Health Information Technology and Electronic Health Records

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Introduction

The QHOM (Mitchell et al. 1998) considers the system as an organized agency that includes hospitals and provider networks. The model further identifies system structural elements that interact with treatment processes to impact outcomes. Structural elements identified include the size of the organization, ownership, client demographics, and technology. Specifically noted is that technology can positively impact outcomes. Health information technology (Health IT) in the context of the QHOM should be considered a significant intervention or tool imposed by the federal legislative agenda to promote and encourage the adoption and implementation of electronic health records (EHRs) and other types of Health IT. This chapter ties the QHOM to the optimization of Health IT. It concludes with a call to address usability, unintended consequences, burden of documentation, and importance of Health IT competencies to improve health outcomes.

Health IT: Linkages to the QHOM

The QHOM is an excellent framework for addressing technology optimization for nursing and the interprofessional team because the model captures essential factors that influence the overall outcomes for individuals, groups, and

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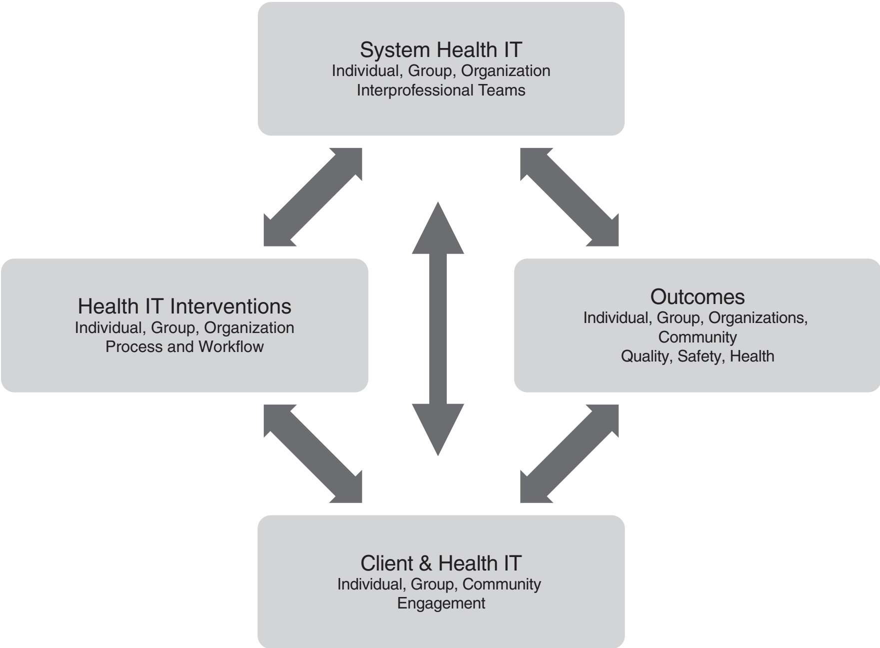

Fig. 6.1 Framework for Health IT

communities. The capacity to reach ideal patient outcomes depends on *system* Health IT expansions and improvements to the EHR that promote interoperability across care settings and foster healthcare consumer engagement and activation.

The QHOM components of system characteristics, interventions, client, and outcomes will be described in terms of Health IT optimization. The individuals, groups, and organizations within each of the QHOM components will be addressed with clinical examples to emphasize the impact on the three levels with respect to Health IT optimization to improve outcomes. Mitchell and colleagues discuss the QHOM as follows: "Interventions affect and are affected by both system and client characteristics in producing desired outcomes … and no single intervention acts directly through either system or client alone" (Mitchell et al. 1998, p. 44). This statement can be directly related to the optimization of technology, mainly seen as an intervention focused on process improvement to use technology as a tool to enhance outcomes. Health IT is impacted by system characteristics and influences individual, group, and community health outcomes. Figure 6.1 reflects these relationships. These relationships are dynamic reciprocal relationships that exist and act upon each other (Mitchell et al. 1998).

Environmental Context of Healthcare Regulation in the USA

With the massive expansion of Health IT throughout the USA, new approaches are needed to wholly realize the vision of a fully interoperable national Health IT infrastructure established by the Office of the National Coordinator (ONC) for Health IT. The ONC was initially established by executive order in 2004 by the Bush Administration. The ONC has federal oversight under Health and Human Services for Health IT regulation. The ONC defines IT as "The application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of healthcare information, data, and knowledge for communication and decision making" (ONC 2020a). The ONC's mission is to promote the wellness and health of individuals and communities through the use of Health IT (ONC 2019).

Baernholdt et al. (2018) conducted a study under the American Academy of Nursing Quality Expert Panel, expanding on the QHOM to include important environmental contextual influences. The authors examined Health IT and the development of electronic measures including the collection, storage, and use of data, all of which were impacted by interventions and changes within the healthcare context. An important contextual factor for Health IT is policy and regulation that significantly expanded the US Health IT infrastructure and the capacity to collect and use data. See Chap. 2 for other policy interventions that have affected US healthcare.

Important Health IT Regulatory Milestones

In 2009, the Health Information Technology for Economic Clinical Health (HITECH) Act was enacted as a component of the American Recovery and Reinvestment Act (ARRA).

The HITECH Act had several key goals:

- Improve quality and efficiency.
- Improve the exchange of information to promote better care coordination between hospitals, providers, labs, and other healthcare organizations.
- Maintain privacy and security of personal health information.
- Establish mechanisms to detect, prevent, and manage chronic illnesses (US Congress 2009).

The HITECH Act was an important legislation for health information technology that propelled the adoption and implementation of Health IT forward exponentially. Based on this legislation, the Centers for Medicare & Medicaid Services (CMS) established the Electronic Health Record (EHR) Incentive Program in 2011 (CMS 2019). In the next several years, the national EHR penetration rate improved substantially. By 2016, 78% of providers and 96% of hospitals had adopted a federally certified EHR system that meets federal requirements for meaningful use of EHRs (see Table 6.1 for stages of meaningful use). Although impressive, the improvement

Table 6.1 Stages of meaningful use and respective years (ONC 2020b)

Years	Stage	Goals
2011–2012	1	Data capture and sharing
2014	2	Advanced clinical processes
2016	3	Improved outcomes

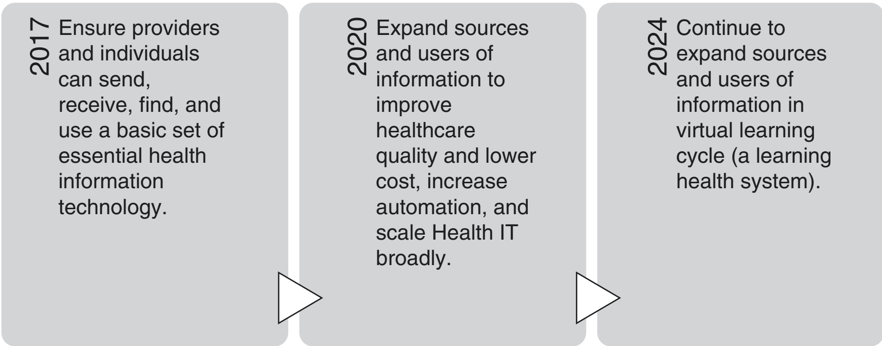

Fig. 6.2 Milestones for promoting interoperability and a learning healthcare system focused on quality

in EHR adoption presents challenges with optimizing certified technology within institutions and across regions, states, and the nation.

The adoption of EHR technology is only one step toward the effective use of Health IT. The decision by organizations to adopt, implement, and reach the meaningful use measures was largely impacted by CMS's financial incentives to implement EHRs, followed by penalties for organizations that did not reach certain levels of adoption and use of EHRs. The CMS EHR incentive program became the framework for promoting EHR adoption. Meaningful use established the specific objectives that providers and hospitals needed to meet to be eligible for financial incentives under the CMS Incentive Program. Meaningful use was defined within the federal regulations specifying a certified EHR's functions and capabilities under the Incentive Program. Three stages were defined and are noted in Table 6.1. These stages of meaningful use pushed to achieve higher levels of adoption and implementation, advancing many of the capabilities of certified EHRs for better interoperability.

Additional important milestones that followed the HITECH Act was the 21st Century Cures Act, which was enacted in 2016 to accelerate the design, development, and use of new technologies needed to support care delivery and outcomes. Finally, in 2014, the ONC released a 10-year road map with a vision established for a fully interoperable learning healthcare system nationwide. This interoperability vision includes hospitals, providers, labs, and other healthcare organizations using Heath IT to exchange important healthcare information to promote health and better care for populations. Figure 6.2 notes several essential milestones for interoperability.

Structural Components of Health IT Established Under Meaningful Use

Certified EHRs under "meaningful use" include electronic prescribing, computer provider order entry (CPOE), clinical decision support systems (CDSS), patient portals, personal health records, and an ability to capture data for electronic clinical quality measures. These components rely on a standardized approach to capturing data to create interoperability within and across institutions and communities. Through the use of all of these structural components, the ultimate national vision for certified technology is a digital highway that connects providers and hospitals and supports healthcare consumers in accessing their personal health information worldwide. This national goal has the potential to impact individuals, groups, and communities as a profound intervention to impact overall outcomes.

The Health IT structural components, coupled with quality improvement methods, constitute Health IT interventions defined in Table 6.2. Within the QHOM framework, the interventions are delivered to individuals, families, or communities to improve outcomes.

The electronic clinical quality measures (eCQMs) within healthcare reform address both process and outcome measures, and the eCQMs are tied to the Triple Aim outlined within the national quality strategy (NQS) (McBride et al. 2019). The Triple Aim is better care, improved population health, and affordable costs (Berwick et al. 2008). Further, the eCQMs are guided by CMS' measurement strategy and the six NQS priorities: care coordination, safety, clinical quality of care, person and caregiver experience and outcomes, population/community health, and efficiency and cost reduction. The CMS measurement strategy includes measurements at multiple levels such as community, practice setting, and individual clinician/provider levels (Agency for Healthcare Research and Quality 2014a).

System Characteristics that Influence Health IT Adoption

Characteristics of the healthcare system within the QHOM model constitute structural components. The QHOM proposes relationships among components such that interventions act upon and through characteristics of the system and the client, and vice versa. Health IT and all its components can be viewed as a significant intervention deployed by "the system" to influence outcomes, particularly when coupled with quality improvement strategies. In other words, the effect of the Health IT intervention is mediated by or interacts with client and system characteristics and it has no independent direct effect on the outcome.

For example, environmental contextual factors, such as federal policy enacted to encourage and regulate Health IT for hospitals and providers, can be viewed within the QHOM framework as influencing the system to adopt certified EHRs. However, organizations elect which EHR to adopt and how quickly to implement it. For instance, many organizations elected "the big bang" approach to certified EHR adoption. Big bang implementation means the system is elected to move over from

Table 6.2 Health IT terminology with definitions (ONC 2020a)

Component	Definition
Electronic prescribing (ePrescribing)	Computer-based electronic generation, transmission, and filling of a medical prescription, taking the place of paper and faxed prescriptions
Computer provider order entry (CPOE)	Computerized provider order entry (CPOE) refers to the process of providers entering and sending treatment instructions—including medication, laboratory, and radiology orders—via a computer application rather than paper, fax, or telephone
Clinical decision support systems (CDSS)	Clinical decision support (CDS) provides clinicians, staff, patients, or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and healthcare. CDS encompasses a variety of tools to enhance decision-making in the clinical workflow
Patient portals	A patient portal is a secure online website that gives patients convenient, 24-hour access to personal health information from anywhere with an Internet connection. Using a secure username and password, patients can view health information such as recent doctor visits, discharge summaries, and medications
Personal health records	A personal health record, or PHR, is an electronic application through which patients can maintain and manage their health information (and that of others for whom they have authorized) in a private, secure, and confidential environment
Health information exchange	Electronic health information exchange (HIE) allows doctors, nurses, pharmacists, other healthcare providers, and patients to appropriately access and securely share a patient's vital medical information electronically—improving the speed, quality, safety, and cost of patient care
Interoperability	The ability of computer systems or software to exchange and make use of information, "interoperability between devices made by different manufacturers"
Data standards	In the context of healthcare, the term data standards encompasses methods, protocols, terminologies, and specifications for the collection, exchange, storage, and retrieval of information associated with healthcare applications, including medical records, medications, radiological images, payment, and reimbursement
Electronic clinical quality measures (eCQMs)	Electronic clinical quality measures (eCQMs) use data electronically extracted from electronic health records (EHRs) and/or health information technology systems to measure the quality of healthcare provided

the old way of documenting (paper or an older legacy electronic record) overnight. One day, clinicians are on one system. The next day, the entire system moves over to a new way of doing things. System characteristics influence many organizations' decisions of how, when, and what type of technology to implement. Further, the environmental context (federal regulations) influences organizations (systems) to reach meaningful use of EHRs through financial incentives. System structural components influence the rapid adoption of clinical processes and workflows, which significantly influences how care processes are delivered.

In many institutions, EHRs were deployed as a technology implementation project and were not coupled with quality improvement strategies. System characteristics of an organization's culture led by an IT department rather than quality improvement likely influenced this approach. Unfortunately, this approach resulted in clinician dissatisfaction primarily due to the negative impact on clinicians' workflow and unnecessary documentation burden (Bodenheimer and Sinsky 2014; McBride et al. 2017).

Staff resources and competencies also influenced how hospitals and providers adopted the new EHR, implemented it, and trained their clinicians to use the new system. The characteristics of an organization would also influence the long-term maintenance of an EHR. Holmgren et al. (2018) reported that several hospital characteristics influenced EHR selection. These include ownership (private nonprofit, private for-profit, or public nonfederal); size (number of beds); participation in payment reform models; rural or urban location; teaching status; critical access hospital status; and participation in a health information exchange program. As a result of the rapid decisions and deployment of Health IT across the nation in the past decade and a half, EHRs and other Health IT components negatively influence the care delivered. Using the QHOM model, these challenges can be examined as opportunities to improve the use of technology and deploy quality improvement strategies discussed under the next section.

Health IT Interventions

The EHR and other point-of-care technologies that support and connect to the EHR, including device integration, are important considerations that impact patient safety and care quality in both positive and negative ways. Point-of-care technologies that supplement the EHR are devices that connect through interoperable connectivity standards to add additional patient care functionality. Examples of this type of technology include but are not limited to intravenous (IV) pumps, smart beds, and barcode administration mobile devices. Certified EHRs created many challenges that impact clinical workflow and, when coupled with additional point-of-care devices, result in better functionality, but at the same time added complexity with additional challenges and often unintended consequences of the technology. This section ties the QHOM to the optimization of technology and emphasizes the use of quality improvement science as a solution to better use Health IT.

The science of quality improvement (QI) is defined by the Institute for Healthcare Improvement (IHI) as follows: "… a unique approach to working with health systems, countries, and other organizations on improving quality, safety, and value in healthcare. This approach is called the science of improvement. The science of improvement is an applied science that emphasizes innovation" (IHI.org 2019, p. 1). As such, QI can be considered as the backbone for improving Health IT. The healthcare industry continues to "innovate" with the use of technology. Yet, many of our fundamental QI tools and strategies have not been used to adopt and implement technology innovations. An examination of a few of these fundamental tools that can be coupled with structural Health IT components to improve clinical processes and outcomes is given next.

Quality Improvement Tools to Improve Structural Components of Health

The QHOM framework creates an excellent foundation for examining technology's effect as an intervention and its impact on process and outcome for individuals, groups, and communities. In this context, the Health IT intervention is implemented using QI tools. As noted, the QHOM (Mitchell et al. 1998) proposes relationships among bidirectional components, with interventions or processes acting through characteristics of the system and of the client, and vice versa. An example of how this occurs is IV pump integration with the EHR. The intended outcome is at least twofold, with improved outcomes for individuals within the system that might be measured by an overall reduction in medication errors or pump infusion errors. The second outcome is improved processes. The process might involve pump integration to increase efficiency in the process of administering and monitoring IV medications on a hospital medical-surgical unit. With this integration, suggested process outcomes might be the total time to administer medications from computer provider order entry (CPOE) to IV pump start and the rate of pump integration errors. The medical-surgical unit's characteristics, such as nurse-to-patient ratio, influence the relationship between the process of administering medications and the outcome of medication errors. Other unit characteristics include the complexity of patients on the unit, day shift compared to evening and night shift, and day of the week. To address unintended consequences, monitoring of the improvement might include measuring patient, physician and nurse satisfaction (the client). In this example, QI tools can improve the process that impacts the outcomes by developing strategies to optimize Health IT's structural components. Useful QI tools include project charter, Plan-Do-Study-Act (PDSA) cycles, control charts, and workflow redesign.

The Project Charter

The project charter establishes "the game plan" for QI by outlining fundamental process improvement components, establishing the overall aim, scope of the project, and plan of action. A well-designed project charter also includes the process, outcome measures, and balancing parameters. When applied to technology optimization or to addressing a flaw or unintended consequence of technology, these measures align with the QHOM by establishing improvement strategies and tools to optimize technology for improved care processes and outcomes. For the example of the IV pump integration, the project charter's aim might be stated as follows: IV smart pump integration within 3 months to improve outcomes for a reduction in IV pump medication errors by 20%.

Plan-Do-Study-Act (PDSA) Cycles

The PDSA cycles originally proposed by Deming (1986) frame an *approach* to QI, upon which the entire QI activity is conceptualized as a more extensive process that is preplanned, executed, and evaluated in a logical, stepwise fashion. Inherent in the PDSA cycle is the assumption that to improve outcomes, processes must also improve. The PDSA model has been used on many occasions as a useful way to map the processes and outcomes of an implementation (Harrison and Lyerla 2012; Murphy 2013). The PDSA cycles can be utilized to plan a project for improving or optimizing Health IT. This approach is very effective when examining technology and its impact on clinician workflow and overall quality of patient care. For example, the PDSA cycles can be used to frame an improvement strategy for the IV pump integration to improve medication errors (outcome), mitigate pump integration errors (structure/process), and improve patient and clinician satisfaction (client). The PDSA approach to the IV pump integration might start with small tests of change in one area following the PDSA cycles and then adding another change depending on the outcome.

However, before starting a PDSA cycle, the QI team should first consider process mapping of the current workflow to lay out the entire process of administering IV medications. Second, the team should consider using a failure mode effect analysis (FMEA) to examine steps in the process and score the steps according to the risk of failure, with the highest risk receiving the highest score. Many system characteristics and client characteristics, including staff and patient, influence the process and risk within the process. A well-executed FMEA helps clarify where the process might fail, how often that failure might occur and how to optimize the technology integration to prevent medication error (Subramanyam et al. 2016). Once the areas of failure are identified, the workflow redesign's focus is determined, and a new process can be mapped using PDSA cycles to optimize the Health IT (structure) for better outcomes. Measuring the process pre- and post-improvement with control charts is a critical step to evaluate if a process is in control and if the improvement has positively impacted the process and outcomes.

Control Charts

A control chart, designed originally by Shewhart, is a chart that displays data over time or units of measure with upper and lower control limits (Best and Neuhauser 2006; McNeese 2016). Control charts are an effective way to differentiate between common cause (chance) and special cause variation (assignable) (Best and Neuhauser 2006). These methods can determine if a process is in control before implementing improvement strategies. Once implemented, detect special cause variation that reflects the impact of the improvement.

Control charts can be applied to Health IT improvement strategies to examine if a process is in control and whether special cause variation is present that should be fully understood before improvement occurs, and to measure the impact of pre- and post-improvement. For example, in the earlier IV pump integration example, integration can result in unintended consequences. These might include significant patient safety incidents or even a sentinel event that might require a root-cause

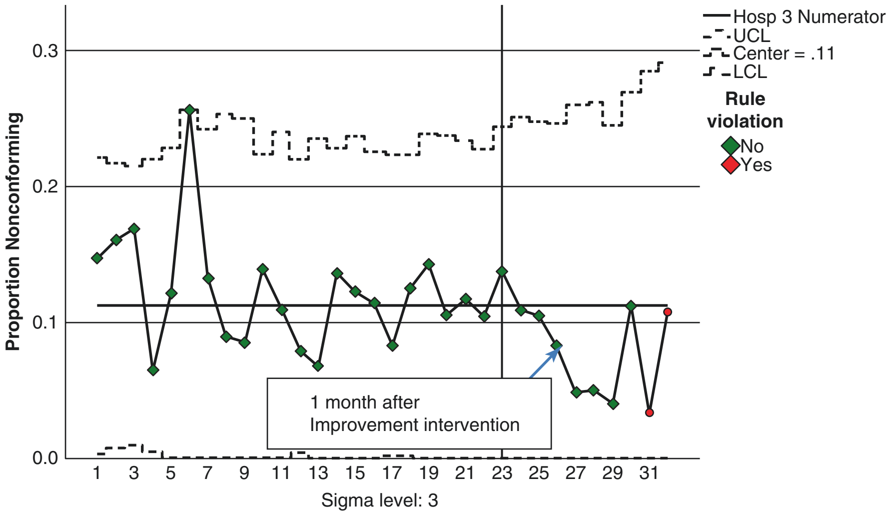

Fig. 6.3 Control chart for proportion of pump integration errors per month

analysis to fully understand the etiology or "root" of the issue. Also, control charts can be deployed to map relevant process measures. Figure 6.3 is a control chart displaying a successful intervention to optimize IV pump technology integration over time. The chart shows the proportion of errors in pre- and post-implementation. In this example, nonconforming is the proportion of errors on the *y*-axis, and time is noted on the *x*-axis. Time can vary by month, day, or quarter depending on the timeline for the improvement. The vertical line denotes 1 month after improvement. Month 23 reflects the onset of the improvement strategy to mitigate errors.

Workflow Redesign to Optimize EHRs and Other Point-of-Care Technologies

Research indicates that EHRs and other point-of-care devices have negatively impacted providers' clinical workflow (McBride et al. 2017). As such, workflow redesign methods are a critical QI tool to deploy for optimizing and rethinking technology within clinicians' workflow. The Health IT structural components can be redesigned to improve both process and outcomes by utilizing this QI tool. Workflow is defined by the Agency for Healthcare Research and Quality as "the sequence of physical and mental tasks performed by various people within and between work environments" (Agency for Healthcare Research and Quality 2014b). Workflow redesign is a method to map "as is" or current-state workflows. It examines opportunities to improve upon the workflow with a designed "to be" or future state based on the evidence and best practices. For example, the workflow of IV pump integration has several considerations related to clinical process and workflow. The following are key questions to consider, as noted by the American Society of Health-System Pharmacists (AHSP) (2020):

- How will automation of IV preparation change current processes?
- What is the new workflow?
- Does the new workflow make the process lean or add extra steps?
- How does the new technology impact the time to perform the task?
- Will there be a need to adjust other preparation or distribution workflows to enable incorporation of the new technology into daily, weekly, or off-shift use?
- Does the new workflow require an increase or decrease in the number of technicians and/or pharmacist staff during automation operations?
- Will the pharmacy department be able to repurpose staff assignments due to the implementation of the new technology (AHSP, p. 4)?

When considering these questions, the device integration implementation presents an excellent tie to how Health IT impacts clinical process and outcomes within the context of the healthcare environment influenced by system characteristics such as staffing and resources.

Health IT Competencies

Along with the introduction of Health IT into the healthcare delivery system came the need to educate clinicians, specifically nurses for whom Health IT education was of most importance. Educating nurses was crucial because of their pivotal role in coordinating patient care delivery. The advancement of technology in patient care delivery has been an ongoing evolution since the late 1990s. However, one can argue that the needed accompanying education in Heath IT has been slow to develop. Current examples are the needed competencies available through online course content such as the HITComp.org program (HITCOMP 2020) and the EU-US Initiative (EU*US eHealth Work 2018).

Along with the needed competencies, various nursing competency-based frameworks or models have evolved. The Nursing Education for Health Informatics (NEHI) is one example where competencies in teaching health informatics are emphasized (McBride et al. 2013). The framework organizes the informatics focus in three main domains: point-of-care technology, data management and analytics, and patient safety and quality for population health (see Fig. 6.4). The development of competencies for teaching in these three domains then yields the central aim of improved healthcare based on the union of each domain with the “nursing role.” The next step is integrating the nursing role in an interprofessional approach with other healthcare team members. The ultimate goal of the framework and the competencies from each domain is creating an organizational culture where the healthcare team can collectively address today’s care delivery challenges.

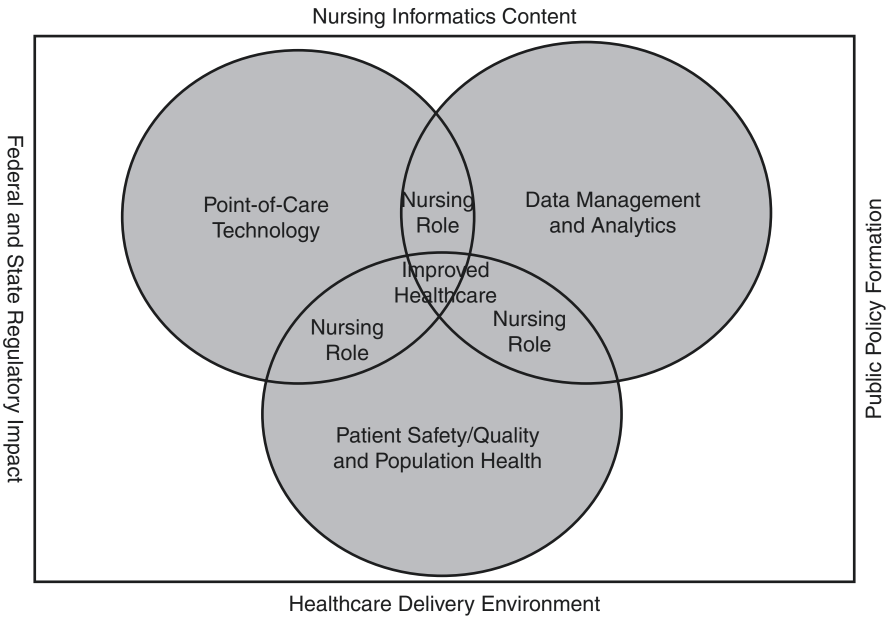

Fig. 6.4 The NEHI model. Framework for the development of curriculum to align with key information technology IOM recommendations (IOM Future of Nursing report) and the American Association of Colleges of Nursing DNP Essentials (with permission from McBride, S. G., Tietze, M., & Fenton, M. V. (2013). Developing an applied informatics course for a Doctor of Nursing Practice program. *Nurse Educator, 38*(1), 37–42. doi: https://doi.org/10.1097/NNE.0b013e318276df5d)

Technology Informatics Guiding Education Reform (TIGER)

One area where technology-based competencies have been consistently and significantly embraced over time is the Technology Informatics Guiding Education Reform (TIGER) initiative (TIGER Initiative 2014). TIGER initiated with a focus on nursing care delivery using technology, but it quickly morphed to an interdisciplinary focus, often the nature of technology in healthcare delivery. Beginning in the early 1990s, TIGER is now a global organization with more than 30 member countries. Besides, research and development of Health IT competencies, a virtual learning environment (VLE), houses the educational programs for teaching these competencies (HIMSS.org 2018b). The TIGER Competency Synthesis Project was comprised of international deployment of a survey questionnaire composed of 24 areas of core competencies in clinical informatics within five domains: (1) clinical nursing, (2) nursing management, (3) quality management, (4) IT management in nursing, and (5) coordination of interprofessional care (Hübner et al. 2016). The questionnaire was sent to 21 countries yielding participation from 43 experts to capture a global perspective.

These TIGER competencies have shed light on the role of executive leaders and what it takes for an organization to be truly technically safe and of high quality (HIMSS.org 2018a; Hübner et al. 2019). For the *Coordination of Interprofessional Care* with a focus on leadership competencies, specific sub-competencies emerge such as those listed here along with the proportion of respondents for each category:

- Data protection and security (85.9%)
- Information knowledge management (85.4%)
- Nursing documentation (83.4%)
- Process management (83.2%)
- Information communication systems (81.5%)
- Ethics and IT (78.8%) (Hübner et al. 2016)

These interprofessional, leadership-focused competencies are being further developed to improve their understanding and application.

Client

This section focuses on the client or healthcare consumer using technology to engage in healthcare delivery management. Patient, or consumer, engagement in their healthcare is a recent purposeful focus of healthcare delivery to achieve optimal patient outcomes. Several researchers have developed consumer engagement scales. One is the Stanford Self-Efficacy Scale (SES) (Ritter and Lorig 2014). The SES has 6 items where the patients report their degree of confidence on a 10-point scale in key aspects of chronic condition management such as fatigue, physical discomfort, and medications. Another scale measuring consumer engagement is the Patient Activation Measure (PAM) (Hibbard and Greene 2013; Hibbard et al. 2005). The PAM is much like the SES except that it contains 13 items, and the responses are on a 4-point Likert scale from strongly disagree to strongly agree (Hibbard et al. 2005). Both the SES and the PAM are extremely useful in quantifying the various levels of consumer engagement, which then guides the clinicians in efforts to support consumers and their family members in becoming optimally engaged in their healthcare, including while using Health IT. Studies have indicated that consumer engagement is associated with an improvement in healthcare outcomes (Centers for Medicare and Medicaid Services 2014; Coulter 2012; Graffigna et al. 2015) and with some decrease in the cost of healthcare delivery (Hibbard and Greene 2013).

Technology tools such as mobile health, telehealth services, and patient portals are commonly used to increase consumer engagement in healthcare delivery and manage their conditions (Tietze and Brown 2019). For example, with their secure online websites, portals give patients convenient, 24-hour access to personal health information from anywhere with an Internet connection. Portals can be accessed using a computer, laptop, iPad, or mobile phone. Portals are an example of a tool that can facilitate self-management in patients with complex chronic conditions (Powell and Myers 2018). Unfortunately, many patients are not taking advantage of this resource. In addition to patient portals, remote patient monitoring (RPM) in the home via technology is another way to engage consumers. The use of RPM is associated with a significant reduction in readmissions (Blum and Gottlieb 2014) and a decrease in emergency department use (Courtney et al. 2009). However, while convenient for patients, nurses, and other clinicians to use, measurements of the associated outcomes from these technology tools are difficult to capture and therefore are a much-needed focus for healthcare practice and research (Schulte and Fry 2019).

Outcomes

This section focuses on the impact of Health IT on positive and negative outcomes. In 2011, post-HITECH Act, Buntin et al. (2011) conducted a literature review to determine Health IT's positive and negative outcomes. They found that 92% of the articles reflected positive overall outcomes as defined by quality, efficiency, and satisfaction measures. More recently, Kruse and Beane (2018), following methods used by Buntin et al., also conducted a systematic review of the literature examining the impact of Health IT adoption on medical outcomes. Their findings also found a positive impact on medical outcomes defined as measures of efficiency and effectiveness. Although both reviews found a positive impact on outcomes, others have indicated that technology also results in unintended consequences with the potential for negative outcomes.

It has been said that Health IT positive outcomes for care delivery are directly related to the leadership's competencies in detecting and managing the unintended consequences of Health IT implementation. Sittig and Ash (2011) found nine unique ways clinicians are subjected to unintended consequences of Health IT. Their study used a retrospective review of over 10,000 patient charts. Numerous unintended consequences of technology-based patient care delivery were noted and grouped into nine major types. The types, along with proportion in each category, are

- More/new work for clinicians (19.8%)
- Workflow issues (17.6%)
- Never-ending system demands (14.8%)
- Paper persistence (10.8%)
- Changes in communication patterns and practices (10.1%)
- Emotions (7.7%)
- New kinds of errors (7.1%)
- Changes in power structure (6.8%)
- Overdependence on technology (5.2%) (Sittig and Ash 2011)

This description's critical aspect is that sometimes the use of Health IT results in patient harm and even contributes to death, without clinicians knowing that they have done so (Sittig and Ash 2011). Rigorous leadership training and education on preventing the issues listed can yield positive patient care outcomes.

As healthcare providers and hospitals continue to be encouraged by regulatory requirements to expand upon technology and to report quality measures for pay-for-performance models, the impact of technology on the client or patient, the clinicians, the organization, and the society is critical to consider.

Summary

In summary, this chapter has examined Health IT in the form of EHRs and other point-of-care technologies. The explosion of technology in the past 10 years has created a new digital healthcare age that creates both positive and negative challenges to processes and outcomes of patient care. As such, the QHOM emphasized throughout the chapter sets up an excellent approach to using QI methods to optimize technology. Several effective QI tools and methods to support Health IT optimization are presented. Both system and client components influence the optimization of Health IT. As per the QHOM model, outcomes must be reflected in both the client and clinician, and characteristics of the system or organization influence both. For example, a safety culture will emphasize competencies to prepare an organization to address outcomes.

Further, the commitment to measurement to positively impact the organization is fundamental. According to Baernholdt et al. (2018), for quality measures to be useful, they must be clearly defined, valid, reliable, and readily available to all stakeholders, i.e., the client, clinicians, organizational leaders, and policymakers. Finally, organizations' Health IT infrastructure ability to capture and report data for measuring process, outcome, and structural measures for all stakeholders is essential. This ability requires that Health IT staff, clinical informatics professionals and leadership maintain competencies in measurement, QI science and an interprofessional team approach to optimize technology for improved processes and health outcomes.

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