability diagnoses or conditions. Over the next two years, CHOC Children’s went from approximately five active care guidelines to 20+ evidence-based care
guidelines – all embedded directly within the EHR and easily accessible during care. Currently there are more than 35 CHOC care guidelines. Asthma is the most common chronic condition in pediatrics, the second to third highest volume inpatient diagnosis at CHOC Children’s, and the only condition identified by The Joint Commission (TJC) for pediatric core measures; therefore, the pre-existing evidence-based care guideline for asthma was an obvious and early guideline identified for review.

**Design and Implementation**

To facilitate spread of a systems-based practice that would cover a variety of clinical circumstances, the EBM Committee decided to standardize the format of all care guideline development. The committee developed a one-page care guideline template, which included considerations, assessment, interventions, inclusion and exclusion criteria, criteria for PICU status, discharge criteria and discharge care considerations. By developing a standardized guideline format, care providers become familiar with how to locate information on all of the care guidelines.

For asthma, as with the care guideline diagnoses, a multidisciplinary team of physicians, nurses, respiratory therapists, and pharmacists was formed to provide clinical guidance as well as act as end-users for both design and testing. The team reviewed the national asthma guidelines set by National Institutes of Health (NIH) and then localized the guidelines to CHOC Children’s specific needs. As with all guidelines, each asthma patient admitted would be assigned the associated specific order set. The order set would include a hyperlink to the guideline. To be fully compliant with the requirement for asthma home care plan at hospital discharge, the EBM and quality committees decided to program a hard stop into the EHR that prevents hospital discharge of patients with a primary or secondary diagnosis of asthma until the home management plan of care is documented. Though hard stops are typically avoided in CHOC Children’s EHR design, this hard stop was seen as enabling rather than impeding the best care for asthma patients. We felt this new technological addition would deliver the improved results we ended up achieving.

By embedding the care guideline for asthma within the EHR, CHOC Children’s hoped to increase the use of asthma inpatient care guidelines, reduce length of stay for asthma patients, increase the percentage of patients discharged with documented home management plans of care, and reduce 30-day readmissions.
How Health IT Was Utilized

A patient admitted with asthma is assigned a specific order set by the admitting physician. A notification that includes a link to an evidence-based care guideline subsequently appears (Figure 1). If the link within the notification is clicked on, the PDF document containing the exact care guideline opens (Figure 2).

![Figure 1. Screenshot of evidence-based care guideline notification](image-url)
Within the asthma care guideline workflow, the provider is prompted to use the electronic Asthma Action Plan form to document the home management plan of care within the EHR (Figure 3). This action plan serves as the basis for subsequent home care by the patient and family after hospital discharge.
In the event a discharge order is attempted without finishing the Asthma Action Plan, a hard stop alert will fire, requiring the Asthma Action Plan to be documented before the discharge order can be completed (Figure 4).

Figure 3. Screenshot of Asthma Action Plan documentation within the EHR

Figure 4. Screenshot of evidence-based alert that fires if an Asthma Action Plan is not completed prior to discharge
Value Derived

The outcome achievements are the result of the evidence-based care documents being embedded within the EHR, as well as the hard stop alert generated if a home management plan of care is not documented. Figure 5 shows that between 2010 and 2016, overall use of the inpatient asthma care guideline increased from an already good 86% to 98%, an overall 12% increase. More importantly, from January 2010 through March 2016 care guideline use averaged 98%.

![Asthma Care Guideline Usage (%)](chart)

**Figure 5.** Asthma Care Guideline Utilization, 2010-2016

The average length of stay for hospitalized asthma patients dropped from 2.14 days to 1.72 days between 2010 and 2016, a 19.6% reduction (Figure 6). This desirable reduction in length of stay directly correlates with the increase usage of the asthma care guideline. There are some individual outliers, such as the spike in length of stay in Q1 of 2015, but length of stay still trends down over time. The benchmark target is the mean of the Children’s Hospital Association Pediatric Health Information System (CHA PHIS), representing over 200 children’s hospitals and busy pediatric units in the U.S.
Figure 6: CHOC Asthma average length of stay, in days

Review shows there is also an expected correlation between the increase in care guideline usage and documented home management plan of care (Figure 7). Since the introduction of the hard stop alert in 2011, the data shows a number of quarters between 96% and 100% documentation from 2012 to 2015. Numbers did dip, but never fell below 90%, in late 2015 and early 2016 because of cases where patients were not assigned an asthma at admission, which is a requirement for the alert to work. The almost 10% drop in a documented home management plan of care suggests providers have become reliant on the alert being in place.
Asthma readmissions within 30 days after discharge fell from a mean of 1.7 per quarter (Q3 2010 through Q4 2011) to 0.7 per quarter (Q1 2012 to Q3 2015) – a 58% decrease. CHOC’s mean for this entire period is 33% lower than the PHIS Children’s Hospital mean. The reduction in readmissions is directly correlated to the increased use of evidence-based care guidelines and the increase in documented home management plan of care. As the medical literature suggests, by having the home management plans to guide symptom-based escalation in medications and care, including when to contact primary care physicians, a patient is less likely to require emergency department care and possible readmission. A byproduct of reducing readmissions is better access for complex care that only a tertiary care facility such as CHOC can provide.

CHOC Children’s thus achieved the value ideal of medical quality over the past five years in asthma patient care - inpatient care was evidence-based and standardized, length of stay was shortened, and readmissions decreased.
The CHOC EBM Committee meets bimonthly to review key metrics and monitor the performance of all care guidelines. The members track a variety of metrics using the Cerner EHR ad-hoc reporting solution, as well as periodic EHR review if individual patient records, typically of outliers. If new literature of import is found concerning asthma care, the care guideline is quickly updated, dramatically shortening the “spread” time of new medical knowledge, which historically is measured in years. A thorough literature review and care guideline update is completed every three years for this and all guidelines and evidence-based statements (Figure 9). All CHOC Children’s care guidelines and evidence-based statements are available on the intranet, internet and populate the CHA national care guideline “library.”
Lessons Learned

Stay patient-centric in your decisions.

It is easier to make decisions based upon what will make your end-users happy. You’ll get a lot less complaints. In this case, the patient-centered decision was to enforce a hard stop for any provider attempting to initiate a discharge order for a patient with a primary or secondary diagnosis of asthma without a documented home plan of care. Complaints were, in fact, minimal as this hard stop just enforced a well-accepted standard for asthma care recognized by CHOC Children’s highly knowledgeable and skilled clinicians.

Have clear criteria for what merits a care guideline

There is a growing amount of evidence-based practice in health care, and just keeping up with all the literature and adjusting care guidelines appropriately requires the initial labor cost and regularly scheduled times to revisit and modify the care guidelines. CHOC Children’s increased the number of guidelines, but initially focused on high volume conditions, high risk conditions, or high variability diagnoses or conditions. By setting clear criteria leadership held themselves accountable to what would receive attention and prevented themselves from overdesigning what should be a practice that assists, not delegates, care.
Financial Considerations

There were not additional software or hardware costs for this initiative. The existing CHOC Children’s EHR was crucial to embedding care guidelines, but all work was an enhancement to previous purchases. CHOC estimates the initial cost for each guideline as $8,300.00 ($8,300 per guideline x 20 guidelines = $166,000).

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<tr>
<td>Total initial cost for 20 Guidelines</td>
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Table 1. All care guideline expenditure

One current study on implementing pediatric care guidelines, also referred to as care pathways, calculates a $155 per month per guideline patient decrease in expenses for patients that follow embedded care guidelines. As CHOC had some 4000 patients on care guidelines in 2015, this translates to a monthly cost-avoidance of nearly $52,000, or an annual cost-avoidance of $624,000.

The 58.8% reduction in 30-day asthma readmissions translates to an average of 2.5 avoided cases per year. At a mean CHOC cost of $6636 per case (2015 dollars), the annual avoided cost savings are $16,590. Over the post-implementation course of three years, the asthma readmission cost avoidance totals $49,770.

References

Appendix 1.

Other Care Guideline Examples

Bronchiolitis – responding to changing practice recommendations

November, 2014
FY17 EBM Committee Priorities

- Bronchiolitis – decrease chest x-ray utilization
- Bronchiolitis – decrease bronchodilator use
Seizure Action Plan Creation

- Care Guidelines for Febrile Seizures, First Unprovoked Seizure, Status Epilepticus
- Alert triggered by diagnosis of seizure at discharge
Fever in Infants < 90 Days Age

• In 2015, adjusted recommendations for discharge for 29-90 day age-group – may discharge at 36 hours if cultures negative, afebrile, good follow-up available

Original Investigation
Blood Culture Time to Positivity in Febrile Infants
With Bacteremia

Eric A. Biondi, MD; Matthew Mitchell, MD; Karen E. Jerardi, MD, ME; Angela M. Strollo, MD, ME; Jason French, MD; Shawn Evans, MD; Victor Lee, MD; Clifford Chen, MD, Carl Andrus, PhD; Jamma Ben, PhD; Sanir S. Shah, MD, MSCE; for the Pediatric Research in Inpatient Settings (PRIS) Network

Average length of stay in days trending down
Monitoring Performance

- Scorecards for 14 guidelines
- Reviewed quarterly by Evidence Based Medicine (EBM) Committee
CHOC Care Guidelines

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What are Care Guidelines?
Care Guidelines are tools to aid in clinical decision making and are utilized by the care team to facilitate the delivery of quality care. Care Guidelines are a form of Evidence-Based Practice.
Click here for Care Guidelines Summary Handbook

Care Guidelines are:
- diagnosis or procedurally based
- developed using the most current and relevant clinical evidence available.

In making clinical decisions in the care of our patients, the care team at CHOC uses:
- Care Guidelines
- Information from the assessment of the patient
- The care team's clinical expertise
- Patient and family preferences and values

Components of Care Guidelines include:
- Inclusion/Exclusion Criteria
- Assessment/evaluation
- Interventions
- Recommendations/Considerations
- Patient education
- Discharge criteria
- Order sets
- Revisions

Current Care Guidelines in use are:
Acute Gastroenteritis
Acute Strains/Acute Traumatic Spinal Cord Injury
Appendicitis
Asthma
Bronchiolitis
Callus/Thick Skin Access

Hemangioma Propranolol
Hypertrophic Subvalvular Aortic Stenosis Tachycardia Guidelines
Ketogenic Diet Initiation
Ketogenic Diet Readmission
Neonatal Fungal Sepsis
Neonatal Necrotizing Enterocolitis (NEC)