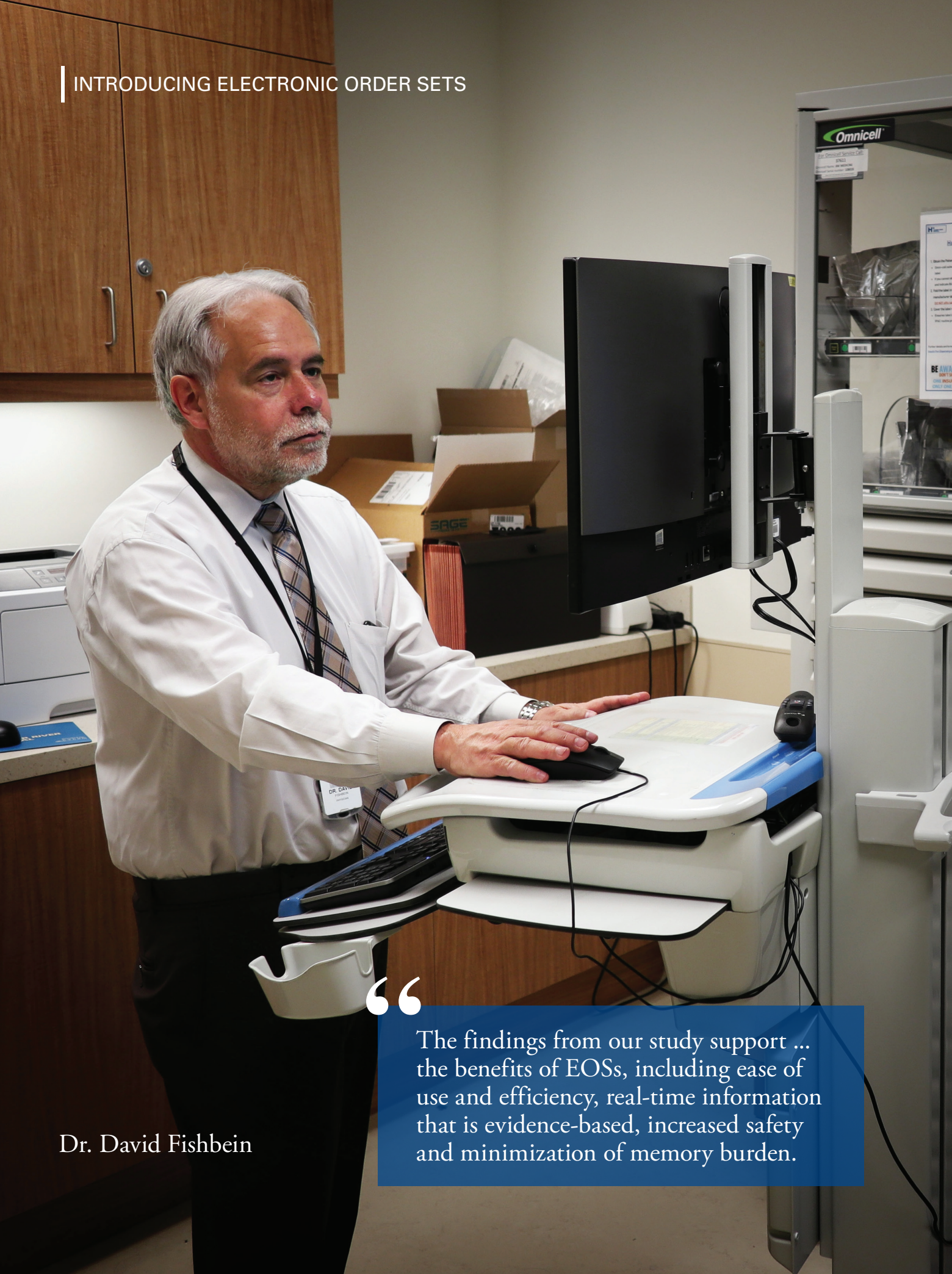

> “The findings from our study support ... the benefits of EOSs, including ease of use and efficiency, real-time information that is evidence-based, increased safety and minimization of memory burden.

Dr. David Fishbein

Physician Experience with Electronic Order Sets

David Fishbein, Meghana Samant, Nasrin Safavi, Susan Tory, Ethan Miller and Shirley Solomon

Abstract

Background: ***Electronic medical record*** **(EMR) and** ***electronic health record*** **(EHR) are used interchangeably to describe a computerized medical information system that collects, stores and displays patient information (Boonstra and Broekhuis 2010). Blumenthal and Tavenner (2010) suggested that computerized medical implementation improves decision-making and patient management. As part of its EMR, Humber River Hospital has implemented electronic order sets (EOSs) by building them into the computerized physician order entry (CPOE) system. Electronic prescribing renders paper prescriptions obsolete as it reduces errors; increases accuracy; and enhances efficiency, compliance and record-keeping (Canada Health Infoway 2017).**

Objective: **The aim of this research was to explore physicians' perspectives and experiences using EOSs.**

Methods: **This qualitative study examined the perceptions of various physicians on the impact of EOSs. Data were collected through semi-structured, in-depth interviews with eligible physicians. Domains explored included usability, efficiency, safety and implications for the physician profession.**

Results: **Major themes that emerged included usability, efficiency and safety. Several implications for physician practice were also revealed.**

Conclusion: **The findings from our study support previous studies that describe the benefits of EOSs, including ease of use and efficiency, real-time information that is evidence-based, increased safety and minimization of memory burden. EOSs were not perceived to be a replacement for clinical reasoning.**

Introduction

Since 1997, the Canadian government has endorsed the benefits of information and communication technology in the healthcare system, citing the potential and significant benefits of electronic systems as increasing accessibility and quality of health practices, as well as enhancing efficiency and reducing errors (Government of Canada 2004). Canada established an organization called Canada Health Infoway in 2001 with the mission of accelerating and spreading the use of digital health throughout the nation (Canada Health Infoway 2017). *Electronic medical record* (EMR) and *electronic health record* (EHR) are used interchangeably to describe a computerized medical information system that collects, stores and displays patient information (Boonstra and Broekhuis 2010). Blumenthal and Tavenner (2010) suggested that computerized medical implementation improves decision-making and patient management. Based on the Canada Health Infoway annual report for 2017, 162,000 active EHR users were identified across Canadian healthcare organizations (Canada Health Infoway 2017).

Humber River Hospital (HRH) is a digital hospital with an integrated EMR. As part of its EMR, the hospital has implemented electronic order sets (EOSs) by building them into the computerized physician order entry (CPOE) system. Order sets are a collection of specific items that are grouped together in a convenient template and can be standardized to contain treatment options for specific medical conditions (Li et al. 2019). For example, if a patient presents to a physician with symptoms concerning congestive heart failure, an order set might include such tests and medication as complete blood count, basic metabolic panel and furosemide (Li et al. 2019). If the patient is subsequently diagnosed with diabetes, then another order set might include hypoglycemic agents and point-of-care glucose checks. Electronic prescribing renders paper prescriptions obsolete as it reduces errors, increases accuracy and enhances efficiency, compliance and record-keeping (Canada Health Infoway 2017).

Various studies have examined the outcomes of CPOE systems. A systematic review of 67 studies examining the impacts of CPOE systems from 1966 to 2006 found overall positive results regarding "adherence to guidelines," "appropriateness of alerts," "costs and organizational efficiency" and "satisfaction and usability" (Eslami et al. 2008). However, there is a paucity of literature pertaining to user experience with EOSs. Li et al. (2019) suggested that order sets are intended to help clinicians, but the extent to which order sets support physician practice and workflow is not well understood. The aim of this research was to explore physicians' perspectives and experiences using EOSs.

HUMBER RIVER HOSPITAL

HUMBER RIVER HOSPITAL is one of Canada's largest community acute care hospitals, serving a population of more than 850,000 people in the northwest Greater Toronto Area. The multi-site hospital currently operates out of its Wilson Avenue acute care site and Finch and Church Street reactivation care centres with a total of 722 beds, just over 3,800 employees, approximately 700 physicians and over 1,000 volunteers.

Affiliated with the University of Toronto and Queen's University, Humber River Hospital is North America's first fully digital hospital. Part of Humber River Hospital's digital infrastructure includes completely automated laboratory services, robots sorting and mixing medications, electronic health records, tracking systems, for patients undergoing surgery, that update families through their cellphones and patient bedside computer terminals – all varieties of technologies that automate information, eliminate paper and provide a connected experience for patients, staff and families.

Humber River Hospital was awarded Accreditation with Exemplary Standing in 2018 and, since its opening in 2015, has received numerous awards and accolades for technological advancements and innovation (www.hrh.ca).

Methods

Study design and participants

This qualitative study examined the perceptions of various physicians on the impact of EOSs. Domains explored included usability, efficiency, safety and implications for the physician profession (Table 1). Detailed descriptive accounts were elicited from participants. Participant eligibility criteria included physicians who had experience using the EOSs at HRH for a minimum of 1 year. In addition, all of those who wished to participate in the study were at least 18 years of age, spoke fluent English and possessed the capacity to consent.

TABLE 1.
Interview Guide

Domain	Sample question
Usability	*Do you find that the system is easy to navigate?*
Efficiency	*Is the EOS beneficial to your workflow? Why or why not?*
Safety	*Can the system reduce medication errors? Why or why not?*
Implications for physician profession	*Do you believe that it can improve your skills as a physician? Can it impair your skills? Why or why not?*

Data collection

Data were collected through semi-structured, in-depth interviews with eligible physician participants at HRH in November 2019. Physician participants had the choice of being interviewed in one-on-one sessions or focus group settings according to their preference. One-on-one interviews lasted approximately 20 minutes, whereas focus group settings ranged from 30 to 45 minutes. Prior to conducting interviews, informed consent and demographic data were obtained. Trained members of the research team continued to conduct interviews until data saturation was met. Veritas IRB, an independent Research Ethics Board, approved the study.

Data analysis

Manifest content analysis was used to analyze the transcribed interviews. This method of analysis identifies core meanings that emerge in the interview transcripts (Downe-Wamboldt 1992). Two analysts independently reviewed the transcribed text and then extracted words and sentences relevant to each domain. Emerging ideas were identified and grouped into themes for each domain. Analysts extensively discussed the analytic categories, and any inconsistencies in themes were discussed until consensus was reached. Quotations were selected to highlight participants' key points. Sociodemographic characteristics from the survey data were summarized using descriptive statistics.

Results

Eighteen physicians participated in the focus groups and one-on-one interviews. Major themes emerging from the in-depth interviews are described below for each domain, along with supporting quotations from the participants. Descriptive statistics of demographic characteristics of the participants are presented in Table 2.

Usability

Two themes could be extracted from the interviews on usability of the EOSs: ease of use and searchability issues. One of the strengths of the EOSs reported by participants was that the system was simple and straightforward. Participants stated:

> I have found that it's been fairly easy to navigate, no question about it. ... I hadn't really had any difficulty with ordering things off of it all. It's very user-friendly from my perspective.

> It's pretty user-friendly; it's pretty intuitive. Point and click. It's not super complicated.

Additionally, participants who reported difficulty mastering the system as a new user were still in favour of it despite the slow adaption initially. Some participants stated:

> It is a bit of a learning curve, but once you're used to it, you're much faster.

> In the beginning, it takes a couple of people to tell you how to do it and know. It's not a huge learning curve – maybe a little bit. Overall, it's fairly easy to do.

An additional theme related to usability was issues with searchability. The most frequently mentioned issue was difficulty identifying the correct search query. For example, some found that certain medications could only be searched for by either their generic or branded names. Another cited issue was search outputs, which were long and slow to navigate:

> When they do the upgrades, we lose a lot of the names between the generics and the actual name of the medication, and now you can't search it the same way.

> [D]epending on the word that you type in, things will not come up. I find that [to be] a huge deal because sometimes if you don't guess the right word, you won't find it. There are things that I have never found because I don't know what it is supposed to be called.

TABLE 2.
Demographic characteristics of physician study participants, *n* = 17*

	n	(%)
Age range		
25–34 years	4	23.5%
35–44 years	7	41.2%
45–54 years	3	17.6%
55–64 years	2	11.8%
65–74 years	1	5.9%
75 years and over	0	0.0%
Gender		
Male	12	70.6%
Female	5	29.4%
Gender diverse	0	0%
Years of experience as a physician		
1 to < 3 years	1	5.9%
3 to < 5 years	4	23.5%
5 to < 10 years	4	23.5%
10+ years	8	47.1%
Length of time at Humber River Hospital		
1 to < 3 years	4	23.5%
3 to < 5 years	3	17.6%
5 to < 10 years	5	29.4%
10+ years	5	29.4%

*One participant did not provide demographic data.

> What I find is that the lists are humongous. ... With imaging, … you just want a CT of the chest or X-ray of the knee, but there's like a zillion trillion choices.

Furthermore, when looking for a particular medication using the system, some had difficulty finding the appropriate category assigned to it:

> Albumin is not in the medication orders; it's in the non-medication orders. But …, technically, it's a medication. [I]t's a blood product; it should be under medications, and it looks like its blood work. So also, for a long time, I couldn't figure out how to order albumin.

> I do think finding the order sets sometimes can be challenging, which is really annoying. If you're not in the right category or the right set. Or the names aren't interchangeable. You have to know exactly what you want. Sometimes it's frustrating when you're on call and you can't find the order set you want.

However, all participants preferred the system to paper order sets, observing that the EOSs were more efficient and far superior to their paper counterparts:

> It's better than writing it; it's still better than writing it.

Efficiency

The main theme extracted from the interviews was positive impact on workflow. Participants emphasized multiple benefits of EOSs on efficiency, most notably that their speed of placing orders had increased because EOSs are readily accessible compared to printed order sets, which were often difficult to find. Another advantage mentioned by participants was that they did not have to return to the patient's bedside to ascertain any additional information as the EOSs could be completed at the bedside:

> The biggest advantage to me is everything is in one place. ... It's a huge piece of efficiency. Otherwise, if things are in different places, I need to get this from here and this from there and this from there, so it's open and closed, and then I'm done.

> I work in two hospitals: one is paper-based, and this is the other one. My efficiency here is 50% better. I will see twice as many consults in the same amount of time because of the order sets.

Additional themes mentioned by participants were facilitated information retrieval and reduction in task completion time. These ultimately resulted in efficiencies in healthcare delivery, especially within the emergency department, as illustrated by the following comments from participants:

> For me, especially for things outside of your particular discipline, like when you're doing acute coronary syndrome – everything is there. All the categories. The platelet, beta-blockade, ACE inhibitors – it's all there for you to click on. [You spend] less time ... typing in medications and remembering what you want to choose. It's nice to be able to just click.

> It makes things faster and easier, especially in [the emergency department]. In [the emergency depart-

ment], when you're admitting 20 patients a night, it's faster because you go through checking things off, and the flow is a little bit easier.

Safety

All participants cited increases to the safety of the care prescribed through EOSs. The most common theme mentioned was increased adherence to guideline-recommended practices, especially for disease-specific order sets such as acute coronary syndrome and deep vein thrombosis (DVT). Evidence-based guidelines were also seen as especially crucial for physicians providing care for patients with uncommon conditions. A decreased reliance on memory was also highlighted in relation to this theme:

> [E]specially if people are not as familiar with a certain area, [such as] a general internist who doesn't do medicine call very much, or a subspecialist, for instance,[such as a] rheumatologist doing [a] general medicine call, they're probably not going to be as up-to-date on the latest cardiac care, for instance. So it helps … remind them what you should be ordering for a patient, and, again, it makes sure that there's some consistency … across the board.

> For instance, we've seen patients who have been admitted with acute coronary syndrome, and the physician doesn't use an order set, so they don't order the correct drugs for them; … they'll order aspirin and Plavix, but they'll forget to order fondaparinux. So I think it does reduce errors if physicians are not as familiar with that condition [and] what the standard of care is. So it provides that for you, which is very helpful. ... [A]lso, when people are busy, that's the other circumstance; ... a lot of the time physicians admitting patients in the [emergency department] are busy, so they're more likely to forget some things. So the order set reminds you so that you don't forget these things. … DVT prophylaxis can be very important, but it might be something that someone could forget if it's not in the order set.

> I like that it standardizes care. And [emergency department] physicians who may come from many different areas of training or levels of training, or some of them may not keep up to the same extent as others do. ... So I find that standardization of care zeros in on specific drugs you can select for specific conditions. So that's been good.

> You don't forget to order something; acute coronary syndrome is a good example because there's a lot of different categories of medication; it's easy to forget. For efficiency and avoiding to omit, it's helpful."

Implications for physician practice

There were multiple discussions surrounding the electronic order set and its implications for physician practice; as a result, several themes emerged from the interviews. One theme mentioned by all participants was that the EOSs had the ability to bridge gaps in care. This was cited as being due to its ability to provide real-time access to best practice standards and was considered particularly beneficial in facilitating care outside of the physician's specialty. The following comments from participants illustrate this theme:

> For instance, if I'm in the [chronic obstructive pulmonary disease (COPD)] order set, I want to rule out [pulmonary embolism] on the off-chance that it's an alternate diagnosis or order a CT scan after I'm done the order set. ... It helps you retain the knowledge for disciplines you don't necessarily do every day.

> The benefit is that if it's not something you do on a regular basis, at least that information is right there – that you are following the right processes.

> Sometimes it might make me think a little bit more about the drug choices because it's listing the drug names right in front of me. So I might think … that medication might be better for this patient because the blood pressure's low and the heart rate is a different rate. So it just reminds me [that] I don't have to order the one medication that I often order, that there might be a better medication for this patient.

A secondary theme that emerged from the interviews was the importance of the physicians' own cognitive process. Participants emphasized that although EOSs have helped to bridge gaps in care, they were not considered by most physicians as a replacement for their clinical reasoning. This theme was demonstrated by the following comments:

> ... you think about what you want to do with the patient. You don't use the order set to think for you.

> It helps implement what you've cognitively processed, but it doesn't help you with the cognitive process.

> For a COPD order set, I can click which puffers to use, but in terms of the frequency, there's a clinical decision. So I could do them as [as needed], or I could do them as a standing order, but that piece of the decision-

> making has to come from me. So the fact that I see both of those options will help me to select one or the other, but I have to make that selection.
>
> Say I do an admission order set for someone with COPD and they have another condition in addition to COPD. Am I more or less likely to miss the other condition because I'm anchored by the order set? I don't think so.

However, some participants felt that the EOSs could obviate physicians' skills, as illustrated by the following remarks:

> When there is reliance on a standardized order set, it perhaps can be a disincentive for some clinicians to reduce reading and keeping up on topics because they expect a standard order set to cover things for them.
>
> Everything is in front of you. Does that impair your skills? I hope not. But it's possible.

The last theme mentioned by participants was the importance of providing individualized patient care:

> I think at the end of the day what's important is having the basics, a discussion with your patient, a physical exam, explaining what you're doing and why ...
> [S]ometimes the menus are very helpful, of course; I'm sure there's a lot of thought put into it. But it's very important to recognize [that] there are other things outside of those boxes, and I try very hard not to fall into that.
>
> I guess to some extent it does make some things automatic, so some people may not be thinking as much about the choices that they're making. ... But … as a physician, you're supposed to be thinking about the kind of care of the patient. So although it may save you some time, you should still be considering, "Is this the right medication for this patient?" In the order set, having more than one category that you could pick should still allow you the time to think about what's the best medication for this patient.

Discussion

Our study explored physicians' attitudes regarding EOSs and confirmed the generally favourable impression that physicians have of them. Most respondents found the order sets easy to navigate and use, even if they had limited time to master their use. This would imply that a user-friendly design and interface of the EOSs had been arranged (i.e., physician respondents knew "how" to order a medication). There were some reported challenges in "finding" a specific medication, but, overall, physicians thought the EOSs was easy to use.

Similarly, the physician participants were almost universal in their feeling that order sets enhanced their efficiency, particularly during busy periods of call, when multiple patients require assessment and admission to hospital. Efficiency in workflow was described by physician participants as having readily accessible and reliable information available "in the moment." For example, standardized lists of medications and doses and corresponding evidence-based literature provide a "one-stop shop" for best practices. As described by Zhang et al. (2018), order sets present appropriately grouped medical orders that increase the efficiency of ordering and workflow. With all of the medication orders and protocols located in one place, efficiencies for individual clinician decision analysis are further supported, including the heuristic principle of "minimizing memory load" (Zhang et al. 2003).

The participants also felt that the use of order sets increased safety by ensuring that physicians followed evidence-based practices and minimized the possibility of omitting important interventions. Zhang et al. (2018) suggested that order sets are designed to embed and encourage compliance with best practices. Similarly, Liu et al. (2011) identified the use of CPOE with clinical decision support methods as contributing to reduced medical errors and adverse drug events. Physicians in this study also recognized the value of real-time learning facilitated by CPOE clinical decision supports. Likewise, Lyman et al. (2010) found that clinical decision support alongside CPOE, such as alerting and reminder systems that "nudge" physicians to pause and consider alternative interventions at the point of care, can increase the quality and safety of care delivery.

Physician respondents felt that EOSs use did not substitute or eliminate the need for physicians to apply their own clinical judgment and skills when assessing patients. Lyman et al. (2010) posited that EMRs, CPOE, and clinical decision support systems are insufficient alone to ensure high-quality care. With such value placed on clinical reasoning, we do reflect on the fact that EOSs may represent different things to different providers. For novice practitioners, the EOSs provides a foundational basis of information and considerations for orders "at a minimum" for a particular disease, whereas for practised clinicians, the EOSs represents an opportunity to pause and consider whether they agree with each order or not based on their clinical experience and judgment. Undoubtedly, there may be a perceived tension for physicians between ensuring that individualized care is provided and adhering to standard order sets.

There are some limitations to our study. The majority of physician participants were beginning their practices, which intuitively would suggest a greater comfort level with newer

technology, but also an appreciation for real-time information made available for clinical decision analysis (Lyman et al. 2010; Yu et al. 2013). However, even more experienced physician respondents perceived that when managing a novel disease entity in their area of specialty (as an emergency physician shared), the EOSs also represented real-time clinical support tools. This experience as well was taken from a very digitally advanced hospital with robust support systems for physicians using order sets. The introduction of order sets and computerized order entry was preceded by an extensive period of training provided to all physicians, and the creation of the specific order sets themselves has always involved significant physician input. Perceptions of CPOE from physicians in other various specialties, as well as more senior physicians or physicians who had only limited training in the use of order sets, need to be explored further. Physicians' attitudes toward order sets might be different in organizations without as great an emphasis on digital innovation and where 24-hour supports for physicians are not available. In addition, their attitudes might also have been impacted if the training period was briefer and there was less physician involvement in the creation of the order sets. However, the insights gleaned from this study may support hospitals endeavouring to scale up their digital landscape through the integration of CPOE and clinical decision support systems.

With the growing use of EOSs, there is a need for further studies pertaining to both the physician experience and their outcomes on patient care. Although EOSs are used by all physician groups, no studies have addressed whether attitudes are affected by physician specialty or physician characteristics, such as age or perceived comfort with technology. There is little knowledge regarding whether physician attitudes vary between academic and community hospitals and whether the degree of previous training affects the attitudes toward order sets. Similarly, no studies have addressed whether there is an association between physicians' impressions and the effectiveness with which order sets are used. The actual impact that the use of order sets has on patient outcomes is also an area worthy of further study. Although almost all of the respondents in this study felt that the use of order sets enhances patient safety, no studies have explored the potential relationship between the use of order sets on hospital length of stay, patient satisfaction or other outcomes.

Conclusion

As part of its EMR, HRH has implemented EOSs by building them into the CPOE. Although various studies have been conducted examining outcomes from CPOE systems, this study was intended to explore physicians' perspectives using EOSs. Our results support previous studies that describe the benefits of EOSs, including ease of use and efficiency, real-time information that is evidence-based, increased safety and minimization of memory burden. EOSs were not perceived to be a replacement for clinical reasoning but to provide a "pause" for clinicians as they decide the appropriate orders for their individual patients. Future studies to address whether physician attitudes toward EOSs are affected by physician specialty or characteristics, such as age or perceived comfort with technology, are needed. Additionally, the impact of using order sets on patient outcomes is an area worthy of further study. Other studies examining the use of order sets in relation to patient safety, hospital length of stay and patient satisfaction are required.

What We Learned:

1. Physician participants in our study overwhelmingly agreed that order sets enhanced their efficiency.

2. All physician participants cited increases to the safety of the care prescribed through EOSs.

3. All participants perceived that the EOSs had the ability to bridge gaps in care. In particular, real-time access to best practice standards was considered beneficial in facilitating care outside of the physician's speciality.

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