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Best Practice Guidelines

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Adopting eHealth Solutions: Implementation Strategies

RNAO
Registered Nurses' Association of Ontario
L'Association des infirmières et infirmiers autorisés de l'Ontario

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Adopting eHealth Solutions: Implementation Strategies

Greetings from Doris Grinspun

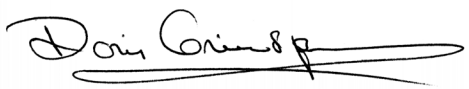
Chief Executive Officer, Registered Nurses' Association of Ontario

The Registered Nurses' Association of Ontario (RNAO), in partnership with Canada Health Infoway, is delighted to present the best practice guideline, *Adopting eHealth Solutions: Implementation Strategies*. We are pleased to acknowledge the work of Maureen Charlebois, former Chief Nursing Executive and Group Director of Canada Health Infoway for initiating this partnership and the development of this best practice guideline. Evidence-based practice supports the excellence in service that health care leaders, nurses and other health professionals are committed to delivering every day. RNAO is delighted to provide this key resource.

We offer our heartfelt thanks to the many stakeholders who are making our vision for best practice guidelines a reality, starting with the Government of Ontario for recognizing RNAO's ability to lead the program and for providing multi-year funding. For their invaluable expertise and leadership, I wish to thank Dr. Irmajean Bajnok (former Director, International Affairs and Best Practice Guidelines Centre), Dr. Valerie Grdisa (Director, International Affairs and Best Practice Guidelines Centre) and Dr. Michelle Rey (Associate Director, Guideline Development). I also want to thank the co-chairs of the expert panel—Maureen Charlebois (Chief Executive Officer, Achieving Care Excellence Consulting Service Inc., and former Chief Nursing Executive and Group Director, Canada Health Infoway) and Diane Salois-Swallow (Chief Information Officer, Mackenzie Health)—for their exquisite expertise and stewardship of this Guideline. Thanks also to RNAO staff for their intense work in the production of this new Guideline: Rita Wilson (eHealth Program Manager and Guideline Development Lead), Tanya Costa (Project Coordinator), and Tasha Penney (Manager, Research and Evaluation), as well as Lisa Ye, Tanvi Sharma, Nafsin Nizum, Laura Legere and Julie Blain (Nursing Research Associates). Finally, special thanks to the members of the RNAO expert panel for generously providing their time and expertise to deliver a rigorous and robust resource. We couldn't have done it without all of you!

Successful uptake of best practice guidelines requires a concerted effort from educators, health professionals, employers, policy-makers, and researchers. Employers have responded enthusiastically by nominating best practice champions, implementing guidelines, and evaluating their impact on individuals and organizations. Governments at home and abroad have joined in this journey. Together, we are building a culture of evidence-based practice.

We have much to learn from one another, and we invite you to share this Guideline with your colleagues and with those who are the recipients of care within your organizations. Together, we must ensure that the public receives the best possible care every time they come in contact with us—making them the real winners in this important effort!



Doris Grinspun, RN, MSN, PhD, LLD (Hon), O. ONT.
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President and Chief Executive Officer, Canada Health Infoway (Infoway)

It has been our privilege to partner with the Registered Nurses' Association of Ontario (RNAO) to develop *Adopting eHealth Solutions: Implementation Strategies.*

We believe that this timely best practice guideline will be a key resource to help health care executives, nurses and other health care providers effectively lead and support the implementation and adoption of digital health solutions across Canada. This will help us achieve Infoway's vision of healthier Canadians through innovative digital health solutions.

Infoway's clinical engagement strategy brings together health professionals in leadership, practice and education to influence and support the necessary people, practice, process and policy changes required to optimize the use of digital health to increase value for individuals and the health system. A key element of this strategy is the support we provide to health professionals to accelerate adoption and use of digital health at the point of care. This is directly aligned with the new best practice guideline, which will provide a road map to integrate new and transformative technologies into professional practice and leadership competencies.

I would like to join the RNAO's Chief Executive Officer, Doris Grinspun, in thanking everyone who worked on this guideline and contributed in other ways. It was truly a collaborative effort and we appreciate the expertise, leadership and dedication of everyone involved. I would also like to thank the RNAO for being such an excellent partner in this endeavour. It was a pleasure to work with you!

We are very proud of the ground breaking, evidence-based best practice guideline that we have developed together. It will have tremendous value for clinicians, patients and Canada's health care system for years to come. We look forward to continuing to work with the RNAO to implement the guideline across the country.

Michael Green
President and Chief Executive Officer
Canada Health Infoway (Infoway)

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How to Use This Document

Adopting eHealth Solutions: Implementation Strategies is an **evidence-based**[G] document. It is not intended to be a manual or "how-to" guide. Rather, this **best practice guideline** (BPG)[G] is a tool to share evidence-based practices to inform various **stakeholders**[G] involved in the implementation of eHealth solutions at the organizational, regional, jurisdictional, or national levels.

For the purposes of this Guideline, the following definitions are used:

a) "**eHealth**"[G] refers to the use of electronic health information systems in the health care sector.

b) "**eHealth solutions**"[G] is broadly used to represent various types of electronic health information systems used across the care continuum to support a variety of functions ranging from administration to health services delivery. It does not refer to personal health records, patient portals or remote patient monitoring systems.

Examples of eHealth solutions as used in this Guideline include (but are not limited to) the following:

- **electronic medical record (EMR) systems**[G] used in non-hospital sectors (e.g., primary care, long-term care and home care);
- hospital information systems and their sub-systems (e.g., laboratory information systems, pharmacy information systems, computerized provider order entry [CPOE], electronic documentation systems, electronic medication administration records [eMAR]);
- public health information systems; and
- national or jurisdictional **electronic health record (EHR) systems.**[G]

How to Adapt the Guideline

The Guideline should be reviewed and adapted in accordance with the needs of individuals, organizations, and the broader health system, as well as the needs and preferences of **persons**[G] accessing the health system for care and services.

If your organization is adopting this Guideline, we recommend the following approach:

1. Assess your existing eHealth implementation policies, procedures, protocols, and educational programs in relation to the recommendations in this Guideline.
2. Identify existing needs or gaps in your eHealth implementation policies, procedures, protocols, and educational programs.
3. Note the recommendations that address your organization's existing needs or gaps.
4. Develop a plan for implementing the recommendations.

* Throughout this document, terms in **bold** that are marked with a superscript G ([G]) can be found in the Glossary of Terms (**Appendix A**).

Purpose and Scope

Purpose

The purpose of this guideline is to provide evidence-based individual, organization, education, and system/policy recommendations to: 1) enhance the capacity of all individuals involved in the implementation of an eHealth solution within a health care organization; 2) establish suitable infrastructures to support eHealth education needs; and, 3) facilitate technology-enabled **health system transformation**.[G]

Specifically, the objectives of this Guideline are to enhance the capacity of:

- Individual health care executives and clinical/non-clinical leaders; **nurses**[G] and other health professionals in practice, education, administration and **informatics**[G]; and health care organizations in general to optimize their involvement in the procurement, design, implementation, adoption, and optimization of an eHealth solution.
- Health care executives and clinical/non-clinical leaders, educators, and administrators at the organization and system levels to effectively identify and address the eHealth education needs of the health care workforce.
- Government agencies, administrators, and policy-makers to identify and implement relevant evidence-based policies that support health system transformation and nationwide **health information exchange**[G] by addressing known barriers to eHealth adoption at the national and jurisdictional levels.

Scope

The **Individual/Organization Recommendations**[G] provided in this Guideline will have relevance for all individuals involved in the implementation of an eHealth solution within a health care organization, regardless of their role. Academic institutions may use the **Education Recommendations**[G] to develop or enhance their eHealth curricula. Lastly, individuals who lead, facilitate, or support eHealth initiatives at the regional, jurisdictional, or national levels may find the **System/Policy Recommendations**[G] useful for developing policies, procedures and protocols.

Use of the Term "Person" in this Guideline

Various terms are used in reference to the individuals with whom health professionals establish therapeutic relationships to promote or enhance health. In this Guideline, "person" is used exclusively to refer to those individuals and their families. An individual's family includes people they identify as significant in their lives (e.g., parents, caregivers, friends, **substitute decision-makers**,[G] groups, communities, and populations). Exceptions to this use may occur in discussions related to specific concepts in the literature (e.g., patient safety and remote patient monitoring systems).

Interpretation of Evidence

Levels of evidence are assigned to study designs to rank how well particular designs are able to eliminate alternate explanations of the phenomena under study. The higher the level of evidence, the greater the likelihood that the relationships presented between the variables are true. Levels of evidence do not reflect the merit or quality of individual studies.

For guideline recommendations, the highest level evidence is assigned that most aligns with the recommendation statement. In cases where there are multiple studies of various design with similar findings, the studies with the highest level of evidence are assigned (and cited) in support of the recommendation.

Guideline recommendations occasionally are assigned more than one level of evidence. This is a reflection of the varied study designs that support the multiple components of a recommendation. For transparency, the individual levels of evidence for each component of the recommendation statement are identified in the discussion of evidence.

LEVEL	SOURCE OF EVIDENCE
Ia	Evidence obtained from **meta-analysis**[G] or **systematic reviews**[G] of randomized **controlled trials**,[G] and/or synthesis of multiple studies primarily of quantitative research.
Ib	Evidence obtained from at least one randomized controlled trial.
IIa	Evidence obtained from at least one well-designed **controlled study**[G] without randomization.
IIb	Evidence obtained from at least one other type of well-designed **quasi-experimental study**,[G] without randomization.
III	Synthesis of multiple studies primarily of **qualitative research**.[G]
IV	Evidence obtained from well-designed non-experimental observational studies, such as **analytical studies**,[G] **descriptive studies**,[G] and/or qualitative research.
V	Evidence obtained from expert opinion, committee reports, and/or clinical experiences of respected authorities.

Source: Adapted from Scottish Intercollegiate Guidelines Network (SIGN) and D. Pati.[221, 222]

Summary of Recommendations

INDIVIDUAL/ORGANIZATION RECOMMENDATIONS		LEVEL OF EVIDENCE
1.0 Individual/ Organization Recommendations	Recommendation 1.1: Health care organizations will ensure visible executive sponsorship throughout all phases of the implementation of the eHealth solution.	V
	Recommendation 1.2: Executive leadership will establish a formalized governance structure with defined roles and responsibilities to guide and support all phases of the implementation and adoption of the eHealth solution, in alignment with the organizational culture, goals, and objectives.	IV
	Recommendation 1.3: Executive leadership will assess individual, organizational, and technical readiness for the implementation of an eHealth solution.	IV
	Recommendation 1.4: Project steering committees will establish an interprofessional team including representation from persons who are/were recipients of care to identify and select an eHealth solution to support the organization's strategic vision and plan. A systematic process that encompasses the use of a decision matrix and structured evaluation guide is recommended.	V
	Recommendation 1.5: Contract negotiation teams will collaborate with the project steering committee to support and inform the licensing agreement negotiations and to ensure that the terms and conditions discussed during the eHealth solution selection process are included in the contract.	V
	Recommendation 1.6: Project managers will use formal project management methodology to guide the implementation of the eHealth solution.	III
	Recommendation 1.7: Project leads will collaborate with the steering committee to ensure that the right people are in the right place at the right time to lead and support various facets of the implementation of the eHealth solution.	V
	Recommendation 1.8: Project leads will collaborate with the steering committee to identify discipline-specific champions at all levels of the organization (representing each stakeholder group impacted) to build awareness of the system, and promote adoption among their peers and across the organization.	III

INDIVIDUAL/ORGANIZATION RECOMMENDATIONS		LEVEL OF EVIDENCE
1.0 Individual/ Organization Recommendations	Recommendation 1.9: Health care organizations will use a formal change management methodology to address the role-specific needs of the individual as they transition from the present to the future state.	IV
	Recommendation 1.10: Project leads will develop a stakeholder management plan early in the planning phase to fully engage all stakeholders for optimal implementation and adoption of the eHealth solution.	V
	Recommendation 1.11: Project leads will collaborate with the steering committee to develop and implement a communication management strategy to control the delivery of targeted communication to specific stakeholders using the most effective media at the right times, with built-in channels for feedback. The communication management strategy should be initiated early in the planning phase and updated regularly throughout the project.	V
	Recommendation 1.12: Health care organizations will incorporate usability processes throughout the implementation and adoption of the eHealth solution to enhance individual and organizational efficiencies, effectiveness, and user satisfaction.	V
	Recommendation 1.13: Project leads will develop a comprehensive education and training plan to enable individuals to learn and integrate the new eHealth solution into their daily routine and workflows.	V
	Recommendation 1.14: Project leads will collaborate with the steering committee to identify key indicators for monitoring and evaluation and use a comprehensive evaluation framework to guide the project evaluation.	III
	Recommendation 1.15: Health care organizations will have an ongoing post-implementation operational plan that includes data governance structures and processes that support sustainability and continuous optimization of the eHealth solution.	V

EDUCATION RECOMMENDATIONS		LEVEL OF EVIDENCE
2.0 Education Recommendations	Recommendation 2.1: Health care organizations and academic institutions will establish an eHealth education and training infrastructure that provides opportunities for health care executives, nurses, and other health professionals to develop role-specific informatics competencies.	IV
	Recommendation 2.2: Health care organizations will facilitate the integration of role-specific informatics competencies within executive and professional practice leadership responsibilities using a shared accountability model.	V
	Recommendation 2.3: All nurses and other health professionals will assume responsibility for their professional growth and development in informatics competencies.	V
	Recommendation 2.4: Health care organizations will facilitate a person's access to health information (personal and educational), empowering them to assume greater responsibility for the self-management of their health and to engage in more informed dialogue with their health professionals.	V

SYSTEM/POLICY RECOMMENDATIONS		LEVEL OF EVIDENCE
3.0 System/Policy Recommendations	Recommendation 3.1: National and jurisdictional agencies responsible for eHealth will develop a comprehensive strategy to achieve nationwide interoperability in consultation with representatives from all stakeholder groups, including nurses, other health professionals, the private sector, regulatory bodies, professional associations, and persons who are (or who were) recipients of care.	IV
	Recommendation 3.2: National and jurisdictional agencies responsible for eHealth will establish an effective governance structure that provides strong, coordinated leadership that works in conjunction with regulatory bodies and professional associations to realize the goal of nationwide health information exchange.	III

SYSTEM/POLICY RECOMMENDATIONS		LEVEL OF EVIDENCE
3.0 System/Policy Recommendations	Recommendation 3.3: National and jurisdictional agencies responsible for eHealth will provide incentives to foster the development of innovative next-generation eHealth solutions aligned with legislation, standards and policies formulated in consultation with professional and regulatory bodies and professional associations.	IV
	Recommendation 3.4: National and jurisdictional agencies responsible for eHealth will provide financial and procurement incentives to mitigate barriers to the adoption of eHealth solutions.	IV
	Recommendation 3.5: National and jurisdictional agencies responsible for eHealth will develop and strategically implement education and training policies to build eHealth capacity in the workforce. These policies will be endorsed by regulatory bodies and professional associations to ensure alignment with the curricula in academic institutions.	IV
	Recommendation 3.6: National and jurisdictional agencies responsible for eHealth will collaborate with regulatory bodies and professional associations to accelerate the adoption of eHealth solutions.	IV
	Recommendation 3.7: National and jurisdictional agencies responsible for eHealth will collaborate with government agencies responsible for the telecommunications infrastructure to plan for increased connectivity in remote areas to support the implementation of eHealth solutions and enable national interoperability.	III

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Declarations of interest that might be construed as constituting an actual, potential, or apparent conflict were made by all members of the expert panel, and members were asked to update their disclosures regularly throughout the Guideline development process. Information was requested about financial, intellectual, personal, and other interests and documented for future reference. No limiting conflicts were identified.

Further details are available from the RNAO.

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Stakeholder Acknowledgement

As a component of the development process for Best Practice Guidelines, RNAO is committed to obtaining feedback from nurses and other health professionals from a wide range of practice settings and roles, knowledgeable administrators and funders of health care services, and **stakeholder**[G] associations. Stakeholders representing diverse perspectives were solicited for their feedback, and RNAO wishes to acknowledge the following individuals for their contributions in reviewing this Guideline:

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Background Context

In an increasingly digital world, governments across the globe are recognizing the potential of eHealth to improve the flow of information among health professionals to support the delivery of health services and the management of health systems; thereby, enhancing the quality and safety of the care and services received by persons accessing the health system.[1–5]

In hospitals, eHealth encompasses (but is not limited to) the use of information and communications technologies for administration, diagnostic services, medication management, and health services delivery. In the home care, community, and public health sectors, eHealth includes the use of EMRs, **remote patient monitoring systems**[G] and public health information systems.[6]

There is general consensus that, when properly deployed and adopted by nurses and other health care professionals (e.g., doctors, pharmacists, dietitians, and therapists), eHealth solutions can increase efficiency, enhance patient safety and care coordination, and optimize health outcomes.[2,7,8] Some countries—including China, Denmark, New Zealand, Singapore, and Sweden—have successfully implemented and adopted eHealth as a national health care strategy.[9–11] Canada continues to lag behind.[12] Results from the Commonwealth Fund international survey of primary care physicians in 2015, indicated that Canada was below average on 19 out of 28 indicators which measured factors such as the use of information technology.[192]

Large-scale implementations of eHealth solutions are inherently complex, with failure rates reported to be as high as 70 percent across the globe.[10,13–15] The following list, which is by no means exhaustive, illustrates the range of factors at the **macro level**,[G] **meso level**,[G] and **micro level**[G] that have reportedly contributed to these failed implementations:

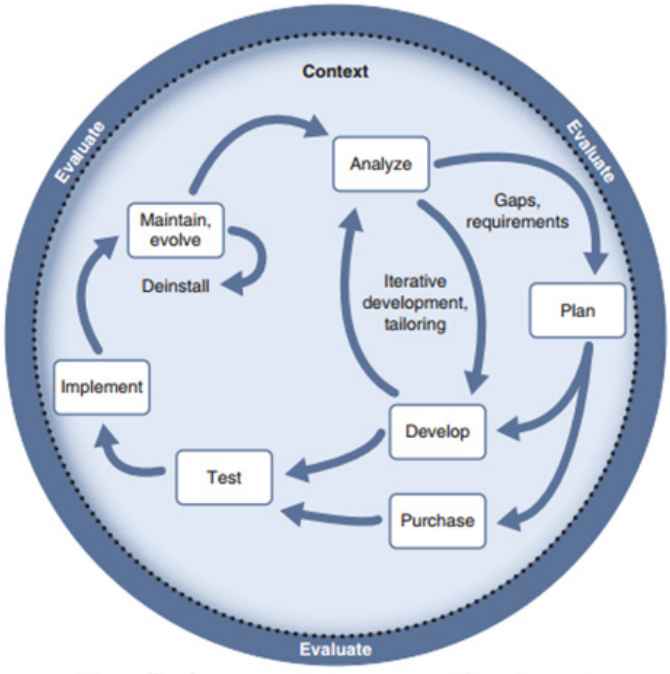
- insufficient government funding;[4]
- poor leadership and planning;[4]
- missing or inadequate health care policies and standards;[16,17]
- escalating implementation costs;[10,13]
- legal complications;[16–18]
- privacy or security concerns;[19–23]
- technical barriers;[24,26-29,34]
- inadequate sustainability planning;[23,30–32]
- user–technology mis-fit;[33,35–38]
- staff resistance;[13,39,40] and
- insufficient training.[38,41–43]

A recurring theme at the meso and macro levels that underlies the challenges to successful implementation of eHealth solutions is inadequate leadership. eHealth solution implementation projects are relatively large undertakings. Therefore, they require strong leadership. Szydlowski and Smith (cited in Delpha) assert that "producing change is approximately 80% leadership—establishing direction, aligning, motivating, and inspiring people—and about 20% management—planning, budgeting, organizing, and problem solving" (p. 57).[40] Consequently, health care leaders have a pivotal role in these projects. If organizations are to realize the intended return on their investments, leaders must be

adequately prepared with the knowledge, skills, and tools to effectively participate in all stages of the project life cycle. Few evidence-based guidelines exist to fill this knowledge gap, so the publication of this Guideline is timely.

The Staggers and Nelson System Life Cycle (SLC) Model (**Figure 1**) identifies the steps involved in an eHealth solution implementation project life cycle.[263] These steps are depicted as a series of seven sequential phases that begin with analysis and then progress through planning, develop/purchase, test, implement, and maintain/evolve phases before returning to analyze. In the SLC Model, evaluation occurs at each phase.[263]

Figure 1: The Staggers and Nelson System Life Cycle (SLC) Model

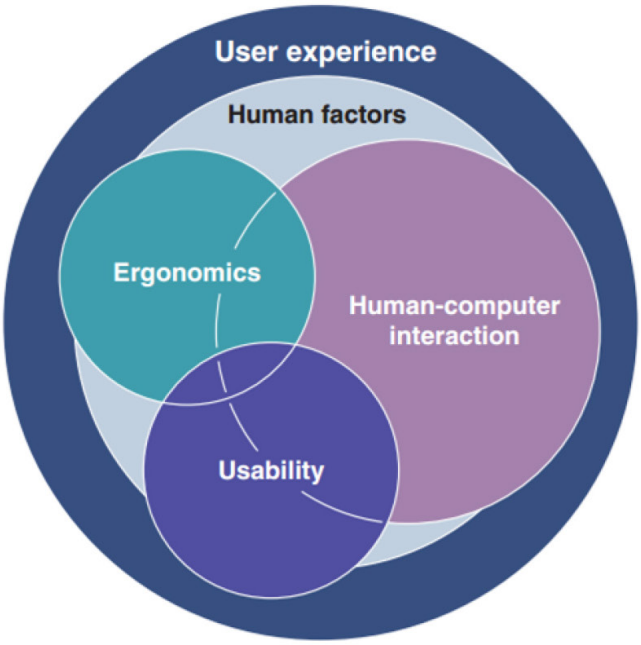


Source: Reprinted from R. Nelson & N. Staggers.[263] Reprinted with permission.

At the micro level, the overarching theme that hinders successful implementation of eHealth solutions is poor user experience. Thus, if health care organizations are to realize the return on their investments in eHealth solution implementation projects, they also must enhance the user experience. The International Organization for Standardization (ISO) 9241-11 defines user experience as a "person's perceptions and responses that result from the use and/or anticipated use of a system, product or service".[45] As seen in **Figure 2,** user experience is a multidimensional concept encompassing human factors, ergonomics, human–computer interaction, and usability.[46]

- Human factors is defined as "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance" (p. 213).[47]
- Ergonomics is an applied science that "promotes a holistic, human-centered approach to work systems design that considers the physical, cognitive, social, organizational, environmental, and other relevant factors" (p. 3).[48]
- Human-computer interaction is "the study of how people interact with computers and to what extent computers are or are not developed for successful interaction with human beings" (p. 34).[49]
- ISO 9241-11 defines usability as the "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use".[45]

Figure 2: The Multiple Dimensions of User Experience



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eHealth solution implementation projects are disruptive in nature and require proactive approaches to enhance the user experience. Harris Decima was commissioned by Canada Health Infoway and the Canadian Nurses Association to conduct a pan-Canadian survey of nurses in 2014.[25] The study found that a high percentage (83%) of the 1,094 clinical nurses who participated in the survey were comfortable using their eHealth solution. Yet, only thirty-eight percent perceived that since the technology was implemented, the productivity and quality of nursing care they provide has increased. Furthermore, fifty-seven percent reported that the eHealth technologies and tools they are using were not adequate for their role.

There were multiple barriers to realizing the full value of their eHealth solution reported by Canadian nurses. For instance, fifty-four percent reported using multiple logins to access different clinical systems. Sixty-one percent were working in hybrid environments using both paper and electronic systems and processes to support their practice. As well, thirty-three percent believed that they had not received adequate training. Regarding nurses' engagement prior to the implementation of an eHealth solution, twenty-eight percent reported that they were consulted "a little". However, the majority, fifty-eight percent, reported they were not at all consulted prior to the implementation. Overwhelmingly, ninety-one percent of nurses providing direct patient care reported that they had little or no influence on the eHealth solution used in their organization.[25]

Internationally, there has been much outcry concerning the negative impact of the current generation of eHealth solutions on patient safety and the productivity of nurses and physicians.[50–52] The Joint Commission (TJC) issued the *Sentinel Event Alert: Safe Use of Health Information Technology* to draw attention to the results of their evaluation of sentinel event reports from January 2010 to June 2013.[52] TJC defines a sentinel event as an incident in a health care setting that compromises patient safety, resulting in death, permanent injury, or severe temporary harm necessitating life-sustaining interventions. Of the 3,375 reports reviewed, 120 were eHealth-related. Factors contributing to these sentinel events were aligned with the eight socio-technical dimensions deemed necessary for safe and effective usage of

an eHealth solution, with more than eighty percent of these factors directly related to usability issues and the overall user experience: human-computer interface (33%); workflow and communication (24%); clinical content (23%); internal organizational policies, procedures, and culture (6%); people (6%); hardware and software (6%); external factors (1%); and system measurement and monitoring (1%).

TJC provided three key recommendations for health care organizations:

1. Foster an organization-wide culture emphasizing the safe usage of eHealth solutions among health professionals and vendors.
2. Proactively enhance internal processes to promote patient safety by ensuring high system and information quality.
3. Ensure **interprofessional**[G] involvement in all phases of eHealth solution implementation projects to identify and resolve risks and inefficiencies prior to the technology being implemented.[52]

The recommendations contained in this Guideline, which were developed by an international and interprofessional panel of experts using a rigorous and systematic process, support the TJC recommendations. For example, the Individual/Organization Recommendations are intended to enhance the capacity of health care leaders and health professionals to strengthen internal processes that promote patient safety and enrich the user experience.

The panel members included health care executives, nurses, and other health professionals from a range of settings (including practice, education, research, and policy). It also included two persons representing recipients of care. All panel members, apart from the representatives of those receiving care, had considerable eHealth expertise; several had previously been actively involved in implementations that resulted in their organizations attaining Stage 6 or higher on the Healthcare Information and Management Systems Society (HIMSS) Electronic Medical Record Adoption Model (EMRAM). The persons representing recipients of care had lived experiences of the health care system and the impacts of receiving care in environments without access to electronic health information.

The expert panel also identified individual, organization, education, and system/policy recommendations that address known micro-level, meso-level, and macro-level barriers to the successful implementation of eHealth solutions. The Individual/Organization Recommendations focus on micro-level and meso-level factors that contribute to the implementation, adoption, and optimal utilization of high-quality eHealth solutions that realize the intended return on investment. The Education Recommendations focus on the eHealth education infrastructure required to facilitate the acquisition of informatics **competencies**[G] by health care executives and health professionals. Finally, the System/Policy Recommendations address the structure, process, and policy requirements at the macro level to realize the long-term goals of nationwide electronic health information exchange and health systems transformation. The processes used for the Guideline development and literature review are detailed in **Appendices B** and **C**.

Individuals, organizations, and health system administrators who adopt the recommendations provided in this Guideline will pave the way for successful eHealth solution implementation projects, defined by McCarthy and Eastman as projects where "the technology works, was implemented on time and within budget, and the people modify their behavior and processes to achieve commensurate value for the investment" (p. ix).[53]

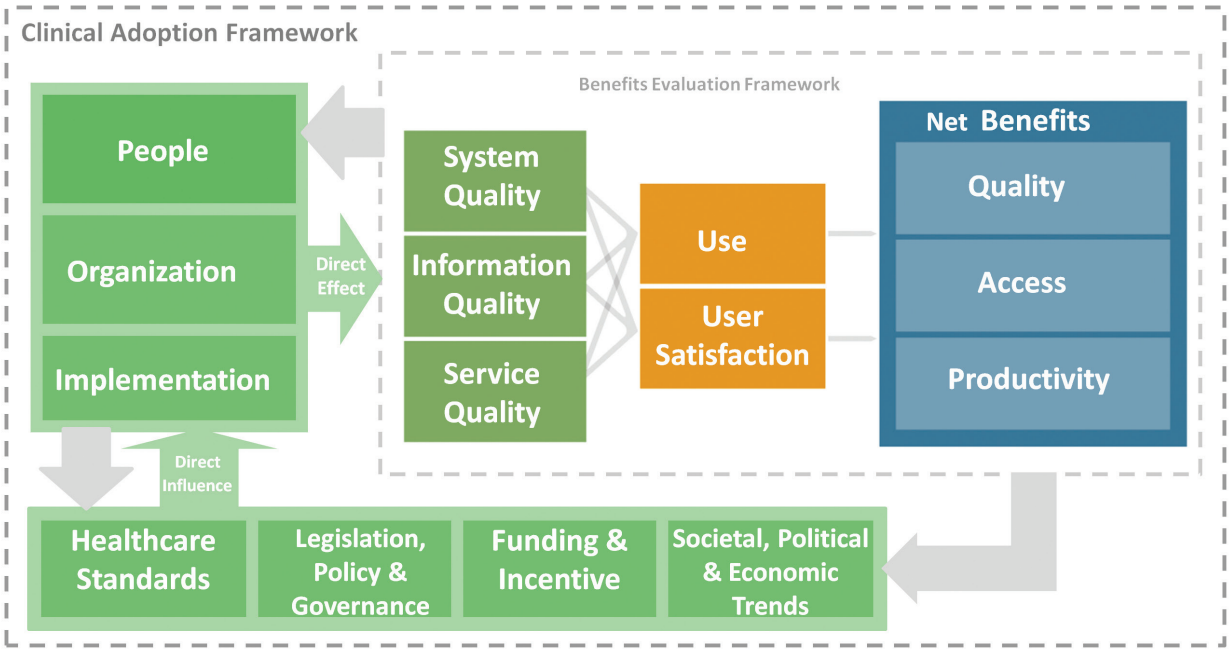
Guideline Frameworks

The following frameworks provide important context for the recommendations in this Guideline.

Clinical Adoption Framework

The Clinical Adoption Framework (**Figure 3**) was used to guide the review of the grey and peer-review literature that provided the basis for the recommendations included in this Guideline. The Framework was deemed suitable for this work because it provides a conceptual model for understanding key dimensions of the implementation context that influence health professionals' successful adoption of eHealth solutions in different settings.[54] These key dimensions are the micro, meso, and macro levels.[54]

Figure 3: Clinical Adoption Framework



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At the micro level, factors that influence the clinical adoption of eHealth solutions include the quality of the system, information, and service; use of the system and user satisfaction with it; and net benefits (interpreted as **quality of care**[G], access, and productivity). Contextual factors at the meso level directly influence the adoption of eHealth solutions at the micro level. These contextual factors include the people, the organization, and the implementation of the technology itself. Environmental factors at the macro level directly influence the degree to which contextual factors at the meso level affect clinical adoption. These environmental factors include health care standards; legislation, policy, and governance; funding and incentives; and societal, political, and economic trends.

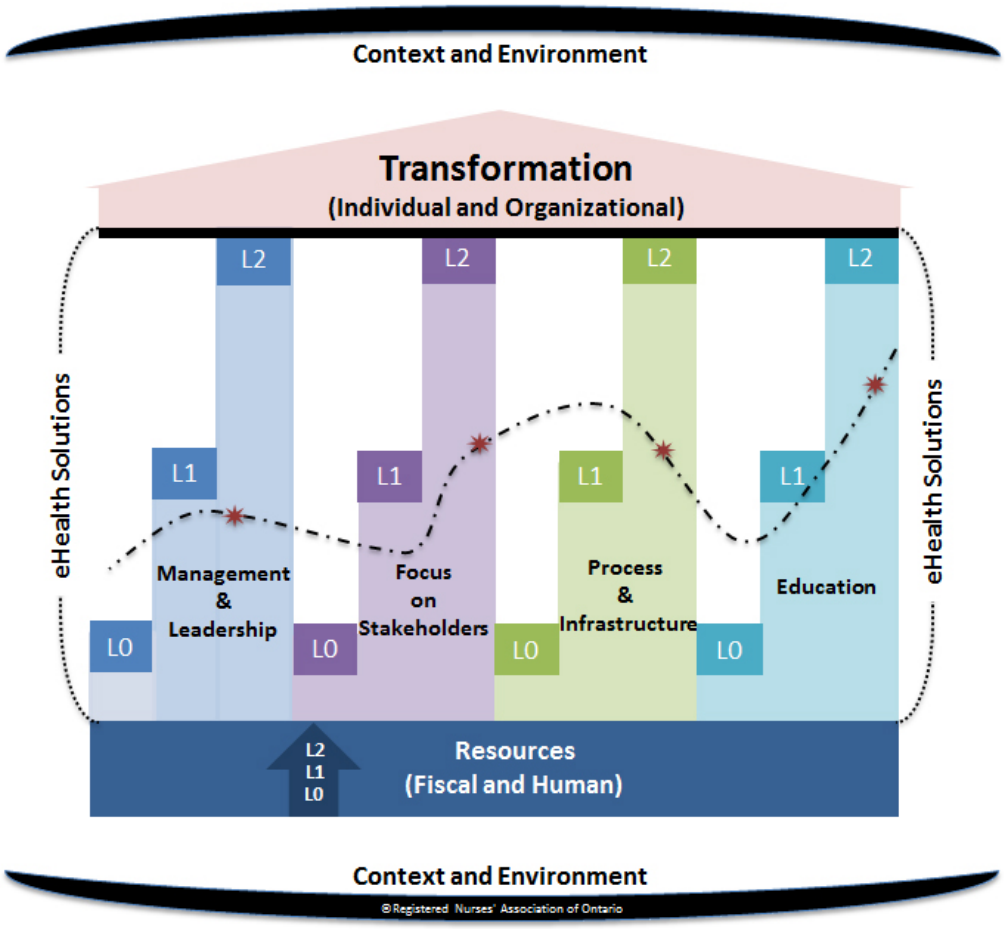
A feedback loop is incorporated at each level of the Framework to inform the adoption efforts at the preceding level. For example, improvements in quality (system, information, or service), user satisfaction, and net benefits will increase clinical adoption at the micro level and inform the adoption efforts at the meso level.

The recommendations in this Guideline address the key dimensions delineated in the Clinical Adoption Framework.

eHealth Adoption Maturity Model

The eHealth Adoption Maturity Model (**Figure 4**) is a conceptual model developed by the expert panel to provide health care leaders, nurses and other health professionals with a visual depiction of eHealth adoption and maturity through the lens of individual and organizational transformation. The Model consists of seven key elements: 1) transformation; 2) management and leadership; 3) focus on stakeholders; 4) process and infrastructure; 5) education; 6) resources; and 7) context and environment.

Figure 4: eHealth Adoption Maturity Model



The following sections describe each of the key elements of the Model and relate them to the recommendations provided in the Guideline.

Transformation

Rather than being merely a technical project, eHealth initiatives constitute significant and meaningful multidimensional transformation over time. Hodges and Gill defined transformation as "the marked change in nature, form or appearance of something" (p. 12).[265] When this concept is leveraged within the context of eHealth, a deeper and more philosophical interpretation of the term emerges. Since eHealth initiatives are primarily designed to help and "support the electronic capture, storage, processing, and exchange of information", the introduction of eHealth solutions into health care environments causes fundamental changes in people, processes, and structures (p. 2).[239] Furthermore, an important aspect of transformation is that once the process is initiated, individuals and organizations will be unable to return to their previous state.

"Individual transformation" refers to the individual forming and restructuring that is enabled by the introduction and sustainment of eHealth solutions in a health care context. Through this dynamic human and technical relationship, individuals are influenced by the newly developing behaviours and abilities afforded by the technology. Maturity of individual transformation is demonstrated when individuals increasingly acknowledge the value of the eHealth solutions, use them in meaningful ways to enhance their work and to foster evidence-based practices.

"Organizational transformation" refers to the marked changes in form and nature that occur at all levels of an organization's environment through the adoption and maturity of eHealth. Organizational transformation is not static, and it may yield a range of multidimensional outcomes. Historically, eHealth has been purported to generate a range of net benefits, such as improved performance, increased innovation, and improved health outcomes. Any dynamic relationship that encompasses both human and technical factors, however, should not be viewed as a unidirectional or a consistently positive experience.

Maturity in organizational transformation is demonstrated when organizations recognize the value of eHealth as a facilitator of safe, high-quality health service delivery, and when the technology becomes integrated within governance structures and related policy.

Management and leadership

For a transformation to occur, eHealth must be enabled and supported by organizational leadership. In the early post-implementation stages, health care leaders may not appreciate the impact of the eHealth solution on health care service delivery and process transformation. As health care leaders mature through the initiation of the transformation process they will begin to view the technology as an enabler and strategic resource for the organization. As their understanding continues to evolve, the eHealth solution will become integral to various health care processes that are occurring in the organization to support safe, effective, and efficient care.

Maturity in management and leadership transformation is demonstrated by the following:

- an executive sponsor is appointed who supports the implementation of eHealth solutions;
- interprofessional leadership teams lead and support eHealth solution implementation projects;
- eHealth is viewed as a core competency for, and by, all users in the organization; and
- transformative leadership facilitates the maturity of the eHealth solution post implementation ensuring successful adoption and sustainability, and ongoing optimization.

Focus on stakeholders

In all eHealth initiatives where humans will use the technology, it is important for health care organizations to incorporate a user-centric perspective. All relevant stakeholders should be identified and afforded the opportunity to assist in the selection, design, testing, and implementation of the technology. Further, it is important to consider the conceptualization, development, and work process redevelopment through a user-centric lens. Depending upon the eHealth solution, its components, and the stage of maturity, the technology may require representation from diverse user groups. For example, the implementation of an eHealth solution requires a focus on physicians, nurses, pharmacists, and other health professionals as well as persons who will receive care. For other eHealth solutions, such as patient portals, health care organizations should focus on persons receiving care as key stakeholders.

Maturity in stakeholder transformation is demonstrated by the following:

- identification and involvement of key stakeholders throughout the eHealth solution implementation life cycle;
- incorporation of user-centered design processes and usability evaluation to optimize human-technical interface requirements; and
- utilization of a user-centric lens that supports the partnership between persons receiving care and their health professionals.

Process and infrastructure

In the initial stages, individuals and organizations may not envision formal techniques (such as change management and project management strategies) as key enablers of the successful implementation of eHealth solutions. As the organization matures, systematic methods often are used to help guide the adoption of these technologies and enable positive transformations. At optimal levels, processes and infrastructure to support the adoption and sustainment of eHealth solutions are well-defined. Policies, procedures, and practices are standardized across the organization using a context-sensitive and purposeful approach. Furthermore, a knowledge management system may be in place to support organizational learning related to eHealth. Formal evaluations also occur throughout the life cycle of eHealth solution implementation projects, with relevant feedback loops to facilitate continuous quality improvement.

Maturity in process and infrastructure transformation is demonstrated through the following:

- business processes (e.g., policies, procedures, and practices) support eHealth;
- workflow and cognitive processes to support decision making and care requirements are examined from an interprofessional perspective;
- infrastructure (e.g., technical infrastructure and knowledge management system) facilitates the effective and efficient use of the technology by end user groups; and
- implementation science and change management knowledge (e.g., usability processes, project management and change management methods) are consistently employed to ensure successful implementation and adoption of the technology.

Education

eHealth education includes awareness of the value of eHealth and its contribution to health care delivery and the organizational strategic goals. eHealth education should be context-specific and sensitive to the individual needs, workflows and role requirements of end users. A maturing health care organization ensures that all stakeholders (e.g., health care executives, nurses and other health professionals, non-clinical staff, and persons receiving care) are supported through education to effectively participate throughout the eHealth implementation life cycle, as required by their role. A maturing health care organization also ensures that ongoing educational opportunities exist to support end user need for continuous learning relevant to rapidly evolving eHealth technology.

Maturity in education transformation is demonstrated by the following:

- clinical education incorporates education on pertinent eHealth solutions;
- on-the-job educational opportunities promote professional growth and development in core informatics competencies;
- performance management systems include tangible demonstration of discipline-specific and **role-specific informatics competencies**[G] competencies; and
- ongoing educational opportunities support end user need for continuous learning to keep abreast of rapidly evolving eHealth technology.

Resources

Fiscal and human resources are foundational to eHealth adoption, meaning that resources must be in place *before* the implementation of the technology may begin. Thus, this element serves as the foundation and prerequisite for the initiation of other Model elements and the larger transformation process. If adequate resources are not available, the core elements and the entire transformation may be negatively influenced or fail to initiate.

Human resources such as super-users and champions can significantly benefit organizations as they introduce eHealth solutions. From the outset of an eHealth solution implementation project, it is important for organizations to identify internal champion resources to:

- fully comprehend the inherent functionality of the technology;
- leverage this in-depth knowledge to contextualize the system design to meet the business and clinical needs of the organization and increase the potential return of the financial investment;
- assume leadership roles to:
  - spread awareness of the eHealth solution implementation project;
  - facilitate diffusion of knowledge and new workflow processes through appropriate staff education and training;
  - ensure ongoing monitoring and evaluation of the system and end user adoption; and
  - monitor the progressive transformation of the organization from Levels 0 - 2.

Maturity in the resource transformation is demonstrated through the following:

- resources exist to evolve and transform fiscal and human capital;
- mechanisms exist to facilitate ongoing optimization and innovation; and
- plans for ongoing operational support and sustainability of the eHealth solution exist to aid individual and organizational transformation.

Context and Environment

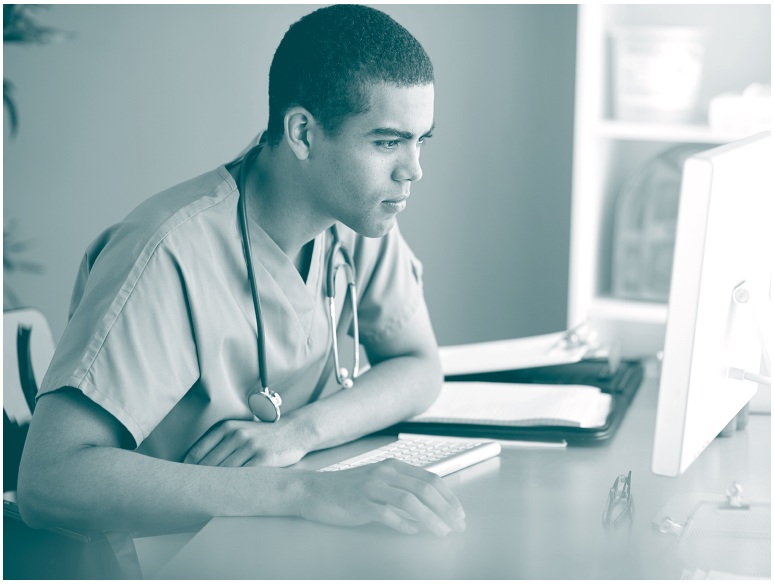
Transformation occurs within a context or environment. The characteristics of the environment influence the technological requirements, the availability and abilities of various Model elements, and the overall transformation process. As seen in **Figure 4**, Model elements may not mature at uniform rates, and they can exist at different levels throughout the process of transformation. As the organization and individuals progressively mature through their adoption of eHealth, some elements of the Model may evolve faster than others resulting in varied levels of maturity by the end of the formalized transformation process.

For each of the Model elements, generic eHealth adoption and maturity characteristics typically seen in health care organizations were identified and categorized along a continuum ranging from Level 0 to Level 2. A brief description of these levels is provided below. More detailed information on each of the Model elements and corresponding levels, and their correlation to the Guideline recommendations is found in **Appendix D** (**Table D1**).

- **Level 0 (Beginning)** is a beginning state of eHealth adoption and maturity where individuals or organizations have little experience, knowledge, or operational commitment in relation to the Model element.

- **Level 1 (Intermediate)** is an intermediate level of eHealth adoption and maturity, achieved by individuals or organizations who have begun their transformation toward using eHealth as a competitive advantage to enhance health service delivery for persons receiving care, and to optimize organizational operations.
- **Level 2 (Advanced)** is an advanced level of eHealth adoption and maturity, achieved by individuals or organization who are fully committed to the use of eHealth as a competitive and foundational driver for their ongoing care delivery and organizational operations.

This information is recognized that not all situations or practice environments have been adequately represented through the generic examples provided in **Table D1** (**Appendix D**). This information should therefore be used as a conceptual taxonomy to view eHealth adoption and maturity as related to transformation, and not as an explicit pathway that is generalizable to all contexts.



1.0 Individual/Organization Recommendations

RECOMMENDATION 1.1:

Health care organizations will ensure visible executive sponsorship throughout all phases of the implementation of the eHealth solution.

Level of Evidence = V

Discussion of Evidence:

In the context of eHealth solutions, the executive sponsor is the person who is ultimately accountable for the successful implementation and adoption of the system.[55] In contrast, sponsorship is a shared accountability that, according to McCarthy et al., encompasses "a set of behaviors and actions" (p. 37).[55] To be effective, sponsorship must be active and visible at all levels of management: executive leadership, mid-level managers, and front-line managers.[40,56] McCarthy et al. assert that sponsorship must begin at the top and cascade down to front-line managers.[55]

Convincing evidence exists in the reviewed **grey literature**[G] that visible executive sponsorship is the single most important factor for ensuring success.[57] Prosci's 2014 edition of *Best Practices in Change Management* is the largest available body of knowledge on best practices in change management.[122] It is a compilation of the findings from eight benchmarking studies involving over 3,400 change leaders in sixty-three countries between 1998–2013. Participants in each of these eight studies consistently identified active and visible executive sponsorship as the greatest success factor.

By virtue of the fact that nursing has the largest number of health professionals, chief nurse executives (CNE) or chief nursing officers (CNO) often assume the role of executive sponsor for large-scale eHealth solution implementation projects.[40,58] However, no studies were found in the peer-reviewed literature that examined the effectiveness of different executive offices serving as the primary executive sponsor in the case of eHealth solution implementation projects. There was mixed evidence from the grey literature.[55,56, 58]

McCarthy et al. purport that the chief executive officer (CEO) should assume the role of executive sponsor for three reasons:

1. The disruptive nature of the project necessitates leadership and guidance from the highest executive office.
2. The extent of resources required for a large-scale project (such as an eHealth solution implementation) can only be authorized by the CEO.
3. Although the chief medical officer (CMO), CNE, CNO, chief operating officer (COO), and chief information officer (CIO) all have important sponsorship roles, it would be a mistake to hold any of these individuals ultimately responsible for an initiative outside of the span of their control.[55]

In contrast, Pitcher viewed the CNO assuming the role of executive sponsor because of the scope of accountability and responsibility inherent in the position.[56] Similarly, Johnson and Dusold provide a case in point involving a large-scale eHealth solution implementation project across 49 hospitals in 12 states in the United States.[58] Each hospital's CNO led

the interprofessional committee that was established to facilitate clinical process improvements, and in many of these hospitals, the CNO assumed the role of the executive sponsor, providing active and visible executive sponsorship.

Delpha described the role of nurse leaders at all levels in large-scale eHealth solution implementation projects.[40] In that context, the CNE worked collaboratively with the other executive officers and nurse leaders, demonstrating visible executive sponsorship throughout all phases of the project.

There is research evidence that shows projects with effective executive sponsorship met or exceeded project deliverables almost 3.5 times more often than projects with ineffective executive sponsorship.[59] Active and visible executive sponsorship encompasses the following behaviours and actions:

- Takes a prominent role in championing the change and motivating others by directly communicating with staff to build awareness in the following ways:
  - articulates the vision;
  - explains the rationale for the change, the significance of the timing, and the anticipated impact to their daily workflow; and
  - outlines their role in contributing to the success of the change.[56,59]
- Builds support for the system throughout all levels of management by explaining the alignment between the system and the strategic goals of the organization.[56]
- Guides the organization through the transition by making effective business and clinical decisions, and by ensuring that the chosen system meets the needs of the organization, the staff, and other key stakeholders (e.g., persons who are or were recipients of care).[40,56]
- Remains accessible during the change by attending regular update meetings and maintaining a clear line of communication with the project and change management teams.[56,59]

According to McCarthy et al., sponsors at the middle- and front-line management levels are equally important.[55] They have a shared accountability for the success of the project and should all be engaged early in the process. Further, they should all ensure that their direct reports are aware of the initiative and adequately prepared for the change. Issues should be escalated up as needed, with positive reinforcements applied as warranted.[55]

RECOMMENDATION 1.2:

Executive leadership will establish a formalized governance structure with defined roles and responsibilities to guide and support all phases of the implementation and adoption of the eHealth solution, in alignment with the organizational culture, goals, and objectives.

Level of Evidence = IV

Discussion of Evidence:

Governance, as it relates to eHealth solution implementation projects, is comprised of the "leadership and organizational structures and processes to ensure that the strategic direction, goals, and objectives" of the system are met (p. 8).[60] An effective governance structure is required to oversee and guide the design, development, implementation, and adoption

of the eHealth solution.[60] A strong eHealth governance structure enhances decision making, improves the alignment between the eHealth solution implementation project and other organizational priorities, and achieves acceptance more easily from stakeholders.[61]

There is consensus in the literature that establishing a formalized governance structure to support the complexities of a large-scale eHealth solution implementation project should be a top priority.[60,62–64] There is no one-size-fits-all governance structure. The grey literature provides some evidence that a robust and dynamic governance structure tailored to organizational culture, goals, and objectives is a key success factor.[61,63,64] Participants in two large-scale implementations in the United States reported that the ideal governance structure for an organization evolves throughout the project.[63,64] Therefore, undue efforts to create a so-called perfect structure in the beginning stages of the project may not be prudent.[63,64] Rather, once the eHealth solution has been selected, a temporary project governance structure should be established.[63,64] A permanent operational governance structure that leverages existing resources and structures is required post implementation to ensure sustainability and to support ongoing maintenance, system optimization, evaluation and quality improvement reporting.[63,64]

Complex eHealth solution implementation projects necessitate governance structures with integrated clinical informatics roles.[220] Clinical informatics is defined by Collins, Alexander, and Moss as "a body of knowledge, methods, and theories that focus on the effective use of information and knowledge to improve the quality, safety, and cost-effectiveness of patient care as well as the health of both individuals and populations" (p. 697).[220] Currently, there is little empirical evidence related to the clinical informatics governance structure and roles that influence the successful adoption of eHealth solutions.[220]

Collins et al. developed a clinical informatics governance structure based on their findings from a cross-sectional study.[220] The study involved 12 health care executives and directors of 12 integrated health systems ranging from 1 to 35 hospitals per system (with an average of 12 hospitals per system). Ten of the integrated health systems had achieved EMRAM Level 6 or higher. The data collected represent the participants' perceptions of the various elements that made their governance structure successful.

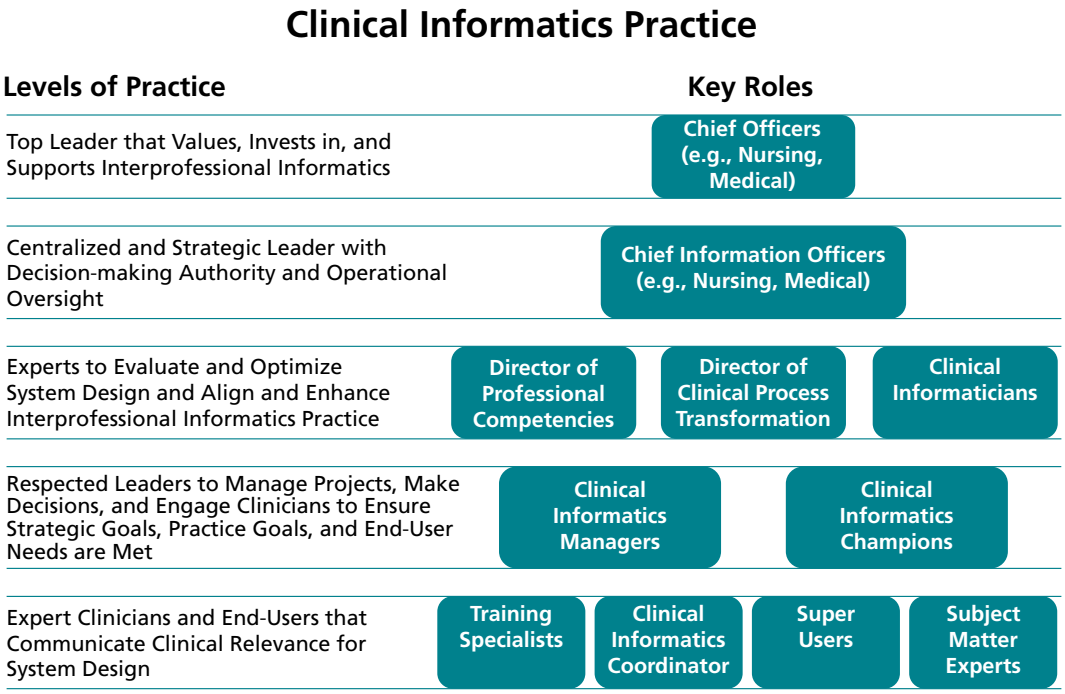
The study identified four major themes that influenced the design of the Model of Clinical Informatics Governance for Nursing:

1. Critical roles and competencies need to be defined.
2. Interprofessional partnerships are vital.
3. Integration of the governance structure within the existing clinical infrastructure facilitates success.
4. Clinical informatics governance is an evolving process requiring periodic re-evaluation.[220]

Based on these findings, Collins et al. developed the Model of Clinical Informatics Governance for Nursing with the following three components: 1) critical roles and the informatics competencies required; 2) critical interprofessional partnerships for each role identified; and 3) an interprofessional clinical informatics governance structure.[220]

The first component is shown in **Figure 5**. It identifies eleven key roles (not an exhaustive list) and the expected clinical informatics practice of each role, stratified within five levels of a health care organization. The Director of Professional Competencies was considered a new and essential role that emerged from the data to establish a program to identify and enhance role-based clinical informatics competencies for employees across the continuum of care.

Figure 5: Model of Clinical Informatics Governance for Nursing: Key Roles



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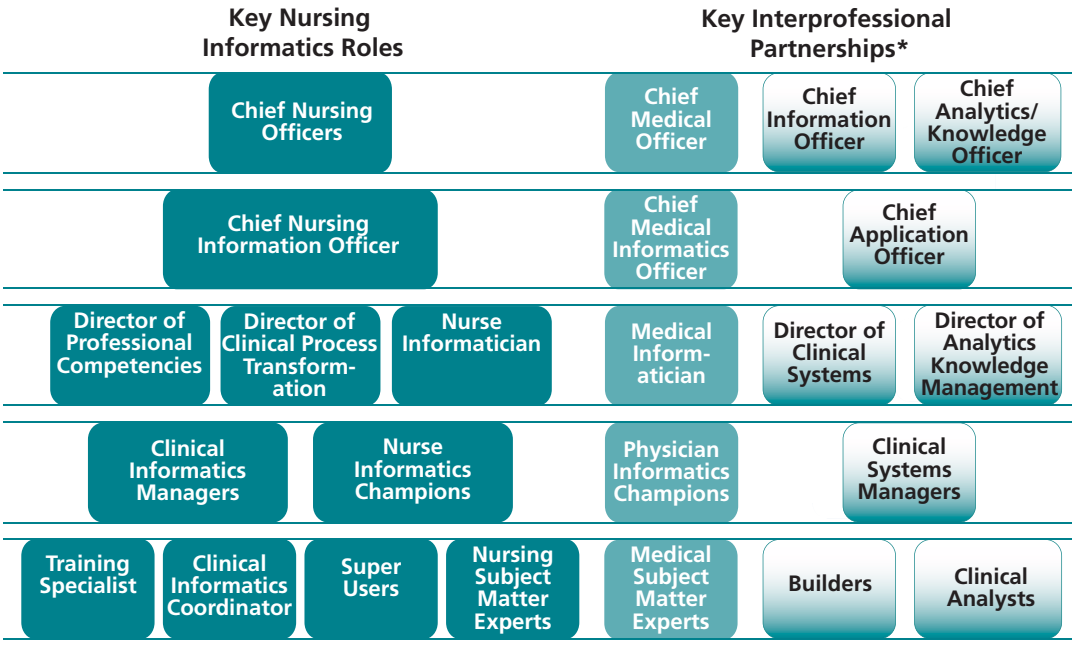
The second component is shown in **Figure 6.** It delineates key nursing informatics roles stratified within the five levels of a health care organization identified in the first component. In addition, it shows key interprofessional partnerships for each of the nursing roles identified.

Figure 6: Model of Clinical Informatics Governance for Nursing: Interprofessional Partnerships



*Example interprofessional partnerships are shown and not intended to be exhaustive of all roles and titles

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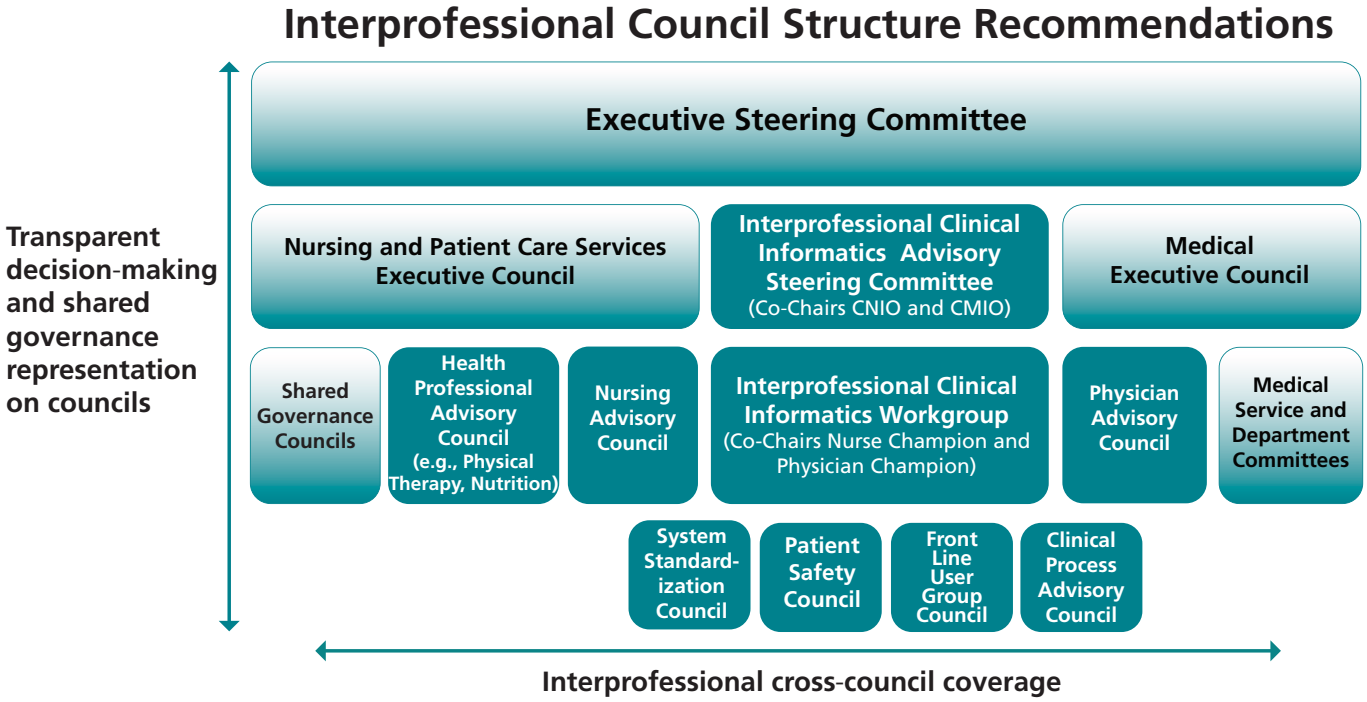
The third and final component of the Model, the interprofessional clinical informatics governance structure, is shown in **Figure 7**. This component demonstrates how the interprofessional clinical informatics governance structure may be integrated within the existing clinical infrastructure of a typical (but simplified) hospital governance structure to form councils. This approach facilitates transparent decision-making and shared governance that ensures successful implementation and adoption of an eHealth solution.

Figure 7: Model of Clinical Informatics Governance for Nursing: Shared Governance Council Structure



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The Model of Clinical Informatics Governance for Nursing reinforces the need for interprofessional governance structures to lead and support eHealth solution implementation projects. The literature reveals that while these interprofessional governance structures are considered a best practice for large health care institutions with access to such expertise and resources, smaller health care institutions typically lack these knowledgeable experts and resources.[238] There is no evidence in the literature concerning best practices for governance structures in smaller health care organizations.[238] In these instances, the expert panel recommends that smaller health care organizations in geographical areas or sectors that do not have access to the key roles identified in the Model replace them with comparable roles that exist in their organizations (where feasible).

A generic project governance structure with corresponding roles and responsibilities is provided in **Appendix E**. It can be tailored to any organizational context and used to guide the formation of the temporary governance structure. **Table E1** (also in **Appendix E**) describes each of the roles shown in the generic project governance structure.

RECOMMENDATION 1.3:

Executive leadership will assess individual, organizational, and technical readiness for the implementation of an eHealth solution.

Level of Evidence = IV

Discussion of Evidence:

Considering that the failure rate of eHealth solution implementation projects is as high as seventy per cent, it is important for organizations to assess their readiness for change.[15] Toure, Poissant, and Swaine defined organizational readiness as "the extent to which organizational members are psychologically and behaviorally prepared to implement organizational change" (p. 168).[15]

An organizational readiness assessment is crucial to the success of a large-scale eHealth solution implementation project.[65] It provides objective information about the organization's knowledge, resources, and structural capacity to succeed with such a large and complex project.[63] A well-executed organizational readiness assessment also can provide insights into the perception of end users and other key stakeholders, gauge their buy-in, and help identify areas of weakness that need to be addressed to ensure success.[65]

There is moderate evidence from the peer-reviewed literature—as well as evidence from the grey literature—suggesting that by conducting a readiness assessment, organizations can positively influence their implementation strategy and subsequent adoption.[15,63] For example, Culler et al. identify readiness to change among staff as the most significant facilitator of the successful implementation and subsequent adoption of a pharmacy information system.[67] This finding accentuates the importance of identifying the readiness of all stakeholders before implementing an eHealth solution.

A qualitative study identified the CNE as a key participant in the pre-implementation organizational readiness assessment.[73] Nurses and other health care professionals also can play a critical role in assessing the preparedness of their units or other working environments, the attitudes of their peers, the readiness of the organization, and the benefit of the technology.[73] Involving health professionals in this process will benefit organizations and increase their understanding of their unique needs prior to the implementation of the eHealth solution.[73]

Similarly, the findings from an observational study provide evidence of moderate quality suggesting that organizations that conduct a pre-implementation multidimensional readiness assessment can positively influence the deployment and subsequent adoption of their eHealth solution.[15]

In the context of eHealth, organizational readiness is a multidimensional concept comprised of individual, organizational, and technical readiness.[39,66] Each of these dimensions is further explicated below.

Individual Readiness

An assessment of individual readiness focuses on the people in the organization. It targets all potential end users (e.g., administrative staff, management, and health care professionals).[15] This assessment determines staff readiness in terms of motivation, perception, and competencies.

- *Motivation.* Motivation to change is a facilitator of eHealth adoption.[24,67,68] Beliefs and attitudes towards eHealth and change among staff therefore are important factors to consider in relation to their intention to adopt the system.[69]
- *Perception.* Important associations are made in the literature between end user perception and the adoption of eHealth solutions. The following end user perceptions are thought to influence adoption of the eHealth solution:
  - perceived usefulness and perceived ease of use;[70]
  - perceived value and benefits of the system;[69]
  - perceived behavioural control, normative beliefs, and attitudes;[69] and
  - perception of management support.[71]
- *Competencies.* Technical competencies are identified as facilitators of the adoption of eHealth solutions.[24,72] Technical competencies include previous computer experience, typing proficiency, and general computer skills.[24,72–74] Assessing technical competencies of staff enables organizations to identify gaps in their knowledge, skills, and abilities that need to be addressed during the planning and implementation phases of the initiative.[15]

Organizational Readiness

The organizational readiness dimension focuses on the organization's structure and processes. This dimension provides information to enable the executive leadership to determine the degree to which the existing structure and processes (e.g., policies, procedures, and resources) support the planned implementation of the eHealth solution, and it helps them take appropriate action to ensure that all requirements are met (if necessary).[75]

Technical Readiness

A technical readiness assessment evaluates the technical infrastructure.[75] This assessment determines the adequacy of the existing technical infrastructure in terms of hardware, software, security, technical support, and maintenance protocols.[75]

Assessing organizational readiness for eHealth would best be accomplished using a structured tool with proven validity and reliability. There is, however, a paucity of such tools. Two tools were identified in the reviewed literature: the Organizational Information Technology/Systems Innovation Readiness Scale (OITIRS) and the eHealth Readiness Measure.[15,76] The OITIRS is a valid and reliable tool that has been used to assess the readiness of three hospitals for a CPOE implementation.[76] The eHealth Readiness Measure was used to assess organizational readiness for eHealth in a rehabilitation center.[15] The validity and reliability of this tool is unknown.

In the reviewed literature, most organizations conducted their readiness assessment before initiating the system selection process.[15,75] Thus, organizations are encouraged to employ a similar strategy. If the assessment reveals a lack of readiness, it is advisable to postpone the implementation of the eHealth solution and address all problem areas before proceeding.[63,65]

Appendix F (Organizational Readiness Assessment Resources) identifies several other tools that can be used to assess each of the dimensions of an organizational readiness assessment.

RECOMMENDATION 1.4:

Project steering committees will establish an interprofessional team including representation from persons who are/were recipients of care to identify and select an eHealth solution to support the organization's strategic vision and plan. A systematic process that encompasses the use of a decision matrix and structured evaluation guide is recommended

Level of Evidence = V

Discussion of Evidence:

Craven et al. provide strong evidence from peer experts participating in their qualitative study that the process used to select an eHealth solution is the most important facilitator of implementation success.[62] Holzmacher describes the project steering committee as an essential component of the eHealth solution selection process.[80] Holzmacher further suggests the need for an interprofessional steering committee with board members included in its membership to ensure alignment between the eHealth solution selected and the organization's strategic vision and plan.[80] It also was suggested that the membership include representation from all departments, programs, or services that will be impacted by the new system. This includes clinical, business, finance, and technical divisions, as well as representatives from persons who are or were recipients of care.[80]

Hunt et al. identify the formation of the eHealth solution selection team as an important task of the project steering committee.[114] They recommend a small, dedicated interprofessional team of full-time members and ad hoc members who can be added to the team as the need arises. **Table 1** (developed by the expert panel) provides one example of an eHealth solution selection team with this structure.

Table 1: eHealth Solution Selection Team Representation

eHEALTH SOLUTION SELECTION TEAM REPRESENTATION	
Full-time members: ■ Frontline health professionals (especially nurses) ■ Physicians ■ Health professionals with expertise in computer systems or informatics (especially nurses) ■ Professional practice leadership (e.g., advanced practice nurses and clinical nurse specialists) ■ Individuals from all ancillary departments impacted (e.g., radiology, diagnostic imaging) ■ **Health information technology professionals**[G] ■ Health information management professionals	Ad hoc members: ■ Board of directors members ■ Department/program/service managers ■ Contract negotiation specialist ■ Legal advisor ■ External partners (e.g., persons who are or were recipients of care) ■ Administrators (e.g., patient registration staff)

Selecting an eHealth solution involves identifying a system that is closely aligned with the specific needs of the institution and the end users.[77,78] Representatives from all end user groups, especially frontline health professionals, therefore must be involved in every step of the process.[62,77–79] The steps in the eHealth solution selection process are listed in **Appendix G** (see **Table G1**).

A major step in identifying the requirements of the new or upgraded system is the assessment of the organization's current state and needs.[44] Using the results of this needs assessment, the eHealth solution selection team can identify the system features that are "required" and those that are "optional". They can then prioritize them using a weighted numerical scoring system (such as a 1–10 scale, where 10 indicates what is most important).[80] **Table 2** (developed by the expert panel) illustrates a weighted numerical scoring system that rates the functionalities of an electronic documentation system under consideration.

Table 2: Weighted Numerical Scoring for An Electronic Documentation System

Electronic Documentation System Functionalities	Required/ Optional	Weighted Score
Supports interprofessional documentation	O	7
Captures and displays allergy information	R	10
Automatically scores assessment tools (e.g., Braden Scale)	R	10
Generates reminders of outstanding assessments	R	10
Calculates fluid balance for each shift and 24-hour period	R	10
Generates and updates the interprofessional care plan	R	10
Summarizes health information to support shift handover	O	8
R=Required; O=Optional		

The findings from a study of moderate quality by Boonstra, Versluis, and Vos suggest that successful eHealth solution implementations require the selection of a mature vendor with a mature product and a commitment to provide a system that meets the institution's specific needs.[77] It is therefore important for the eHealth solution selection team to evaluate multiple systems using a decision matrix based on their list of system requirements and weighted numerical scoring system.[44]

The eHealth solution should be designed to support the needs of the health care organization and the end users.[81] There is growing concern, however, about the usability of many systems on the market.[82] A poorly designed eHealth solution can impact productivity, patient safety, user satisfaction, and adoption.[83] Health care organizations are encouraged to employ a proactive approach to safeguard recipients of care and improve the experience of those using these systems.[52] Several strategies are recommended below to mitigate these risks.

First, it is recommended that organizations have a privacy impact assessment (PIA) conducted for the eHealth solution being considered.[234] A PIA helps organizations evaluate the actual or potential negative effects that a proposed eHealth solution may have on a person's privacy.[234] A PIA also determines the extent to which the proposed eHealth solution is compliant with applicable privacy requirements and helps identify possible mitigation strategies to address privacy risks.[234]

Second, organizations should consider incorporating a heuristic evaluation into the eHealth solution selection process.[235] A heuristic evaluation assesses the quality of a user interface by examining its compliance with recognized usability principles; Nielsen's Heuristics are the most commonly used.[235] Carvalho, Borycki, and Kushniruk identified evidence-based, eHealth-specific heuristics that can be used to evaluate the extent to which a user interface can prevent technology-induced errors.[236] The eHealth-specific heuristics evaluate workflow, content, safeguards, and functionality:

- *Workflow heuristics* evaluate the steps required to complete a task.[236]
- *Content heuristics* determine the quality of the information provided by the eHealth solution.[236]
- *Safeguard heuristics* assess the effectiveness of "passive and active decision supports…(e.g., alerts, reminders, [and] laboratory reference range values)" to prevent a technology-induced error (p. 50).[236]
- *Functional heuristics* evaluates the user interface functionality (e.g., the number of clicks and the ability to scroll through screens).[236]

Third, it is recommended that organizations limit their eHealth solution selection process to systems that satisfy national or jurisdictional certification requirements (where available), to enhance patient safety.[72] The formal certification of systems is in its nascent stages in the United States and Canada.[72]

Fourth, the Office of the National Coordinator for Health Information Technology (ONC) recommends that the eHealth solution selection team conduct a reference check for all vendors under consideration.[225] This team is also strongly encouraged to visit existing customers of the vendor to observe the functionality of the eHealth solution and inquire about their experiences with the system (e.g., configuration, customization, and user interface), reporting capability, support (during and after implementation), and end user adoption.[62]

Fifth, organizations should consider conducting a usability evaluation of the eHealth solution under consideration prior to making the final decision.[235] A usability evaluation determines end user satisfaction with the eHealth solution, and the effectiveness and efficiency with which they can achieve a specific set of tasks using it.[237] A formal, professional, and in-depth usability evaluation may not be feasible for some organizations, however. In these instances, the resource *Selecting an EHR for Your Practice: Evaluating Usability* (available on the HIMSS website: http://www.himss.org/selecting-ehr-your-practice-evaluating-usability-himss) may be beneficial.[79] It provides fundamental steps to include in the eHealth solution selection process to evaluate usability based on current recommendations and best practices. It also includes usability questions that can be included in a request for proposal (RFP).

Some jurisdictions have pre-written statements that can be integrated into an RFP or request for information (RFI) to support interoperability with jurisdictional systems. Organizations should consult their jurisdictional eHealth agencies for this information. For example, health care organizations in Ontario should review the eHealth Ontario Connectivity Strategy and the document *EHR Connectivity Requirements for Point of Service (POS) Procurements*.[262] In some instances, it may be prudent to have an RFP reviewed by a jurisdictional representative to ensure jurisdictional and cross-jurisdictional interoperability. The ONC document *EHR Contracts Untangled: Selecting Wisely, Negotiating Terms, and Understanding the Fine Print* provides additional information on the requirements to facilitate interoperability, in Chapter 5: Fostering Interoperability and Integration.[84] Additional information on these two documents is provided in **Appendix G** (see **Table G4**).

Appendix G (Resources to Support the Selection of eHealth Solutions) also contains information on the following:

- sections of an RFI (**Table G2**);
- major components of an RFP (**Table G3**);
- RFP template (**Table G4**);
- list of eHealth solutions certified by Canada Health Infoway (**Table G4**);
- vendor reference checking (**Table G4**); and
- vendor evaluation matrix tool (**Table G4**).

RECOMMENDATION 1.5:

Contract negotiation teams will collaborate with the project steering committee to support and inform the licensing agreement negotiations and to ensure that the terms and conditions discussed during the eHealth solution selection process are included in the contract.

Level of Evidence = V

Discussion of Evidence:

Contract negotiation is a critical component of the eHealth solution selection process.[84] There is grey literature support for health care organizations employing a contract negotiating team with the requisite knowledge and expertise to assess and negotiate software licensing agreements with vendors.[44,85]

Christiansen asserts that the negotiating team composition may vary depending on the organization and the governance structure.[85] In larger organizations, the negotiating team may be at the executive level, with a composition similar to that shown in **Table 3**.

In other organizations, the designated contract negotiation team may be at a lower level and include a project lead and IT representation. When the contract negotiation team is not at the executive level, the designated team works with the vendor to tailor the contract terms and conditions to the organization prior to it being signed by an executive with the appropriate authorization (e.g., CEO, CIO, or CFO). In any case, the contract negotiation team should collaborate with the steering committee and eHealth solution selection team during the contract negotiations to ensure that the offered contract includes all the elements specified in the RFP and discussed during the selection process.[44]

The importance of ongoing collaboration between the negotiating team and representation from the stakeholder groups impacted by the implementation of the eHealth solution is accentuated in a study by Sheikh et al.[179] In that qualitative case-based study of moderate quality, the researchers examined the implementation of the National Health Service England (NHS England) Care Records Service in early adopter hospitals. They reported that the implementation had progessed much more slowly than expected, with a narrower scope and significantly less clinical functionality than originally envisioned. Major contributing factors were multiple contract renegotiations and contractual agreements

Table 3: Contract Negotiation Team Composition

CONTRACT NEGOTIATION TEAM COMPOSITION
■ **The CFO.** This person or designed representative represents the financial interests of the HCO. ■ **An attorney.** This attorney should generally understand relevant health care technology, intellectual property rights, and contract law. Experience in software license agreements is essential for proper representation. ■ **THE CIO or designated representative.** This team member understands the relevant technology, including the information systems of the HCO and the licensed software. ■ **Key users.** One or more key stakeholders represent the software users and know what functionality and features are needed or expected by those users. These stakeholders may include a chief medical informatics officer or chief nursing informatics officer for a clinical system and/or clinical executive such as the chief medical or nursing executive. ■ **Contract Administrators.** If the HCO has contract administrators, then one of them may also be on the negotiating team. ■ **Compliance officer.** This officer is needed to make sure that the agreement adequately and properly addresses HIPAA, Stark, anti-kickback, and other regulatory issues and does not include any provisions that could be construed as violating applicable law or patient privacy. ■ **Security Expert.** Software licenses and related services and data storage often trigger security concerns. A member of the HCO's security team should be involved not only to identify security risks in the agreement but to make sure that the agreement proactively address security risks as needed in a manner consistent with the HCO's security policies and practices. **CFO: Chief Financial Officer; CIO: Chief Information Officer; HCO: Health care organization.**

Source: Reprinted from J. Christiansen.[85] Reprinted with permission.

made without adequate consultation with those who would actually configure or use the eHealth solution. The consequences of this approach are captured in the following quote:

> The tensions relating to contracts often led to a rigid focus on a limited set of "deliverables," thereby hindering any attempts at fostering local ownership or meaningful engagement with NHS England staff. There was consequently a lack of attention to more productive deliberations that might have helped to overcome the many challenges that were (inevitably) encountered. Hospitals . . . were hampered by a . . . lack of information about contractual arrangements, and lack of ability to configure the software (constrained by contractual clauses) . . . . nor could they effectively engage in direct communication with the software supplier . . . participants suggested that contracts were focused on the delivery of the product rather than on its quality, the process of delivery, achieving meaningful use, and wider consequences of its implementation (p. 4).[179]

The main components that should be included in a licensing agreement are delineated in **Table 4**.

Table 4: Main Components of a Licensing Agreement

MAIN COMPONENTS OF A LICENSING AGREEMENT
■ Definition of terms ■ Time schedule ■ Scope of the license ■ Scope of use ■ Derivation works ■ Software and SaaS escrow ■ Specifications ■ Software warranties ■ Service level agreements ■ Acceptance ■ Maintenance and support, other services (e.g., implementation support) ■ Revenue recognition and payments ■ Dispute resolution ■ Termination ■ Limitation and exclusions of liability ■ Special clauses - confidentiality, intellectual property infringement **SaaS, Software as a service.**

Source: Reprinted from J. Christiansen.[85] Reprinted with permission.

Information on the following contract negotiation resources is included in **Appendix H** (Contract Negotiation Resources):

- *Contracting Guidelines and Checklist for EHR Vendor Selection*
- *EHR Contracts: Key Contract Terms for Users to Understand*
- *Health Information Technology Toolkit for Physician Offices*
- *EHR Contracts Untangled: Selecting Wisely, Negotiating Terms, and Understanding the Fine Print*

RECOMMENDATION 1.6:

Project managers will use formal project management methodology to guide the implementation of the eHealth solution.

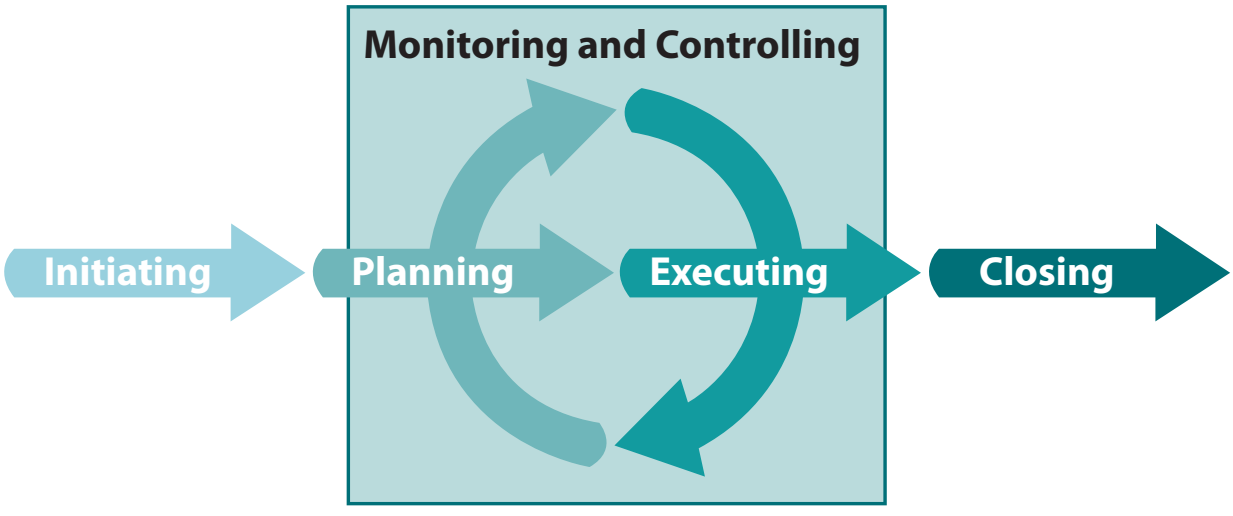
Level of Evidence = III

Discussion of Evidence:

The increased demands for effectiveness and efficiency in the implementation of eHealth solutions necessitates the use of best practices and individuals with the right knowledge, skills, and abilities.[52] An evidence-based technical report prepared for the U.S. Department of Health and Human Services (HHS) to disseminate best practices in the implementation of eHealth solutions highlights the need for a strong project manager to provide oversight for these large-scale initiatives.[65] A project manager serves as the bridge between senior management and other stakeholders, playing a key role in ensuring that the eHealth solution is deployed on time and on budget.[86]

Several studies in the reviewed literature support the use of project management methodology to increase effectiveness and efficiency in the implementation of eHealth solutions.[87–89] Safdari, Ghazisaeidi, and Jebraeily conducted a cross-sectional study of moderate quality to identify critical success factors influencing the implementation of eHealth solutions from the perspective of various stakeholders (including senior management, health professionals, and health information technology professionals).[88] The highest-rated critical success factor was project management. In a systematic review of weaker quality, Sadoughi, Kimiafar, Ahmadi, and Shakeri also reported that the use of formal project management methodology was listed as a success factor for the implementation of eHealth solutions.[89] Similar findings were reported in another systematic review that explored the lessons learned from eHealth solution implementation projects in seven countries.[87] In that study, the researchers concluded that the literature supports the use of project management techniques to increase the success rate of eHealth solution implementations. Given this evidence, it is recommended that project managers who lead the implementation of eHealth solutions have expertise in project management methodology.

Figure 8: Project Management Phases



Source: Reprinted from M. Mills.[92] Reprinted with permission.

The Project Management Institute (PMI) is recognized globally as a leader in project management standards.[90] PMI defines project management as "the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements."[91] Project management is invaluable for large-scale eHealth solution implementations, as it provides a structured methodology for planning and guiding each phase of the project.[92] Further, project management has been shown to improve the outcome of eHealth solution implementation projects through the efficient and effective use of resources, ensuring that projects are completed on time and within budget.[92]

Project management encompasses five process groups or phases: initiating, planning, executing, monitoring and controlling, and closing.[91] **Figure 8** shows the relationships among these phases, each of which has prescribed activities that must be completed before the next phase is started.[92] The one exception is the monitoring and controlling phase, which spans both the planning and executing phases.[92] A description of each phase and the corresponding activities are provided in **Table 5**.

Other essential competencies for the project manager include managerial, technical, and negotiation skills.[86] Ideally, the project manager uses a participatory management style to create an empowering work environment in which to plan, motivate staff, engage external and internal contacts, coordinate project activities, communicate with stakeholder groups, and resolve issues.[78]

A key responsibility of the project manager is to create a comprehensive project plan that includes the following:

- an implementation strategy;[56,93,94]
- a detailed implementation roadmap;[88]
- realistic timelines;[58,95]
- resources;[95] and
- a comprehensive budget.[62]

Each of these components of the project plan is described below.

Implementation Strategy

Selecting the appropriate implementation strategy is essential to success. There are two implementation strategies used for the deployment of eHealth solutions: 1) a "big bang" approach, and 2) an incremental or phased approach.[56,87] The "big bang" approach consists of simultaneously deploying the system organization-wide for immediate utilization by all relevant end users.[56,87] According to Pitcher, the advantages of this approach include "short-term use of human resources . . . less support needed for highly integrated legacy systems and decrease in 'scope creep' or second-guessing" (p. 33–34).[56] A disadvantage of this approach is that it can overwhelm end users, which could affect user acceptance of the new system.[56] The incremental or phased approach is a more conservative implementation strategy, where the system is deployed to end users in planned stages.[56,87] The advantages include a more manageable implementation, less intensive staff training, and increased time for end users to develop the required technical competence.[56] The disadvantages include working in a hybrid environment and the possibility of implementation fatigue.[56]

A number of studies recommended the incremental approach.[87,93] A strong literature review identified incremental and non-mandatory change as one of the elements for a successful eHealth implementation.[93] Furthermore, a literature

review of weaker quality identified three studies recommending the incremental approach for large organizations with complex processes.[87] The grey literature provides an example of a health care organization where the implementation strategy was a combination of both methods (which is referred to as a "mini-big bang in a phased approach").[56] In this modified approach, the implementation was limited to a self-contained area of the organization (i.e., one nursing unit).[56]

Table 5: Project Management Phases and Activities

PROJECT MANAGEMENT PROCESS GROUPS (STEPS)		
Process Group	**Description**	**Activities and Steps**
Initiation	Project managers collect sufficient data to make a determination about the viability of a project and to assess what is needed.	■ Define objectives ■ Define scope ■ Define purpose ■ Define deliverables ■ Provide financial and human capital estimates ■ Obtain necessary approval and funding ■ Create project proposals
Planning	Project managers collaborate with domain and subject matter experts to create a detailed plan to guide the project team throughout project execution and closure.	■ Create project charters ■ Break down deliverables into workable tasks ■ Create project plan ■ Identify critical work path and schedule ■ Assign resources ■ Create communication plan ■ Identify risks and create risk mitigation plans ■ Create testing plans ■ Create quality assurance plans ■ Create release management plans ■ Create education and training plans
Execution	Staff and vendors begin building the project deliverables and providing them to customers for testing and sign-off. Monitoring and control of the project are significant to ensure the executed plan does not deviate from the original purpose or scope.	■ Complete project tasks ■ Monitoring and control time, cost, quality, change, risks, issues, procurements, customer acceptance, communications, etc. ■ Adhere to plans established in planning phase
Closure	The project is delivered (includes communication with and handoff to operations and maintenance teams).	■ Create ongoing support models for operations and maintenance ■ Document lessons learned

Source: Reprinted from M. Mills.[92] Reprinted with permission.

Detailed Roadmap

Safdari et al. identified the creation of a detailed eHealth solution implementation roadmap as an important element of project management that paves the way for success.[88] A roadmap provides a high-level overview of the project's goals, milestones, and deliverables, with the projected timelines for completion.[96] It also identifies potential risks and dependencies.[96]

Resources

It is important to identify the human, technical, physical, and time resources for each task in the project plan.[39,62,63,93,97] Human resources may include executive sponsors, discipline-specific champions, project managers, informaticians, health information technology professionals, practice leaders, subject matter experts, super-users, and external consultants.[39,62] Additional considerations for human resources include the need for back filling end users seconded to the project.[39] Technical resources may include pre-implementation upgrades, hardware, software, additional equipment, connectivity, and ongoing maintenance.[39,62] Physical resources may include additional physical space, educational resources, and equipment for staff education and training.[68,98] Lastly, time resources might include the time required for system configuration, staff education, system testing, post-implementation support, system optimization, and ongoing staff education.[19,99]

Timelines

The project plan must include realistic timelines for all project activities.[95] Key activities for which timelines should be included are the following:

- pre-implementation upgrades to the physical and technical infrastructure; [88,89,100–102]
- risk assessment;[97]
- system configuration;[62]
- user acceptance testing;[62,94]
- pre-implementation activities (e.g., data migration);[103]
- post-implementation support;[78] and
- project evaluation.[104]

Budget

Large-scale eHealth solution implementations are costly.[23,95,99] Expenses may include the following:

- start-up costs;[23]
- ongoing maintenance costs (e.g., annual vendor fees);[23,105]
- education and training costs;[99]
- costs associated with back filling staff seconded to project working groups or attending education and training sessions;[99]
- consultant fees;[106] and
- costs for additional equipment.[106]

The project plan must clearly itemize these costs in the budget to ensure adequate financial resources are allocated for the project.[23,95,99]

For a list of additional project management resources and templates, please see **Appendix I**.

RECOMMENDATION 1.7:

Project leads will collaborate with the steering committee to ensure that the right people are in the right place at the right time to lead and support various facets of the implementation of the eHealth solution.

Level of Evidence = V

Discussion of Evidence:

Project team composition and competency have been identified in the literature as key organizational barriers to success during eHealth solution implementations projects.[65,107] The reviewed literature supports an interprofessional project team comprised of individuals from diverse departmental backgrounds such as informaticians, health professionals, business analysts, subject matter experts, health information technology professionals, functional/business representation, and vendor representatives.[65] Some project team members will be required on a full-time basis, while others will serve as ad hoc members. **Table 6** provides a list of some potential project roles and their descriptions.

Table 6: Potential Project Roles and Descriptions

Project Role	Description
Chief medical information officer (CMIO) Chief nursing information officer (CNIO)	The CMIO and CNIO serve as a bridge between the health professionals and the IT leadership. The CMIO and CNIO have expert knowledge of clinical workflows and existing systems. They help the project team to understand the potential impact that the eHealth solution might have on existing systems and workflows.
Pharmacy director	The pharmacy director is required for the implementation of eHealth solutions involving computerized order entry, medication administration, and medication reconciliation, to ensure patient safety.
CNE CNO Director of nursing (DON) Director of care (DOC)	The CNE, CNO, DON and DOC serves as a bridge between the health professionals and the project team. The CNE, CNO, DON and DOC also may be required to select champions and/or serve as a champion, depending on the organizational structure.
IT/informatics leadership	IT/informatics leadership plays an important role on the project team. Given their knowledge of existing systems, they will help the team understand the potential impact that the eHealth solution might have on these systems.
Champions	Champions help to gain support for the eHealth solution and serve as a liaison between the end users and the project team, bringing feedback concerning changes to the system or workflows.
Super-users	Super-users are those who receive training to increase their proficiency in using the new eHealth solution, and who actively assist others with on-the-job training and support to increase their level of proficiency.

Project Role	Description
Skeptics	Skeptics are those who habitually express a negative attitude toward the eHealth solution. Including these individuals on the project team will provide more opportunities to sell them on the merits of the system.
Persons who are or were recipients of care	The implementation of an eHealth solution will inevitably impact persons who are or were recipients of care in some way. In some instances, the eHealth solution could detract from the provider-patient interaction. Persons who are or were recipients of care might more readily identify such distractions and their potential consequences.
Legal counsel	Legal counsel may be required to address potential liability concerns (e.g., legal requirements to safeguard the electronic health information).
Subject matter experts	The subject matter expert enhances the project team's competency by providing knowledge and expertise concerning a particular clinical or technical area and existing workflows.
Vendor's project manager and analysts	The vendor's project manager works in partnership with the organization's project manager to ensure shared accountability for the successful implementation of the eHealth solution. Through this partnership, the vendor's project manager facilitates access to analysts with the requisite knowledge of the eHealth solution and implementation strategies to enhance the protect team's competency.
Health information management professionals	Health information management professionals safeguard the integrity, privacy, and confidentiality of personal health information, and they gather and interpret the data on which decisions affecting health services are made.

Source: Adapted from C. Byrne et al.[65] Used with Permission.

It is also critical that the project team be comprised of individuals with the required competencies to lead and support the project.[107] Byrne et al. purports that the project team should collectively possess the following competencies:

- in-depth knowledge of the workflows of all end users and other stakeholders who will be affected by the implementation of the eHealth solution;
- ability to customize and configure the eHealth solution (as required);
- ability to communicate key messages to the end users and obtain feedback;
- ability to facilitate end user education and training; and
- ability to provide end user support during and post implementation.[65]

There also is literature support for project members with both clinical expertise and informatics knowledge (e.g., pharmacy informatics, medical informatics, and nursing informatics).[108] For example, Laurie-Shaw, Taylor, and Roach describe the invaluable contribution of nurses with informatics competencies during the implementation of an eHealth solution.[108] In that case, the nurses "combined their clinical knowledge with an understanding of the information requirements of nurses and the use of technology in the nursing environment" to positively influence the design of the system and increase adoption (p. 51).

The project lead will work in collaboration with the steering committee to establish this diverse project team. It might be necessary to negotiate the secondment of resources deemed most qualified for specific roles in terms of their knowledge, skills, and ability, as well as their capacity to represent particular stakeholder groups.[65] Project members who are held in high regard by their peers will be invaluable to achieving their buy-in.[65]

RECOMMENDATION 1.8:

Project leads will collaborate with the steering committee to identify discipline-specific champions at all levels of the organization (representing each stakeholder group impacted) to build awareness of the system, and promote adoption among their peers and across the organization.

Level of Evidence = III

Discussion of Evidence:

There is general consensus that champions contribute to the success of large-scale eHealth solution implementation projects.[33,37,39,40,77] A champion is defined as a "person who voluntarily takes extraordinary interest in the adoption, implementation, and success of a cause, policy, program, project, or product…[and tries] to force the idea through entrenched internal resistance to change, and…evangelize it throughout the organization".[249] Identifying "local" champions is reported to reduce resistance among staff and promote their engagement and participation.[21,77] Lorenzi, Kouroubali, Detmer, and Bloomrosen purport that clinically-respected health professionals who are tech-savvy and committed to the eHealth solution are the optimal choice for the role of champions.[224]

Several systematic reviews of moderate and weak quality underscore the importance of the champion role in eHealth solution implementation projects.[21,39,77,100] Evidence from three of these studies suggest that it is imperative to identify discipline-specific champions from all levels of the organization to build awareness of the system and promote adoption among their peers and across the organization.[39,73,77] This is hugely significant in light of the diversity of staff within an organization that require workflow changes to successfully adopt a new eHealth solution.[87]

Discipline-specific champions may have a variety of responsibilities, including serving as a liaison between the project team and their peers, contributing to decision making throughout all aspects of system planning and implementation, serving as a super-user to their peers, and coordinating training for their peers.[93,97]

In one case study, nurse champions played an important role in positively influencing the implementation and adoption of an eHealth solution. Nurse champions had the opportunity to work at the individual and team levels to support the unique needs of their peers as they incorporated changes in their practice, and to help ensure that best practices were maintained throughout the adoption process and over time.[97] Most importantly, nurse champions directly influenced the attitude and perceived usefulness of the technology amongst their peers, which proved to positively affect the successful adoption of the eHealth solution within the health care organization.[97]

RECOMMENDATION 1.9:

Health care organizations will use a formal change management methodology to address the role-specific needs of individuals as they transition from the present to the future state.

Level of Evidence = IV

Discussion of Evidence:

McCarthy et al. defined change management as a structured process designed to address human factors through behaviour change in order to achieve the anticipated benefits.[55] They purport that project and change management work synergistically to realize the successful implementation and adoption of eHealth solutions. A good project management plan establishes the structure to support the change management process required to manage the people side of the change.[53]

There is evidence of strong and moderate quality in the literature that change management positively influences eHealth solution implementation projects.[62,119,120] Craven et al. found that effective change management builds trust and creates buy-in at all levels of the organization.[62] Simon et al. examined the lessons learned from the implementation of a CPOE system in five community hospitals and reported that addressing staff fears of change contributed to the success of their initiative.[120] McAlearney, Hefner, Sieck, Rizer, and Huerta similarly reported that establishing and acknowledging the need for the change management process helped organizations and end users better understand and accept the behaviour changes required to effectively integrate the eHealth solution into daily practice.[119]

Despite these benefits, change management is often overlooked in eHealth solution implementation projects, as evidenced by a recent Canada-wide survey that found only fifty percent of organizations surveyed used a change management methodology.[121] Likewise, an international study found that approximately fifty percent of the participants from sixty-three countries reported that a change management methodology was applied to less than twenty-five percent of the projects in their organization.[122]

A study of global change leaders found that the most prevalent project team structure in use included a change management resource as an integral member of the team.[122] The top competencies of this resource were communication skills, change management competencies, flexibility, and effective interpersonal skills.[122]

Health care organizations are strongly encouraged to use formal change management methodology and a change management framework to guide their change activities as they transition from the present to the future state.[61] The Canada Health Infoway Change Management Network developed a change management framework (**Figure 9**) to address the human factors involved in eHealth solution implementation projects. This framework is comprised of six core change management dimensions: (1) governance and leadership, (2) stakeholder engagement, (3) communications, (4) workflow analysis and integration, (5) training and education, and (6) monitoring evaluation.[61] For more information on each of these dimensions and other change management frameworks and resources, please see **Appendix J**.

Figure 9: Change Management Framework

Source: Canada Health Infoway.[61]

RECOMMENDATION 1.10:

Project leads will develop a stakeholder management plan early in the planning phase to fully engage all stakeholders for optimal implementation and adoption of the eHealth solution.

Level of Evidence = V

Discussion of Evidence:

People are the most important resource in health care delivery systems making user involvement critical throughout all stages of an eHealth solution implementation project.[102] Neglecting to engage end users with the goal of understanding and addressing their unique needs is one of the most common factors contributing to the high failure rate of these types of projects.[30,94,110]

There is strong and moderate quality evidence globally that demonstrates end users are more likely to accept and adopt an eHealth solution when they are involved in all stages of the implementation.[77,97,102,111,112] For instance, Boonstra et al. identified intensive end user involvement in the selection and design of the eHealth solution and the direct involvement of physicians as facilitators of implementation success.[77] Boddy, King, Clark, Heaney, and Mair found that implementation outcomes were dependent on the engagement of stakeholders with the project and their level of support for it.[111] Success factors in that study included allowing stakeholders to interact with each other and with the system prior to the implementation. A national survey conducted in Norway reported that physicians were closely involved in the design of their eHealth solutions from the outset, which contributed to their successful development and diffusion.[113] Two systematic reviews that examined factors influencing adoption of eHealth solution also identified user involvement as critically important.[94,110] Similar findings were reported in a cross-sectional descriptive study that involved participants from teaching hospitals in Iran.[88]

The grey literature identifies stakeholder management as critical to the success of eHealth solution implementation projects.[55] Stakeholders can be internal or external to the organization implementing the eHealth solution.[55]

The following key project stakeholders are identified in the literature.

- *Users.* Individuals who will interact with the eHealth solution to fulfill their job responsibilities (e.g., health professionals, managers, educators, health information technology professionals, and decision support personnel).[55,114]
- *Committees.* Groups of individuals whose mandates might be impacted by the eHealth solution.[55]
- *External stakeholders.* Individuals or groups who might be impacted by the project (e.g., persons who are or were recipients of care) or those who govern policy that influences and could influence the project (e.g., regulatory bodies, professional associations, unions, vendors, or business partners).[55,109]

Stakeholder management is required to fully engage all stakeholders and optimize the project outcomes.[55] Forman described stakeholder management as an iterative process that addresses the needs of all stakeholders throughout the life of the project, using a predetermined plan of action and strategic communications.[109] Effective stakeholder management is contingent upon accurate stakeholder identification, analysis, and engagement.[109]

Stakeholder identification and analysis are foundational to the other dimensions of effective change management.[61] These include communication, workflow analysis and integration, education and training, and monitoring and evaluation.[61] McCarthy et al. recommend that project teams complete a stakeholder identification and analysis early in the planning phase of the project.[55] The stakeholder identification process involves generating a detailed list of all internal stakeholders, beginning with the frontline users and departments impacted, then identifying their managers from the frontline to the senior management levels. The list should also include other individuals, groups, or departments with whom they interrelate. Lastly, those outside of the organization with whom the identified stakeholders interact (e.g., persons who are or were recipients of care, government agencies, or suppliers) should be added to the list.

Stakeholder analysis helps the project team understand the project stakeholders. This step determines how each stakeholder will be impacted by the eHealth solution, and it identifies their level of support and degree of influence to positively or negatively impact the project.[55] **Table K1** in **Appendix K** (Stakeholder Management Resources) provides a stakeholder analysis and segmentation template than can be used to facilitate this process.

A detailed stakeholder analysis enables the team to identify the level of engagement required by each stakeholder. This information is critical for the development of a stakeholder management plan that is tailored to each stakeholder's level of interest and involvement in the project.[109]

Figure K1 in **Appendix K** provides a model for prioritizing stakeholder engagement that is based on their degree of influence and support for the system.[61] In the model, stakeholders are divided into four different cohorts that are used to prioritize engagement strategies and goals.[61] A formal stakeholder management plan should be documented that describes all stakeholders, their degree of power and influence, and key strategies to increase their support and decrease any potential negative impacts throughout the life of the project. A communication plan is required to implement the stakeholder management plan, and the effectiveness of the stakeholder management plan should be evaluated on an ongoing basis.[109]

Please see additional information on the following in **Appendix K** (**Table K1**):

- stakeholder engagement planning;
- stakeholder management plan template;
- stakeholder engagement planning template;
- target audience analysis template;
- communicating with stakeholders;
- force field analysis process; and
- resistance management framework.

RECOMMENDATION 1.11:

Project leads will collaborate with the steering committee to develop and implement a communication management strategy to control the delivery of targeted communication to specific stakeholders using the most effective media at the right times, with built-in channels for feedback. The communication management strategy should be initiated early in the planning phase and updated regularly throughout the project.

Level of Evidence = V

Discussion of Evidence:

Communication failure is one of the greatest threats to an eHealth solution implementation project.[114] Communication management is therefore an important element of change management.[65] Tan (cited in Hunt et al.) defines communication management as the "transmission of data between sources in and around the organization, as well as identification of the forms of transmission data to be communicated and reproduced" (p. 140).[114]

There is supporting evidence that communication is an essential facilitator of the successful implementation of eHealth solutions. For instance, researchers in two studies of strong and moderate quality reported that communication was identified among the top five critical success factors for implementing eHealth solutions.[62,116] Furthermore, a qualitative study of moderate quality found that 45 physicians and other participants from six exemplary health care organizations repeatedly emphasized ongoing, clear, and consistent communication as a critical success factor during their respective eHealth solution implementation projects.[33]

An effective communication management strategy is required to control the delivery of targeted communication throughout the project.[233] An audience analysis is an essential component of an effective communication management strategy. An audience analysis is key to determining the communication requirements of all stakeholders who will be impacted by the eHealth solution, and to developing a plan that delineates how these communication requirements will be addressed.[233]

An effective communication plan helps manage expectations, creates a forum for constructive feedback, and influences attitudes towards the eHealth solution.[33] McCarthy et al. purport that an effective communication plan facilitates the "delivery of planned, consistent, targeted, timely communication to the right groups, at the right times, using the most effective medium with built-in means for two-way communication" (p. 99).[55] They identified the following key components of a communication plan:

- stakeholder/target audience;
- purpose for the communication;
- communication vehicle and delivery method;
- sender and developer of the communication;
- duration and frequency of the communication;
- communication date(s) and timelines;
- communication feedback mechanisms; and
- communication status/comments.[55]

Peer experts in the Craven et al. study recommended that project leads work collaboratively with their project team to develop and implement an effective communication plan.[62] This plan should be developed and implemented at the beginning of the project, and delivered consistently throughout its duration, with the message tailored to specific stakeholders and groups, as needed.[86]

The reviewed literature recommends including the following key messages in the planned communication to help rally the support and cooperation of all stakeholders:

- a clear articulation of the vision of the project;[33,86]
- the project goals, plans, and implementation timelines;[86]
- the rationale for (and benefits of) the project;[33,62,86]
- the impact of the eHealth solution on specific end user roles;[33] and
- the ongoing progress and major changes to the original plan.[86,116,117]

Studies also support incorporating social events into communication plans as a stakeholder engagement strategy and to increase awareness of the project.[62] Examples include the use of a consistent logo and branding for the project, special promotional material, and celebratory events during the kick-off.[62] Various communication channels are identified in the literature such as regular email blasts, newsletters, monthly lunch-and-learns, a countdown clock and a website with live-progress updates.[62,86]

Communication management tools are provided in **Appendix L** (Communication Management Resources).

RECOMMENDATION 1.12:

Health care organizations will incorporate usability processes throughout the implementation and adoption of the eHealth solution to enhance individual and organizational efficiencies, effectiveness, and user satisfaction.

Level of Evidence = V

Discussion of Evidence:

In the context of eHealth solution implementations, usability is often conceptualized in relation to the technology. Despite this focus, usability also encompasses the human interactions that occur with the technology within a particular context or environment.[46, 238] This expanded scope is evident in the ISO 9241-11 definition of usability: "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."[45] The ISO further defined these terms as follows:

- *Effectiveness*. The accuracy and completeness with which users achieve specified goals.
- *Efficiency*. The resources expended in relation to the accuracy and completeness with which users achieve goals.
- *Satisfaction*. Freedom from discomfort and positive attitude toward use of the product.
- *Context of use*. Characteristics of the users, their tasks, and their organizational and physical environments.[45]

Convincing evidence exists in the reviewed literature supporting the potential for usability to be negatively impacted at various stages of an eHealth solution implementation.[115, 228, 238] Walker, Carayon, and Leveson described poor usability as "EHR-related system flaws," which they defined as "any characteristic of an EHR or its interactions with other healthcare systems that has the potential to worsen care quality or health outcomes. Other healthcare systems include individuals, care teams, facilities, policies, care processes, and healthcare organizations" (p. 273).[228] They also posited that "flaws may be introduced during the specification, design, configuration, or continuous-improvement phases of the EHR lifecycle" (p. 273).

Similarly, a recent systematic review by Ratwani et al. examined usability and safety practices and challenges during eHealth solution implementation projects.[238] The researchers concluded that decisions made during the implementation of an eHealth solution may profoundly affect usability and patient safety.

Further, the American Medical Association asserts that not all usability issues are directly attributable to the design of the technology.[51] In some cases, usability issues are the result of "sub-optimal implementation, required by the practice itself or part of an organizational policy (e.g., risk management, institutional liability concerns or inadequate training of users) . . . usability issues may also be due to suboptimal practice workflow processes that have been incorporated into EHRs" (p. 3).[115]

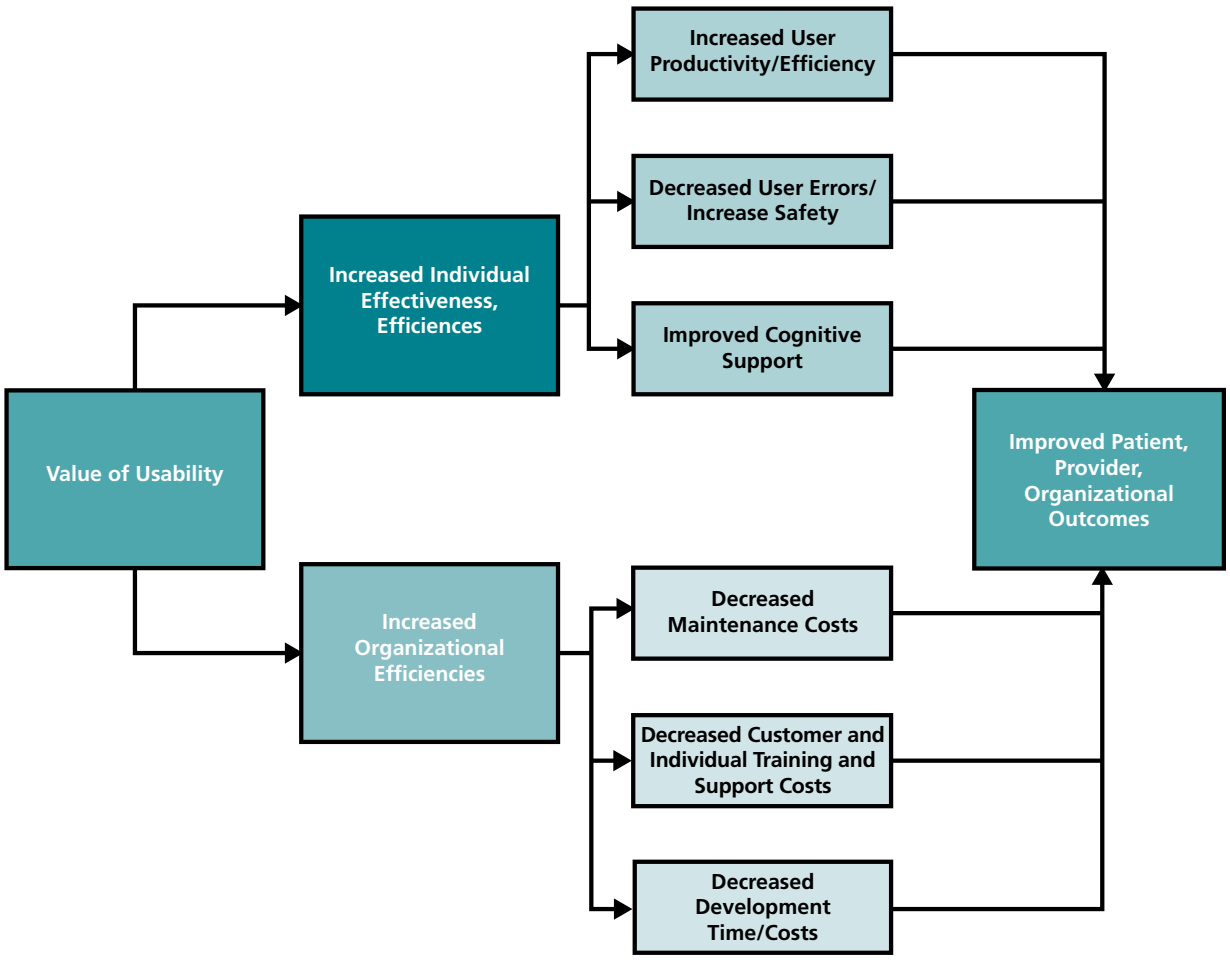
In response to growing safety concerns related to the poor usability of eHealth solutions, the American Medical Informatics Association (AMIA) issued recommendations that addressed four key areas, among them the need for both vendors and health care organizations to promote best practices for the safe implementation of these systems.[195]

Staggers, Xiao, and Chapman concur that vendors have a responsibility for usability as it relates to the system design.[83] However, they emphasize that health care organizations also have a responsibility for usability that is a continuous obligation, beginning with the purchase of the eHealth solution and extending into all others stages of the system life cycle: planning, development (i.e., customization and configuration), testing, implementation, and ongoing monitoring and evaluation.

Health care organizations require staff with usability expertise to integrate usability best practices into all stages of the system life cycle. These individuals could perform workflow analysis and integration, conduct usability evaluation, and influence decisions related to the eHealth solution design and subsequent adoption.[123]

The potential value of incorporating usability into organizational processes for both individuals and organizations is illustrated in the framework shown in **Figure 10**.[123] Usability can potentially increase individual effectiveness and efficiencies in three areas: increased user productivity/efficiency, decreased user errors/increased safety, and improved cognitive support.

Figure 10: The Value of Usability to Health Organizations



Source: Adapted from N. Staggers et al.[123] Adapted with permission.

In the reviewed literature, several studies of strong and moderate quality highlighted negative impacts of eHealth solutions on the effectiveness and efficiencies of health professionals.[20,24,33,62,125] For example, Edwards, Kitzmiller, and Breckenridge-Sproat reported that a significant number of tests commonly ordered by physicians either were not included in the eHealth solution or were built with non-standardized names when the system was implemented, resulting in a loss of productivity.[157] Culler et al. reported that fifty percent of the nurses in their qualitative study believed that the eMAR had increased their risk of making medication errors because the medication times were based on when the pharmacist processed the order instead of when the person who was receiving care actually received the last dose.[67] This flawed design made it necessary for nurses to adjust the medication times manually on a regular basis. The grey literature reports on the case of a teenager who received a 39-fold increase in his usual dose of a common antibiotic.[229] The medication error was attributed to the design of the user interface of a CPOE system that required the physician to convert the usual medication dose (one pill, twice daily) into a weight-based dose (5 milligrams/kilogram of body weight). In this instance, the interface design set off a cascade of events that jeopardized patient safety. To minimize usability issues such as these, HIMSS purports that "usability methods specifically targeted to health IT error reduction are imperative for designing life-critical systems, decreasing user error, and improving patient safety" (p. 16).[123]

Employing usability principles and processes has the potential to enhance productivity and efficiency.[123] Saitwal, Feng, Walji, Patel, and Zhang evaluated the usability of an outpatient system that had been found to have decreased productivity due to usability issues resulting in the number of outpatient visits being reduced from four to three per hour post implementation.[230] The usability evaluation found that the system design incorporated an unnecessarily high number of steps for common tasks, an average execution time that was rated as high, and a large percentage of cognitive operators. The researchers concluded that usability could be enhanced by reducing the number of steps and the percentage of cognitive effort required for the tasks.[230]

In a study by Borycki and Kushniruk, the researchers conducted high-fidelity simulation studies of users (nurses and physicians) of a new medication administration system prior to its implementation.[240] Video and audio were recorded as health professionals interacted with the medication administration system and live simulated persons seeking care. It was determined that the eHealth solution would significantly change the workflow of the end users, resulting in predictable technology-induced errors during emergency situations. The usability evaluation led to system modifications that complemented the workflow of the end users and eliminated the risks to patient safety.

A white paper from HIMSS describes another example in the United States where usability processes were applied to an eHealth solution implemented in a health care organization.[123] The design of the eHealth solution required users to consult various screens to piece together the person's medical status and health care needs. Following a usability evaluation, an electronic summary display was incorporated to support more effective information retrieval and decision making by health professionals.

There is currently no statistical evidence on return on investment for organizational efficiencies resulting from the utilization of usability processes in eHealth solution implementation projects.[123] There is ample evidence from other non-health care settings, however, to suggest that health care organizations that incorporate usability into their processes will realize similar results in the following areas: decreased maintenance costs, decreased customer and individual training and support costs, and decreased development time and costs.[123]

For instance, Pressman (cited in HIMSS) reported that 80 percent of the costs associated with an eHealth solution implementation occurs during the maintenance phase in response to usability concerns attributed to unmet user requirements.[123] By taking a proactive approach to incorporate usability processes early in the project, organizations can significantly reduce maintenance costs.[126] Pressman's point is further supported by a study involving usability testing on an eHealth solution which found that improvements to the user interface resulted in a dramatic reduction in the number of support calls received, which translated into significant cost savings.[126] In another example, a cost–benefit analysis of a new system determined that a well-designed user interface had "an Internal Rate of Return of 32% . . . realized through a 35% reduction in training, a 30% reduction in supervisory time, and improved productivity" (p. 32–33).[126]

Marcus (cited in HIMSS) estimates that the usability cost–benefit ratio varies: correcting a problem during the development is ten times more costly than correcting it during the design stage, and one hundred times more expensive if the system has been deployed.[123]

It is recommended that each health care organization incorporates usability into its processes.[123] **Table 7** identifies various methods that can be used to begin this process. The Health Usability Maturity Model identifies the path to maturity and the five key milestones that organizations need to achieve as they integrate usability into their processes.[123] Each of these milestones or phases provides information to enable organizations to evaluate their level of usability and provides guidance to empower them to move to the next phase. A detailed description of the Health Usability Maturity Model is included in **Appendix M** (**Figure M1** and **Table M1**).

Table 7: Methods for Initiating Usability into Health Care Organizations

Method	Description
"Wake-up call"	A "wake-up call" is an event that is significant enough to warrant a change in organizational directions. The event might be uncovering usability-related errors with patient safety impacts, severe productivity issues or a series of complaints by key clinicians about the safety or usability of an eHealth solution. Individuals can leverage an untoward event to their advantage and keep the momentum toward usability flowing by telling the event story to organizational leaders and proposing recommendations.
Individual infiltration methods	Individuals can educate others, including managers, about usability and interview individuals to uncover usability issues related to their eHealth solution. Available methods to help individuals ease the transition to incorporating usability into eHealth solution implementation projects include: gathering evidence about the need for usability in current projects and helping teams understand usability principles and methods. Individuals will want to keep a ready list of projects and outcomes for easy reference. Telling stories about the impact of projects and leveraging successes can be an ongoing, powerful tactic. A powerful tactic is for individuals to coalesce around critical usability issues, forming a user voice that is not easily ignored.

Method	Description
Finding internal champions	Usability efforts in organizations often begin with one manager or analyst who has an interest in usability. The manager can direct initial projects to include usability methods, gather data about the impacts, and communicate findings to executives for their decision making about expanding usability methods into other projects. Once managers or individuals have the opportunity to speak with executives, presentations should be data-driven, concise, and include specific recommendations. An executive champion for usability can be a key element for making and sustaining change. Most likely, usability will not be the center of an executive's priorities, so concentrate on providing usability values congruent with the organization's mission and priorities. The business values of efficiency, patient safety, and effectiveness will be recognized by executives.
Using external experts as a catalyst	Individuals interested in usability can speak early and often to the consultants and work through them to incorporate usability into their organizations. Usability experts are readily available within and external to health informatics. Organizational leaders may find using external consultants more palatable and quicker than developing internal expertise in usability.

Source: Adapted from N. Staggers et al.[123] Used with permission.

Figure 11 provides additional strategies that can be employed to expand the focus on usability in health care organizations after initial efforts to raise awareness of the value of usability have been achieved.

Figure 11: Expanding Usability within Organizations

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Additional resources to assist health care organizations integrate usability into their processes include the following:

- *eSafety Guidelines*–published by COACH
- Safety Assurance Factors for EHR Resilience (SAFER) guides more commonly known as the *SAFER Guides*–published by ONC

Refer to **Table M2** in **Appendix M** (Usability Resources) for more information on these guidelines.

RECOMMENDATION 1.13:

Project leads will develop a comprehensive education and training plan to enable individuals to learn and integrate the new eHealth solution into their daily routine and workflows.

Level of Evidence = V

Discussion of Evidence:

The education and training of staff is a critical step in the implementation of a new eHealth solution, but it is a complex undertaking.[41,77,127] Training prepares stakeholders impacted by the implementation to use the new eHealth solution and gain confidence with their new workflows.[55] It is the means to a greater goal, and it can only be considered a success if the strategy employed results in successful end user adoption.[65] Several organizations in the studies reviewed attributed their success to comprehensive education and training plans developed to teach staff how to integrate the new system and workflows efficiently and effectively into their daily routine.[41,62,73,77,87,120]

To ensure successful adoption of the eHealth solution, project teams need to develop a comprehensive education and training plan that includes both individual and organizational strategies.[65] McCarthy et al. suggest that the training strategy at the individual level must be "user-centric, meaning that it is role- and workflow-based, not system-based" (p.111).[55] Thus, a comprehensive education and training plan necessitates an assessment of learning needs for specific roles and job functions; the identification of staff who may require some type of pre-implementation training (e.g., basic computer training); and strategies to support the diversity of learning needs throughout the organization.[128-133,136]

There is general consensus in the reviewed literature that the most effective education and training strategies are delivered by the appropriate trainers (e.g., champions and super-users).[130,133,141,142] The literature also recommends multiple and active training approaches (e.g., classroom, simulation, hands-on training, and blended learning).[132,135,137–140] The education and training plan also should include relevant role-based training by integrating realistic scenarios and hands-on practice to help end users gain proficiency with the new workflows and system functionality.[55] In clinical settings, user-centric training is facilitated through the help of health professionals (e.g., physicians, nurses, and super-users) who understand user workflows and can help to tailor the content to reflect relevant clinical contexts.[65]

Key topics to be included in a comprehensive education and training plan are as follows:

- new workflows, processes, policies, and procedures;[97,119]
- system and equipment utilization (e.g., bar code scanner);[97,119] and
- interpersonal communication skills when using a computer.[134,135]

Post-implementation support is integral to successful adoption.[128,133,137] Boonstra et al. emphasize the importance of peers and super-users providing real-time support to optimize effectiveness and efficiency.[77] The ultimate goal of post-implementation support is self-sufficiency.[55]

Optimal adoption of an eHealth solution does not occur by chance. It requires the commitment of end users and organizational leadership.[65] To be successful, the comprehensive education and training plan must be supported by organizational strategies, including visible leadership support at all levels, investments of adequate human and financial resources, and adequate time allocation for the staff to learn the system.[97,128,130,133,142]

For a list of resources to support the development of a comprehensive education and training plan, please see **Appendix N** (Education and Training Resources).

RECOMMENDATION 1.14:

Project leads will collaborate with the steering committee to identify key indicators for monitoring and evaluation and use a comprehensive evaluation framework to guide the project evaluation.

Level of Evidence = III

Discussion of Evidence:

Monitoring and evaluating are important components of project and change management.[61,143] The International Labour Organization (ILO) describes monitoring as an ongoing process that measures specific indicators to track the extent to which a project has achieved its planned or intended results.[143] Monitoring is an essential project and change management tool that: (1) facilitates effective resource management, (2) identifies areas requiring corrective action, and (3) assists with status reporting to relevant stakeholders.[143] Monitoring—which is concerned with activities, outputs, and resources—has a narrower focus than evaluation.[143]

ILO defines evaluation as "an assessment of an intervention, focusing on what worked, what didn't work, and why this was the case. The evaluation process also examines if the best approach was taken, and if it was executed in an optimal fashion" (p. 144).[143] Within the context of eHealth solution implementation projects, evaluations can assume various forms and be conducted during different phases of the project.[143]

Ideally, considerations for evaluation should begin during the project design stage and carry through to the post-implementation stage. Depending on their timing, evaluations may be used to inform future phases of the project (e.g., formative evaluations). Evaluations performed later in the project (e.g., summative evaluations) may serve accountability purposes by examining and reporting specific outcome metrics and lessons learned to relevant stakeholders (such as project funders and partners). The acronym METRIC—Measure Everything That Really Impacts Customers—can be used to help identify evaluation priorities.[145] In the context of eHealth, the term "customers" refers to all stakeholders, including persons who are receiving care, health professionals, health care leaders, and health care organizations.

The literature supports the need for all eHealth solution implementation projects to be formally evaluated using a comprehensive evaluation framework.[65,89, 231] Despite this, there is a paucity of evidence in this area. Multiple

researchers have described the challenges associated with the evaluation of eHealth solution implementation projects and the problems resulting from studies not guided by a comprehensive evaluation framework.[231] Nykänen and Kaipio analyzed the scope and quality of evaluation studies conducted within the last fifty years.[231] They concluded that many of these studies had design flaws attributed to the evaluation methods employed. Given the complexity of the health care environment, the variety of users, uses and practice settings, the researchers emphasized the need for "systematic approaches and guidelines to design and to carry out different kinds of evaluation studies to provide evidence about the impacts and actual efficiency, quality, usability and safety of health IT" (p. 295).[231]

Sadoughi et al. reported on the popularity of the DeLone and McLean Information Systems (IS) Success Model for evaluating eHealth solution implementation projects.[89] They concluded that the model lacks important factors that influence the outcomes of eHealth solution implementation projects, such as executive leadership support, user involvement, culture, and organizational characteristics. The model therefore does not provide a bone fide comprehensive evaluation framework. Canada Health Infoway's Benefits Evaluation (BE) Framework, which was adapted from the DeLone and McLean IS Success Model, was intended to provide "a conceptual model for understanding the quality, use and net benefits of HIS adoption within health care organizations…. However, it was originally based on a stable business IS environment and did not take into account the organizational and societal contexts involved" (p. 40).[54]

Given the complexity of eHealth solution implementations, the relatively high failure rate (as high as seventy percent), and the myriad of factors that may contribute to their success or failure, it is important for the project evaluation to be guided by a comprehensive evaluation framework to objectively identify factors that contributed to the outcome achieved.[15,89,146] In the reviewed literature, one comprehensive evaluation framework was identified: the Clinical Adoption Framework.[54] This multidimensional framework provides three conceptual views of key factors thought to influence health professionals' adoption of an eHealth solution: the micro, meso, and macro views.[54] A high-level description of the Clinical Adoption Framework, which is applicable to different health care settings, can be found in the *Guideline Frameworks* section of this Guideline.

Health care organizations wanting to conduct a comprehensive project evaluation may find the following resources to be useful:

- Monitoring and evaluation structure, process and outcome indicators (**Table 10** (page 78)); and
- **Appendix O** (Project Monitoring and Evaluation Resources).

RECOMMENDATION 1.15:

Health care organizations will have an ongoing post-implementation operational plan that includes data governance structures and processes that support sustainability and continuous optimization of the eHealth solution.

Level of Evidence = V

Discussion of Evidence

The sustainability of end user adoption and utilization of an eHealth solution beyond the initial post-implementation phase is a critical success indicator.[100] The literature identifies numerous factors that influence sustainability.[4,16-43] One study involving more than [100] health care organizations found that the most important sustainability factors for eHealth solutions are health professionals' buy-in and support, tangible benefits, and ongoing operational costs.[105]

A systematic review identified specific technology, human and organization factors that influenced acceptance and thus sustainability of an eHealth solution.[245] In that study, the most frequently reported technology factors positively influencing sustainability were ease of use, system flexibility, relevance of data, ease of access to computers and technical support. Perceived usefulness was the most commonly cited human factor. Organization factors that increased sustainability included the involvement of health professionals throughout all stages of the implementation of the eHealth solution, the supporting clinical processes, and adequate financial resources. Further, the systematic review by Stolee et al. found that good data management practices positively influenced sustained end user adoption.[22] These data management practices included the establishment of data standards and processes for change control, data security and high-quality data. This study also identified two recommendations from the literature to support high data quality: ongoing evaluation and quality assurance plans.[22]

McGrath et al. purport that sustainability requires a process that supports "continuous review and improvement of health service delivery to meet a set of agreed standards" (p. S34).[232] Therefore, to ensure successful end user adoption of the eHealth solution, health care organizations require a post-implementation operational plan that supports sustainability and ongoing optimization.[241]

The expert panel recommends that this operational plan incorporate mechanisms that support:

- continued funding and resource allocation;
- ongoing maintenance of the eHealth solution;
- changes to regulatory and professional standards; and
- practice changes and workflows (e.g., clinical, operational and financial).

The panel purports that strategies to address these aspects of the operational plan include: data governance structures and processes to support continuous quality improvement (e.g. quality improvement plan, clinical content review and change control processes).

Data governance is "the exercise of decision-making and authority for data-related matters".[242] It defines the structure to effectively manage an organization's data from the point of collection in the eHealth solution through to its "aggregation into reporting data stores and warehouses, and finally through its disposal and archiving" (p. 2).[243] Good data governance ensures that "each step of the data management process is controlled and the effects of processes on the data are well documented and understood" (p. 2).[243] For data governance to be effective, HIMSS recommends that its structures should be seamlessly integrated within an organization's management and operational practices to support its overall mission and strategic plan.[244]

Continuous quality improvement (CQI) is a quality management process.[226] CQI involves "using a structured planning approach to evaluate the current practice processes and improve systems and processes to achieve the desired outcome and vision for the desired future state. Tools commonly used in CQI include strategies that enable team members to assess and improve health care delivery and services" (p. 1) [226]

Additional information on data governance structures and CQI is available in **Appendix P** (Resources for Sustainability and Ongoing Optimization)

2.0 Education Recommendations

RECOMMENDATION 2.1:

Health care organizations and academic institutions will establish an eHealth education and training infrastructure that provides opportunities for health care executives, nurses, and other health professionals to develop role-specific informatics competencies.

Level of Evidence = IV

Discussion of Evidence:

Several studies in the literature reported an association between failed implementations of eHealth solutions and inadequate eHealth education and training infrastructure.[17–19,31,38,41,147] These findings are consistent with the World Health Organization (WHO) perspective that eHealth education and training are fundamental components of the infrastructure required to realize a country's national eHealth vision.[148] In keeping with this perspective, it is important for health care organizations and academic institutions to establish an eHealth education and training infrastructure that provides opportunities for health care executives, nurses, and other health professionals to develop role-specific informatics competencies.[129,136]

There is general consensus that health care executives, nurses, and other health professionals require a core set of role-specific informatics competencies that will enable them to use eHealth solutions effectively in the course of their work.[150–152] Internationally, there is some evidence of work being undertaken to develop role-specific informatics competencies.[129] For instance, the *Standards and Guidelines for Electronic Medical Record Systems in Kenya* includes a matrix of mandatory informatics competencies and the required ranges (aware, basic, and advanced) for five specific roles: clerical, data entry personnel (including frontline nurses), data managers, high-level managers, and IT/system support and administrators.[75] The mandatory informatics competencies are general eHealth knowledge, information use, data quality and confidentiality, general EMR system knowledge, EMR system navigation, EMR system maintenance and improvement, and computer literacy. The complete list of role-specific competencies is available in **Appendix Q** (**Table Q1**).

There also is ongoing work in this area in the United States, as evidenced by a recent publication of nurse executive competencies.[164] Additionally, a collaborative initiative between the HHS and NHS England identified role-specific informatics competencies that are reported to be vitally important for the implementation and adoption of eHealth solutions globally.[155] These competencies were derived from existing informatics competency frameworks in the United States and individual European Union (EU) countries. These role-specific competencies are delineated in **Appendix Q** (**Table Q2**).

A noticeable gap in this list of role-specific competencies is the absence of informatics competencies for frontline managers. One study that sought to address this gap in the reviewed literature identified a list of forty-nine core research-based informatics competencies for generic nurse manager positions.[156] **Appendix Q** (**Table Q3**) contains these nurse manager informatics competencies.

In the case of health care organizations, an ideal eHealth education and training infrastructure would consist of the following:

- mechanisms to assess individual informatics skills and training needs;[128,129]
- experienced and knowledgeable training staff;[128,130,133,141]
- flexible and customized training aligned with individual needs and roles;[130–133,136,142]
- diverse delivery modes incorporating active training approaches (e.g., classroom, simulation, hands-on training, blended learning, and e-learning);[135–139,157,158]
- champions and super-users to support peer learning;[141,142] and
- opportunities for ongoing departmental training from the point-of-care through to executive roles to ensure sustainability.[151,155]

In the case of academic institutions, an ideal eHealth education and training infrastructure would consist of the following:

- continuing education programs offering basic computer and informatics training;[129] and
- courses targeting health care executives, nurses, and other health professionals that have incorporated role-specific informatics competencies into the curricula.[151,155]

RECOMMENDATION 2.2:

Health care organizations will facilitate the integration of role-specific informatics competencies within executive and professional practice leadership responsibilities using a shared accountability model.

Level of Evidence = V

Discussion of Evidence:

Health care executive leadership—along with nursing and other health professional practice leaders—have a shared responsibility for the establishment of a work environment that enables staff to satisfy the requirements of their professional standards of practice.[159,160] Many regulatory bodies for nurses and other health professionals have revised their standards of practice to include informatics competencies.[154,161-164] It is therefore vitally important for health care organizations to facilitate the integration of role-specific informatics competencies within their professional practice models.

Similarly, the literature supports the need for health care executive leadership to have expertise in informatics competencies to lead and support the implementation of eHealth solutions in an effective manner.[152,155,164] Thus, it is also essential for health care organizations to integrate role-specific informatics competencies into executive leadership roles and responsibilities.[152,164]

The expert panel recommends using a shared accountability model to accomplish this goal. A shared accountability model would foster a partnership between the organization and its employees that reinforces their mutual obligation to acquire and nurture the required role-specific informatics competencies. This partnership would motivate the organization to provide opportunities and resources to facilitate staff professional development related to these competencies, and staff would be obligated to assume responsibility for their ongoing learning and professional development.

RECOMMENDATION 2.3:

All nurses and other health professionals will assume responsibility for their professional growth and development in informatics competencies.

Level of Evidence = V

Discussion of Evidence:

A growing number of health professionals' regulatory bodies and professional associations have developed discipline- and role-specific informatics competencies to realize the goals of health system transformation. For example, there are informatics competencies for nurses, physicians, pharmacists, nurse executives and health informatics professionals.[149,151,164-168] Furthermore, informatics competencies are being embedded in curricula offered to nurses and other health professionals by academic institutions in Canada and the United States.[165,167–170]

There also are a variety of continuing education opportunities that are offered to develop informatics competencies among nurses and other health professionals. In some cases, eHealth education programs are being combined with traditional discipline-specific curricula at the graduate level.[151] For information on Canadian eHealth education programs or to access an informatics self- assessment tool, please see the Canadian Nursing Informatics Association website (https://cnia.ca/).

Given this paradigm shift, it is imperative that all nurses and other health professionals assume responsibility for their professional growth and development to satisfy the informatics competencies developed by their respective regulatory bodies and professional associations.[165,167,168] This is particularly significant because these competencies are increasingly recognized as a foundational skill set for health professionals, who are required to work in technology-enabled and information-rich practice environments.[165,167,168]

For more information on discipline-specific informatics core competencies, please see **Table Q4** in **Appendix Q** (Role- and Discipline-specific Informatics Competencies).

RECOMMENDATION 2.4:

Health care organizations will facilitate a person's access to health information (personal and educational), empowering them to assume greater responsibility for the self-management of their health and to engage in more informed dialogue with their health professionals.

Level of Evidence = V

Discussion of Evidence:

Hilberts and Gray reviewed the international peer-reviewed literature on the topic of eHealth education and found a prevalent theme that emphasizes the need to acknowledge all end users of eHealth solutions, including persons who are or were recipients of care.[201] There also was some evidence to support alignment of eHealth education strategies with the needs of these stakeholders.

This finding is consistent with the evidence of ongoing work in the United States and EU countries to develop competencies for persons who are recipients of care to enhance their self-management capacity by facilitating their access to electronic health information (personal and educational).[155] These informatics competencies are shown in **Table 9**.

Table 9: Informatics Competencies for Persons Who Are/Were Recipients of Care

INFORMATICS COMPETENCIES FOR PERSONS WHO ARE RECIPIENTS OF CARE
■ Understand how accessing reliable health information online can empower them to take greater control over self-management of their own health and engage in a more informed dialogue with health professionals.
■ Have the capability to communicate with their primary care provider online (for example, to book appointments and request prescriptions).
■ Understand medical terms and language.
■ Understand how their EMR documents their history, treatment, and care plan, and how they can share this information with others.

Source: Adapted from NHS England & HHS.[155] Used with permission.

The increasing reliance on eHealth solutions to provide safe, high-quality, and person-centred care accentuates the need for health organizations to facilitate a person's access to health information (personal and educational), empowering them to assume greater responsibility for the self-management of their health and to engage in more informed dialogue with their health professionals.[155] Further, there is a need for persons we are (or who were) recipients of care to acquire informatics competencies to enable them to effectively interact with the technology and the accessible electronic health information (personal and educational).

3.0 System/Policy Recommendations

RECOMMENDATION 3.1:

National and jurisdictional agencies responsible for eHealth will develop a comprehensive strategy to achieve nationwide interoperability in consultation with representatives from all stakeholder groups, including nurses, other health professionals, the private sector, regulatory bodies, professional associations, and persons who are (or who were) recipients of care.

Level of Evidence = IV

Discussion of Evidence:

A national government responsible for health care generally enacts legislations and establishes policies, guidelines, standards, and funding models to achieve optimal health outcomes.[9] The role of jurisdictional governments responsible for health care often is to implement programs within their geographical areas and to provide funding for operationalizing the national government's vision.[9] Additionally, they actively monitor performance indicators to measure the quality and outcome of health care services provided within their jurisdictions.[9]

eHealth plays a vital role in enhancing the quality of health care management decisions at all levels of the health system.[4] The literature is replete with examples of health professionals and organizations sharing health information electronically to varying degrees within specific geographic locations.[55,171–175] The full value of eHealth will only be realized when national interoperability is achieved.[6,172] Salzberg et al. define interoperability as "the use of technological applications to provide the ability to exchange clinical data across providers, institutions, regions, or jurisdictions" (p. 717).[7] This type of health information exchange is in its infancy in most counties.[172] The national strategy to accelerate clinical interoperability and achieve nationwide health information exchange in Canada is documented in *Accelerating Clinical Interoperability in Canada The Path Forward* (available on the Canada Health Infoway website: https://www.infoway-inforoute.ca/en/).

Several studies of moderate quality report that national and jurisdictional governments play a vital role in realizing the goal of national interoperability.[2,7,12,176] Internationally, governments have employed one of two approaches to achieve this goal: 1) a macro approach, or 2) a meso approach.[2,7,12,176–178] A macro (or "top-down") approach focuses on the development of the national infrastructure to support the sharing of information across jurisdictions.[2,12,177,178] This approach is extremely complex, costly, and time-consuming.[12,178,179] A meso (or "bottom-up") approach to interoperability focuses on health information exchange across institutions, regions, and providers.[2] It is less costly and easier to implement.[12,178] In general, regional, institutional, and provider interoperability are considered to be greater priorities than national interoperability, as these approaches deliver more immediate results by increasing the rate of eHealth adoption and expediting the spread of health information exchange across the care continuum.[9,12,178]

Regardless of the approach to interoperability that is chosen, there is evidence supporting the need for government agencies responsible for the eHealth infrastructure at the macro and meso levels to develop a comprehensive strategy to achieve nationwide health information exchange.[172,180,181] This strategy should be developed in consultation with representatives from all stakeholder groups, including nurses, other health professionals, persons who are or were recipients of care, the private sector, regulatory bodies, and professional associations.[2,7,12,176,178]

Stakeholder involvement is consistently reported as a major contributor to successful health system transformation and health information exchange.[12,55,174,175] Partner organizations must agree on the data to be shared and the technical infrastructure to be used, which necessitates the involvement of health professionals and health information technology professionals.[55,174,175] Furthermore, all participating health care facilities must sign a formal data sharing agreement.[174]

Several studies have identified the involvement of persons who are or were recipients of care as essential to the exchange of health information.[55,174,175,177] In all of these studies, the person's consent was required before their information could be shared; in some cases, this was facilitated using either an opt-in or opt-out approach.[55,174,175,177] To opt-in, the person had to actively agree by providing written consent; where the opt-out approach was used, it was presumed that the person had consented to the sharing of their information among partnering organizations unless they explicitly refused.[55,175,177] In one case study, persons who were recipients of care were required to give consent separately for each health care facility that wished to view their information.[177] This approach afforded them increased control over their health information.

The literature identified the following key components of a comprehensive interoperability strategy:

Data and interoperability standards

Findings from studies of moderate quality suggest that the national health information exchange strategy should mandate the use of data and interoperability standards for network systems, health information, and vendor applications to support data sharing among providers, institutions, regions, or jurisdictions.[7,176] Health Level (HL) 7 standards are the most commonly used interoperability standards globally, and they establish parameters for the exchange, integration, sharing, and retrieval of electronic health information to support clinical practice and the management, delivery, and evaluation of health services. More information on HL7 standards is available on the Health Level 7 International website: (http://www.hl7.org/implement/standards/).

Examples of data standards that support interoperability include standardized terminology languages, such as the Systematized Nomenclature of Medicine—Clinical Terms (SNOMED CT®) and the International Classification for Nursing Practice (ICNP®). SNOMED CT is the most comprehensive clinical health terminology product in the world.[183] Detailed information about SNOMED CT is available on the SNOMED International website: (http://www.snomed.org/).

ICNP is an international standardized terminology language that is used to describe nursing data.[184] Refer to the International Council of Nurses (ICN) website: (http://www.icn.ch/what-we-do/icnp-benefits/) for more information on ICNP.

The literature also supports the incremental development and use of technology and data standards, beginning with the minimum datasets known to influence key health outcomes before gradually incorporating more comprehensive data sets.[7,177] A case study of the health system transformation in Japan reported that an instrumental part of that country's successful efforts to expedite widespread health information exchange was the government's strategic identification of the minimum dataset and interoperability standards that could be adopted by all hospitals and community-based health care facilities, and the creation of requirements for their mandatory use.[177] They also developed a larger set of interoperability standards that could voluntarily be adopted by more advanced hospitals and other health care facilities. These data and interoperability standards were developed in collaboration with representation from the hospitals,

community-based facilities, regulatory bodies, and professional associations.[177] An additional strategy employed in this case was a government-sponsored certification program to ensure that vendor applications satisfied the requirements of the mandatory interoperability standards.[177]

Legislation and policies

A number of studies of primarily moderate quality reported that successful health information exchange requires legislation and policies.[171–173,175–177,180] Among these are three quantitative studies that found a positive association between the establishment of government legislation and policies and the adoption of eHealth solutions.[8,186]

Collectively, the three studies identified the need for legislation and policies that accomplish the following:

- articulate the national eHealth vision clearly and advance the major strategic directions of this mandate without being overly prescriptive;[7,12,173,175]
- mandate the development and use of technology and data standards;[7,176,177]
- support effective and efficient data sharing;[7,171]
- stimulate the adoption and effective use of the technology through investments in the technical infrastructure and outcome-based financial incentives;[7,12,173,175]
- address investments made in existing legacy eHealth solutions;[7]
- promote the use of data for performance and quality measures, population health monitoring, and research;[7,174,175] and
- maintain the privacy and security of personal health information.[177]

Evidence from the literature includes the Health Information Technology for Economic and Clinical Health (HITECH) Act in the United States, which has been a catalyst for interoperability among hospitals and community-based health care facilities in multiple jurisdictions.[173,181,185,186]

Sustainable business model

Several studies of weak quality reported the need for a sustainable business model that facilitates and supports nationwide interoperability long term.[174,177,187] These studies identified a number of business models that focused on sustaining interoperability through cost containment, perpetual funding, and maintaining data integrity.[174,177,187]

In Japan, the nationwide health information exchange vision included the development of sustainable, interoperable network systems that reduce the operational and maintenance costs for all participating health care facilities through the use of a centralized EMR system, software as a service licensing, and outsourcing data storage.[177] In addition, their sustainable business model included government funding for the initial start-up costs, with ongoing funding derived from the hospital's IT operational budget and dues from primary care physicians. To sustain data integrity over time, the case study established a coordinator to provide strong leadership, define roles and responsibilities within each participating health care organization, and identify the data for which each party is accountable.[177]

In the United States, some health care organizations established business models that included government funding for start-up costs and funding from their operational budget for ongoing maintenance costs.[174] One study suggested research grants as an additional funding source for operational costs and ongoing evaluation of the usage and effectiveness of the health information exchange infrastructure.[177]

RECOMMENDATION 3.2:

National and jurisdictional agencies responsible for eHealth will establish an effective governance structure that provides strong, coordinated leadership that works in conjunction with regulatory bodies and professional associations to realize the goal of nationwide health information exchange.

Level of Evidence = III

Discussion of Evidence:

Best et al. defined large system transformations (LSTs) as a "coordinated, system-wide change affecting multiple organizations and care providers, with the goal of significant improvements in the efficiency of health care delivery, the quality of patient care, and population-level patient outcomes."[188] An LST is a complex undertaking, and nationwide implementations of eHealth solutions are generally viewed as LSTs.[188]

A significant theme in the systematic review conducted by Best et al. is the importance of both designated and distributed leadership to realizing the goal of LST.[188] In this context, "designated leadership" refers to the national and jurisdictional agencies responsible for leading the change initiative; and "distributed leadership" refers to professional and partner organizations who share the responsibility of bringing about the desired change.[188]

There is evidence from the grey literature that suggests LSTs are enhanced when the designated leaders (i.e., national and jurisdictional agencies) establish an effective governance structure that supports their collaboration with distributed leaders (e.g., regulatory bodies and professional associations) to provide strong, coordinated leadership.[188] Strong leadership is required to clearly articulate the national vision and the technical infrastructure requirements for each jurisdiction and health care sector.[7,12,176,177,180,189] The national vision should be comprehensive in scope, with clear direction, policies, and funding commitment to facilitate interoperability among public health and clinical eHealth solutions.[9,176] The realization of this goal requires strong leadership with IT and clinical knowledge within government agencies and health care organizations.[177]

It is recommended that health care organizations establish roles to provide strong clinical and IT leadership (e.g., CIO, CMIO, and CNIO); this will help optimize their eHealth infrastructure and capacity for health information exchange.[177] In instances where health care organizations are unable to institute these roles due to budgetary constraints, it is recommended that the government establish regional implementation teams and contract consultants that have the required IT and clinical leadership skills to provide this service to multiple facilities in a particular geographical area.[177] Key responsibilities of these consultants would be to provide oversight for all phases of the implementation of the eHealth solution and to build capacity within the organization's leadership team or the regional implementation team so they can assume those responsibilities at a later time.[177] By integrating this approach within the national comprehensive interoperability strategy, governments would decrease the inequality among health care organizations in various sectors and geographical areas.[177] They also would establish a strong eHealth infrastructure to support health information exchange across the care continuum.[177]

There is moderate quality evidence that suggests establishing an effective governance structure that provides strong leadership will help national and jurisdictional agencies responsible for eHealth realize the goal of nationwide health information exchange.[181,185] There also is evidence of this outcome from the grey literature of government agencies

working in conjunction with regulatory bodies and professional associations to increase the rate of adoption of eHealth solutions in many countries, including Australia, England, and New Zealand.[8,11,188]

Several studies identified key areas that an effective governance structure should address, including (but not limited to) the following:

- developing policies related to the technical infrastructure, data standards, and data ownership that promote efficient and effective data sharing;[7,9,12,14,55]
- ensuring policy alignment at all levels of government;[7,11,188,190]
- engaging key stakeholders (e.g., persons who are or were recipients of care, health professionals, management, administrators, educators, researchers, and representatives from public health units) to identify and prioritize their needs;[174–177,189,198]
- facilitating collaboration and consensus building among key stakeholders;[55]
- establishing private–public partnerships;[11]
- overseeing the development of the building blocks required to establish a nationwide interoperable health information infrastructure;[171,173,177,190] and
- accelerating the adoption of eHealth solutions in clinical and public health settings.[55,155, 176,191]

RECOMMENDATION 3.3:

National and jurisdictional agencies responsible for eHealth will provide incentives to foster the development of innovative next-generation eHealth solutions aligned with legislation, standards and policies formulated in consultation with regulatory bodies and professional associations.

Level of Evidence = IV

Discussion of Evidence:

A recurrent theme in the literature is the poor usability of the current generation of eHealth solutions.[181] According to Sheikh, Sood, and Bates, many health professionals perceive these systems as immature technologies that are "sub-optimal for supporting the multidisciplinary teamwork essential to delivering patient-centered care" (p. 851).[181] System limitations reported in the literature include a lack of interoperability, time-consuming documentation, a lack of concise and context-specific information for persons who are receiving care, and insufficient mechanisms to track referrals and consultations to support care coordination.[181,193]

The International Data Corporation reported on the results of a study in 2013 that was designed to investigate the adoption of eHealth solutions by health professionals.[227] Fifty-eight per cent of the physicians surveyed were experiencing lower productivity after the implementation of an eHealth solution due to "workflow, usability, productivity, and supplier [vendor] quality issues" that need to be addressed by practice and vendors" (p. 19). A more recent survey found that fifty-five per cent of the health professionals (i.e., physicians, nurse practitioners, and physician assistants) who participated in a similar study reported that it was difficult or very difficult to use their eHealth solution to improve

efficiency.[194] There also are growing concerns about the potential for harm due to poor usability of eHealth solutions for those receiving care.[195]

Patient safety is a major concern in the literature.[196] A sentinel event alert issued by the TJC highlighted concerns with medication errors resulting from flaws in the design of CPOE and clinical decision support systems.[52] Other studies have reported concerns related to the introduction of risks to patient safety related to alert fatigue and workarounds resulting from suboptimal implementation strategies.[197] Participants in the landmark RAND study suggested that it is "a national imperative to reframe policy around the desired future capabilities of this technology and emphasize clinical care improvements as the primary focus". [193] They also asserted that requiring eHealth solutions "to be all things to all people—regulators, payers, auditors, and lawyers—diminishes the ability of the technology to perform the most critical function—helping physicians care for their patients."[193]

The literature suggests the need for national and jurisdictional agencies responsible for eHealth to incentivize vendors to develop innovative next-generation eHealth solutions for clinical and public health settings with enhanced functionality to support safe, integrated care.[181,195] Participants in the Sheikh et al. study highlight the need for federal agencies responsible for eHealth to stimulate development of next-generation of eHealth solutions for public health settings with enhanced functionality to better support population health management.[181] Federal agencies also were seen as key players in incentivizing the development of innovative next-generation eHealth solutions for the acute care sector by stimulating competition among the vendors.

It is also suggested that federal agencies stimulate innovation among vendors to better support patient safety, integrated person-centered care, and interoperability among eHealth solutions and health care organizations.[181] Achieving this vision would require legislation and policies to facilitate data sharing and supportive standards developed by the federal government or standards development organizations in the private sector. Such standards also would require endorsement from the health care industry and professional associations.[11,188] Ideally, these policies would be aligned with other health system reform policies that promote outcome-based and quality-based compensation.

RECOMMENDATION 3.4:

National and jurisdictional agencies responsible for eHealth will provide financial and procurement incentives to mitigate barriers to the adoption of eHealth solutions.

Level of Evidence = IV

Discussion of Evidence:

Studies of varying quality identified a number of barriers to the adoption of eHealth solutions that are delineated in the Background section of this Guideline. Financial concerns are frequently cited as a significant barrier,[28] with several studies specifically reporting the following concerns:

- high start-up costs;[4,18,19,21,23,36]
- lack of resources and funding;[17,41,198,199]
- high ongoing maintenance costs;[19,23,30¬–32,35] and
- uncertainty about return on investment.[30]

In many countries, national and jurisdictional government agencies have provided financial incentives to mitigate the aforementioned barriers, spur the adoption of eHealth solutions, and increase health information exchange.[8,55,171,173¬–175,177,180,187] In some instances, these funding incentives have focused on hospitals and physician practices in primary care settings, with little-to-no funding being made available to other sectors.[174,177,187]

There is literature suggesting that limited financial resources in some sectors (e.g., primary care and public health) and geographical areas (e.g., rural communities and developing countries) has slowed progress towards the realization of the national eHealth vision.[4,8,176] Government funding is essential to address this inequity: it can cover the initial start-up costs to acquire the technical infrastructure required for health professionals and organizations in all sectors.[7,8,171,173,174,180,186,189,200] Where possible, it also can transform existing legacy systems into systems that are compliant with interoperability and data standards.[7,175]

Financial incentives that directly target health professionals also have proven effective for optimizing the use of eHealth solutions by rewarding primary care practices and health care organizations for achieving predefined targets associated with: 1) specific outcomes for persons receiving care; and 2) with advanced functionality for quality improvement (such as clinical decision support, clinical analytics, and data usage).[7,12,172,173,177,189,190] Financial incentives also are important to support and sustain the technical infrastructure required to facilitate nationwide interoperability and obtain long-term improvements in person-centered care.[55,171,173,175,190]

The literature provides evidence to support the use of non-monetary incentives to establish centralized technology support resources to assist smaller health care organizations, primary care practices and health care agencies in rural areas.[55,173,186,187] These resources were shown to facilitate access to technical expertise to support implementation and adoption, promote peer-to-peer mentorship, and provide staff education and training.[55,173,187]

RECOMMENDATION 3.5:

National and jurisdictional agencies responsible for eHealth will develop and strategically implement education and training policies to build eHealth capacity in the workforce. These policies will be endorsed by regulatory bodies and professional associations to ensure alignment with the curricula in academic institutions.

Level of Evidence = IV

Discussion of Evidence:

The WHO identifies workforce capacity building as one of the "eHealth foundation actions" that a country requires when implementing its national eHealth strategy.[148] Workforce education in large-scale nationwide eHealth system transformations requires national and jurisdictional government agencies to strategically implement education and training policies that are endorsed by the health care industry, regulatory bodies and professional associations, and to invest heavily in capacity-building activities.[11,155,181,188,201] There is limited evidence on what constitutes an effective eHealth education and training policy or best practices for the development of an education, training, and professional development infrastructure to support a national eHealth strategy.[201]

Hilberts and Gray examined the role of education in various national eHealth strategies and found a lack of consistency in the reporting of national eHealth education initiatives in various countries.[201] In many instances, education was invisible in the articulation of the country's eHealth infrastructure.[201] Notable exceptions were Canada, the United Kingdom, and the United States, where great variability was observed in the role of education in the national health strategy. In Canada, for instance, the national eHealth implementation strategy included "approaches to training . . . [to] streamline workflow and standardize policies and procedures" (p. 121).[201] In the United Kingdom, the NHS assumed responsibility for eHealth workforce capability development and provided support to individuals and organizations in the form of guidance and educational resources.[201] In the United States, the national agency responsible for eHealth focused heavily on academic institutions to facilitate the country's eHealth capacity development.[201]

One case study described the eHealth education strategy in Australia and the roles of various national and jurisdictional agencies in collectively helping to build a competent workforce.[201] There were three guiding principles for their work: "avoid duplication of effort, build on existing organizations and efforts, and adopt a collaborative approach" (p. 123).[201] To achieve this goal, Health Workforce Australia (HWA) was established as a joint initiative of the national and jurisdictional agencies. HWA engaged the national education sector to "integrate health workforce planning, policy, and reform with essential complementary reforms to the education and training system" (p. 123).[201] Specific activities of this collaborative work involves the identification of eHealth competencies for health professionals, the integration of interprofessional eHealth competencies within a common national resource, and the assessment of the learning needs of the workforce.

No criteria or benchmarks were available at the time of publication of the Hilberts and Grey study to evaluate the impact of this collaborative effort or the strengths or weakness of this collaborative approach.[201] Nonetheless, in light of the WHO recommendation that workforce capacity building be viewed as an essential building block for successful nationwide implementation of eHealth solutions, the study is invaluable. It provides insights into one approach that may be adapted to foster collaboration among national and jurisdictional agencies, regulatory bodies, professional associations, and academic institutions as part of the efforts to develop and strategically implement education and training policies to build eHealth workforce capacity among the following:

- health professionals;
- health system managers;
- health informatics professionals;
- health information technology professionals;
- providers of university, college, and vocational education and training programs;
- health degree accreditation bodies;
- regulatory bodies and professional associations; and
- consumers.[201]

RECOMMENDATION 3.6:

National and jurisdictional agencies responsible for eHealth will collaborate with regulatory bodies and professional associations to accelerate the adoption of eHealth solutions.

Level of Evidence = IV

Discussion of Evidence:

There is moderate evidence in the literature that highlights the importance of national and jurisdictional agencies working collaboratively with regulatory bodies and professional associations to accelerate the adoption of eHealth solutions. A systematic review of weak quality suggests that public endorsements of the national eHealth strategy by professional associations help to reduce end user fear and anxiety and to increase adoption rates.[177] In a study by Rozenblum at al., the participants perceived that greater collaboration between government agencies, regulatory bodies, and professional associations would translate into more meaningful involvement of health professionals.[12]

Internationally, Abraham, Nishihara, and Akiyama reported that the Japanese eHealth strategy and policies have been informed and greatly influenced by a consortium comprised of government agencies, health care administrators, researchers, and health information technology professionals, with the majority of input being provided by professional associations.[177]

Specific areas where regulatory bodies and professional associations have collaborated with national and jurisdictional agencies to accelerate eHealth adoption include the following:

- development of eHealth policies and standards for data and health information exchange;[177]
- alignment of professional practice standards with the national and jurisdictional eHealth strategies;[201]
- development of informatics competencies for regulated health professionals;[201] and
- development and implementation of initiatives to increase awareness of the benefits of eHealth for health professionals and persons who are receiving care.[201]

RECOMMENDATION 3.7:

National and jurisdictional agencies responsible for eHealth will collaborate with government agencies responsible for the telecommunications infrastructure to plan for increased connectivity in remote areas to support the implementation of eHealth solutions and enable national interoperability.

Level of Evidence = III

Discussion of Evidence:

In the reviewed literature, several studies reported on the limited diffusion of eHealth solutions in areas with the greatest needs, such as developing countries, remote communities, and First Nation communities.[4,176,189] It is the responsibility of government agencies to establish the technical infrastructure required to address the digital divide and facilitate equitable access to safe, high-quality, person-centered care for all of its citizens.[189] It is therefore important for national and jurisdictional agencies responsible for eHealth to collaborate with government agencies responsible for the telecommunications infrastructure to plan for increased connectivity in remote areas to support the implementation of eHealth solutions and enable national interoperability.[189]

Research Gaps and Future Implications

In reviewing the evidence for this Guideline, the RNAO expert panel identified the following priority areas for eHealth research set out in **Table 9**. These research areas are broadly organized into three categories: individual/organization, education, and system/policy research.

Table 9. Individual/Organization, Education, and System/Policy Research Areas

Category	Priority Research Area
Individual/ organization research	Governance structures and roles that influence successful adoption of an eHealth solution across the care continuum.
	Valid and reliable tools to assess organizational readiness for the implementation of an eHealth solution.
	Impact of nursing and clinical informatics on the organizational outcomes (for nurses and other health professionals, and persons who are recipients of care) post implementation of eHealth solutions.
	Strategies to effectively engage persons who are recipients of care in eHealth solution implementation projects.
	Functionalities of eHealth solutions that best support the interprofessional team.
	Best practices for usability evaluation to enhance patient safety.
	Role of the senior nurse leader (e.g., CNE, CNO, DOC, DON) in effective implementation of eHealth solutions.
Education research	Role- and discipline-specific Informatics competencies that positively influence eHealth solution implementation and adoption.
System/policy research	Impact of role- and discipline-specific informatics competencies on health system outcomes.
	Best practices for building eHealth capacity in the workforce.
	Best practices for national and jurisdictional collaboration to achieve a national EHR.

Many of the recommendations in this Guideline are based on evidence from qualitative research and the grey literature, while others are based on consensus or expert opinion. Further substantive research is required to validate the latter. Additional research will increase the evidence to enhance the implementations and adoption of eHealth solutions to support safe, high-quality care, as well as optimal health outcomes and health system transformation.

Implementation Strategies

Guideline implementation is multifaceted and challenging at all levels. The uptake of knowledge in any practice setting requires more than the awareness and distribution of guidelines: application in any practice setting requires systematic and participatory adaptation, ensuring recommendations are customized to fit the local context.[202] RNAO recommends the use of the *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)*, which provides an evidenced-informed process for a systematic, well-planned implementation.[203]

The *Toolkit* is based on emerging evidence that the likelihood of achieving successful uptake of best practice in health care increases when the following occurs:

- leaders at all levels are committed to support facilitation of guideline implementation;
- guidelines are selected for implementation through a systematic, participatory process;
- stakeholders relevant to the focus of the guideline are identified and engaged in the implementation process;
- an environmental readiness assessment for implementation is conducted for its impact on guideline uptake;
- the guideline is tailored to the local context;
- barriers and facilitators to use of the guideline are assessed and addressed;
- interventions are selected that promote guideline use;
- guideline use is systematically monitored and sustained;
- evaluation of the impacts of guideline use is embedded into the process; and
- adequate resources to complete the activities related to all aspects of guideline implementation are available.

The *Toolkit* uses the Knowledge-to-Action Framework to demonstrate the process steps required for knowledge inquiry and synthesis.[202] It also guides the adaptation of the new knowledge to the local context and implementation. The Knowledge-to-Action Framework suggests identifying and using knowledge tools (such as guidelines) to identify gaps and begin the process of tailoring the new knowledge to local settings.

RNAO is committed to widespread deployment and implementation of our Best Practice Guidelines (BPGs). We use a coordinated approach to dissemination, incorporating a variety of strategies, including:

1. the Nursing Best Practice Champion Network®, which develops the capacity of individual nurses to foster awareness, engagement, and adoption of BPGs;
2. implementation at the organization and system levels. BPSOs® focus on developing evidence-based cultures with the specific mandate to implement, evaluate, and sustain multiple RNAO BPGs.

In addition, we offer annual capacity-building learning institutes on specific BPGs and their implementation. Information about our implementation strategies can be found at:

- RNAO Best Practice Champions Network®: www.RNAO.ca/bpg/get-involved/champions
- RNAO Best Practice Spotlight Organizations®: www.RNAO.ca/bpg/bpso
- RNAO capacity-building learning institutes and other professional development opportunities: www.RNAO.ca/events

Monitoring and Evaluating Guideline Implementation

Organizations implementing the recommendations in this Guideline are encouraged to consider how the implementation and its impact will be monitored and evaluated. **Table 10** is based on a framework outlined in RNAO's *Toolkit: Implementation of Best Practice Guidelines (2nd ed.)*.[203] It provides some examples of monitoring and evaluation indicators (categorized as structure, process and outcome indicators) to determine the impact of implementing this Guideline. It also includes information on tools or resources to aid monitoring and evaluation.

Table 10. Structure, Process, and Outcome Indicators for Monitoring and Evaluating This Guideline

eHEALTH MONITORING AND EVALUATION INDICATORS			
Structure	**Process**	**Outcome**	**Tools**
Recommendations 1.1-1.2			
▪ Executive leadership established a formalized governance structure with roles, responsibilities, and sponsorship to guide and support all phases of the implementation of the eHealth solution.	▪ Governance structure established with diverse representation (e.g., interprofessional and cross-functional) and clearly delineated roles and responsibilities.	▪ Governance structure supports successful implementation of the eHealth solution.	▪ Sample governance structures (see pages 31-32 and **Appendix E**).
Recommendation 1.3			
▪ Organization implemented policies and procedures to support a comprehensive organizational readiness assessment in the early planning phase.	▪ Organization completed a readiness assessment that included individual, organizational, and technical dimensions. ▪ Organization addressed all gaps identified.	▪ Organization demonstrated individual, organizational, and technical readiness.	▪ Standardized organizational readiness assessment tool (see page 34 and **Appendix F**).
Recommendation 1.4			
▪ Organization implemented policies and procedures that support a rigorous vendor selection process with active involvement of the appropriate individuals (e.g., working group of the executive steering committee and diverse end user groups).	▪ Organization identified a diverse team that completed the "Steps in the eHealth Solution Selection Process" (see **Table G1** in **Appendix G**).	▪ The eHealth Solution selected supports the requirements of the organization and the end user groups.	▪ eHealth solution selection resources (**Appendix G- Tables G2, G3** and **G4**). ▪ Structured evaluation guide (e.g., HIMSS usability evaluation guides).[124,191]

Structure	Process	Outcome	Tools
Recommendation 1.5			
▪ Organization implemented policies to support contract management, informed by the project steering committee.	▪ Contract negotiation was informed by the project steering committee with input from the interprofessional and cross-functional eHealth solution selection team, as needed.	▪ Organization's licensing agreement included all items on the contract checklist and structured evaluation guide. ▪ Satisfaction with the contract among stakeholders (e.g., senior management, interprofessional and cross-functional, contract negotiation team, and vendor).	▪ Contract Negotiation Resources (**Appendix H**). ▪ Stakeholder survey instrument.
Recommendations 1.6-1.11, 1.14			
▪ Organization implemented policies and procedures that supported the use of formal project and change management methodologies.	▪ Organization's eHealth solution implementation project was guided by the following: □ formal project and change management methodologies that included plans for: ◆ stakeholder management; communication management; and ◆ project evaluation. □ resource allocation plan for all phases of the project to ensure the right people in the right place at the right time.	▪ Organization achieved all project milestones and goals included in the evaluation framework.	▪ Project management tools (**Appendix I**). ▪ Change management tools (**Appendices J, K and L**). ▪ Project evaluation framework and tools (**Appendix O**).
Recommendation 1.12			
▪ Organization implemented usability processes to enhance individual and organizational efficiencies, effectiveness, and user satisfaction.	▪ Organization facilitated access to individuals with expertise in usability processes. ▪ Organization implemented processes to capture usability incidents in their risk management system	▪ All usability issues and risks reviewed to identify trends and implement process improvements.	▪ Usability evaluation guidelines (**Appendix M - Table M2**).

Structure	Process	Outcome	Tools
Recommendation 1.13			
▪ Organization implemented policies and procedures to ensure adequate training is provided for new and existing end users to ensure efficient and effective use of the technology.	▪ Project team developed comprehensive education and training plan that included formal evaluation of end user knowledge and skills.	▪ Percentage of end users who were deemed proficient in role-specific competencies related to the eHealth solution and discipline-specific informatics core competencies following formal evaluation of their knowledge and skills. ▪ End user satisfaction with the education and training received.	▪ Competency evaluation instrument that includes role- and discipline-specific informatics competencies.[164–168] ▪ Education and Training Resources (**Appendix N**) ▪ Role- and Discipline-specific Informatics Competencies (**Appendix Q**)
Recommendation 1.15			
▪ Organization implemented policies and procedures to support sustainability and ongoing optimization.	▪ Organization developed post-implementation operational plan that included mechanisms that support the following: □ funding and allocation of resources; □ changes to regulatory and professional standards; and □ practice changes and workflows (e.g., clinical, operational, or financial).	▪ Evaluation metrics confirm adoption and integration: □ percentage of end users who perceive that the quality of the system, information, and service is high; □ percentage of end users who report a high level of satisfaction with the eHealth solution six months after training; and □ percentage of end users who perceive that the eHealth solution facilitates safe, high-quality care.	▪ Resources for sustainability and ongoing optimization **(Appendix P)**. ▪ End user survey instrument.

Structure	Process	Outcome	Tools
Recommendations 2.1-2.3			
▪ Academic institutions incorporated health discipline-specific core competencies into their entry-to-practice curricula for pre-licensure students and continuing education curricula for post-licensure health professionals. ▪ Organizations partnered with academic institutions to design and create access for education and training that support on-the-job delivery of: □ basic computer skills; □ informatics knowledge; and □ informatics skills.	▪ Academic institutions used a standardized framework to integrate health discipline-specific core competencies into their curricula for pre-licensure students and post-licensure health professionals. ▪ Organization facilitated on-the-job education to support professional growth and development in informatics competencies. ▪ Organization used performance management systems that included tangible demonstration of role-specific informatics competencies.	▪ Percentage of pre-licensure students and post-licensure health professionals who demonstrated competence in their discipline-specific core competencies after graduation. ▪ Nurses and other health professionals accessed continuing education programs to build informatics competency. ▪ Increased capacity and competency in informatics knowledge and skills. ▪ Healthcare executives (e.g., CNO, CNE, or CMIO), nurses, and other health professionals demonstrated the necessary competencies to effectively lead or support the implementation and adoption of their eHealth solution.	▪ Discipline-specific core competencies (e.g., AONE, CASN, TIGER, AFMC, and AFPC)[164–168] ▪ Informatics competency assessment tool ▪ Education and Training Resources **(Appendix N)** ▪ Role- and Discipline-specific Informatics Competencies **(Appendix Q)** ▪ Baseline survey instrument for end user competencies. ▪ Informatics competency assessment tool. ▪ Survey instrument to poll academic institutions. ▪ *Nurse Educator eHealth Resource*: *Integrating eHealth into the Undergraduate Nursing Curriculum.*[170]
Recommendation 2.4			
▪ Organization implemented policies and procedures to facilitate a person's access to electronic health information (personal or educational).	▪ Organization facilitated access to electronic health information (personal or educational) for persons receiving care.	▪ A person's perception of and satisfaction with their access to electronic health information (personal or educational). ▪ Increased utilization of technology-enabled information-sharing solutions.	▪ Survey instrument for persons receiving care.

Structure	Process	Outcome	Tools
Recommendations 3.1-3.7			
▪ Federal and jurisdictional agencies responsible for eHealth developed and implemented a policy framework to support all aspects of eHealth.	▪ Federal and jurisdictional agencies developed the policy framework in conjunction with health care organizations, regulatory bodies and professional associations. ▪ Federal and jurisdictional agencies performed current state assessment of eHealth strategies and aligned efforts based on best practices. ▪ Federal and jurisdictional agencies responsible for eHealth provided leadership and identified resources, supports, and partnerships to achieve nationwide health information exchange. ▪ Federal and jurisdictional agencies responsible for eHealth established processes for financial and procurement incentives.	▪ Successful implementation and adoption of a nationwide interoperable EHR. ▪ Health care organizations have equitable access to funding and eHealth solutions that enable health professionals to deliver safe, high-quality evidence-based care. ▪ There are adequate numbers of individuals with informatics competencies to meet health system demands.	▪ Survey instrument to poll health care organizations and health professionals nationally to facilitate a comparative analysis of the: □ eHealth infrastructure nationally and across jurisdictions, and □ informatics competencies of nurses and other health professionals.

Source: Adapted from RNAO.[203]

Review of Best Practice Guidelines

RNAO commits to updating its BPGs as follows:

1. Each BPG will be reviewed by a team of specialists in the topic area every 3-5 years following publication of the previous edition.
2. RNAO's International Affairs and Best Practice Guideline (IABPG) Centre staff regularly monitor for new systematic reviews, randomized controlled trials, and other relevant literature in the field.
3. Based on that monitoring, IABPG Centre staff may recommend an earlier revision period for a particular BPG. Appropriate consultation with members of the original expert panel and other specialists and experts in the field will help inform the decision to review and revise the BPG earlier than the targeted milestone.
4. Three months prior to the review milestone, IABPG Centre staff commence planning of the review by doing the following:
   a) Inviting specialists in the field to participate on the expert panel. The panel will be composed of members from the original expert panel as well as other recommended specialists and experts.
   b) Compiling feedback received and questions encountered during the implementation, including comments and experiences of BPSOs® and other implementation sites regarding their experiences.
   c) Compiling new best practice guidelines in the field and conducting a systematic review of the evidence.
   d) Developing a detailed work plan with target dates and deliverables for developing a new edition of the BPG.
5. New editions of BPGs will be disseminated based on established structures and processes.

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Appendix A: Glossary of Terms

Analytical studies: Analytical studies test hypotheses about exposure–outcome relationships. Investigators do not assign an intervention, exposure, or treatment, but they do use a comparison group to measure the association between exposure and outcome over time.[204] Analytical study designs include case-control studies and cohort studies.

Case-control study: "a study that compares people with a specific disease or outcome of interest (the cases) to people from the same population who do not have that disease or outcome (controls)" (p. 4).[205]

Cohort study: "an observational study in which a defined group of people (the cohort) is followed over time", either prospectively or retrospectively (p. 4).[205]

Best practice guidelines (BPG): Systematically developed statements to assist practitioner and client decisions about appropriate health care for specific clinical (practice) circumstances.[206] Also called "clinical practice guidelines".

Competencies: The "knowledge, skills, attitudes, and judgments required to perform safely and effectively in a broad range of environments and practice settings" (p.9)[149]

Controlled study: A clinical trial in which the investigator assigns an intervention, exposure, or treatment to participants who are not randomly allocated to the experimental and comparison or control group.[205]

Descriptive Studies: Studies that generate hypotheses and describe characteristics of a sample of individuals at one point in time. The investigators do not assign an intervention, exposure, or treatment to test a hypothesis; they merely describe the who, where, or when in relation to an outcome.[204,205] Descriptive study designs include cross-sectional studies.

Cross-sectional study: "a study measuring the distribution of some characteristic(s) in a population at a particular point in time. (Also called a survey)" (p. 13).[205]

Education recommendations: Statements of educational requirements and approaches, or strategies for the introduction, implementation, and sustainability of the Guideline.

eHealth: A term used broadly to describe the utilization of information and communications technologies across the care continuum to support a variety of functions that range from administration to health services delivery.[6]

eHealth solutions: Used as an umbrella term in this Guideline to represent various types of electronic health information systems that support the delivery of health services across the care continuum. Examples of these technologies include (but are not limited to) public health information systems, EMR systems, hospital information systems and sub-systems (e.g., radiology information system, CPOE, eDoc, eMAR and pharmacy information system), and national or jurisdictional EHR.

Electronic health record (EHR) system: An electronic health record (EHR) system is "an electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization" (p.6).[196] Sometimes incorrectly used interchangeably with electronic medical record (EMR).

Electronic medical record (EMR) system: An electronic medical record (EMR) system is "an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization" (p.6).[196] Sometimes incorrectly used interchangeably with electronic health record (EHR).

Evidence-based: Evidence is information that comes closest to the facts of a matter. The form it takes depends on the context. The findings of high-quality, methodologically appropriate research provide the most accurate evidence. Since research is often incomplete and sometimes contradictory or unavailable, other kinds of information are necessary supplements to (or substitutes for) research. The evidence base for a decision is the multiple forms of evidence combined to balance rigour with experience while privileging the former over the latter.[207]

Grey literature: Grey literature (or gray literature) refers to non-peer reviewed materials and resources that cannot be easily found through conventional channels (such as publishers or electronic databases). Examples of grey literature include conference papers and proceedings, theses, reports from government agencies or scientific research groups, working papers from research groups or committees, white papers, and interviews and informal communication (e.g., blogs, podcasts, or email).[264]

Health information exchange: Health information exchange allows health professionals and persons who are/were receiving care to securely access and share health information electronically—improving the speed, safety, quality, and cost of health care.[267]

Health information technology professional: Individuals who demonstrate their proficiency in certain health information technology workforce roles integral to the implementation and management of eHealth solutions.

Health system transformation: Refers to "interventions aimed at coordinated, system-wide change affecting multiple organizations and care providers, with the goal of significant improvements in the efficiency of health care delivery, the quality of patient care, and population-level patient outcomes" (p. 422).[188]

Individual/organization recommendations: Statements of best practices directed at individuals or health care organizations that enable the successful implementation of the Guideline.

Informatics: The "collection, classification, storage, retrieval, and dissemination of recorded knowledge treated both as a pure and as an applied science" (p. 20).[114]

Interprofessional: A group of individuals from different professions working and communicating with each other.

Macro level: A term used to distinguish between the different levels of the health system.[246] The macro level is the national level of the health system, which is influenced by global (national and international) contexts.[247]

Meso level: A term used to distinguish between the different levels of the health system. [246] The meso level refers to the local or district health system and health care organizations. [247]

Meta-analysis: A systematic review of randomized controlled trials that uses statistical methods to analyze and summarize the results of the included studies.[205]

Micro level: A term used to distinguish between the different levels of the health system. [246] The micro level refers to the individuals within the system (e.g., health professionals, persons who are or were recipients care, community populace, administrators, and policy-makers). [247]

Modified Delphi technique: The Delphi technique is an iterative consensus-building approach that is used to collect data from a panel of experts.[254] Subject anonymity is a key characteristic of this technique.[254] Subject anonymity reduces the effects of group dynamics (e.g., manipulation or coercion by dominant group members to adopt a certain viewpoint).[254] A modified Delphi technique was used during the Guideline development process. Whereas the identity of the panel members was not concealed, their individual responses to the survey questionnaires used to capture their opinion were concealed from the other members of the group.

Nurses: Refers to registered nurses, licensed practical nurses (known as registered practical nurses in Ontario), registered psychiatric nurses, and nurses in advanced practice roles (such as nurse practitioners and clinical nurse specialists).[210,211]

Organization recommendations: Statements of requirements for health care organizations that enable the successful implementation of the Guideline. The requirements for success are largely the responsibility of the implementing organization.

Person: Refers to any individual(s) with whom health professionals establish a therapeutic relationship for the purposes of partnering for health. The term person is inclusive of individuals, clients, patients, residents, consumers, and their families (such as parents, significant others, caregivers, friends, substitute decision-makers, groups, communities, and populations). [212-214]

Qualitative research: Research that uses an interactive and subjective approach to investigate and describe phenomena (e.g., lived experience) and to give them meaning. The nature of this type of research is exploratory and open-ended. Analysis involves the organization and interpretation of non-numerical data (e.g., phenomenology, ethnography, grounded theory, and case study).[215]

Quality of care: The degree to which health care services for individuals and populations achieve the desired health outcomes and are consistent with current professional knowledge.[216]

Quasi-experimental study: A study that lacks randomization and a control group, and therefore is not considered a "true" experimental design (e.g., a randomized controlled trial). The investigator controls assignment to the intervention, exposure, or treatment by using some criterion other than random assignment (e.g., pre-post design).[217]

Randomized controlled trial: An experiment in which the investigator assigns an intervention, exposure, or treatment to participants who are randomly allocated to either the experimental group (which receives intervention) and the comparison (which receives conventional treatment) or control group (which does not receive an intervention or placebo).[205] The participants are followed and assessed to determine the efficacy of the intervention. Double-blind, non-blind, and single-blind trials are examples of randomized controlled trials.

Remote patient monitoring system: The use of technology to facilitate the monitoring of persons receiving care outside of conventional clinical settings (e.g., in the home) to increase access to care and decrease health care delivery costs.

Role-specific informatics competencies: Informatics competencies that are required to fulfil the responsibilities of specific roles that interact with eHealth solutions within a health care organization.

Stakeholders: Stakeholders include all individuals, groups, or organizations that will be directly or indirectly affected by the implementation of the eHealth solution.[55]

Substitute decision-maker: A person identified by the applicable legislation as having the capacity to make treatment decisions for someone who is deemed not capable.[212]

System/policy recommendations: Statements of requirements to enable the successful implementation of the Guideline throughout the health care system. The conditions for success are associated with policy development at a broader government, and system level.

Systematic review: A review of a clearly formulated questions that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyse data from the studies that are included in the review.[205]

Appendix B: Guideline Development Process

This Guideline was developed by the RNAO with funding from the Government of Ontario and Canada Health Infoway. An international and interprofessional panel of experts was convened by the RNAO in January 2016 to collaboratively develop the Guideline, independent of any bias or influence from the Government of Ontario. The panel members included health care executives, nurses, and other health professionals from a range of settings (including practice, education, research, and policy). It also included two persons representing recipients of care.

All panel members, apart from the representatives of those receiving care, had considerable expertise in eHealth; several had previously been actively involved in implementations that resulted in their organizations attaining Stage 6 or higher on the HIMSS EMRAM. The persons representing recipients of care had lived experiences of the health care system and the impacts of receiving care in environments without access to electronic health information. For more on the RNAO expert panel, please see page 13.

The Guideline development process included a systematic review of the peer-reviewed literature and a targeted review of the grey literature to identify the best available evidence to answer the following research questions:

1. What individual-level factors contribute to high-quality electronic health information systems and their successful adoption?
2. What organizational-level factors contribute to high-quality electronic health information systems and their successful adoption?
3. What education and training do individuals/organizations need to lead and support high-quality electronic health information system implementations and adoption?
4. What system-level factors contribute to high-quality technology-enabled health service delivery and successful health systems transformation?

The Guideline recommendations were formulated using the evidence obtained from the literature review. A **modified Delphi technique**[G] was employed to obtain panel consensus on the recommendations included in this Guideline.

Appendix C: Process for Systematic Review, Targeted Grey Literature Review and Search Strategy

Targeted Grey Literature Search: Guideline Review

The literature review began with the targeted grey literature search that focused on identifying existing eHealth-related guidelines. RNAO's Guideline Development Lead and Project Coordinator searched an established list of guideline databases and websites for eHealth-related guidelines published between January 2006 to March 2016.

This search yielded six guidelines that met the search criteria from one of the seven databases searched—the *National Institute for Health and Care Excellence (NICE): Evidence Services*. The guidelines are listed below:

1. *Guidelines for the Specification, Implementation and Management of Information Technology (IT) Systems in Hospital Transfusion Laboratories*.[250]
2. *Promoting Better Integration of Health Information Systems: Best Practices and Challenges*. [251]
3. *The Good Practice Guidelines for GP Electronic Patient Records*. [103]
4. *A Guide to Achieving High Performance in Multi-Hospital Health Systems*. [252]
5. *Best Practices for Management and Board Collaboration in Health IT Adoption*.[253]
6. *Support Tool to Assess Health Information Systems and Develop and Strengthen Health Information Strategies*.[5]

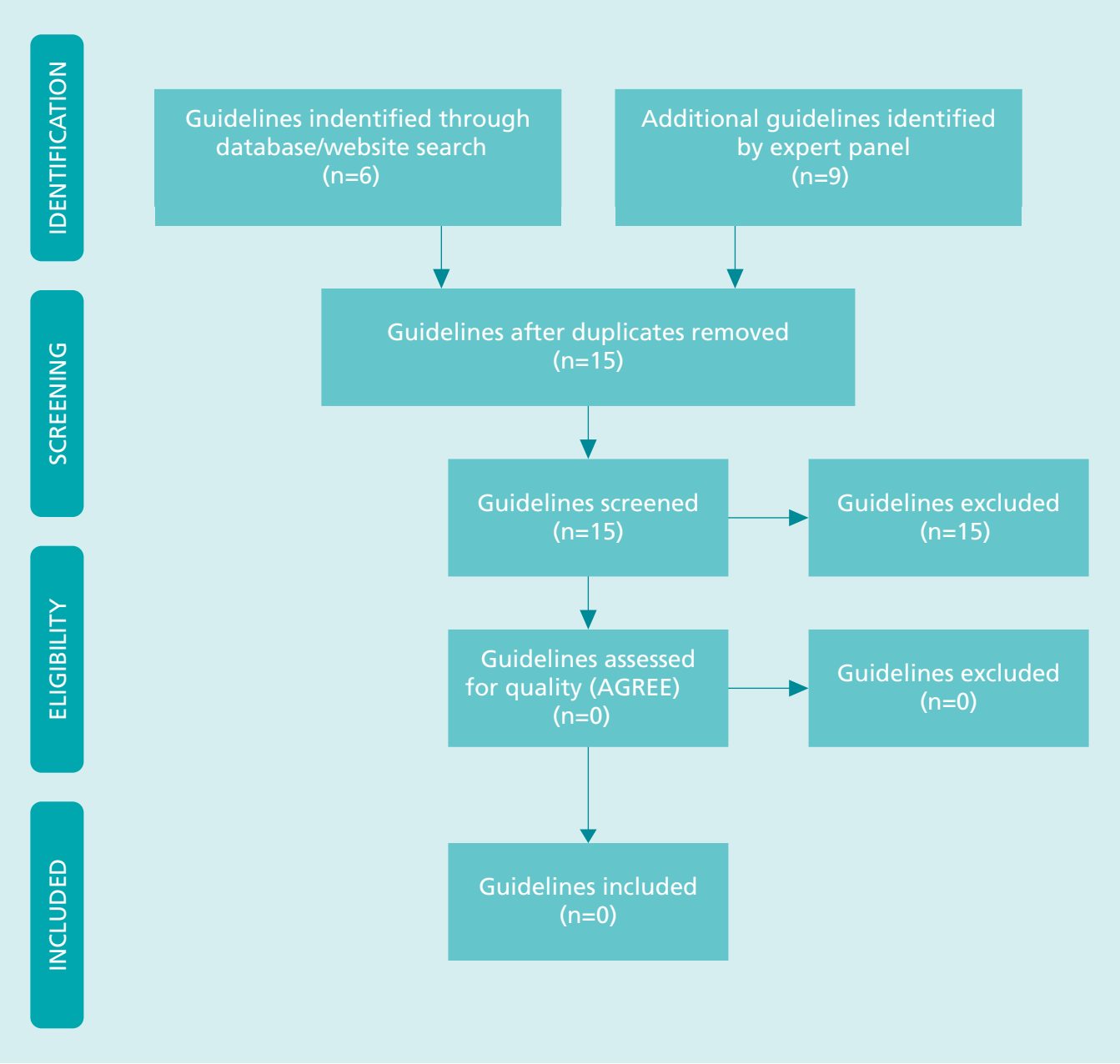
The RNAO expert panel also was asked to provide a list of pertinent guidelines or other websites, which yielded an additional nine resources, that are listed below:

1. *Health IT and Patient Safety: Building Safer Systems for Better Care*.[255]
2. *eSafety Guidelines: eSafety for Health*.[99]
3. *General Guidelines for Implementing an Electronic Document and Records Management System*.[256]
4. *Components of a Strong Health Information System: A Guide to the HMN Framework*. [257]
5. *Planning an Information Systems Project: A Toolkit for Public Health Managers*. [258]
6. *Standards and Guidelines for Electronic Medical Record Systems in Kenya*. [75]
7. *eHealth Ontario EMR Connectivity Guidelines*.[259]
8. *Framework and Standards for Country Health Information Systems*.[260]
9. *Safety Assurance Factors for EHR Resilience (SAFER) Guides*.[261]

None of the fifteen guidelines identified met the requirements of the Appraisal of Guidelines for Research and Evaluation (AGREE) II Instrument.[218] As a result, none of these guidelines were critically appraised or selected to inform the recommendations and discussions of evidence, although some were used to identify pertinent resources included in the appendices.

Figure C1 provides an overview of the process used for this guideline search. Detailed information about the search strategy, including the inclusion criteria and the list of databases and websites searched, is available online at www.RNAO.ca/bpg/guidelines/ehealth-solutions.

Figure C1: Guideline Review Process Flow Diagram



Source: Adapted from D. Moher et al.[198] Used with permission.

Systematic Review

A comprehensive, three-pronged search strategy was developed by RNAO's research team and a health sciences librarian based on the inclusion and exclusion criteria created with the RNAO expert panel.

The first prong of the search strategy (for Research Questions 1 and 2) included a search for relevant articles published in English between January 2006 and May 2016. The search was applied to the following databases: Cumulative Index to Nursing and Allied Health (CINAHL), the Cochrane Library, MEDLINE, and MEDLINE in Progress.

The second prong of the strategy (for Research Question 3) was a search for relevant articles published in English between January 2011 and June 2016. The search was applied to the following databases: CINAHL, MEDLINE, and Education Resources Information Center (ERIC).

Finally, the third prong of the strategy (for Research Question 4) included a search for relevant articles published in English between January 2011 and June 2016. The search was applied to the following databases: CINAHL, MEDLINE, and MEDLINE in Progress.

In addition to this systematic search, panel members were asked to review personal libraries for key literature relevant to the 4 questions that was not found through the above search strategies. Panel members provided twenty-one additional articles.

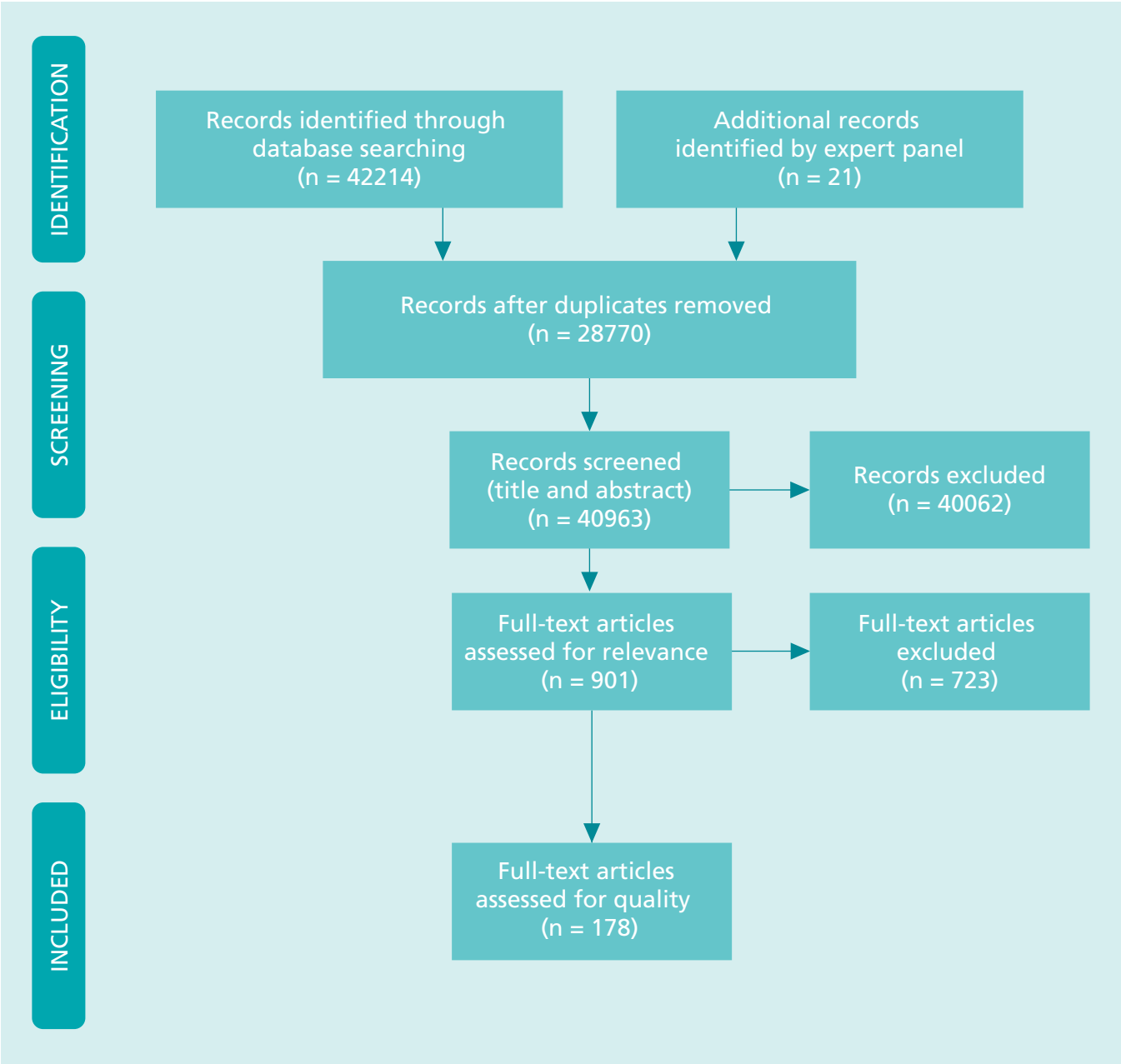
Figure C2 provides an overview of the systematic review process. Detailed information about the comprehensive search strategy for the systematic review—including the inclusion criteria, exclusion criteria, and search terms—is available online at www.RNAO.ca/bpg/guidelines/ehealth-solutions

Five RNAO nursing research associates (nurses holding master's degrees) independently assessed the eligibility of the studies retrieved according to the established inclusion and exclusion criteria. The Guideline Development Lead resolved discrepancies.

Quality appraisal scores for 50 articles (a random sample of 28% of articles eligible for data extraction and quality appraisal) were independently assessed by RNAO nursing research associates. Acceptable inter-rater agreement (kappa statistic, K = 0.66) justified proceeding with quality appraisal and data extraction by dividing the remaining studies equally between the two research associates.[219] A final summary of literature findings was completed. The comprehensive data tables and summary were provided to all RNAO expert panel members for review and discussion.

A complete bibliography of all full text articles screened for inclusion is available at www.RNAO.ca/bpg/guidelines/ehealth-solutions

Figure C2: Peer-Reviewed Literature Process Flow Diagram



Source: Adapted from D. Moher et al.[198] Used with permission.

Grey Literature Review

A targeted grey literature search was conducted by the Guideline development project team based on inclusion and exclusion criteria created with the RNAO expert panel. This involved searching select websites for materials available in English between January 2006 and July 2016 that were relevant to the research questions. The search resulted in a total of 85 resources, including government reports, white papers, technical reports, research studies, conceptual frameworks, articles, and other materials. See **Figure C3** for more information on the targeted grey literature review process.

The following websites were included in the grey literature search:

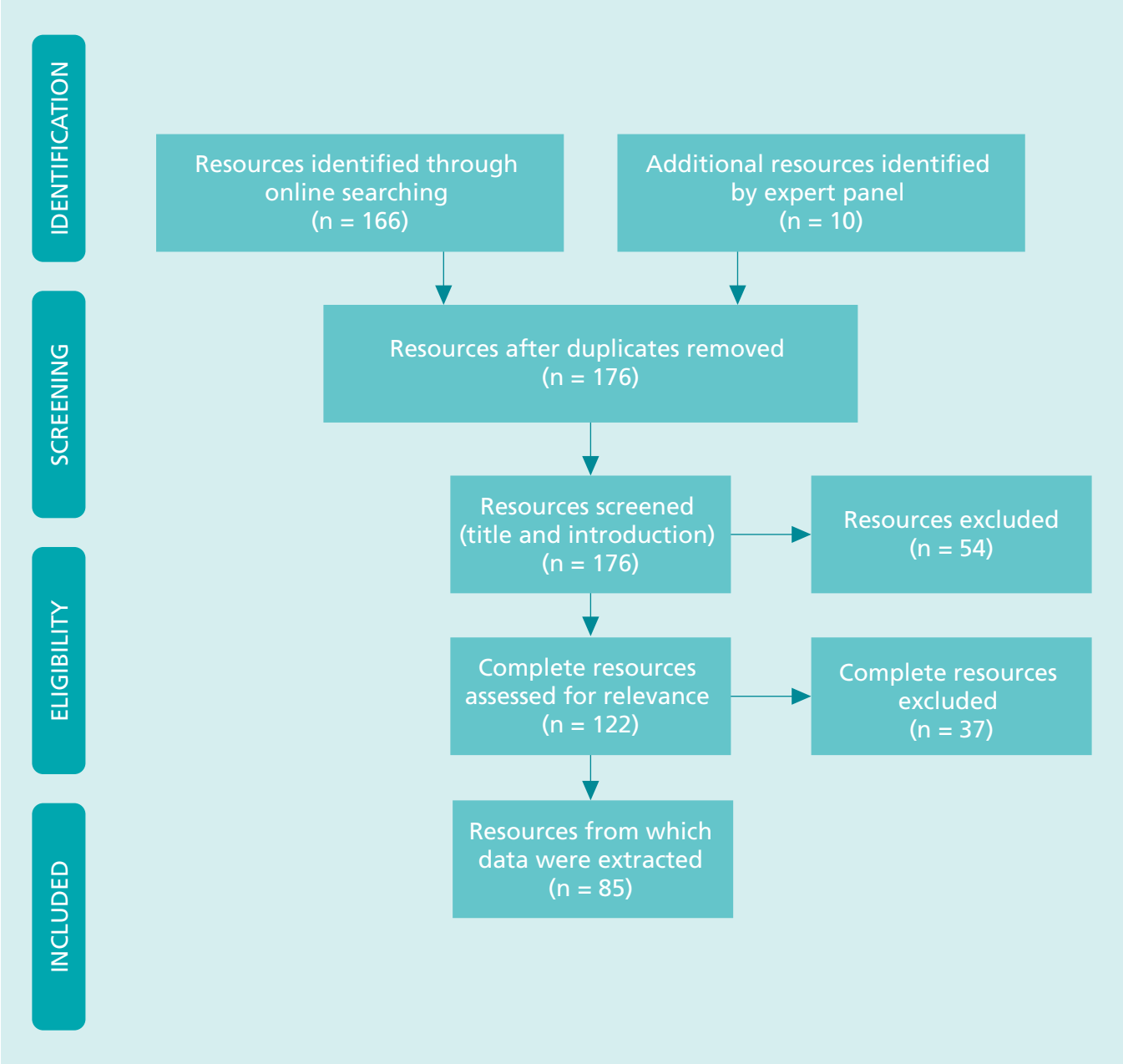
- Agency for Healthcare Research and Quality: http://www.ahrq.gov
- Alberta Medical Association: https://www.albertadoctors.org/
- American Medical Association: http://www.ama-assn.org
- American Medical Informatics Association: http://www.amia.org
- American Nurses Association: http://www.nursingworld.org
- Association of Faculties of Medicine of Canada: http://www.afmc.ca
- Association of Faculties of Pharmacy of Canada: http://www.afpc.info
- Australia and New Zealand Horizon Scanning Network: www.horizonscanning.gov.au/
- British Columbia Ministry of Health: www2.gov.bc.ca
- Canada Health Infoway: www.infoway-inforoute.ca
- COACH: www.coachorg.com
- Canadian Agency for Drugs and Technologies in Health: www.cadth.ca
- Canadian Association of Schools of Nursing: http://www.casn.ca
- Canadian Medical Association: http://www.cma.ca
- Canadian Nurses Association: http://www.cna-aiic.ca
- Canadian Nursing Informatics Association: www.cnia.ca
- CSA Group: www.csagroup.org/
- Centre for Global eHealth Innovation: http://www.ehealthinnovation.org
- Forum Strategies & Communications: http://www.forumstrategies.com
- Freelance Project Management Services: http://project-management.magt.biz/
- EuroScan International Network: www.euroscan.org
- Health Information and Quality Authority: http://www.hiqa.ie
- Health Quality Council of Alberta: www.hqca.ca
- Health Quality Ontario: www.hqontario.ca
- Health Resources & Services Administration: http://www.hrsa.gov
- Health Service Executive: www.hse.ie/eng/
- Healthcare Improvement Scotland: www.healthcareimprovementscotland.org
- Healthcare Information and Management Systems Society(HIMSS): www.himss.org

- Office of the National Coordinator for Health Information Technology: http://www.healthit.gov
- Institute for Clinical Systems Improvement: www.icsi.org
- The National Academies of Sciences, Engineering, and Medicine: Health and Medicine Division: www.nationalacademies.org/ hmd/
- Institute of Technology Assessment: http://www.oeaw.ac.at/ita/en/home
- International Labour Orgnization: http://www.ilo.org
- International Network of Agencies for Health Technology Assessment: www.inahta.org
- Joanna Briggs Institute: www.joannabriggs.org
- Lenus, the Irish Health Repository: www.lenus.ie
- Manitoba Centre for Health Policy: http://umanitoba.ca/faculties/health_sciences/medicine/units/chs/departmental_units/mchp/
- McGill University Health Centre: www.muhc.ca
- McMaster University and the McMaster Health Forum: www.mcmasterhealthforum.org/
- Mind Tools: https://www.mindtools.com/
- Monash Health Centre for Clinical Effectiveness: www.monashhealth.org/page/CCE
- Ottawa Hospital Research Institute: www.ohri.ca/home.asp
- Programs for Assessment of Technology in Health: http://www.path-hta.ca
- Scottish Intercollegiate Guidelines Network (SIGN): www.sign.ac.uk
- Stratis Health: http://www.stratishealth.org
- University of British Columbia Centre for Health Services and Policy Research: www.chspr.ubc.ca/
- University of Waterloo: http://www.uwaterloo.ca
- Washington State Health Care Authority: www.hca.wa.gov/
- Winnipeg Regional Health Authority: www.wrha.mb.ca
- World Health Organization: www.who.int
- World Health Organization Regional Office for Europe: www.euro.who.int

A website search for relevant materials also was conducted using Google and key search terms.

A complete bibliography of all grey literature resources screened for inclusion is available at www.RNAO.ca/bpg/guidelines/ehealth-solutions

Figure C3: Grey Literature Review Process Flow Diagram



Source: Adapted from D. Moher et al.[198] Used with permission.

Appendix D: Levels of eHealth Adoption and Maturity in Health Care Organizations

Table D1: Levels of eHealth Adoption and Maturity in Health Care Organizations

Model Elements	Level 0 (Beginning)	Level 1 (Intermediate)	Level 2 (Advanced)	Guideline Recommendations
Transformation	■ Individuals use the eHealth solution to varying degrees. ■ Organization sees the eHealth solution as another information technology (IT) project and tool, but not as a strategic innovation to support health service delivery.	■ Individuals use eHealth solutions in isolation, with plans for further development and interoperability. ■ Organizational outcomes are measured and tracked for specific tasks and processes. ■ All individuals acknowledge that the eHealth solution is core to their work and their decision making.	■ Individuals in specific areas use various eHealth technologies to facilitate care and work processes. ■ The IT department collaborates with other departments to support optimal use. ■ Important organizational outcomes are measured and tracked. ■ Corporate decisions are made based on quality outcome indicator data obtained from the system. ■ The eHealth solution is used as a core tool to support the institution as a learning organization and to improve outcomes.	Not applicable
Process and infrastructure	■ Few formal corporate processes are in place to effectively support eHealth projects (e.g., change management, data governance, project management and system maintenance).	■ There is partial development and use of systematic methods and tools in the organization to effectively support eHealth projects.	■ Formalized policies and procedures and coordinated processes are in use across the organization to effectively support eHealth projects. ■ Tools to support continuous quality improvement and organizational learning in relation to eHealth (e.g., knowledge management system, data governance, and project evaluation) are in place and used.	1.5, 1.6, 1.10, 1.11, 1.14, 1.15, 2.2

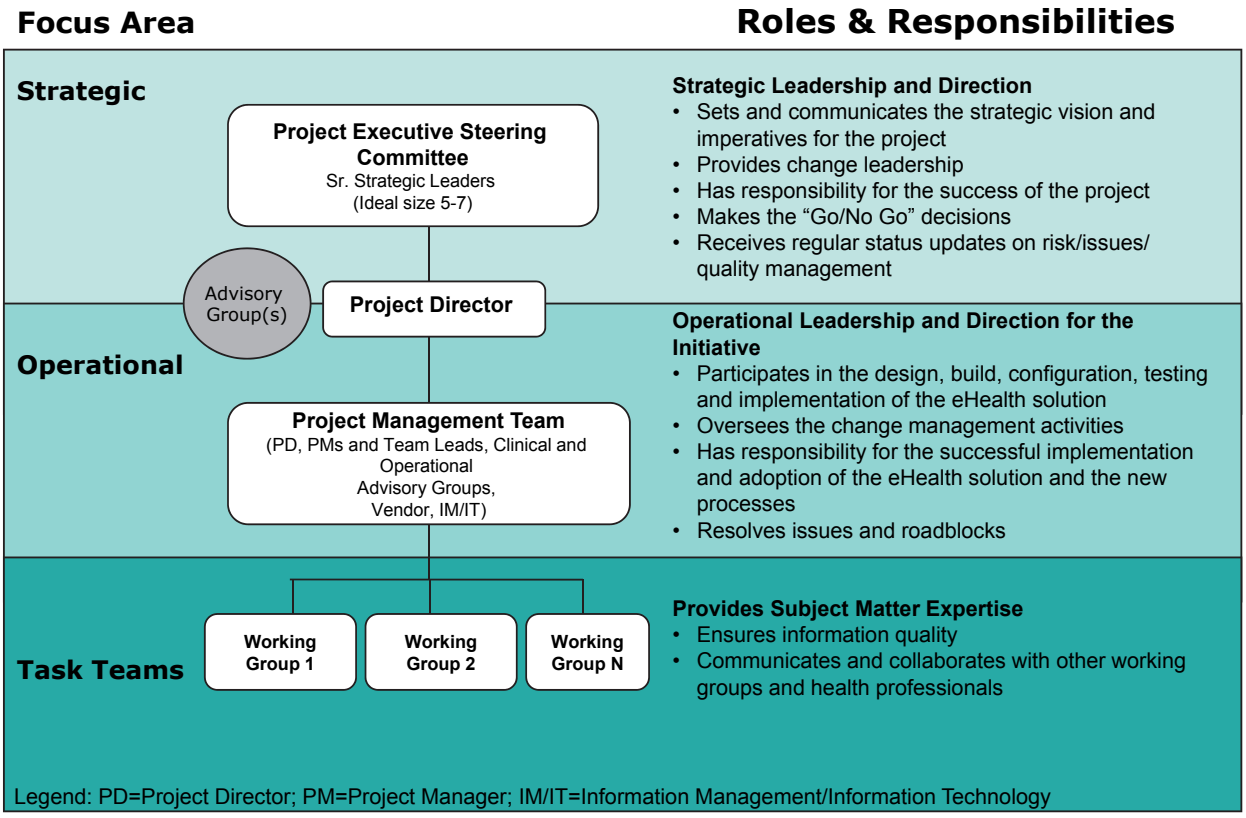
Model Elements	Level 0 (Beginning)	Level 1 (Intermediate)	Level 2 (Advanced)	Guideline Recommendations
Management and leadership	■ Executive leadership is only present at varying levels in the eHealth initiatives. ■ Executive leaders do not yet acknowledge eHealth adoption as a transformative initiative to support care delivery and services.	■ Some executive leaders embrace eHealth as a strategic direction for the organization. ■ Some executive leaders voice and provide support for eHealth adoption.	■ All executive leaders view eHealth as a direct enabler of better health, value, and care, and as an integral component of the corporate strategy. ■ Executive leadership supports and provides the necessary resources for the transformation.	1.1–1.4, 1.7, 1.8, 2.3
Education	■ Few formalized methods are employed to guide eHealth education for end users. ■ Some individuals or groups opt-out of training.	■ Education departments begin to incorporate eHealth training. ■ Some areas use best practices to inform the design and delivery of eHealth education and training.	■ eHealth educational programs are coordinated across the organization. ■ Informatics competencies are integrated into ongoing educational programs and professional development. ■ Educational tools to deliver eHealth education include informatics competencies and adult learning principles.	1.13, 2.1, 2.4

Model Elements	Level 0 (Beginning)	Level 1 (Intermediate)	Level 2 (Advanced)	Guideline Recommendations
Focus on stakeholders	■ There is little acknowledgement or engagement of key stakeholders. ■ There is little, if any, use of formal usability processes to inform the design of the eHealth solution.	■ There is a fragmented approach to engaging stakeholders. ■ There is some emphasis on usability processes to align the eHealth solution with stakeholder workflows. ■ Usability processes are not utilized at an operational and strategic level. ■ Monitoring and evaluation of eHealth systems is commonly undertaken.	■ Key stakeholders are involved in the purchase, design, and tailoring at all phases of the eHealth solution implementation life cycle. ■ The design of the eHealth solution supports stakeholder workflows and cognitive processes. ■ All implementations of eHealth solutions possess a pre-planned focus on the persons receiving care and actively engage them in all phases of the project. ■ Monitoring and evaluation of the eHealth solution post implementation is consistently undertaken to support quality improvement. ■ Persons receiving care have access to their personal electronic health information.	1.4, 1.9, 1.12. 2.4

Model Elements	Level 0 (Beginning)	Level 1 (Intermediate)	Level 2 (Advanced)	Guideline Recommendations
Resources	■ Fiscal and human resources are allocated for the eHealth solution implementation project on a short-term basis. ■ Strategic directions for eHealth maturity are not yet considered, and some aspects are missed. ■ Long-term allocation of fiscal and human resources for eHealth sustainability is not planned.	■ Fiscal and human resources to support the eHealth solution implementation project are available for several years. ■ Strategic directions for eHealth maturity are not yet explicitly supported (e.g., persons receiving care have access to their personal electronic health information, population health, and data analytics).	■ Long-term fiscal and human resources to support eHealth maturity are allocated in a comprehensive manner. ■ New roles and responsibilities are established (e.g., usability team and data governance) and adequately resourced to support ongoing optimization and utilization of electronic health information and relevant data (sustainability plan).	3.1–3.7

Appendix E: Generic Project Governance Structure and Role Alignment

Figure E1: Generic Project Governance Structure and Role Alignment



Source: Adapted from Canada Health Infoway.[223]

Table E1: Generic Project Governance Structure–Role Descriptions

GENERIC PROJECT GOVERNANCE STRUCTURE ROLE DESCRIPTIONS	
Process Role	**Role Description**
Executive steering committee	■ Champions and leads the change process. ■ Develops the vision for the initiative and builds excitement for the project and the vision. ■ Provides strategic direction, vision, and imperatives. ■ Communicates the vision in a clear and compelling manner. ■ Sets and meets project targets, and understands and accepts accountability for results. ■ Has decision-making power and authority. ■ Uses positional power and influence to achieve the project and business change objectives. ■ Manages behaviours and attitudes to support successful implementation of project goals. ■ Allocates the resources needed for time, people, and funds. ■ Sustains the balance between this project and other initiatives. ■ Removes barriers and obstacles that threaten the project's success.
Operational leadership	■ Comprised of directors and manager-level functional and process leaders who: □ understand the functional requirements and cross-functional interdependencies; □ are the experts and or leaders in their areas; □ represent specific functional, departmental, and disciplinary perspectives; □ assist in design and development of the eHealth solution based on direction of the steering committee; □ make recommendations to the steering committee; and □ provide leadership to ensure successful implementation and adoption.
Advisory group(s)	■ Comprised of key stakeholders who have the knowledge and expertise about the process and functional areas that will be affected by the change initiative (e.g., may include representatives from regulatory bodies, professional associations, unions, health authorities, health professionals, health information management, and persons who are or were recipients of care). ■ Supports the operational and strategic project leadership teams and exercises varying degrees of influence over the project. ■ Provides input on the design, implementation strategy and evaluation of the eHealth solution.
Project management team	■ Completes structured work activities guided by detailed project plans, timelines, and milestones that support the implementation of the eHealth solution. ■ Leads and supports the change management activities.
Working groups	■ Comprised of the functional and process knowledge experts. ■ Focuses on the delivery of specific project activities intended to enhance the information quality of the eHealth solution.

Source: Adapted from Canada Health Infoway.[223]

Appendix F: Organizational Readiness Assessment Resources

Table F1: Organizational Readiness Assessment Resources

ORGANIZATIONAL READINESS ASSESSMENT RESOURCES		
Organization/ Program/ Resource	**Description**	**Link**
Organizational readiness	This organizational readiness assessment tool encompasses multiple areas: organizational culture, leadership and management, operations, workflow and process improvement, and technology	http://www.stratishealth.org/documents/HITToolkitHospital/1.Adopt/1.1Assess/1.1Organizational_Readiness_Assessment.doc
Health IT attitude assessments	This resource can be used to assess organizational readiness for the adoption of an eHealth solution. It aids in understanding staff attitudes and beliefs to plan, develop and implement an effective education strategy.	http://www.stratishealth.org/documents/HITToolkitHospital/1.Adopt/1.1Assess/1.1HIT_Attitudes_Assessment.doc
Financial assessment	This tool can be used in conjunction with the other financial planning tools to assess the organization's financial readiness for an eHealth solution implementation.	www.stratishealth.org/documents/HITToolkitclinic/1.Adopt/1.1Assess/1.1Financial_Assessment.doc
IT system inventory	This resource can be used to identify and document the existing IT infrastructure to help organizations assess and budget for the hardware required for an eHealth solution implementation.	http://www.stratishealth.org/documents/HITToolkitclinic/1.Adopt/1.1Assess/1.1IT_System_inventory.doc

ORGANIZATIONAL READINESS ASSESSMENT RESOURCES		
Organization/ Program/ Resource	**Description**	**Link**
Staffing inventory	This tool can be used to determine the IT staffing skills that may be required for the implementation of an eHealth solution	http://www.stratishealth.org/documents/HITToolkitclinic/1.Adopt/1.1Assess/1.1IT_Staffing_Inventory.doc
A Framework and Toolkit for Managing eHealth Change: People and Processes	This Canada Health Infoway toolkit contains the following resource to assess organizational readiness: ■ Organizational Change Readiness Assessment (p. 39)	https://www.infoway-inforoute.ca/en/component/edocman/resources/toolkits/change-management/methodologies-and-approaches/1659-a-framework-and-toolkit-for-managing-ehealth-change-2

Appendix G: Resources to Support the Selection of eHealth Solutions

Table G1: Steps in the eHealth Solution Selection Process

STEPS IN THE EHEALTH SOLUTION SELECTION PROCESS
Identify the Project as a Formal Organizational Priority ■ Have the organization executives endorse the project as a priority, define its initial scope, and provide start-up resources. **Identify Responsible Groups and Individuals** ■ Establish the interdisciplinary selection committee, outline the scope of their responsibilities, and provide release time for participating individuals. ■ Establish reporting relationships for the selection committee. **Perform Initial Internal and External Data Collection** ■ Review the mission and goals of the institution and how this project relates to them. ■ Review resources (both internet-based and available literature) on real installations of the new project. Work with a formal project manager (if available) to formulate project steps. ■ Attend trade shows and major conferences related to the project. ■ Obtain related guidelines and regulations. ■ Develop initial system specifications. ■ Develop a list of vendors that offer the planned new system. ■ Review computerized, manual, and/or paper processes and forms in use. ■ Identify information systems that could interface with the project. ■ Identify all current projects that might interface or conflict with the project. ■ Develop lists of institutions and contracts with project experience. **Develop Goals, Benefits, and Scope of the Project** ■ Prepare a statement outlining the goals, benefits, and scope of the project. ■ Develop a feasibility statement and refine system specifications. ■ Send RFI to potential vendors (optional). ■ Review the responses to the RFI (optional). ■ Create a list of potential vendors for RFP distribution. **Develop and Distribute RFP** ■ Conduct preliminary site visits for specification development. ■ Define and prioritize system requirements as "must have" or "nice-to-have." ■ Create an RFP, including a standardized response format and weighted evaluation criteria (best value across clinical, technical, vendor, pricing criteria). ■ Develop and include criteria and mechanisms to be used in committee evaluation. ■ Finalize list of potential vendors. ■ Finalize and distribute RFP to potential vendors. **Analyze Vendor Proposals and Make Recommendation(s)** ■ Evaluate responses to RFP across these factors (at least): clinical functionality, technical capability/ feasibility, financial aspects, project timeline, and vendor attributes, including projected company stability. ■ Have vendors conduct demonstrations using scenarios devised by the committee. Use formal evaluation criteria to rate them. ■ Conduct site visits and use formal evaluation criteria to rate the vendors. ■ Combine findings and develop decision recommendations. **Conduct Contract Negations** ■ Include the RFP as part of the contract, including vendor responses to issues or questions. ■ Review and negotiate the terms of the agreement. ■ Sign the agreement and begin the installation process.

Source: Adapted from C. M., Mascara & M. Debrow.[44] Used with permission.

Table G2: Sections of a Request for Information

SECTIONS OF A REQUEST FOR INFORMATION
Purpose of Request This is a brief statement describing the type of information systems that the institution is planning to select. For example, is the institution searching for an EMR for use in physician offices or a classification and staffing system for use in out-patient clinics? **Background** This is a description of the institution, including mission size and number and type of persons treated. **Qualifications** This covers any specific qualifications that the institution requires of the vendor. For example, does the vendor need to have been in business for 5 or more years? **Information Requested** This section should provide a list of specific elements that should be answered as part of the vendor's response. For example, this might include the following: ■ the size, history, and financial status of the company; ■ the basic system architecture and software configuration; and ■ the number of installations it has completed in the past and the names of some of its customers. **Time and Type of Resources** This section includes the due date for the response, where the response should be sent, and who the vendor should contact about the RFP if the vendor has any questions. The vendor should be discouraged from contacting anyone else at the institution.

Source: Adapted from C. M., Mascara & M. Debrow.[44] Used with permission.

Table G3: Major Components of a Request for Proposal

MAJOR COMPONENTS OF A REQUEST FOR PROPOSAL
■ Overview of the institution and its mission. ■ Project overview (including purpose, goals, rationale for the project, number of locations, services/specialties impacted, and timelines). ■ System specifications (e.g., functional, technical, interfaces, data integration, currently installed systems related to the new project, or projected Agile development for specific areas). ■ Services requested (what is needed from the vendor). This can include training, installation, maintenance and support, equipment, required uptime, and response to issues. ■ Vendor requirements and information, such as number of installed sites, qualifications of vendor team personnel, and projected company stability. ■ Projected pricing and payment provisions (i.e., high level project cost rather than a breakdown). ■ RFP evaluation criteria. ■ Submission guidelines (a standardized format for responses). ■ Any exclusions (e.g., timelines for responses, company size, or lack of monolithic system capabilities).

Source: Adapted from C. M., Mascara & M. Debrow.[44] Used with permission.

Table G4: Additional Resources—eHealth Solution Selection

ADDITIONAL RESOURCES—eHEALTH SOLUTION SELECTION		
Organization/Program/Resource	**Description**	**Link**
RFP template	This template can be used to structure requests for proposals from vendors for consideration during the eHealth solution selection process.	https://www.healthit.gov/providers-professionals/implementation-resources/request-proposal-rfp-template-health-information
Canada Health Infoway certified products	This resource includes a list of eHealth solutions that meet the certification requirements of Canada Health Infoway.	https://www.infoway-inforoute.ca/en/our-partners/vendors/infoway-certified-products
Vendor reference checking	This worksheet is intended to assist organizations to conduct a reference check for a vendor of interest prior to selecting an eHealth solution.	https://www.healthit.gov/providers-professionals/reference-checking-ehr-vendors-worksheet
Vendor evaluation matrix tool	This resource is a general evaluation tool that rates the basic functionalities of an eHealth solution.	https://www.healthit.gov/providers-professionals/implementation-resources/vendor-evaluation-matrix-tool
EHR Connectivity Requirements for Point of Service (POS) Procurements[262]	This document provides the technical requirements for health care organizations in Ontario to achieve interoperability. These requirements should be included in RFIs, RFPs, contracts etc. (The link to download the document is located at the bottom of the web page).	http://www.ehealthontario.on.ca/en/ehr-connectivity-strategy
EHR Contracts Untangled: Selecting Wisely, Negotiating Terms, and Understanding the Fine Print[84]	This ONC guide is intended to assist organizations to better understand and communicate their eHealth solution requirements to potential vendors, negotiate appropriate contract terms and manage risks that may arise during the implementation and adoption. Chapter 5 outlines requirements to foster interoperability and integration.	https://www.healthit.gov/sites/default/files/EHR_Contracts_Untangled.pdf

Appendix H: Contract Negotiation Resources

Table H1: Contract Negotiation Resources

CONTRACT NEGOTIATION RESOURCES		
Organization/Program/Resource	**Description**	**Link**
Contracting Guidelines and Checklist for EHR Vendor Selection	This resource provides: ■ details on writing a contract to select an eHealth solution vendor; ■ a checklist to assist with contract negotiations; and, ■ a template to establish goals to guide the eHealth solution vendor selection process.	https://www.healthit.gov/providers-professionals/implementation-resources/nlc-contracting-guidelines-and-checklist-ehr-vendor
EHR Contracts: Key Contract Terms for Users to Understand	This document explains key contract terms for the eHealth solution to help organizations effectively negotiate contracts that ensure the technology performs as expected and protect against known business and patient safety risks.	https://www.healthit.gov/sites/default/files/ehr_contracting_terms_final_508_compliant.pdf
Health Information Technology Toolkit for Physician Offices	Section 1.3 of this Toolkit has several resources to aid eHealth solution selection and contract negotiations including a contract checklist.	http://www.stratishealth.org/expertise/healthit/clinics/clinictoolkit.html
EHR Contracts Untangled: Selecting Wisely, Negotiating Terms, and Understanding the Fine Print[84]	This ONC guide is intended to assist organizations to better understand and communicate their eHealth solution requirements to potential vendors, negotiate appropriate contract terms and manage risks that may arise during the implementation and adoption. Chapter 5 outlines requirements to foster interoperability and integration.	https://www.healthit.gov/sites/default/files/EHR_Contracts_Untangled.pdf

Appendix I: Project Management Resources and Templates

Table I1: Project Management Resources

PROJECT MANAGEMENT RESOURCES		
Organization/Program/Resource	**Description**	**Link**
The Project Manager's Guide to Health Information Technology Implementation (Chapter 4- Project Knowledge Areas)	This chapter of the Guide provides an overview of the Project Management Institute's nine knowledge areas that identify processes to facilitate effective project management.	http://www.himss.org/project-manager-s-guide-health-it-implementation
Project Leadership: Key Elements and Critical Success Factors for IT Project Managers	This resource delineates project management success factors.	http://www.himss.org/project-leadership-key-elements-and-critical-success-factors-it-project-managers-jhim
15 Essential Steps of IT Project Management	This resource describes essential project management steps.	http://www.himss.org/15-essential-steps-it-project-management-hfma
Medical Informatics: An Executive Primer, 2nd Ed. (Chapter 11- Project Management: Lessons from the Primary Care Information Project)	This book chapter describes how best-practice project management concepts can be applied to eHealth solution implementation projects.	http://www.himss.org/project-management-lessons-primary-care-information-project-medical-informatics-executive-primer

Table I2: Project Management Templates

PROJECT MANAGEMENT TEMPLATES		
Organization/Program/Resource	**Description**	**Link**
Project Management Plan Template	This website provides an overview of project management and a downloadable project management plan template.	https://uwaterloo.ca/it-portfolio-management/methodologies/project-management/planning/project-management-plan
Project Charter Template	This website provides an overview of the project charter and a downloadable project charter template.	https://uwaterloo.ca/it-portfolio-management/methodologies/project-management/initiation/project-charter

Appendix J: Change Management Resources

Table J1: Infoway's Framework & Toolkit for Managing eHealth Change

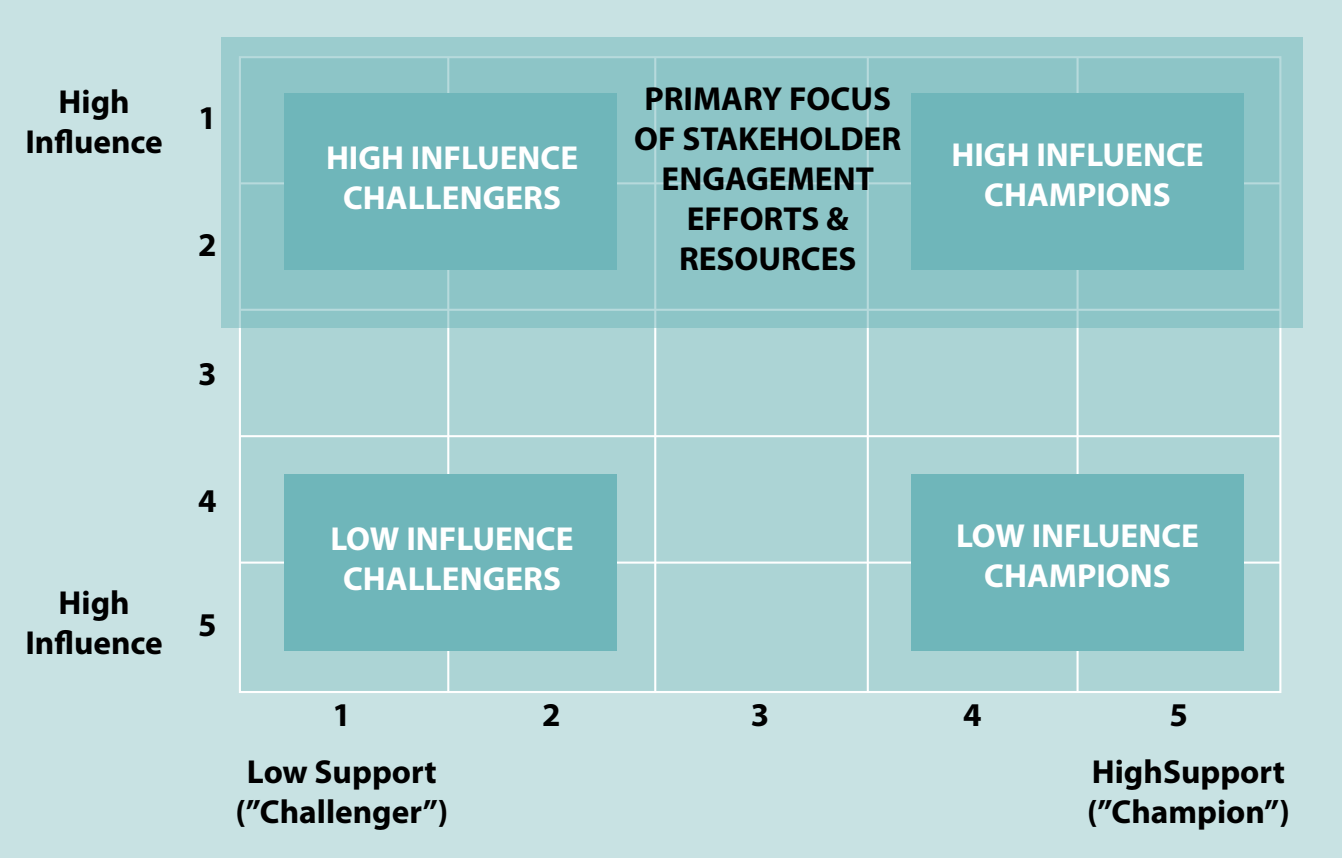
INFOWAY'S FRAMEWORK & TOOLKIT FOR MANAGING eHEALTH CHANGE		
Organization/Program/Resource	**Description**	**Link**
Managing eHealth Change: People and Processes **(Overview)**	This brochure provides an overview of the resource: *A Framework and Toolkit for Managing eHealth Change: People and Processes*	https://www.infoway-inforoute.ca/en/component/edocman/563-managing-ehealth-change-people-and-processes/view-document?Itemid=101
A Framework and Toolkit for Managing eHealth Change: People and Processes	This toolkit highlights leading practices and lessons learned for managing change in eHealth projects from across Canada.	https://www.infoway-inforoute.ca/en/component/edocman/1659-a-framework-and-toolkit-for-managing-ehealth-change-2/view-document?Itemid=101

Table J2: Additional Change Management Frameworks and Resources

ADDITIONAL CHANGE MANAGEMENT FRAMEWORKS AND RESOURCES		
Organization/Program/Resource	**Description**	**Link**
Change Management in EHR Implementation	This primer provides change management resources to assist those involved with eHealth solution implementation projects.	https://www.healthit.gov/sites/default/files/tools/nlc_changemanagementprimer.pdf
Prosci® ADKAR Change Management Model Overview	This website provides an overview of the ADKAR Change Management Model.	https://www.prosci.com/adkar/adkar-model
Lewin's Change Management Model: Understanding the Three Stages of Change	This website describes Lewin's Change Management Model.	https://www.mindtools.com/pages/article/newPPM_94.htm
Kotter's 8-Step Change Model: Implementing Change Powerfully and Successfully	This website describes Kotter's 8-Step Change Model.	https://www.mindtools.com/pages/article/newPPM_82.htm

Appendix K: Stakeholder Management Resources

Figure K1: Model for Prioritizing Stakeholders



Source: Adapted from Canada Health Infoway[61]

In this Model, stakeholders are grouped into the following cohorts:

- **High Influence Challengers:** outreach efforts should focus on converting these individuals to champions. Failing that, plan countermeasures that could help neutralize actions they might take that could potentially harm or derail the project.
- **High Influence Champions:** proactively leverage the positive energy from these individuals and groups to further your objectives to build a strong foundation of support.
- **Low Influence Challengers:** maintain awareness of any actions that could potentially harm the project, but put less energy into converting these challengers into champions.
- **Low Influence Champions:** ensure that positive relationships are maintained, but put less energy into further cultivating these champions.

Project managers are advised to allocate stakeholder engagement resources to the High Influence Challengers and High Influence Champions.

Table K1: Stakeholder Management & Engagement Resources

STAKEHOLDER MANAGEMENT & ENGAGEMENT RESOURCES		
Resource	**Description**	**Link**
Stakeholder Engagement Planning Overview	This document was developed to support organizations in their stakeholder engagement efforts.	http://www.forumstrategies.com/content/pdf/stakeholder_engagement.pdf
Stakeholder management plan template	This stakeholder management plan template can assist health care organizations to formalize the management strategies that will be used to effectively engage stakeholders.	http://project-management.magt.biz/templates/10-stakeholder-mgmt/index.php
A Framework and Toolkit for Managing eHealth Change: People and Processes	This Canada Health Infoway toolkit contains the following resources to aid stakeholder engagement: ■ Stakeholder engagement planning template (p. 63) ■ Stakeholder analysis and segmentation template (p. 64) ■ Target audience analysis template (p. 65) ■ Communicating with stakeholders (p. 67) ■ Force field analysis process (p. 68) ■ Resistance management framework (p. 69)	https://www.infoway-inforoute.ca/en/component/edocman/resources/toolkits/change-management/methodologies-and-approaches/1659-a-framework-and-toolkit-for-managing-ehealth-change-2

Appendix L: Communication Management Resources

Table L1: Communication Management - Audience Analysis Template

Intended Audience (Stakeholder [individual/ group])	Description of Audience	Criticality to Success*	Impact of Change	Change Effort Required*	Audience Needs (Concerns/ Issues)	Degree of Commitment*

* Rated as Low, Medium or High

Source: Reprinted from Canada Health Infoway.[61]

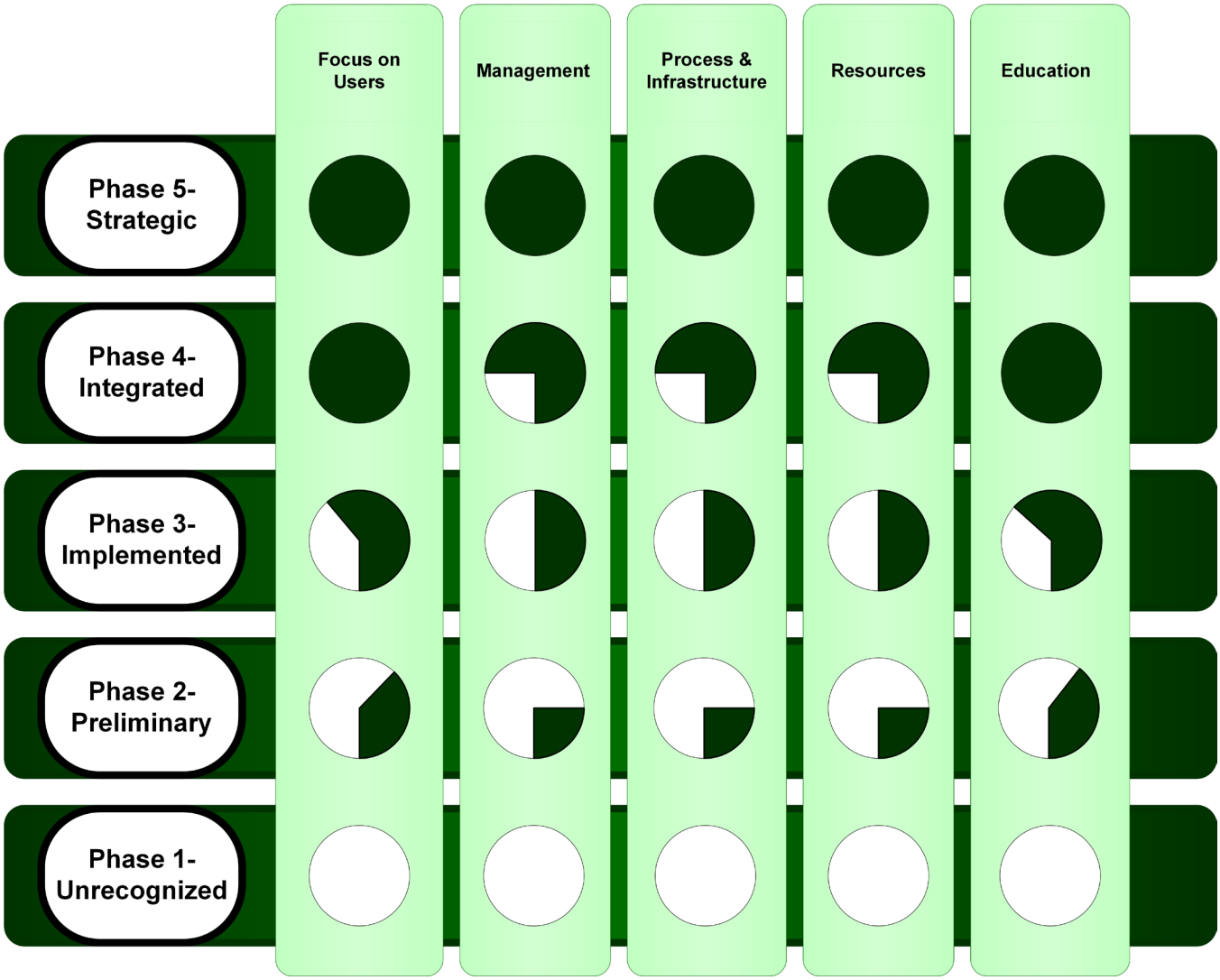
Commun-ication/Action	Key Messages/ Details	Audience Targeted	Due Date	Channel	Develop	Review/ Approve	Deliver	Status

Source: Adapted from Canada Health Infoway.[61]

Appendix M: Usability Resources

The Health Usability Maturity Model (**Figure M1**) delineates five phases of usability found in health care organizations as these relate to five key dimensions: focus on users, management, process and infrastructure, resources and education.[123]

Figure M1: Health Usability Maturity Model



Source: Reprinted from N. Staggers et al.[123] Reprinted with permission.

Table M1 describes the characteristics of each of these five usability phases and demonstrates how each phase correlates with the level of maturity achieved when usability processes are fully integrated within a health care organization. Using this Model, health care leaders can identify their organization's current phase of usability and develop a plan to progress towards more advanced phases.[123]

Table M1: Detailed Health Usability Maturity Model Phases and Characteristics

DETAILED HEALTH USABILITY MATURITY MODEL PHASES AND CHARACTERISTICS					
Phase	**Unrecognized**	**Preliminary**	**Implemented**	**Integrated**	**Strategic**
Description	■ Organizational lack of awareness of usability. ■ Organization does not recognize usability as the core problem. ■ Resistance to usability methods from IT groups.	■ Limited inclusion of usability in system development and deployment. ■ Sporadic or limited attempts to include usability practice in the organization. ■ Insufficient budget or resources to do all the work required. ■ No resources or influence to mandate organizational change. ■ Reliance on outside experts to execute most usability activities.	■ Organization has small team of usability practitioners. ■ Some of the infrastructure required to fully integrate usability is apparent. ■ Organization may develop usability standards and processes for assessing systems for introduction. ■ For internal development: a library of design patterns and previous test results to improve the efficiency of usability activities.	■ All benchmarks of a usability program are implemented. ■ Usability group has a recognized mandate. ■ Accountability is achieved through objective setting and measurement. ■ Usability group is involved in the selection and introduction of new systems. ■ Critical resources and infrastructure are in place to support usability activities.	■ Usability program is recognized as strategic. ■ Business benefits of usability are well understood. ■ Usability activities are mandated and measured for all new IT system implementations. ■ When products are sourced the competitive bidding process includes key usability criteria. ■ A standardized process for measuring whether these criteria are met is a key part of the selection process.
Focus on Users	■ None: focus is on product, processes and 'market'.	■ Emerging focus on end-users. ■ Focus is on individual users and their issues rather than user groups.	■ Users are recognized, but needs may be traded off for other considerations.	■ Users are formally recognized and user focused development is mainstream.	■ The organization has become human-centered.

DETAILED HEALTH USABILITY MATURITY MODEL PHASES AND CHARACTERISTICS					
Phase	**Unrecognized**	**Preliminary**	**Implemented**	**Integrated**	**Strategic**
Manage-ment	■ Usability is not a management concern. ■ There is no usability policy in place.	■ Senior management realization that usability is an issue to be considered in certain functional areas. ■ Little or no management of UCD process. ■ Project driven usability activities.	■ Senior management is aware that some workflow issues and staff dissatis-faction are related to usability issues. ■ Proactive approach to usability issues. ■ Usability may have limited organizational mandate.	■ All levels of management are fully aware of usability issues and the need to address them for purposes of care quality and staff satisfaction. ■ Management begins to link ROI of usability program with the organization's business goals.	■ Usability is viewed by senior management as a market advantage. ■ Usability is a criterion for performance evaluations. ■ Usability is embedded in organizational culture. ■ Usability key process indicators (KPI's) are routinely tracked.
Process & Infra-structure	■ No processes exist. ■ Usability not recognized as measurable criteria.	■ Some usability processes are documented and repeatable but no continuous usability improvement plan is in place. ■ These projects have non-standard benchmarking in place. ■ Beginning of a systems approach to usability. ■ Usability information begins to be collected.	■ Usability processes for a small number of IT applications are documented and achieve consistent results. ■ Usability improvement plan is in place. ■ Usability plan is sometimes used when processes reach across the organization. ■ Benchmarks for usability assessment begin to be standardized. ■ User interface tools are used in new technology development and implementation.	■ Usability standards and polices are in place individuals and projects are accountable. ■ Usability processes are used consistently and reliably across most of the organization. ■ Benchmarking is standardized and consistently used	■ Usability is fully incorporated across the organization. ■ Usability extends to customers/ clients. ■ A knowledge management system is in place.

DETAILED HEALTH USABILITY MATURITY MODEL PHASES AND CHARACTERISTIC					
Phase	**Unrecognized**	**Preliminary**	**Implemented**	**Integrated**	**Strategic**
Resources	■ No resources are allocated to achieving usability.	■ Resources may be assigned ad hoc to address a certain instance of usability problem.	■ Budget for usability concerns included in the IT budget. ■ Suitable facilities and tools for usability improvements are provided. ■ Organization may employ usability consultants to augment IT staff competencies.	■ All new and on-going IT projects have allocations for usability. ■ All projects have at least one usability expert on the team.	■ Intensive and informed management of human and other resources. ■ Knowledge of usability is key factor in hiring and employment.
Education	■ No usability training is provided to staff. ■ No awareness of usability as a business indicator for organization.	■ IT staff may have some usability training, usually gained on the job rather than from a formal training process. ■ Internal training on users and how to assess needs and implement is critical.	■ Internal awareness program initiated. ■ Formal training to broaden usability skills. ■ IT training on integrating UCD in system development and introduction.	■ Updates on recent projects are provided to reinforce the positive impact of usability. ■ Staff receive training and understand how to apply best practices developing and evaluating systems for internal and external use.	■ On-going training of integrated development teams.

Legend: IT=information technology; UCD=user-centered design; ROI=return on investment

Source: Reprinted from N. Staggers et al.[123] Reprinted with permission.

Table M2: Usability Guidelines

USABILITY GUIDELINES		
Resource	**Description**	**Link**
eSafety Guidelines	This resource was published by COACH to promote a culture of patient safety in health care delivery while fostering the adoption of safer eHealth solutions.	https://www.coachorg.com/en/resourcecentre/resources/Fact_Sheets/eSafety_FSheet_2015-Final.pdf
SAFER Guides	This resource was published by the ONC to help health care organizations to assess their eHealth solution in key areas to optimize patient safety.	https://www.healthit.gov/safer/safer-guides

Appendix N: Education and Training Resources

Table N1: Education and Training Resources

STAKEHOLDER MANAGEMENT & ENGAGEMENT RESOURCES		
Resource	**Description**	**Link**
EHR Implementation Communication Guidelines	This resource provides communication guidelines to foster smooth integration of computers into a health care setting.	https://www.healthit.gov/providers-professionals/ehr-implementation-communication-guidelines
Promoting Patient- and Family-Centred Care in a Digital Era (video)	This video was developed by RNAO to highlight best practices for integrating computers into the health professionals' clinical context.	https://www.youtube.com/watch?v=roYiH7n4g30
HRSA training resources	This website provides information on the components of a comprehensive training plan and provides resources to support the implementation of eHealth solutions.	https://www.hrsa.gov/healthit/toolbox/RuralHealthITtoolbox/Selection/trainingmaterials.html
A Framework and Toolkit for Managing eHealth Change: People and Processes	This Canada Health Infoway toolkit contains the following resources to aid the development of an education and training plan to supports user of an eHealth solution: ■ Training roles and responsibilities (p. 91) ■ Training session evaluation template (p. 92) ■ Computer training needs assessment (p. 93) ■ Training and course planning matrix (p. 95)	https://www.infoway-inforoute.ca/en/component/edocman/resources/toolkits/change-management/methodologies-and-approaches/1659-a-framework-and-toolkit-for-managing-ehealth-change-2

Appendix O: Project Monitoring and Evaluation Resources

Table O1: Monitoring and Evaluation Resources

MONITORING AND EVALUATION RESOURCES		
Resource	**Description**	**Link**
Development Cooperation Manual	Chapters 6 and 7 of this resource provide detailed information and resources applicable to monitoring and evaluation.	http://www.ilo.org/wcmsp5/groups/public/---dgreports/---exrel/documents/publication/wcms_452076.pdf
Health Information Technology Evaluation Toolkit	This toolkit, developed by the Agency for Healthcare Research and Quality, provides step-by-step guidance for developing project evaluation plans to assess the implementation of an eHealth solution in any health care organization.	https://www.healthit.gov/unintended-consequences/sites/default/files/pdf/ModuleIIpdf1.5.pdf
HIMSS Davies Awards	This resource provides a framework for evaluating the implementation of eHealth solutions in primary care and specialty medical practices.	https://www.himss.org/sites/himssorg/files/FileDownloads/2013-Ambulatory_howToApply%20(1).pdf
Canada Health Infoway Methodology for System & Use Assessment Survey	This document is designed to detail the process of adapting and administering an evaluation tool. A key objective of this resource is to "provide preliminary benefits evaluation as a precursor to a more comprehensive evaluation allowing this knowledge to inform subsequent evaluation activities and health planning" (p.1).	https://www.infoway-inforoute.ca/en/component/edocman/2911-methodology-for-administering-a-system-and-use-survey/view-document?Itemid=101
Benefits Evaluation Toolkit	This toolkit is designed to assist organizations to implement, adopt and promote eHealth solutions.	https://www.infoway-inforoute.ca/en/resource-centre/toolkits/benefits-evaluation-toolkit

Appendix P: Resources for Sustainability and Ongoing Optimization

Table P1: Resources for Sustainability and Ongoing Optimization

RESOURCES FOR SUSTAINABILITY AND ONGOING OPTIMIZATION		
Resource	**Description**	**Link**
Practical steps to enterprise data governance	This HIMSS resource is intended to be used with the document *A roadmap to effective data governance: How to navigate five common obstacles* to establish a data governance structure.	http://www.himss.org/practical-steps-enterprise-data-governance
A roadmap to effective data governance: How to navigate five common obstacles	This HIMSS resource describes and offers solutions to five obstacles often encountered when implementing data governance: ■ Organization Culture ■ Lack of an Enterprise Systems View ■ Choosing Where to Start ■ Resourcing Issues ■ Unclear Measures of Success	http://www.himss.org/roadmap-effective-data-governance-how-navigate-five-common-obstacles
Data management: A foundation for analytics	This HIMSS resource provides guidance to establish a data governance structure that supports high data quality and data analytics.	https://www.himss.org/sites/himssorg/files/HIMSSorg/Content/files/201304_DATA_GOVERNANCE_FINAL.pdf
The Data Governance Institute	The Data Governance Institute provides vendor-neutral data governance best practices and guidance.	www.datagovernance.com
Continuous Quality Improvement (CQI) Strategies to Optimize Your Practice	This Primer introduces CQI concepts, strategies and techniques that a health care organization can use to design an effective CQI strategy to improve the quality and safety of patient care.	https://www.healthit.gov/sites/default/files/tools/nlc_continuousqualityimprovementprimer.pdf
Strategies for Optimizing an EHR System	This resource describes various strategies that can be used to optimize an eHealth solution post implementation. It can be use to optimize eDoc, CPOE, clinical decision support and eMAR.	https://www.healthit.gov/providers-professionals/implementation-resources/strategies-optimizing-ehr-system

Appendix Q: Role- and Discipline-specific Informatics Competencies

Table Q1 presents a matrix of informatics competencies for five specific roles typically found in a health care organization. The matrix was derived from the international literature reviewed for this Guideline.[75] The level of informatics competencies required for each of these roles ranges from awareness to basic and advanced knowledge. Three of these roles are categorized as "facility based users", which refers to individuals within health care organizations who are responsible for collecting, entering, and reporting health data using an eHealth solution. These facility based users are further sub-divided in accordance with role responsibilities as follows:

- *Clerical* refers to individuals who are the first point of contact for persons receiving care at the health care facility (e.g., receptionists, nurses or other health professionals). They access the person's electronic medical record to retrieve information.
- *Data entry* refers to individuals who are responsible for initiating or updating the person's electronic medical record (e.g., clerical staff, nurses or other health professionals).
- *Data managers* refer to individuals who have the oversight for the program/unit/department/clinic and are responsible for the data quality and integrity and the reporting of health data for trending, population health management and the ongoing monitoring and evaluation of health outcomes.

The fourth role is categorized as "high level managers" and refers to individuals who use the information collected and stored in the eHealth solution to inform decisions related to health service delivery and resource management. The fifth and final role identified is "IT/system admin". It encompasses individuals who are responsible for the development and maintenance of the eHealth solution and for providing general end user support.

Table Q1: Matrix of Mandatory Informatics Competency Levels by Role

MATRIX OF MANDATORY INFORMATICS COMPETENCY LEVELS BY ROLE						
Competency		Mandatory Recommended Skill Level By Personnel				
		Facility Based Users			High Level Managers	IT/System Admin
		Clerical	Data Entry	Data Managers		
General Health Information Systems (HIS) Knowledge	Describe the purpose of an HIS	Basic	Basic	Advanced	Advanced	Aware
	Explain the basic components of an HIS and how they function together	Aware	Basic	Advanced	Advanced	Aware
	Describe the roles and responsibilities of health workers throughout the HIS	Basic	Basic	Advanced	Advanced	Aware
	Outline the flow of data in an HIS	Aware	Basic	Advanced	Advanced	Aware

MATRIX OF MANDATORY INFORMATICS COMPETENCY LEVELS BY ROLE

Competency		Mandatory Recommended Skill Level By Personnel				
		Facility Based Users			High Level Managers	IT/System Admin
Information Use	Distinguish between data needed for service delivery and data needed for programmatic decision making and resource management	Aware	Aware	Advanced	Advanced	Aware
	Describe the main decisions and health outcomes informed by health data from an HIS	Aware	Aware	Basic	Advanced	Aware
	Determine appropriate uses and limitations of different types of data	n/a	Aware	Advanced	Advanced	Aware
	Extract and interpret data from different types of reports	n/a	Aware	Advanced	Advanced	Aware
	Identifies and applies basic research methods	n/a	Aware	Basic	Advanced	Aware
	Analyzes and uses data from a variety of sources to make key decisions regarding patient care, programmatic and policy directions, and use of human, financial, and other resources.	n/a	Aware	Basic	Advanced	Aware
	Presents data to effectively communicate information and advocate for decisions to lay and professional audiences	n/a	Aware	Basic	Advanced	Aware
Data Quality and Confidentiality	Explain the importance of data quality and confidentiality	Basic	Basic		Advanced	Aware
	Identify key threats to data quality and actions that can be taken to improve data quality	Basic	Basic	Advanced	Advanced	Aware
	Identify gaps in data	Aware	Aware	Advanced	Advanced	Aware
	Evaluate the strength and validity of data	n/a	Aware	Advanced	Advanced	Aware
General EMR System knowledge	Describe the purpose of an EMR	Basic	Basic	Advanced	Advanced	Aware
	Explain the role of the EMR in a functioning HIS	Basic	Basic	Advanced	Advanced	Aware
	Describe the roles and responsibilities of health workers using the HIS and EMR as well as IT/system administration and support providers	Basic	Basic	Advanced	Advanced	Aware
	Understand basic medical terminologies as they relate to the EMR and to the specific disease area.	Basic	Basic	Advanced	Advanced	Aware

MATRIX OF MANDATORY INFORMATICS COMPETENCY LEVELS BY ROLE

Competency		Mandatory Recommended Skill Level By Personnel				
		Facility Based Users			High Level Managers	IT/System Admin
EMR System Navigation	List various sources of data	Aware	Basic	Advanced	Advanced	Aware
	Explain how data from different data sources is collected	Aware	Basic	Advanced	Advanced	Aware
	Describe the forms and reports used in an EMR and how they correspond to a facility's workflow as well as the flow of information in an HIS.	Basic	Basic	Advanced	Advanced	Aware
	Navigate an EMR system and use a variety of techniques to enter data into fields (i.e.: using drop down menus, calendars, typing)	Basic	Basic	Advanced	Basic to Advanced	Advanced
	Understand the purpose of required data fields	Basic	Basic	Advanced	Basic to Advanced	Advanced
	Recognize, analyze, and correct data entry errors and gaps	Basic	Advanced	Advanced	Advanced	Advanced
	Aggregate electronic data, generate and electronically submit appropriate reports in response to routine and ad hoc requests	Aware	Basic	Advanced	Advanced	Basic
EMR System Maintenance and Improvement	Access and use new versions of software	Aware	Basic	Advanced	Basic	Advanced
	Take basic action in response to simple software messages and errors	Basic	Basic	Advanced	Basic to Advanced	Advanced
	Refer complex software errors to the appropriate personnel	Basic	Basic	Advanced	Basic	Advanced
	Provide feedback on and suggestions for improvement to software to system administrators	Basic	Basic	Advanced	Basic	Advanced
	Identify and perform basic hardware and software support and administrative tasks	n/a	Aware	Basic	Aware	Advanced
	Find, analyze and resolve common end user problems or errors	n/a	Aware	Aware	Aware	Advanced
	Manage system user accounts and passwords	n/a	n/a	Aware	n/a	Advanced
	Maintain system security	n/a	n/a	Aware	n/a	Advanced
	Install, configure and maintain secure hardware and server systems	n/a	n/a	n/a	n/a	Advanced
	Install a virtual machine on hardware and run operating systems and applications on a virtual machine	n/a	n/a	n/a	n/a	Advanced

MATRIX OF MANDATORY INFORMATICS COMPETENCY LEVELS BY ROLE

Competency		Mandatory Recommended Skill Level By Personnel				
		Facility Based Users			High Level Managers	IT/System Admin
		Clerical	Data Entry	Data Managers		
EMR System Maintenance and Improvement	Securely install, configure, update, navigate and edit an operating system	n/a	n/a	n/a	n/a	Advanced
	Securely install, configure, upgrade and maintain relevant software applications on a server system.	n/a	n/a	n/a	n/a	Advanced
	Proactively monitor and manage relevant software applications within an OS environment	n/a	n/a	n/a	n/a	Advanced
	Orient and support an on-site IT system administrator of hardware and relevant EMR software applications	n/a	n/a	n/a	Aware	Advanced
Computer Literacy	Correctly identify and navigate components of a computer and its desktop	Basic	Basic	Advanced	Advanced	Advanced
	Demonstrate use of mouse functions	Basic	Basic	Advanced	Advanced	Advanced
	Troubleshoot basic computer problems	Basic	Basic	Advanced	Advanced	Advanced
	Open, edit, save, and exit a program	Basic	Basic	Advanced	Advanced	Advanced
	Explain the difference between a document and a program	Basic	Basic	Advanced	Advanced	Advanced
	Demonstrate an understanding of a computer's desktop, filing systems and drives	Basic	Basic	Advanced	Advanced	Advanced
	Navigate the Internet	Basic	Basic	Advanced	Advanced	Advanced
	Access specific web pages	Basic	Basic	Advanced	Advanced	Advanced
	Create a username and password and successfully log in to a web page	Basic	Basic	Advanced	Advanced	Advanced

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Table Q2: Informatics Competencies for Health Care Executives, Informatics Leaders, and Health Professionals

INFORMATICS COMPETENCIES FOR HEALTH CARE EXECUTIVES, INFORMATICS LEADERS, AND HEALTH PROFESSIONALS	
Roles	**Competencies**
Health care executives (CEO, CNE/CNO or equivalent [e.g., director of care in the long-term care sector])	■ Understand the critical role of information and IT to the business and to the delivery of safe, effective, and efficient delivery of health care, ensuring that local strategies are fully aligned, with informatics acting as a golden thread that connects them all together. ■ Promote a clear vision of the future state and the benefits for persons receiving care and for staff. ■ Provide strong and visible leadership and act as champions for IT-enabled change. ■ Specify their business and information needs, interpret and challenge the data and information presented to them, and use this as the basis for decision-making. ■ Understand the risks, issues, and benefits associated with the use of information systems and ICT, and ensure these are managed appropriately. ■ Advocate transformational change programs rather than IT projects, and identify and address the cultural and behavioural barriers to change and new ways of working with appropriate levels of investment and priority. ■ "Walk the talk": be confident users of information and ICT and model the behaviours needed in the workforce.
Informatics leadership (CCIO, CMIO, CNIO, and CIO or equivalent in non-hospital settings)	■ Seen as a partnership between the CIO (or equivalent) and the CCIO/CMIO/CNIO. ■ Skilled in communication and engaging with peers and colleagues to sell the benefits of informatics and secure involvement in design and development. ■ Able to win the hearts and minds of staff across the organization. ■ Set out clear objectives and benefits that build on the corporate vision, and establish plans that include input from a diagonal slice of stakeholders. ■ Listen to users in a demonstrable way and respond appropriately. ■ Remain cognizant of the importance of effective communications and the avoidance of "geek speak." ■ Foster productive working relationships with system suppliers. ■ Ensure adequate levels of staff and expertise, and demonstrate commitment to building and developing (or commissioning and requiring) excellence in the informatics workforce. ■ Skilled in project and program management to ensure delivery according to plans and within budget. ■ Provide high-quality customer support and help desk facilities. ■ Plan effectively for training of staff at the right time and to the right level.

INFORMATICS COMPETENCIES FOR HEALTH CARE EXECUTIVES, INFORMATICS LEADERS, AND HEALTH PROFESSIONALS	
Roles	**Competencies**
Nurses and other health professionals	■ Understand the risks, issues, and benefits of using IT systems in health and care delivery. ■ Possess the knowledge and skills to use information and IT with confidence. ■ Actively contribute to the development and deployment of information and IT systems, and represent the perspective of both the persons receiving care and the profession at all times. ■ Able to review and recommend changes to a care or business process enabled by information or ICT. ■ Handle and share data and information safely and securely, and understand the implications of poor data quality. ■ Demonstrate good practice in the creation, use, and storage of electronic health and care records and adhere to standards that have been agreed upon. ■ Routinely share information with persons who are receiving care, and use information and IT effectively in the consultation. ■ Identify the barriers to successful informatics-enabled change and how each barrier might be tackled or prevented through the use of effective change management techniques and good practice.

Source: Adapted from NHS England and HHS.[155] Used with permission

Table Q3: Informatics Competencies for Nurse Managers

LEVEL ONE BEGINNING NURSE MANAGER COMPETENCIES		
Computer Skills	Administration	■ Uses administrative applications for practice management (e.g., searches for patient, retrieves demographics, and billing data) ■ Uses applications for structured data entry (e.g., patient acuity or classification applications)
	Communication (email, internet, and telecommunications)	■ Uses e-mail (e.g., create, send, respond, and use attachments) ■ Uses the Internet to locate and download items of interest (e.g., patient and nursing resources)
	Data access	■ Uses sources of data that relate to practice and care ■ Accesses, enters, and retrieves data used locally for patient care (e.g., uses HIS and CIS for plans of care, assessments, interventions, notes, and discharge planning) ■ Conducts online literature searches
	Documentation	■ Uses an application to document patient care ■ Uses an application to plan care for patients to include in discharge planning ■ Uses an application to enter patient data (e.g., vital signs)
	Education	■ Uses information management technologies for patient education (e.g., identifies areas for instruction, conducts education, and evaluates outcomes and resources)
	Monitoring	■ Uses computerized patient monitoring systems
	Basic desktop software	■ Uses multimedia presentations ■ Uses word processing ■ Demonstrates keyboarding (typing) skills
	Systems	■ Operates peripheral devices (e.g., bedside terminals and hand-held devices) ■ Uses existing external peripheral devices (e.g., CD-ROMs and zip drives) ■ Uses computer technology safely ■ Identifies the appropriate technology to capture the required patient data (e.g., fetal monitoring device) ■ Demonstrates basic technology skills (e.g., turn computer off and on, load paper, change toner, remove paper jams, and print documents)

LEVEL ONE BEGINNING NURSE MANAGER COMPETENCIES		
Informatics Knowledge	Data	■ Recognizes the use and/or importance of nursing data for improving practice
	Impact	■ Recognizes that a computer program has limitations due to its design and capacity of the computer ■ Recognizes that it takes time, persistent effort, and skill for computers to become an effective tool ■ Recognizes that health computing will become more common ■ Recognizes that the computer is only a tool to provide better nursing care and that there are human functions that cannot be performed by computer ■ Recognizes that one does not have to be a computer programmer to make effective use of the computer in nursing
	Privacy/security	■ Seeks available resources to help formulate ethical decisions in computing ■ Describes patient rights as they pertain to computerized information management
	Systems	■ Recognizes the value of clinician involvement in the design, selection, implementation, and evaluation of applications and systems in health care ■ Describes the computerized or manual paper system that is present ■ Explains the use of networks for electronic communication (e.g., the Internet) ■ Identifies the basic components of the current computer system (e.g., features of a PC or workstation)

LEVEL TWO EXPERIENCED NURSE MANAGER COMPETENCIES		
Computer Skills	Administration	■ Uses administrative applications for budget ■ Uses applications to manage aggregated data ■ Uses administrative applications for staff scheduling ■ Uses administrative applications for maintaining employee records
	Quality improvement	■ Uses data and statistical analyses to evaluate practice and perform quality improvement
Informatics Knowlege	Data	■ Promotes the integrity of nursing information and the access necessary for patient care within an integrated, computer-based patient record ■ Provides for efficient data collection
	Impact	■ Defines the impact of computerized information management on the role of the nurse
	Privacy/security	■ Discusses the principles of data integrity, professional ethics, and legal requirements ■ Describes ways to protect data
	System	■ Describes general applications to support administration (e.g., staffing and budget) ■ Describes general applications and systems to support clinical care ■ Describes general applications to support nursing education
Informatics Skills	Role	■ Participates in influencing the attitudes of other nurses toward computer use for nursing practice ■ As a clinician (nurse), participates in the selection process, design, implementation, and evaluation of systems ■ Acts as an advocate of system users, including patients or clients
	Systems maintenance	■ Performs basic troubleshooting in applications

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Table Q4: Discipline-specific Informatics Core Competencies

DISCIPLINE-SPECIFIC INFORMATICS CORE COMPETENCIES		
Resource	**Description**	**Link**
Entry-to-Practice Competencies for Pharmacists	This document identifies core informatics competencies for ph armacists.	https://www.afpc.info/system/files/public/AFPC%20ICT%20Informatics%20Brochure%20In%20house1%5B1%5D.pdf
eHealth Competencies for Undergraduate Medical Education	This document identifies core informatics competencies for physicians.	https://chec-cesc.afmc.ca/en/system/files/documents/ehealth-competencies-ume_en.pdf
Nursing Informatics: Entry-to-Practice Competencies for Registered Nurses	This document identifies core informatics competencies for nurses.	http://www.casn.ca/wp-content/uploads/2014/12/Nursing-Informatics-Entry-to-Practice-Competencies-for-RNs_updated-June-4-2015.pdf
Health Informatics: Professional Core Competencies	This document identifies core informatics competencies for health informatics professionals.	https://www.coachorg.com/en/resourcecentre/resources/Health-Informatics-Core-Competencies.pdf

Endorsements

Association canadienne d'informatique de la santé

COACH™

Canada's Health Informatics Association

March 3, 2017

Doris Grinspun RN, MSN, PhD, LLD(hon), O.ONT.
Chief Executive Officer
Registered Nurses Association of Ontario (RNAO)

Dear Dr. Grinspun,

On behalf of COACH: Canada's Health Informatics Association, I am pleased to endorse the evidence-informed best practice guideline, *Adopting eHealth Solutions: Implementation Strategies*, developed by the Registered Nurses' Association of Ontario (RNAO) in partnership with Canada Health Infoway (Infoway).

In 1975 COACH was formed by health professionals and vendors in the medical industry who recognized that the sharing of ideas and efforts is vital to enable Canadian health institutions to effectively use information technology and systems. Since that time, COACH members have worked passionately to make a difference in advancing health care through information technology. As a knowledge resource that will aid in adoption decision making, this guideline aligns with COACH's mission to promote adoption, practice and professionalism of health informatics.

The guideline's evidence-based individual, organization, education and system recommendations will enhance the leadership capacity of health-care executives, nurses and other health-care providers, to effectively lead and support the implementation and adoption of high quality digital health systems. COACH commends RNAO on their commitment and dedication on this important work.

Sincerely,

Mark Casselman
Chief Executive Officer
COACH: Canada's Health Informatics Association

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20 January, 2017

Doris Grinspun RN, MSN, PhD, LLD(hon), O.ONT.
Chief Executive Officer
Registered Nurses Association of Ontario (RNAO)

Dear Doris,

The Honor Society of Nursing, Sigma Theta Tau International (STTI) is pleased to endorse the Registered Nurses' Association of Ontario's (RNAO) Clinical Best Practice Guideline - *Adopting eHealth Solutions: Implementation Strategies*. I commend RNAO, in partnership with Canada Health Infoway, on this important work to enhance the leadership capacity of executives, nurses and other health-care providers, to effectively lead and support the adoption and implementation of high quality digital health systems.

As you know, STTI is dedicated to advancing world health and celebrating nursing excellence in scholarship, leadership, and service. With 135,000 active members in more than 90 countries, we promote products and services that focus on education, leadership, career development, evidence-based nursing, research, and scholarship. As such, we view this guideline as a timely, effective eHealth resource that will benefit the nursing profession and global healthcare.

RNAO's *Guidelines for Healthcare Leaders and Clinicians to Optimize Implementation and Adoption of eHealth Solutions* will support nurses in all roles as they lead the digital age in delivering evidence-based, high-quality care across all sectors.

Thank you for your leadership in developing this impressive work for global implementation.

Patricia E. Thompson

Patricia E. Thompson, EdD, RN, FAAN
Chief Executive Officer
Honor Society of Nursing
Sigma Theta Tau International

Notes

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INTERNATIONAL
AFFAIRS & BEST PRACTICE
GUIDELINES

Best Practice Guidelines

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