

## Are Subspecialists' Needs Different?

### Mixed-methods Evaluation of a Decision-support System for Pediatric Pulmonologists

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asthma

#### Abbreviations:

CDS – clinical decision support

EPR-3 – Expert Panel Report 3

GLIDES – GuideLines Into DEcision Support

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## ABSTRACT

### Objective

The objective of this study was to investigate use of a guidelines-based, computerized clinical decision support system in a pediatric subspecialty setting.

### Methods

We created a computerized clinical decision support system for asthma care by pediatric pulmonologists in a subspecialty clinic. We investigated use of the system through review of electronic data, direct observation of clinicians, and qualitative interviews of all nine pediatric pulmonologists for whom the decision support system was created. We analyzed transcripts using a grounded theory approach. We identified components of the decision support system used by clinicians and recorded timing of computer use in relation to patient care. We identified themes and patterns surrounding the relationship between asthma care and computer use.

### Results

The pediatric pulmonologists entered enough structured data to trigger the decision support system in 397/445 (89.2%) of all asthma visits from January 2009 to May 2009. However, real-time utilization was low. Barriers to real-time utilization were related to clinical, social, technical, and workflow factors, several of which were unique to subspecialty care. Key subspecialist-specific themes included the high complexity of patients seeking subspecialty care, the need for subspecialist-only pathways, the impact of subject matter expertise on the perceived need for decision support, and the necessity to create letters to referring physicians.

## Conclusions

Pediatric pulmonologists demonstrated low real-time use of a computerized decision support system for asthma care because of a combination of general and subspecialist-specific factors. Subspecialist-specific factors should not be underestimated when designing guidelines-based, computerized decision support systems for the subspecialty setting.

## I. INTRODUCTION

Computerized clinical decision support (CDS) systems enhance care by providing intelligently filtered, patient-specific information and advice to clinicians at the appropriate time.<sup>1,2</sup> Current knowledge about the promoters and barriers to the use of CDS rests largely on data collected in primary care and in hospital settings.<sup>3-6</sup> Nearly 200 million ambulatory care visits are made to subspecialists' office each year in the United States, yet relatively little is known about the use of CDS by subspecialists.<sup>7-9</sup> Well-designed systems for subspecialists will require accurate knowledge about subspecialist perspectives.

Asthma care is the focus of a growing number of CDS systems, but most of these systems have been implemented in primary care settings.<sup>10</sup> Subspecialists such as allergists and pediatric pulmonologists care for roughly one third of the 6.7 million children diagnosed with asthma in the United States.<sup>11</sup> Subspecialists tend to adhere to asthma care guidelines more closely than do primary care providers.<sup>12-14</sup> However, accurate identification of patients with uncontrolled asthma remains a problem, even in subspecialty settings.<sup>15</sup> Preliminary studies suggest subspecialists may view electronic health records differently from their primary care counterparts.<sup>16</sup> Whether subspecialist-specific factors such as subject matter expertise impact subspecialists' regard for computerized CDS is not known.

We developed a computerized CDS system for pediatric pulmonologists who provide asthma care in a subspecialty clinic. Our goal was to investigate use of the system while paying particular attention to subspecialist-specific factors. By taking a mixed-methods approach including qualitative analysis of interview data, we sought to gain information about the nature of pediatric pulmonologists' use of the electronic health record, about key obstacles to their use

of the CDS system during patient care, and about their thoughts on the usefulness of a guideline-based CDS system in a pediatric subspecialty setting.

## II. METHODS

### A. Context

This study is part of a demonstration project termed GLIDES (GuideLines Into DEcision Support), which brought together researchers from Yale University School of Medicine, Yale-New Haven Health System, and Nemours. We selected the pediatric pulmonology clinic at Yale University to receive the first CDS system. The clinic has a total of nine clinicians: five attending pediatric pulmonologists, three fellows, and one nurse practitioner. Patients are referred to the clinic by primary care physicians from throughout Connecticut, from parts of Rhode Island, and from parts of New York.

The clinic has used an electronic health record (Centricity EMR/formerly "Logician," General Electric, Fairfield, CT) to document all ambulatory care visits since May 2005. Clinicians can document their visit notes by using a desktop computer located in each examination room or by using one of several desktop computers located in conference rooms adjacent to the examination rooms. Electronic documentation for asthma care visits occurs via templates that capture pertinent asthma history, physical examination findings, and management decisions. As part of the GLIDES project, new "smart forms" were added to existing templates.<sup>17</sup>

### C. CDS description

The "smart forms" were based on Expert Panel Report 3 (EPR-3), the most recent version of the National Heart, Lung, and Blood Institute's guideline for the diagnosis and management of

asthma, released in 2007.<sup>18</sup> Although it pays particular attention to primary care providers, EPR-3's Guideline Implementation Panel explicitly targets any "prescribing clinician" for asthma care.<sup>19</sup>

The "smart forms" featured screens that visually resembled figures in EPR-3 (see Figures 1 and 2). Clinicians clicked radio buttons to record risk factors for asthma and to document history of asthma symptoms. Based on structured data entry by the clinician, the computer classified the patient's level of asthma severity and level of asthma control and then calculated a suggested level of therapy. If the clinician chose a different level of therapy, red text appeared at the top of the screen that indicated a potential variance with EPR-3 based on the data available to the computer (see Figure 2). To document a reason for variance or to record any other findings, clinicians were encouraged to enter free text.

The "smart forms" were designed based upon recommendations found in EPR-3 and with input from the pediatric pulmonologists, two of whom served on the GLIDES design team. The pediatric pulmonologists supplied expert knowledge and provided insight into anticipated usage of the "smart forms." The pediatric pulmonologists helped plan the implementation and launch of the "smart forms," which became available for use in their subspecialty clinic in January 2009.

#### D. Data collection

We retrieved utilization data from the electronic health record about asthma care visits to the pediatric pulmonology clinic at Yale-New Haven Hospital from January 2009 to May 2009. These data included use of each data element in the "smart form" as well as demographic data about patient age, gender, race/ethnicity, and provider level of training. One investigator (DEE)

directly observed each pediatric pulmonologist on two separate occasions, at approximately four months post-implementation (May 2009) and again at nine months post-implementation (September 2009). Observation periods lasted between thirty and forty-five minutes, during which DEE noted each "smart form" screen accessed by each clinician at the time of the patient visit.

EAL conducted individual, semi-structured interviews with all nine pediatric pulmonologists between May 2009 and July 2009. Interviews lasted between eighteen and forty-eight minutes. Each interview was digitally recorded and subsequently transcribed. Topics for discussion included clinic workflow, computer use during clinical care, and clinical practice guidelines. To ensure accurate understanding of the clinician's perspective, at several points the interviewer repeated elements of the conversation back to the clinician for clarification or confirmation.

#### E. Transcript analysis

We used a grounded theory approach to identify emerging themes directly from the clinicians' own words.<sup>20</sup> At least three authors reviewed each transcript and came to a consensus view of how each transcript should be coded. We followed an iterative process of clinician interview, transcript review, and adjustment of the coding framework. We identified new themes until saturation was achieved and all nine clinicians had been interviewed. The interviews yielded 213 typed double-spaced pages and one photograph for analysis. We used qualitative data analysis software (NVivo 8, QSR International, Melbourne, Australia) to manage codes and to identify illustrative quotes.



### III. RESULTS

#### A. Study sample

Between January 2009 and May 2009, there were 445 visits to the pediatric pulmonary clinic for asthma. Patients were a median of 7 years old (interquartile range 3 – 12). A total of 209/445 (47.0%) were white, 105/445 (23.6%) were Hispanic, and 104/445 (23.4%) were African-American. Attending pediatric pulmonologists documented 186/445 (41.8%) of patient visits, while the fellows documented 138/445 (31.0%) and the nurse practitioner documented 121/445 (27.2%) of patient visits, respectively.

Clinicians triggered the computerized CDS (i.e., by clicking at least one data entry field leading to automated assessment of asthma severity) in 43/55 (78.2%) of new patient visits. Clinicians triggered the computerized CDS (i.e., by clicking at least one data entry field leading to automated assessment of asthma control) in 354/390 (90.8%) of return patient visits. As a result, clinicians entered enough structured data to trigger decision support for 397/445 (89.2%) of all patient visits for asthma care.

#### B. Real-time utilization

Despite the high use rates of the CDS system, none of the pediatric pulmonologists used the computers in the exam rooms. Furthermore, the pediatric pulmonologists limited their computer use in conference rooms to activities such as review of patient medications, generation of asthma action plans, and printing prescriptions. Only one pediatric pulmonologist entered structured data about clinical history and then encountered a computerized assessment of asthma control while the patient was still in clinic. Two pediatric pulmonologists accessed the screen for deciding level of therapy, but only one of these pulmonologists had entered any structured data

to trigger the decision support. The "smart forms" were generally used for documentation purposes after patient care decisions had been made and only completed once clinic sessions had ended.

### C. Reflections on computer use

To better understand reasons for delayed use of the CDS system, we interviewed each clinician. The pediatric pulmonologists identified clinical, social, technical, and workflow-related factors when asked to comment on the "smart forms," on the utility of computers during patient care, and on guidelines-based decision support in their clinic. Each set of factors included statements applicable to all physicians and statements unique to asthma subspecialists (see Tables 1 and 2).

#### 1) Clinical factors

Discussions about clinical practice guidelines led to the often-repeated comment, "Guidelines are guidelines." The pediatric pulmonologists regarded clinical practice guidelines as starting points, not endpoints, for clinical care. Much of the pediatric pulmonologists' reasoning for delaying use of the "smart forms" until the completion of clinic sessions revolved around notions of patient complexity in the subspecialty setting. They believed that their patients' clinical scenarios were more complex than the scenarios encountered by primary care providers and that guidelines focused on the "typical" patient were therefore less applicable to their patients.

As subspecialists in respiratory medicine, the pediatric pulmonologists also considered themselves experts who did not need decision-support when it came to asthma management. The

pediatric pulmonologists pointed out that in addition to scientific evidence, expert opinion played a major role in the development of recommendations appearing in EPR-3. As long as expert opinion played a role, then the pediatric pulmonologists felt justified in using their own expertise. Neither EPR-3 nor its computerized version as "smart forms" was positioned to change what the pediatric pulmonologists already believed from their own experience.

Finally, the pediatric pulmonologists would have preferred decision support outside the scope of "smart forms" based on EPR-3 recommendations. They looked for pathways that were specifically oriented towards subspecialist decision-making, such as when to order sophisticated allergy testing or when to begin immune therapy. Thus, their own expert knowledge, combined with a lack of tools appropriate for expert care, led the pediatric pulmonologists to largely ignore the "smart forms" assessments.

## 2) Social considerations

In addition to misgivings about the value of the "smart forms," the pediatric pulmonologists raised a concern common to general medical care that computer use during the patient encounter would adversely affect the patient-clinician relationship. A good rapport with the patient required the clinician's full attention, which they felt could not be maintained while viewing the computer screen or clicking for structured data entry. Some pediatric pulmonologists believed that use of a smaller device (e.g., a computerized tablet) might be acceptable, but use of the desktop computer under their current conditions posed too much of a social risk.

The pediatric pulmonologists' view of a good patient-clinician relationship was further influenced by their role as consultant experts. Referring again to notions of patient complexity, the pediatric pulmonologists reported that primary care providers referred patients to the clinic

for help managing difficult cases. Patients often represented diagnostic or therapeutic challenges. Consequently, the pediatric pulmonologists felt obligated to provide a level of care not yet experienced by the patients. They interpreted this as maximizing "face time" and postponing computer use until after the patient left. Furthermore, expert "face time" appeared to satisfy patient expectations about the differences between primary care and subspecialty care.

### 3) Technical factors

Technical factors also contributed to computer avoidance during the patient visit. Computers in the exam room were rarely turned on at the start of clinic, and when they were turned on, they were often slow and distracting. In conference rooms, the pediatric pulmonologists found working computers to write letters about patient visits back to referring physicians. While structured data entry within the "smart forms" accomplished much of this task, the automated output required a substantial amount of editing. Consequently, the pediatric pulmonologists delayed modification of the letter until the end of clinic and after patient care decisions had been made. As a result, any opportunity for the computer to influence decision-making came too late.

### 4) Workflow-related factors

The potential for computer use to disrupt clinic workflow, in the context of general medical care, represented a major area of concern. The pediatric pulmonologists worried that computer use would slow the pace of seeing patients. Consequently, they developed numerous workarounds that allowed the clinic to function smoothly with a minimum level of computer use.

In addition, paper-based processes that preceded the introduction of the electronic health record in their clinic persisted.

One of the key paper-based processes was the completion of an Interval History form by patients in the waiting room. Patients used the Interval History form to communicate recent events, respiratory complaints, and any other concerns to the pediatric pulmonologists for the upcoming visit. Because the pediatric pulmonologists needed this information to guide the visit and to make management decisions, they referenced the paper Interval History form instead of the computer. Furthermore, the Interval History form was a paper-based medium on which the pediatric pulmonologists took notes. In contrast, the computerized "smart forms" seemed to only impede clinic workflow.

Discussions about workflow also revealed subspecialist-specific perspectives. The pediatric pulmonologists believed that they had more time than primary care providers to see patients, but they did not find that the extra time was effectively spent taking advantage of the computerized CDS. The "smart forms," for example, did not help to solve a relatively simple but common reason for referral, which was improper inhaler technique. According to the pediatric pulmonologists, improper inhaler technique by patients was often overlooked by primary care providers seeking to explain persistent asthma symptoms. So the extra time was better spent with extra history-taking and extra patient education, not extra computer use.

#### IV. DISCUSSION

We used a mixed methods approach to investigate use of a guidelines-based, computerized CDS system for asthma care by pediatric pulmonologists. The pediatric pulmonologists triggered the CDS by entering structured data for 89% of asthma care visits but

only did so as part of documentation activities after the completion of clinic sessions. Low real-time utilization was related to a variety of clinical, social, technical, and workflow-related factors. These factors indicated barriers to computer use during the course of general medical care but also pointed to unique aspects of computerized CDS in a subspecialty setting.

Knowledge about the use of computerized CDS in subspecialty settings is sparse. Lo *et al* found that subspecialists working in cardiology, dermatology, endocrinology, and pain management clinics could adopt an electronic health record without increasing overall patient visit time.<sup>21</sup> Unertl *et al* found that providers in specialized clinics for diabetes, multiple sclerosis, and cystic fibrosis avoided computerized documentation during clinical encounters.<sup>22-24</sup> Computerized CDS must be used during clinical encounters if it is to have an optimal effect on the care process.<sup>2,25</sup>

The pediatric pulmonologists identified many of the same factors reported to impede use of computerized CDS in primary care settings.<sup>3-5,26</sup> Ease of use, adaptability to local workflow, and opinions about the underlying guidelines all impact the level of use.<sup>6,27</sup> Use of the electronic health record in general depends heavily on the availability of non-electronic artifacts exemplified by the Interval History form used by the pediatric pulmonologists.<sup>28</sup> Although the pediatric pulmonologists used the computerized CDS system for ambulatory care, providers using computerized systems for order entry report the same technical, social, and clinical issues for inpatient care.<sup>29</sup>

The pediatric pulmonologists also identified factors unique to the subspecialty setting. These included the necessity to compose well-written letters back to referring primary care providers, the influence of their own subject matter expertise on their opinions about practice guidelines, and the importance of meeting patient expectations for "face time" with

subspecialists. While the computer supported various aspects of general medical care (e.g., printing prescriptions and creating asthma action plans) the computerized CDS did not adequately address what the pediatric pulmonologists believed to be the most important aspects of subspecialty care.

If subspecialist care encompasses unique characteristics, then unique opportunities may exist for computerized CDS to influence care in subspecialist settings. Incorporation of subspecialist-only pathways into CDS algorithms may be one way to accommodate subject matter expertise. Facilitating the composition of consultant letters to referring physicians may also prove amenable to computerized CDS systems. If the pediatric pulmonologists were able to complete their documentation during patient visits, including consultant letters facilitated by the computerized CDS, then they would have encountered the CDS as they were making patient care decisions and not afterwards.

Our evaluation has both strengths and limitations. By taking a mixed-methods approach that included qualitative interviews, we identified key subspecialist-specific factors that were not evident from the electronic data or from direct observation. However, we did not interview primary care providers or subspecialist providers in other settings to validate our general and subspecialist-specific themes. Another limitation is that we performed interviews approximately four months after implementation of the computerized CDS system. It is possible that the pediatric pulmonologists would have exhibited greater use of the CDS or viewed the CDS differently after a longer period of time. However, a second round of direct observation nine months after implementation revealed no discernible changes in patterns of use.

## V. CONCLUSION

We found that pediatric pulmonologists documented a high percentage of asthma care visits using a new guidelines-based, computerized CDS system but that real-time utilization of the system was low. Although the pediatric pulmonologists raised many general concerns about computer use during patient care, unique aspects of subspecialty care significantly influenced the pediatric pulmonologists' patterns of computer use and their regard for the computerized CDS. Subspecialist-specific factors such as the need for subspecialist-only pathways, the impact of subject matter expertise on the perceived need for decision support, and the necessity to create letters to referring physicians played key roles. Designers of computerized CDS tools will need to address unique aspects of subspecialty environments if they hope to influence the level of guidelines-based care in these settings.



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**Asthma Severity and Treatment5: GARY5-11 ZGLIDES**

**CLASSIFYING COMPONENTS OF ASTHMA SEVERITY AND INITIATING TREATMENT**

		←----- Persistent -----→				
		←----- Intermittent -----→		Mild	Moderate	Severe
<b>Impairment</b>	Cough	<input type="checkbox"/> None	<input type="checkbox"/> ≤2days/wk	<input type="checkbox"/> >2days/wk	<input type="checkbox"/> Daily	<input type="checkbox"/> All Day
	Wheezing	<input type="checkbox"/> None	<input type="checkbox"/> ≤2days/wk	<input type="checkbox"/> >2days/wk	<input type="checkbox"/> Daily	<input type="checkbox"/> All Day
	Chest tightness	<input type="checkbox"/> None	<input type="checkbox"/> ≤2days/wk	<input type="checkbox"/> >2days/wk	<input type="checkbox"/> Daily	<input type="checkbox"/> All Day
	Shortness of breath	<input type="checkbox"/> None	<input type="checkbox"/> ≤2days/wk	<input type="checkbox"/> >2days/wk	<input type="checkbox"/> Daily	<input type="checkbox"/> All Day
	Nighttime awakening	<input type="checkbox"/> None	<input type="checkbox"/> ≤2x/month	<input type="checkbox"/> 3-4x/month	<input type="checkbox"/> >1x/wk	<input type="checkbox"/> Often 7x/wk
	SABA use (not for EIB)	<input type="checkbox"/> None	<input type="checkbox"/> ≤2days/wk	<input type="checkbox"/> >2days/wk but not daily	<input type="checkbox"/> Daily	<input type="checkbox"/> Several times per day
	Reduction in school/ play/work activities	<input type="checkbox"/> None		<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe
	Lung function FEV1 (predicted)	<input type="checkbox"/> >80%		<input type="checkbox"/> >80%	<input type="checkbox"/> FEV=60-80%	<input type="checkbox"/> FEV<60%
	FEV1/FVC	<input type="checkbox"/> >85%		<input type="checkbox"/> >80%	<input type="checkbox"/> =75-80%	<input type="checkbox"/> <75%
<b>Risk</b>	Acute/ER visit(s) due to asthma	<input type="checkbox"/> 0	<input type="checkbox"/> 1 in last year	<input type="checkbox"/> 2 in last year	<input type="checkbox"/> 3 in last year	<input type="checkbox"/> ≥4 in last year
	Hospitalizations due to asthma	<input type="checkbox"/> 0	<input type="checkbox"/> 1 in last year	<input type="checkbox"/> 2 in last year	<input type="checkbox"/> 3 in last year	<input type="checkbox"/> ≥4 in last year
	Exacerbations requiring oral systemic corticosteroids	<input type="checkbox"/> 0-1/year		<input type="checkbox"/> ≥2 exacerbations in last year AND <input type="checkbox"/> Risk Factors for persistent asthma		
	Treatment-related adverse effects	<b>Medication Adverse Effect</b> <input type="checkbox"/> Thrush <input type="checkbox"/> Palpitations <input type="checkbox"/> Jitteriness <input type="checkbox"/> Sleep Disturbances <input type="checkbox"/> Decreased Growth <input type="checkbox"/> Other			<b>Comments</b> <div style="border: 1px solid gray; height: 60px;"></div>	

*\*\* The purple font indicates selections where YNHH has augmented NHLBI guideline.*

**CC**

**Med Hx**

**ROS**

**Environ Hx**

**Family Hx**

**Phys Exam**

**Treat Plan**

**Test**

**Prescrip**

**Assessment**

**Steps**

**Meds**

**Plan**

Prev Form (Ctrl+PgUp)

Next Form (Ctrl+PgDn)

Close

**Figure 1.** Screenshot of a “smart form” for classifying asthma severity in a new patient. The “smart forms” were designed to resemble figures appearing in EPR-3.

**Asthma Steps and Plan: GARY5-11 ZGLIDES**

**Recommended Step for Asthma Management**

\*\*\* Based on recorded symptoms the NHLBI Guideline step 2 is recommended. \*\*\*

Intermittent Asthma	Persistent Asthma: Daily Medication				
<input type="radio"/> Step 1	<input type="radio"/> Step 2	<input type="radio"/> Step 3	<input checked="" type="radio"/> Step 4	<input type="radio"/> Step 5	<input type="radio"/> Step 6
Preferred: SABA PRN	Preferred: Low-dose ICS  Alternative: Cromolyn, LTRA, Medocromil  Consider consultation	Preferred: Low-dose ICS+ either LABA, LTRA, or COMBO  OR  Medium-dose ICS  Consult Asthma Specialist	Preferred: Medium-dose ICS+LABA, or COMBO  Alternative:  Medium-dose ICS+LTRA  Consult Asthma Specialist	Preferred: High-dose ICS+LABA, or COMBO  Alternative:  High-dose ICS+LTRA  Consult Asthma Specialist	Preferred: High-dose ICS+LABA, or COMBO+ oral systemic corticosteroid  Alternative:  High-dose ICS+ LTRA + oral systemic corticosteroid  Consult Asthma Specialist
<<==== Step down if possible (If asthma is well controlled at least 3 months)			====>> Step up if needed (adherence, inhaler technique, and environmental control)		
<b>Patient Education and Environmental Control at Each Step</b>					
Quick-Relief Medication for All Patients * SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-minute interval as needed. Short course of oral systemic corticosteroids may be needed. * Caution: Increasing use of SABA or use >2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and the need to step up treatment.					
Comments/Reason for variance:					
CC	Med Hx	ROS	Environ Hx	Family Hx	
Phys Exam	Treat Plan	Test	Prescrip	Sev/Ctrl	
Assessment		Meds	Plan		
Prev Form (Ctrl+PgUp)		Next Form (Ctrl+PgDn)		Close	

**Figure 2.** Screenshot of a “smart form” for deciding asthma controller medications. The CDS has detected a variance between the user’s planned step for therapy (Step 4) and the step for therapy recommended in EPR-3 (Step 2). The variance has triggered an alert, which appears in red at the top of the page.