

Ten key considerations for the successful optimization of large-scale health information technology

RECEIVED 22 October 2015
REVISED 8 February 2016
ACCEPTED 17 February 2016



OXFORD
UNIVERSITY PRESS

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ABSTRACT

Implementation and adoption of complex health information technology (HIT) is gaining momentum internationally. This is underpinned by the drive to improve the safety, quality, and efficiency of care. Although most of the benefits associated with HIT will only be realized through optimization of these systems, relatively few health care organizations currently have the expertise or experience needed to undertake this. It is extremely important to have systems working before embarking on HIT optimization, which, much like implementation, is an ongoing, difficult, and often expensive process. We discuss some key organization-level activities that are important in optimizing large-scale HIT systems. These include considerations relating to leadership, strategy, vision, and continuous cycles of improvement. Although these alone are not sufficient to fully optimize complex HIT, they provide a starting point for conceptualizing this important area.

Keywords: Health policy value, quality of health care, safety, leadership

INTRODUCTION

Health information technology (HIT) represents a fundamental component of health system improvement strategies internationally.^{1,2} Accordingly, implementation of these systems is picking up pace. Well over three-quarters of US hospitals have implemented at least a basic electronic health record system.³ Similar deployments are also being seen in many other countries.⁴

As health care systems and delivery organizations overcome the initial very substantial implementation hurdles, focus is shifting to how best use HIT to transform care processes, patient experiences, and outcomes.^{5–7} There is currently a great deal of frustration that, despite investing significant financial and human resources in HIT implementation, many organizations do not yet feel that they are achieving the hoped-for returns. What is often not appreciated is that deriving value is dependent on organizations putting in place carefully considered optimization strategies. These processes should be conceptualized as continuous organizational efforts to improve HIT systems and the ways they are used.⁸ This may involve refining advanced system functionalities, such as computerized decision support systems; developing data analytic functionalities to support quality improvement and/or research efforts; and developing sound approaches to deal with new emerging problems, some of which may have been introduced by the HIT systems themselves. We have summarized some exemplar overall optimization areas and specific strategies associated with these in Table 1, but this list is by no means exhaustive. These functionalities are central to the Stage 3 Final Recommendations of the Meaningful Use Incentive Program recently announced by the United States (US) Department of Health and Human Services.⁹

To help healthcare organizations achieve advanced HIT use, we build on our previous work detailing essential organizational considerations associated with implementing and adopting HIT.^{10,11} We draw on our experiences of working with benchmark sites in the US and United Kingdom (UK) and our ongoing research to share key findings, in the hope that this will help health care organizations in their

continuing journey of refining HIT systems to maximize benefits. This work is intended as a framework for optimization deliberations, but it is important to keep in mind that our list is not intended to be comprehensive. There may be additional important points that will be necessary to fully optimize HIT, and these are likely to vary between systems and across organizational contexts.

TEN KEY CONSIDERATIONS FOR THE SUCCESSFUL OPTIMIZATION OF LARGE-SCALE HEALTH INFORMATION TECHNOLOGY

Before substantive efforts are made on optimizing systems, it is vital that these are functioning as well as possible to support the organizational processes and work practices of users.^{12–15} This stabilization effort may include ironing out high-priority HIT-related safety threats and usability issues through either technical customization and/or changes in user/organizational practices. Once systems have achieved a certain level of stabilization, which in itself is typically a long and difficult process, the journey toward optimizing systems can begin.⁸ In this respect, it is important to note that quite often there are no clear boundaries between the various stages from implementation to optimization. We discuss the most essential elements of the optimization journey below.

1. Maintain organizational leadership and develop agile support structures

As with system implementation, ongoing high-level commitment is essential to ensure that sufficient resources are devoted to support optimization activities.^{16–20} Such leadership needs to continuously and consistently drive improvements by following the transformational vision, determining medium- and long-term priority areas, and providing financial support and incentives for related initiatives.^{1,21,22} At present, many organizations are trying to manage enormous numbers of requests for HIT changes, and if these are not actively addressed, value is not likely to be achieved, with the consequence that “sharp end” providers may become discouraged. The systems that vendors offer

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Table 1: Examples of optimization strategies for HIT

Exemplar over-all optimization area	Advanced computerized provider order entry and clinical decision support (please also see Reference 23)	Data reuse and data linkage	Increased patient involvement and ownership	Integration of information and interfacing across settings
Examples of specific activities addressing the exemplar area	Drug-allergy, drug-drug interaction, and contraindication checking	Quality improvement	Patient access to records	Ability to exchange data across care settings (electronic links to primary and specialty care)
	Laboratory test reminders	Research	Patient involvement in care activities	Electronic referral summaries
	Dosing support	Financial management	Patient education	Reconciliation activities
	Order entry of medication, laboratory tests, and diagnostic imaging linked to patient characteristics	Health care professional education and learning		

tend to be “bare-bones,” and the implicit assumption being made is that organizations will use the system tools offered to make care improvements. But achieving this requires organizations to continuously develop local human resource and governance structures. During this process, it is important to recognize that priorities may change and therefore a certain degree of flexibility is imperative. Useful practical guidance can be found in the US Office of the National Coordinator for Health Information Technology SAFER Self Assessment Guides, which are designed to help organizations optimize safety in high-priority areas.²³

2. Strive to create “learning health systems”

The overall vision surrounding HIT optimization needs to be articulated within the framework of what the Institute of Medicine (now part of the National Academy of Sciences) has called the “learning health system.”²⁴ HIT has great potential in this respect, since it allows the creation of a wealth of electronic data for analysis of trends, retrospective reviews/audits, identification of patterns, and analysis of potential contributing factors to adverse events.²⁵ Such systems, therefore, if adequately optimized, should be able to facilitate collection and analysis of data that can then be used to inform future planning through iterative cycles of feedback to users, units, and organizations. Here it is important to consider that learning and sharing needs to occur at different levels. Ideally, individuals and organizations should make data available for analysis in exchange for being able to draw on data themselves (thereby resulting in reciprocal benefits).²⁶ This implies that organizations need robust quality monitoring, tools, and organizational structures that enable relevant staff to get the data they need to improve care. This work should also involve embedding quality improvement and research from the start to drive quality and innovation.²⁷ Intermountain Healthcare in Salt Lake City, Utah, for instance, routinely provides performance data to individual clinicians, which in turn motivates individual users to input high-quality data.²⁸

3. Follow a medium- to long-term vision

Optimization of HIT takes time and needs to follow a medium- to long-term vision, as implementation-related activities are likely to consume a significant amount of initial resources.^{29–33} A degree of medium-term prioritization will likely be needed in order to agree on which optimization strategies should take precedence. For instance, integration of information and interfacing across settings is a strategic priority that transcends organizational boundaries and stakeholder groups (Table 1).^{34,35} This therefore presents an ideal starting point for considering

medium-term goals associated with HIT optimization. Longer-term goals should be in line with the vision but also open to continuous revision, as priorities and circumstances are likely to change over time. Establishing firm organizational processes to periodically revise longer-term goals can be very helpful in maintaining focus.

4. Develop relationships with and continuously learn from benchmark organizations

Developing relationships with and continuously learning from benchmark sites that have already implemented and refined optimization approaches can prove very helpful. Although approaches need to be tailored to local needs and environments, there are likely to be important transferable lessons, particularly in relation to continuous system customization and data reuse. Important benchmark sites in the US include the Regenstrief Institute at the Indiana University School of Medicine, the Mayo Clinic in Rochester, Minnesota, Intermountain Healthcare, and the University of Vermont Medical Center Hospital.^{36,37}

5. Keep developing human capital and maintaining user motivation

Project teams with necessary clinical, informatics, analytics, and organizational skills are essential for continuing system optimization, but once a system is implemented, many talented staff tend to leave to work on implementations in other institutions.¹¹ As technologies become more advanced, there may also be a need to recruit staff with new skills and/or train existing staff in optimization strategies.³⁸ Required skill sets include technical expertise to customize systems (eg, incorporating new computerized decision support alerts or interfaces and modeling their effects),³⁹ organizational change capability to ensure that new functionalities are adequately used and desired data is collected,¹⁵ and development of analytics skills to ensure that data is effectively drawn on to improve quality.⁴⁰ Some settings have made significant progress in this respect, at least in the short-term. More medium- and longer-term capacity development strategies are also needed in order to derive maximum value from HIT.⁴¹

Moreover, data to be collected through HIT needs to be of good quality. Otherwise there is a danger that analysis will produce misleading results.⁴² In order to develop and maintain high-quality data that can be used repeatedly, stakeholders need to be motivated to record the data and to use electronic health records and related HIT as intended.⁴³ The more the data are used, the better they will get. The development of informal workarounds is a continuous threat to data quality and may jeopardize system optimization.^{14,15} Workarounds tend to be developed by users to get around concerns surrounding

system usability, which highlights the underlying need for sustained engagement in relation to identifying, understanding, and responding to changing technical features.⁴⁴ A periodic formal organizational review of shifting levels of engagement and potential associated unintended consequences should therefore be an essential part of organizational efforts.

6. Measure progress and gather evidence

Evaluation of optimization initiatives can help to create a baseline, track progress over time, and facilitate learning.⁴⁵ This work ideally commences well before implementing any system and/or operational changes, and should be designed to obtain good-quality indicators for improvement surrounding optimization.⁴⁶ In doing so, attention to both quantitative outcome measures and qualitative process measures is vital. Evidence also needs to reflect the complexity of the environment in which changes are taking place, paying attention to both technical and social dimensions, including improvements and risks.⁴⁶ In relation to technical aspects, for instance, continued measurement and monitoring of technical functioning, including system reliability, response time, upgrades, and system-induced errors, can help in anticipating and mitigating risks.^{47,48} Some useful guidance in this respect can be found in a recent conceptual framework surrounding the monitoring and measurement of social and technical threats associated with HITs.⁴⁸

Learning from experiences with using electronic data can help to improve data quality, and careful tracking of progress can help to ensure that this data has real-world applicability.⁴⁹ A key to achieving this is establishing close links between academic and health care communities.

7. Be clear what data to collect, how it will be used, and who will have access to it

Agreement in relation to goals is important to ensure that the optimization efforts of stakeholders are aligned.⁵⁰ Multi-stakeholder consensus around key organizational, professional, and patient priorities is therefore a crucial step in any optimization strategy.^{11,19} Specifying associated electronic data to address priority areas should follow.⁵¹ Here, it is important to consider which data is actually needed to achieve the desired goal, otherwise there is a danger that efforts will be spent on collecting information that is ultimately not used.⁵² For instance, the approach of Intermountain Healthcare's data analytics team begins with the identification of a specific aim (eg, 5% reduction in hospital readmissions within 12 months), followed by an assessment of current and future states.⁴¹ After these important preliminary steps, relevant data items are identified and specified, which allows monitoring of progress toward this goal.

Another pitfall is that organizations frequently establish approaches that are too restrictive regarding who can access data after implementation of new systems, so that those responsible for quality and safety or researchers cannot access data in a timely fashion. Therefore, careful thought should be given to balancing the need to protect data with allowing access to support improvement efforts.

8. Continuous monitoring of HIT-related safety issues

HIT-related safety threats can occur at any stage of the implementation process, but given their critical importance, there is a continuing need to address these. This should include constant monitoring of risks and unintended consequences, as technical functionalities and ways of use are likely to change over time.¹³ Such activity needs to be characterized by a willingness to learn from user experiences and draw on formal reporting systems to respond to identified problems.

Users must be encouraged to report adverse events, which can then be collected, analyzed, and interpreted. Systems and processes subsequently need to be put into place to prevent similar issues from occurring in the future.^{53–55}

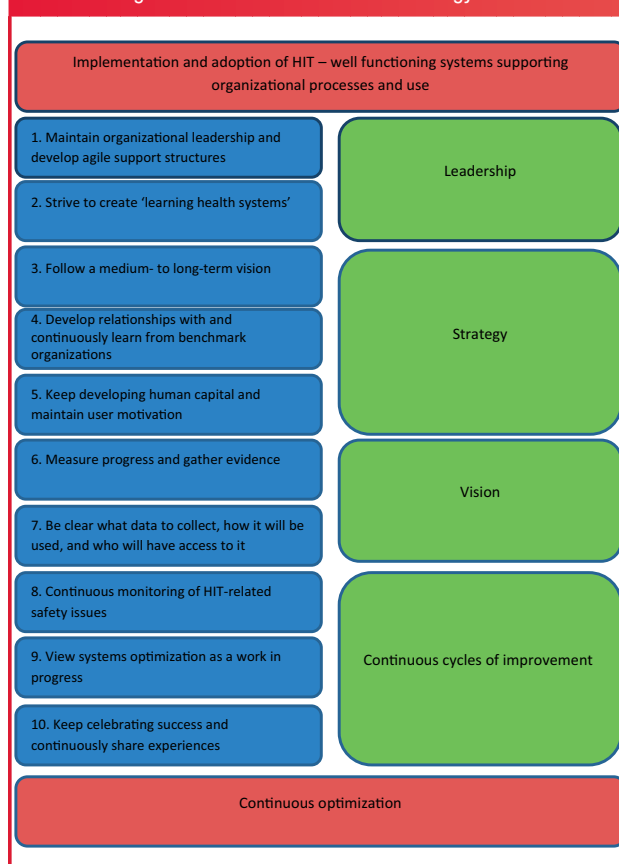
9. View systems optimization as a work in progress

The work surrounding HIT optimization activities is best conceptualized as an ongoing process of improvement.^{8,11} Although milestones are important, there is no actual endpoint. Quality improvement needs to adapt to technical changes (eg, emerging innovations and refinement of existing functionalities) and social dynamics (eg, national, organizational, and user factors),^{56,57} paying attention to both formal/planned and informal/emergent use.^{56,57} Emergent informal and potentially innovative optimization activities deserve special attention, as these often identify or address existing technical/social issues associated with new systems/practices. For example, workarounds employed by system users can be drawn on to improve system design and integration with work/organizational practices.⁵⁸

10. Keep celebrating successes and continuously share experiences

In order to keep organizational actors motivated, successes need to be celebrated, and in order to promote learning across organizations, experiences and insights should be shared.^{15,21} This will likely entail establishing organizational structures that guide the collection of data associated with success (eg, the number of reduced readmissions) as well as mechanisms to record and disseminate lessons learned (eg,

Figure 1: Ten key considerations for the successful optimization of large-scale health information technology



by establishing collaborations with academic centers and communications teams).

The larger the scale of such sharing, the better. Organizational learning can help to inform the efforts of establishments yet to embark on optimization activities.⁵⁶ In this context, sharing of negative experiences is important, as it can potentially prevent unnecessary use of resources and iatrogenic harm.⁵⁹ However, these should not be one-off activities; rather, they should become established as part of the core identity of healthcare organizations.^{52,53}

CONCLUSIONS

We have outlined 10 key considerations for optimization that we hope will help to inform efforts to refine HIT systems as organizations are moving from implementation toward embedded use (Figure 1). This list of considerations is by no means exhaustive, and we hope that others will, in due course, build on it. The 10 areas we have identified can be conceptually divided into leadership, vision, strategy, and improving outcomes; covering technical, organizational, user, and patient dimensions. These need to be considered together and, if possible, aligned to effectively optimize HIT. It is important to keep in mind that before any of this optimization can begin, systems must be working appropriately and used as intended in individual settings.

Many health care organizations have made major investments HIT. However, the extent to which these investments will result in the desired improvements is still uncertain, and is the subject of significant political debate in many countries, including the US. We believe that these benefits will be achieved, but it will take time, and that achieving them will be absolutely contingent on developing effective and robust optimization approaches. We strongly advocate a wider recognition that optimization efforts must be conceptualized as an ongoing journey and not as a destination that can be reached shortly after implementation. This journey will almost certainly be difficult, time consuming, and expensive, but the investments made will likely be worth it.

CONTRIBUTORS AND SOURCES

A.S. and D.W.B. conceived this work. A.S. is currently leading a National Institute for Health Research-funded national evaluation of electronic prescribing and medicine administration systems. K.C. is employed as a researcher on this grant and led on the write-up and drafting of the initial version of the paper, with A.S. and D.W.B. commenting on various drafts.

FUNDING

This work has drawn on data funded by the National Health Service Connecting for Health Evaluation Programme (National Health Service Connecting for Health Evaluation Programme 001, National Health Service Connecting for Health Evaluation Programme 005, National Health Service Connecting for Health Evaluation Programme 009, National Health Service Connecting for Health Evaluation Programme 010), the National Institute for Health Research under its Programme Grants for Applied Research scheme (RP-PG-1209-10099), and The Commonwealth Fund. K.C. is supported by a Chief Scientist Office of the Scottish Government Postdoctoral Fellowship, and A.S. is supported by the Farr Institute. The views expressed are those of the authors and not necessarily those of the National Health Service, the Chief Scientist Office, the National Institute for Health Research, or the Department of Health.

COMPETING INTEREST

The authors declare that they have no competing interests.

ACKNOWLEDGEMENTS

We are very grateful to all participants who kindly gave their time and to the extended project and program teams of work we have drawn on. We would also like to thank 2 anonymous expert reviewers for very helpful comments on an earlier draft of this manuscript.

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