



The relationship between  
**Electronic Health Records and Patient Safety**

A joint report on  
**Future Directions for Canada**



# Electronic Health Records and Patient Safety

## *Future Directions for Canada*

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# Electronic Health Records and Patient Safety

## **Future Directions for Canada**

- > **The scientific evidence connecting Electronic Health Records (EHRs) to improvements to patient safety is incomplete.** While Computer Physician Order Entry (CPOE) with Clinical Decision Support (CDS) applications can significantly reduce medication errors, little is known about other aspects of EHRs, particularly in community care settings.
- > **EHRs may sometimes reduce rather than enhance patient safety.** There are “unintended consequences” of implementing EHRs. While these are not always negative, they can sometimes result in new adverse events which can compromise patient safety.
- > **EHRs trigger profound cultural and organizational changes in healthcare delivery.** It takes time for healthcare providers to adjust to these changes. To maximize potential benefits to patient safety, implementation should be incremental and carefully paced.
- > **Technical and research standards are vital for EHRs to advance patient safety.** Information cannot be shared between healthcare providers if systems are not interoperable. Likewise, researchers need common measures for patient safety outcomes.
- > **Expectations for EHRs and patient safety must be realistic.** EHRs may be a powerful tool for improving patient safety, but they are not a cure-all. Clearly documenting attainable outcomes will help to establish reliable evidence for any potential benefits to patient safety.
- > **Consensus among Canadian healthcare leaders is needed to move the EHR and patient safety agendas forward.** Processes are needed to determine common short and long-term goals for future research and advocacy.
- > **The time to act is now.** Let's take advantage of the fact that EHR development in Canada is still in its early days and learn from others who have gone ahead.

# Executive Summary

*This report discusses the results of an environmental scan examining the relationship(s) between EHRs and patient safety in Canada. This study was jointly conducted by the Integrated Centre for Care Advancement through Research (iCARE), Canada Health Infoway (Infoway), and the Canadian Patient Safety Institute (CPSI).*

Information collected from a literature scan, key stakeholder interviews, and a roundtable discussion revealed that **there is important potential for EHRs to improve patient safety in Canada. However:**

- > **More evidence linking EHRs and patient safety outcomes is needed**
- > **Understanding and addressing the human and organizational impacts of EHRs is crucial to realizing any possible benefits**

According to stakeholders, **a long-term strategy is needed to encompass:**

- > **Advocacy**
- > **Setting Realistic Goals**
- > **Research, Evaluation and Informed Development**
- > **Standardization**
- > **Building Stakeholder Consensus**
- > **Seizing Opportunities**

***Immediate action*** is called for on the following items:

- > ***Identify and prioritize galvanizing issues by specific criteria***
- > ***Speak to urgency and develop an appropriate communications strategy***
- > ***Target approaches to engage specific stakeholder groups***
- > ***Anchor strategies in additional healthcare system challenges***
- > ***Pursue opportunities for research funding and capacity enhancement***
- > ***Invest in research, standardization, systems, and usability***

## Introduction

*This report discusses the results of an environmental scan which examined the relationships between EHRs and patient safety.* The information presented here was gathered from three main sources. First, an initial literature scan of over 300 peer-reviewed and non-peer-reviewed documents pertaining to EHRs and patient safety was conducted (see Appendix for search strategy). Of these documents, 135 were examined in detail and 103 are directly cited in this report.

*Next, 28 semi-structured interviews with key stakeholders in the field of EHRs and patient safety were conducted and analyzed using a purposive sampling strategy.* These stakeholders, who are key Canadian and international researchers, clinicians and policy-makers in the fields of EHRs and/or patient safety, were asked about the following:

- > **Their role as a stakeholder, and how it relates to EHRs and/or patient safety**
- > **Their definition of an EHR**
- > **The relationship between EHRs and patient safety**
- > **The linkage(s) between EHRs and patient safety in their country**
- > **Any gaps in knowledge for EHRs and patient safety**
- > **Their suggested next steps to advance the EHR and patient safety agendas**

Data from these interviews were then analyzed and combined with relevant information from the literature scan and presented in a briefing paper entitled *EHRs and Patient Safety: Evidence, Issues, and Future Directions*.<sup>1</sup>

Finally, selected stakeholders (including some interviewees) were invited to a roundtable discussion jointly hosted by *Infoway* and CPSI, entitled *Realizing Opportunities. Promoting Patient Safety*. (Toronto, May 7–8, 2007). Here, the briefing paper formed an introduction to the major issues for discussion, and attendees were given the task of creating a platform for patient safety and EHRs, and of identifying pressing next steps for action. Following presentations from selected stakeholders, attendees discussed strategies for stakeholder engagement, developing a supportive policy environment, and future investment in research and system development. The contents of this discussion were summarized, and a list of action items was produced. These data, as well as additional literature collected as the project progressed, round out the evidence presented in this report.

Ethical approval for this study was granted by the University of Alberta, and the analysis was conducted by Nicole Grimm, Micaela Brown, and Dr. Nicola Shaw of the PATH Research Group at *iCARE*, with the assistance of librarian Orvie Dingwall at CPSI. The project was jointly funded by *Infoway*, the CPSI, and *iCARE*.

## What do we know about EHRs and Patient Safety?

*In many ways the heart of patient safety is ensuring that individual clinicians or practitioners have relevant information in front of them at the right time, in the right way—information that's appropriate to the services they're providing at that particular time, in a format that may be customized to their particular requirement, in the setting they're in, whatever that might be.*

Interviewee 16

*According to current research, there are some clear and important indications of potential benefits to patient safety through the use of EHRs.* Most of the evidence to date relates to Clinical Physician Order Entry (CPOE)<sup>2-19</sup> and Clinical Decision Support<sup>20-25</sup> components, particularly regarding their potential to reduce preventable Adverse Drug Events (ADEs).<sup>8-19</sup> For example, Bates and colleagues have found that CPOEs with decision support reduced non-missed-dose drug errors<sup>A</sup> by 81% in one study<sup>10</sup>; in another, the rate of nonintercepted serious medication errors was reduced by 55%.<sup>11</sup> The potential benefits to patient safety are significant, according to the *Canadian Adverse Events Study*,<sup>26</sup> adverse events (including ADEs) likely account for 185,000 hospital admissions in Canada each year.

While these results clearly demonstrate the potential for significant benefits to patient safety, it is important to acknowledge that these benefits are not always simple to achieve. Nebeker and colleagues, for example, have found that CPOEs that lack decision support can cause high rates of ADEs to persist.<sup>27</sup> Similarly, Smith and colleagues have asserted that CPOEs must use validated drug information in order to decrease potential ADEs.<sup>28</sup> These examples are not meant to dispute the evidence that CPOEs may be an important tool for improving patient safety—rather to make the critical point that **they must be used properly** to do so. Other areas where evidence indicates potential benefits include electronic prescribing (e-prescribing),<sup>29-32</sup> barcoding,<sup>29,33</sup> electronic medication administration records,<sup>29,34-37</sup> and surveillance and monitoring through secondary analysis of EHR data.<sup>38-46</sup>

Though not yet as well represented by scientific data, an assumption of many stakeholders is that EHRs will help to improve patient safety by providing for the continuous and efficient flow of relevant and accurate health information between caregivers in different care settings. Or, as more plainly stated by Interviewee 1, when EHRs are implemented well, *“all the clinicians on the healthcare team get a better picture of what's going on with a patient, and they get it in real time in a more continuously updated way than they did with the paper records.”*

Recent reports from two organizations in the United States effectively demonstrate the potential value of this “better picture” to increase patient care quality. Kaiser Permanente (KP) is *“the largest U.S. not-for-profit integrated healthcare delivery system,”* serving 8.5 million members in eight geographic regions.<sup>47</sup> Using data from their integrated EHRs, KP HealthConnect, six KP regions have collaborated with each other and outside organizations to form the Cancer Research Network. Through this network, they have conducted several research studies as well as responded to *“ad hoc inquiries for population-based data on cancer incidence and treatment patterns.”*<sup>47</sup>

Similarly, the Veterans Health Authority (VHA) *“serves 5.3 million patients annually across nearly 1,400 sites of care.”*<sup>48</sup> Using data from their EHR, VISTA, they have created a diabetes registry, which has allowed the VHA to improve its diabetes care performance in a number of ways, including through refining performance measures; influencing patients' and clinicians' behaviours; identifying high-risk populations; and facilitating targeted interventions.<sup>48</sup> Although neither of these examples provides clear evidence for direct improvements in patient safety, they clearly demonstrate the potential of EHRs to improve care quality and support the logical assumption that improvements to patient safety may naturally follow.

<sup>A</sup> “Non-missed-dose drug errors” refers to medication errors resulting from route errors, frequency errors, substitutions, drug-drug interactions, inappropriate drugs, illegible orders, known allergies to drugs, drugs not being available, avoidable delays in treatment, and preparation errors.<sup>10</sup>

## What do we need to know?

*I think if you went back to the early nineteenth hundreds and did a controlled clinical trial—or, not clinical but a controlled trial—on the horse versus the car, in the very early days of the car, the horse probably would have won. And if you took a snapshot of those early days and based your future projections on it, you'd say, "Well, let's throw out the car and go with the horse. They're obviously much more reliable." And so on and so forth. But cars got better and people had the vision to realize that and stay with them and improve them to the point where they soon outdistanced the horse.*

Interviewee 19

As many stakeholders pointed out, both the EHR and patient safety agendas, particularly in North America, are still in the early stages of their development. For example, in the United States, less than 5% of hospitals have fully implemented CPOES;<sup>49</sup> in a recent Commonwealth Fund international survey, Canada placed last in many categories related to Information Technology (IT) implementation in primary health care.<sup>50</sup> In fact, in an updated survey published by this same group in May 2007, Canadian doctors were the least likely of all surveyed to receive computerized alerts or prompts to provide patients with test results.<sup>51</sup> Clearly, both EHR adoption and research are very limited in Canada. As such, more information is needed—particularly in the areas of EHRs and patient safety outcomes and human and organizational issues—where a number of important barriers continue to prevent the optimization of patient safety through the use of EHRs.

### **EHRs and Patient Safety Outcomes**

*For computerized order entry there's some very suggestive evidence that errors are reduced, but actually no studies have shown an improvement in actual patient outcomes...It's all presumptive, you know, other industries do it, so why haven't we done it? And conceptually it makes sense...[but] we don't really know that it improves anything.*

Interviewee 15

Currently, much of the available evidence regarding EHRs and patient safety is limited for a number of important reasons. First, much of it tends to be anecdotal in nature, or produced by single institution studies.<sup>52</sup> Second, even the higher quality evidence that has been produced does not necessarily demonstrate concrete improvements in patient outcomes. Several CPOE studies, for example, point to **potential and indirect benefits** to patient safety, such as increasing compliance rates with treatment guidelines,<sup>53</sup> "potential" reductions in overall medication-turn around times,<sup>6</sup> and the "potential" elimination of transcription errors.<sup>7</sup> Third, according to one roundtable participant—a recognized leader in CPOE research—even the most well-known studies<sup>10;11</sup> demonstrating a clear reduction in medication errors as the result of CPOEs with decision support have not been powered to detect actual changes in adverse events (AEs). A significant number of adverse events *may* actually have been prevented in these studies—the fact remains that we cannot be certain whether that is the case or not.

The need to be certain about outcomes takes on a special significance when considered in light of the potential for unintended consequences of EHR implementation. Some unintended consequences of EHR implementations may benefit patient safety—such as increased collaboration and/or learning from alert messages provided by CPOEs with decision support.<sup>54</sup> Others, however, may detract from patient safety, as clinicians may experience unforeseen changes in organizational power structures, workflow, and communication patterns and practices, or may encounter problems related to overdependence on technology, negative emotions, and paper persistence.<sup>54–57</sup> Finally, on their website, <http://iig.umit.at/efmi/>, the Working Group on Assessment of Health Information Systems of the European Federation of Medical Informatics has even documented cases where patients have been directly harmed or killed by "Bad Health Informatics."<sup>58</sup>

These cases “often show that a combination of different reasons leads to failures of ICT and patient harm”<sup>58</sup> and so should not be interpreted as evidence that EHRs themselves are detrimental to patient safety. What they do indicate, however, is that any discussion of EHRs and patient safety should at least consider the question, “How can we prevent negative side effects of information technology?”<sup>58</sup>

Although controversial, there is also evidence to suggest that EHRs may facilitate medical errors<sup>59–66</sup> and/or generate new kinds of errors,<sup>55–57</sup> which in turn may have direct and far-reaching negative impacts on patient safety.<sup>58</sup> In survey interviews conducted by Ash and colleagues, for instance, 176 physicians from various U.S. hospitals with implemented CPOE systems reported various “new kinds of errors” associated with using CPOEs, including “entering orders for the wrong patient, errors of omission, nurses not knowing an order had been generated, desensitization to alerts, loss of information during care transitions, wrong medication dosing, and overlapping medication orders.”<sup>57</sup> Fortunately, these respondents reported “many near misses but few actual errors.”<sup>57</sup> Similarly, in their recently published study combining survey and claims data from 18 metropolitan U.S. pharmacies, Malone and colleagues found that pharmacists were at an “increased risk of dispensing a potential DDI [Drug-Drug Interaction]” with “use of specific automation, and dispensing software programs providing alerts and clinical information.”<sup>67</sup>

The importance of fully investigating these issues cannot be overstated, because, as summarized by Interviewee 3, “the whole issue of safety is an ethical issue because it leads to the institutional, as well as professional, obligations to ensure that the transition, as well as the use, is at least as safe as what you’ve got with paper based records, and that applies also to the liabilities you attach to health information professionals themselves.”

## Human and Organizational Issues

*It’s one thing to buy the software; it’s another thing to turn it on, and then you’ve got to get people to use it, and we’ve seen more and more literature coming out [about] mistakes...sometimes big mistakes that take away from patient safety.*

Interviewee (13)

Current research has established that EHR implementation is “socially negotiated.”<sup>68,69</sup> It is an unpredictable social process which transforms both technology and practice.<sup>68</sup> As such, implementing EHR technology is a complex and challenging undertaking, and its success or failure may directly impact patient safety. Improper implementation, for example, may result in limited uptake and use by clinicians, or even, as Interviewee 15 put it, “almost a mutiny and they shut the thing off.”

## What do we need to know?

(continued)

### **Human and Organizational Issues**

(continued)

Two recent clinical studies demonstrate the direct impacts that human and organizational implementation factors may have on patient safety. In 2005, Han and colleagues published a study following the implementation of a CPOE in the Children's Hospital of Pittsburgh (CHP), where an alarming "unintended consequence" of increased mortality was observed.<sup>70</sup> In discussing this result, Han and colleagues point to several changes in organizational culture and workflow; such as an alteration in the "*chain of events*" when patients were admitted; delays in treatment and diagnosis; increased drug order time; and increased time for both doctors and nurses away from the patients' bedsides.<sup>70</sup>

In 2006, Del Beccaro and colleagues published a paper describing their implementation of the same CPOE in a different children's hospital, which they conducted *after* visiting CHP and incorporating "*the lessons that they learned into [their] implementation plan.*"<sup>71</sup> Chief among these lessons were those related to human and organizational factors, as Del Beccaro and colleagues were careful to secure "*active involvement*" of staff during the "*design, build, and implementation stages,*" and also instituted a pre-registration process for admitting patients.<sup>71</sup> Del Beccaro and colleagues found no significant difference in mortality after implementing their CPOE.<sup>71</sup>

Although the research methodologies used in these two studies make it impossible to truly compare them,<sup>72</sup> seven internationally recognized experts reviewed and commented on both of these studies and stated: "*There is one message that stands out in all commentaries: implementing a clinical informatics application in health care is a socio-technical activity...Ignoring the existing organizational workflows and social interactions in the redesign of clinical processes may have negative impacts on clinical outcomes...Hence the application as such is not necessarily the deciding factor, but rather the implementation process may be much more important.*"<sup>72</sup>

A particularly useful metaphor for human and organizational implementation issues is also offered by this group of experts, who later go on to say, "*The introduction of an informatics system to an organization has analogies to implanting an artificial organ in a human: you either adapt the artificial organ to be accepted by the body or you suppress the rejection reaction by the immune system. The latter makes a human vulnerable to all kinds of infections and can lead to a seriously compromised person.*"<sup>72</sup> Fortunately, however, as two roundtable participants with recognized expertise in implementing CPOEs asserted, rejection of EHR technologies does not have to be final. In fact, these stakeholders argued that such systems *should* be implemented incrementally, and that users should always have the option of turning them off when necessary, so that appropriate adaptations can be made to both the technology and the relevant work policies and practices.

Finally, it must also be noted that human and organizational issues related to the successful implementation of EHRs sometimes also result from conditions that originate outside the realm of healthcare practice. For roundtable participants, two such issues were especially important, particularly as they related to one another. Participants acknowledged that while the global shortage of healthcare workers continues to grow, patients in Western countries are living longer than in the past and require increasing amounts of care as they age. Both of these factors place significant additional strain on the healthcare system and its workers and cannot be ignored in the context of implementing EHR technologies.

# What needs to be done?

Evidence from the literature, stakeholder interviews, and roundtable discussions revealed the need for action in five major areas, discussed below.

## Advocacy

*I think we need to be quite dramatic in talking about patient safety in terms of getting the attention of the politicians. You know, politicians are driven by the public, and I don't think the public fully appreciates how unsafe the healthcare system is.*

Interviewee (27)

A major theme emerging from this study—especially in stakeholder interviews and roundtable discussions—was the need to educate policy-makers and the public and rally their support for the cause of patient safety. Many stakeholders also felt that this need extended to the topic of EHRs. Interviewee 26 stated, *“I think the general public at the moment is woefully uneducated and uninformed about the electronic health record systems and why they are being introduced.”* A roundtable presenter and recognized patient safety advocate agreed, citing a reluctance among patients to adopt EHRs in part because of a number of common and important questions:

- > Why does the move to an electronic system have to start with prescriptions? Why not start with hospital cleanliness?
- > What about system crashes?
- > Would the implementation of an EHR result in cuts elsewhere?
- > Will medical information be accessible to people beyond the hospital walls?
- > Can computer hackers access these files?<sup>73</sup>

## What needs to be done?

(continued)

To begin addressing these questions and engaging the public more meaningfully, several interviewees suggested adopting a “*patient-centric*” perspective. This approach is discussed in detail by Brennan and Safran,<sup>74</sup> who “assert” that:

- > Determination of what constitutes safe care must be informed by the patient’s perspective and experiences
- > No amount of activity by health professionals, regulatory bodies or researchers can succeed without commensurate participation by the patient
- > Patient preferences for interventions and outcomes should enlighten guidelines for safe practices
- > The tools for assuring patient safety, including information systems, standards of practice, error reporting and remediation strategies, and the mechanisms to understand and apply them, must be place in the hands of the patient<sup>74</sup>

Finally, in order to facilitate patient engagement, several study participants felt that both EHR and patient safety advocates could learn from two important examples. First, many interviewees drew comparisons between Canada and other nations, particularly the United States. As summarized by Interviewee 5, “*When we look to Europe, patient safety is absolutely the platform that is building EHRs, and other countries have also used that as a very strong message. Whereas here in Canada we’ve kind of lost that message, since the Baker-Norton report [Canadian Adverse Event Study] didn’t even take hold as strongly as the Institute Medicine report from the U.S.*” Second, roundtable participants also noted how, largely through effective communications strategies, reducing wait times for healthcare services in Canada has become an “*unequivocal commitment*” of the current Canadian government.<sup>75</sup> In both of these examples, stakeholders recognized the strategic use of the media as a powerful lever for influencing public opinion.

### Setting Realistic Goals

*There is a relationship [between EHRs and patient safety] on the level of hope and hype and there is a relationship on the level of the ground, what is actually happening...On the practical level on the ground, there are many obstacles for these hoped for and at times hyped up expectations to be actually achieved.*

Interviewee (26)

Clearly, properly developing, using, and evaluating even one component of an EHR—such as a CPOE—is an enormously complex and potentially problematic undertaking. This does not mean that EHRs do not have the potential to improve patient safety in important ways. What it does mean, however, is that if we are to advocate for improving patient safety through the use of EHRs, our expectations for exactly what those improvements will be must be realistic and attainable. As stated previously, the most compelling and

**Research,  
Evaluation,  
and Informed  
Development**

well-documented evidence for potential patient safety improvement through EHRs is currently that related to medication error reduction as the result of implementing CPOEs with decision support. During roundtable discussions, many participants suggested that this issue might be an appropriate focus for additional research, standardization, education and advocacy. Others, however, suggested focusing on continuity of care, the other major anticipated (yet less well researched) potential benefit to patient safety from EHRs.

Whichever focus is adopted, many participants and other stakeholders urge us to remember, as Interviewee 19 stated, that *"records are never going to deliver care ...An enhanced record certainly can facilitate the delivery of better care but...it can never be ultimately responsible for better care, because the care is...delivered by people."*

*Unfortunately, the evidence is in a premature stage. Some of the authors...have written about computer order entry systems and the fact that you can make a communication from a physician or nurse legible, in itself can make things a lot safer. However,...our review of the literature [showed that it] is...naïve and immature, and [a] number of the studies that were done had weak methodologies and sample sizes that are very low.*

Interviewee 14

In order to inform advocacy with realistic goals, evidence based on methodologically sound research is needed. In addition to suggesting that more research be undertaken regarding patient outcomes and human and organizational issues relating to EHRs, stakeholders also identified a number of other areas where additional study is warranted. These areas included *"silent errors"* (errors made as a result of being interrupted from the task at hand)<sup>76</sup>; financial costs<sup>77-80</sup>; return on investment<sup>81</sup>; patient access to EHRs<sup>82-84</sup>; ethical issues (especially privacy and confidentiality)<sup>85;86</sup>; and information regarding adverse events following hospital discharge.<sup>87</sup> Of these, the last was most important to interviewees and roundtable participants, many of whom called for increased attention to the potential effects of EHRs in community-based and outpatient care settings.

Stakeholders also suggested that more comprehensive evaluations of EHR implementations should be undertaken.<sup>88-90</sup> Specifically, they argued for the use of longitudinal and well-documented approaches,<sup>89</sup> and studies based on mixed (both qualitative and quantitative) methods rather than Randomized Control Trials (RCTs).<sup>90</sup> These issues are well summarized by the seven experts who critically examined the Han and Del Beccaro studies when they state, *"We want to emphasize the need to promote systematic evaluation studies with strong methodologies for assessing the many socio-technical factors that influence the introduction of increasingly sophisticated computer technologies within human organizations."*<sup>72</sup>

## What needs to be done?

(continued)

Finally, along with the call for stronger and more comprehensive EHR evaluations, a common theme encountered in our stakeholder interviews was that of informed development: stakeholders suggested that end-users (be they clinical, research, or administrative) be actively involved in shaping EHR technology *as it is being developed*. Within the literature, suggested methodologies include those employed in the disciplines of human factors and usability engineering,<sup>91-95</sup> such as usability testing and usability inspection,<sup>96</sup> which can be used in simulations to test systems prior to deployment. Some stakeholders also stressed that CPOEs should be continually enhanced and redesigned through interaction with the system<sup>97</sup> and observational workflow studies<sup>98</sup> so that both evaluation and redesign are ongoing throughout the life of a given system in a given setting.

### Technical and Research Standardization

*It's the herding cats thing, you know: we've just got to keep herding the cats. Eventually we'll get them all in the pen together.*

Interviewee (20)

Several stakeholders pointed out that the current lack of standardized technology prevents integration and interoperability of information systems, severely limiting the ability of EHRs to facilitate continuous, informed care across healthcare settings. As Interviewee 24 stated: *"Our different systems don't talk to each other. We coordinate a lot of community care, and our hospital records and our community care records are not compatible, and our information has to be all handwritten."* Fortunately, as one roundtable presenter indicated, the International Health Standards Development organization is working to combat part of this problem, by promoting products such as SNOMED (Systematized Nomenclature of Medicine) and Dictionary of Medications and Devices (DM+D), which attempt to control the vocabularies used to describe EHR data.

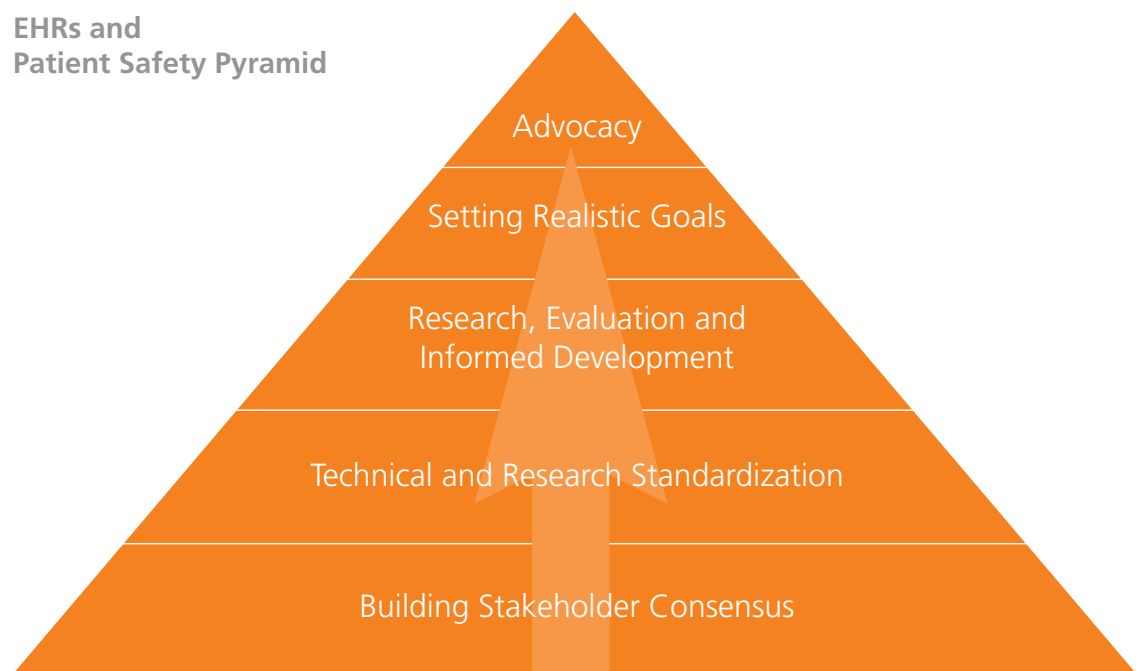
In addition to identifying the lack of technical standards, stakeholders indicated areas in which conceptual standardization also is needed. Some, for example, linked this issue to the ability to measure quality of care and patient safety in a meaningful and standardized way. Interviewee 19 made this comment, *"large-scale studies of quality by standard measures are just not part of the landscape today...because they'd all have to have common standards, definitions and formats built into the software...In a sense, it's very hard to talk about improving quality or safety, if you don't know where you are now; if you can't measure where you are, how do you know whether you've improved or not."* Similarly, this concern is echoed in a recent review of the literature regarding *"the governance of technology in health settings, which is addressed in relation to patient safety"*; Balka and colleagues discuss adverse events related to medical devices and caution that *"until greater standardization of medical device reporting practices occurs, reported rates should be treated*

*with some skepticism (and assumed to be higher than reported)."*<sup>99</sup> Therefore, as these examples demonstrate, researchers must also develop standardized definitions of vital concepts—such as quality of care, patient safety, and adverse events—in order to build the evidence base for the successful use of EHRs to improve patient safety.

**Building  
Stakeholder  
Consensus**

As outlined above, most stakeholders agree that more research is needed to construct a solid evidence base linking EHRs and patient safety, particularly regarding patient safety outcomes and human and organizational issues related to implementation. In addition, they have also called for both technical and research standards, and more education and advocacy for patient safety, while also reminding us that our expectations for the potential benefits of EHRs to patient safety must be realistic. The fundamental issue linking all of these themes together, however, is that consensus between stakeholders is needed for effective action to be taken in promoting the enhancement of patient safety through the use of EHRs. As illustrated in the following diagram, this consensus forms the foundation on which the other elements rest.

**EHRs and  
Patient Safety Pyramid**



## What needs to be done?

(continued)

This matter is exceedingly complicated by the multitude of stakeholders with various agendas and vested interests in both EHRs and patient safety. For example, when asked if the EHR and patient safety agendas are or should be linked, interviewees presented a wide array of responses, ranging from affirmations that these agendas are and should be linked, to concerns that they are not currently but should be linked, to insisting that they are not, cannot, and even *should not* be linked. Not surprisingly, therefore, stakeholders' views on widespread adoption of EHRs also varied considerably, ranging from optimistically eager (Interviewee 9) to cautiously reserved (Interviewee 17) to deeply concerned (Interviewee 1):

*"I think there needs to be some more clear health policy articulation around the importance of doing this and that we really shouldn't have a choice, and that, falling short of mandating everything, it's irresponsible of the health system to not put these tools into place."* Interviewee 9

*"I think there's a common problem that we try to do too much too fast. It may be better just to go slowly and invest piece by piece and think of each small implementation as a success/failure before going on to the next one."* Interviewee 17

*"I think studies are needed before we jump headlong into something we may regret later."* Interviewee 1

In addition to the agendas noted above, there are also those of vendors, who must consider proprietary issues and have a vested interest in selling the products they produce. At the same time, there are also pressures from influential EHR adoption advocates<sup>77</sup>, such as the Leapfrog Group.<sup>8</sup> Additionally, especially in Canada, jurisdictional conflicts add another set of agendas to the mix, as health care is partially federally funded but provincially administered. Unfortunately, this political complexity both reflects and reinforces divisions among stakeholders, dividing the research and development funds that are available and making it difficult to effectively lobby for more. As one roundtable participant effectively summarized, *"It would be a shorter list to say who isn't a stakeholder."*<sup>73</sup>

Speaking directly to this issue, another roundtable participant characterized the goal of enhancing patient safety through the use of EHRs as a *"change process"* that cannot be initiated until a clear objective is identified.<sup>73</sup> This participant also voiced a concern that was implicitly echoed throughout this study—her frustration over stakeholders' inability to *"pick one thing and drive it."*<sup>73</sup> This *does not* mean that a single perspective must be adopted to the exclusion of all others, but rather that more work needs to be done to identify specific and achievable objectives that stakeholders can agree to work toward together.

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<sup>8</sup> *The Leapfrog Group is a strong advocate of CPOE adoption, representing many of the "largest [U.S.] corporations and public agencies that buy health benefits on behalf of their employees, dependents and retirees."*<sup>100</sup> For more details, see the organization's website, [www.leapfroggroup.org](http://www.leapfroggroup.org), and publications by Birkmeyer,<sup>101</sup> Hilman,<sup>102</sup> and Milstead.<sup>103</sup>

## Seizing Opportunities

*There are enormous opportunities for us—as a region, as a province, as a country—to make real improvement...We're at a watershed where we all, as consumers in our health system, are expecting us to do better. And we're working hard to do that.*

Interviewee 16

This stakeholder reminds us that while there will be challenges and barriers to enhancing the EHR and patient safety agendas, there are opportunities in the short-term to continue to move the agenda forward.

Undeniably, the current research regarding EHRs and patient safety is limited in both quantity and quality, and the complex mixture and interplay of multiple agendas can make addressing this issue difficult. In recognizing these obstacles, however, we must not overlook the opportunities for immediate gains to both the EHR and patient safety agendas.

While the pyramid outlines a strategy for advancing the long-term Canadian EHR and patient safety agendas, stakeholders can, in the meantime, exchange and combine knowledge and resources aimed strategically at addressing “*low-hanging fruit*”<sup>73</sup>—such as the evidence for reducing medication errors in the use of CPOEs—that can be immediately promoted for the mutual benefit of both the EHR and patient safety agendas. As summarized by Interviewee 5, “*there is an opportunity for us to not only raise the profile of both of these areas, but to contribute to each other’s successes.*”

## How can we do it?

*With both a long- and short-term strategy in mind, participants at the Realizing Opportunities. Promoting Patient Safety. roundtable produced a list of action items for the EHR and patient safety communities in Canada, as outlined below.*

### **Action Items**

- > **Identify and prioritize galvanizing issues by explicit criteria.**
  - > Focus on “low-hanging fruit,” such as:
    - Reducing medication errors
    - Continuity of care
- > **Speak to urgency and develop an appropriate communications strategy.**
  - > Target approaches to engage
    - Patients
    - Clinicians
    - Administrators
    - Policy-makers
    - Vendors
- > **Anchor strategies in additional healthcare system challenges beyond patient safety, such as:**
  - Rising healthcare costs
  - Global shortage of healthcare workers
  - Expectation of accountability
  - Access issues (including wait times)
- > **Pursue opportunities for research funding, through:**
  - Industry/agency and/or agency/agency partnerships
  - Lobbying CIHR: Canadian Institute for Health Research and “NSERC: National Science and Engineering Research Council
  - Identifying priority areas and “low-hanging fruit”
  - Exploring capacity enhancement through training programs and data sharing
- > **Invest, in:**
  - Development (or compilation) of standards
  - Systems, hardware and functionality
  - Usability
  - Research providing evidence

## Conclusion

*Our research demonstrates that the task of uniting the EHR and patient safety agendas in Canada is not an easy one.* While evidence does exist to support the enhancement of patient safety through the use of EHRs, there are significant gaps in the evidence base and complex human and organizational issues that must be addressed in order to realize those benefits. At the same time, however, an immense opportunity exists to develop appropriate research methodologies *as we develop* the EHR, paving the way for evidence-based EHRs with patient safety solutions for the entire world. In short, there is a lot of work to be done in uniting these agendas, but with a solid long-term strategy beginning with clearly defined items for immediate action, stakeholders believe it can be accomplished.

### **Recommended Reading**

Ammenwerth E, Talmon J, Ash JS, Bates DW, Beuscart-Zephir M-C., Duhamel A, Elkin PL, Gardner RM, and Geissbuhler A Impact of CPOE on Mortality Rates—Contradictory Findings, Important Messages. *Methods of Information in Medicine* 2006; 45:586–593.

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# Appendix: Literature Search Strategy

*by Orvie Dingwall, Librarian, Canadian Patient Safety Institute, January 11, 2007*

## Search Scope

- > Intersection of Electronic Health Records (EHR) and patient safety
- > Impact of EHRs on patient safety

EHR is defined as the electronic management and communication of a patient's chart, within and between professionals.

- > Electronic Health Record
- > Computerized Provider Order Entry (CPOE)
- > Computerized Decision Support Systems (CDSS)
- > Medication administration/barcoding
- > Transition of care between providers

The scope at this time excludes telehealth, incident reporting systems, Public Health Surveillance (PHS), and secondary use of data for post-marketing surveillance.

## Appendix: Literature Search Strategy

(continued)

### MEDLINE—January 11, 2007

#	Search History	Results
1	safety management/	6,849
2	(safe\$ adj3 manage\$).mp.	8,813
3	exp medical errors/	52,397
4	(medica\$ adj3 error\$).mp.	12,605
5	(patient\$ adj3 safe\$).mp.	11,961
6	patient safety.jw.	171
7	(adverse\$ adj3 event\$).mp.	30,952
8	(adverse\$ adj3 effect\$).mp.	63,072
9	(health care adj3 error\$).mp.	122
10	(healthcare adj3 error\$).mp.	40
11	(diagnos\$ adj3 error\$).mp.	25,060
12	(nurs\$ adj3 error\$).mp.	206
13	(physician\$ adj3 error\$).mp.	247
14	(patient care adj3 error\$).mp.	45
15	(surg\$ adj3 error\$).mp.	607
16	(safe\$ adj3 cultur\$).mp.	482
17	(safe\$ adj3 climate\$).mp.	97
18	near\$ miss\$2.mp.	606
19	(critical\$ adj3 incident\$).mp.	912
20	(critical\$ adj3 outcome\$).mp.	1,185
21	(adverse\$ adj3 outcome\$).mp.	10,416
22	(unanticipated adj4 outcome\$).mp.	49
23	(electronic adj2 health\$ adj2 record\$).tw.	542
24	(electronic adj2 medical adj2 record\$).tw.	1,353
25	computeri?ed provider order entr\$.tw.	47
26	computeri?ed decision support system\$.tw.	85
27	computeri?ed physician\$ order entr\$.tw.	208
28	(electronic adj2 patient\$ adj2 record\$).tw.	716
29	computeri?ed patient record\$.tw.	268
30	or/23–29	3,043
31	or/1–22	172,940
32	30 and 31	345

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