The Chief Information Officer's (CIO) View: Observations, Perspective, and Opinions

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Charles E. Christian

Learning Objectives
- Discuss the space Clinical Informatics occupies with People, Process, and Technology
- Discuss the early years of clinical automation and the contributing event
- Review the impacts of automating a paper-based process
- Identify the appropriate skill sets required for the clinical informatics team, from the chair of the CIO

Key Terms
- Intersection of technology and healthcare
- People
- Process
- Technologies
- Staff skill set
- Collaboration of care silos
- CIO as partner

Introduction

Over the last 30–40 years, the role of Healthcare Information Technology (HIT) has evolved and continuously impacted the care delivery and business processes of healthcare. In the early 1970s, healthcare operations and clinical processes were all paper-based (at least in most hospitals). With the changes around how care is reimbursed, the advent of employer-provided healthcare, and an ever-increasing regulatory burden, the business side of healthcare was one of the first areas that applied information technology to automate the processes of patient registration, revenue cycle, and order management. These changes began with the introduction of Diagnostic Related Groups or DRGs as they are referred to affectionally.

For someone working in Radiology, before DRGs, the first introduction to information technology was in an early attempt to automate the patient study history index that was then kept on 4×6 index cards. As many can well imagine in a bustling Radiology department, there were a significant number of index cards that were updated each day, with a percentage of them getting misfiled. This type of record-keeping just begged for a more efficient and accurate process; however, the opportunity costs were very high due to the current state of computer automation availability. Mainframe computers were costly, and minicomputers were just beginning to arrive at a somewhat affordable price point. Only as a historical marker, Intel was founded in 1968 and announced the 4004 microprocessor in 1971.

C. E. Christian (✉)
Franciscan Alliance, Indianapolis, IN, USA
e-mail: chuck.christian@franciscanalliance.org

CIO's Role at the Intersection of Technology and Healthcare

Clinical Informatics lives at the intersection of People, Process, and Technology (Fig. 7.1).

The **people** equate to our patients, the providers, and other members of the care team, not just the physicians and nursing, but the ancillary departments with direct and indirect patient care responsibilities. The **processes** equate to those that impact the care processes and workflows, quality improvement, best medical evidence/clinical practice, and data/terminology standardization. Last but not least, the **technology** equates to our electronic systems, such as the Electronic Health Record (EHR), ancillary process systems (i.e., Pharmacy, lab, radiology, etc.), which may be part of an integrated EHR solution, and the directly connected medical devices (i.e., IV pumps, O_2 sensors, physiological monitors, etc.). The clinical informatics professional navigates within the space where these intersect, understanding the role, actions, and workflows of the individual while having experienced the related workflows and then leverages the technology tools to engage the people and streamline/improve the processes. The informaticist needs to possess experience in clinical disciplines. They also need to have more than a working knowledge of the care processes they are expected to support and/or improve and need to possess a clear understanding of the technology they hope to leverage in the process.

In the early years of healthcare automation, we were striving to automate data capture and quickly found that the acquired data's usefulness required standardization of both the discrete data and the associated coding methods. Even today, the data's value is directly related to how well it is defined/described, and standardized, not only across a single healthcare system/enterprise but also across all healthcare settings and healthcare providers.

During this same period, the standardization of the data was complicated by the fact that there were no solutions/applications that encompassed all of the departments of a healthcare organization; there were hundreds of "best-of-breed," department-specific applications that were
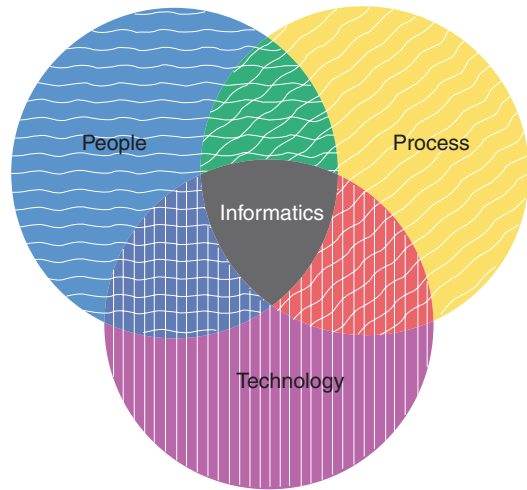

Fig. 7.1 The three components of informatics

designed and built without a great deal of consideration given to the need to communicate and share data/information with other departmental based systems. Of the two most widely implemented EHR solutions in use today, one was born out of the automation of the laboratory and the other out of the ambulatory/physician practice EHR market. Both are far more robust in the fact that the integration is internal to all applications, rather than the IT departments having to create and maintain the required level of integration; however, none of the solutions/systems truly contains functionality that every healthcare system requires for their clinical or business processes.

While the field of informatics has come a long way and is a very valuable tool in our quest to deliver higher quality care, at a lower cost point; it is not a panacea; it is the discipline that is expected to help delivery clarity where people, processes, and technology collide.

Challenges of the Profession Through the Eyes of My Early Experience with Health Care Automation and the Migration to the Digital Clinical Era

With the introduction of DRGs, the focus shifted to automating patient registration processes, including capturing the patient's employer-

provided insurance information required to bill for the services provided. With the insurance information being captured in a timelier manner and hopefully more accurately, the processes of charge capture and billing were the next logical step. The manual process of charge capture and posting in an automated system leads to creating the data processing departments, which employed data-entry clerks. As the charge processes became more complex and numerous, the next target for automatization was order entry and communication. Most procedures in the care process required some level of a physician's order, either written or procedurally standard. Moving from a paper-based solution to communicate orders to an automated solution that would capture the charge as a by-produce of delivering the order increased the billing process's efficiency and decreased the amount of manual data entry required, reducing the need for, or eliminating the data-entry staff. One could say that the introduction of DRGs launched many electronic boats or processes.

While many individuals in leadership roles in the clinical disciplines welcomed the electronic assistance for the routine but required order management and billing processes, these business function systems had little impact on healthcare's core purpose: patient care. Nevertheless, the order management process did speed diagnostic and procedural processes. They allowed for an early level of data analytics but did little to assist in either augmenting the direct patient care processes or removing the related documentation burdens. In essence, most of the clinical processes took a backseat to the business office focused processes.

Entering the Digital Clinical Era

Just as DRGs launch the automation of the business side of healthcare, there was a similar catalyst for clinically focused automation; that was the seminal report from the Institute of Medicine (IOM), "To Err is Human: Building a Safer Health System," published in 2000 [1] and followed by "Cross The Quality Chasm: A New Health System for the 21st Century" [2]. The first of these publications created a laser focus on the fact that too many people are dying due to medical errors in our country, especially calling out those deaths caused by medication errors. The IOM explained the current understanding of why these errors occurred and asked the primary question; can we learn from these mistakes.

In this report, the IOM offered recommendations for improving patient safety and decreasing the number of error-related deaths; many were leadership and process-related (note: people and process), while others pointed toward the use of automation in the direct patient care setting (note: technology).

In the second publication, "Crossing the Quality Chasm," the IOM recommendations were around evidence-based best practices and the use of clinical information systems. Both IOM reports were escorting in the role of the clinical informaticist and providing a prescription for decreasing the number of medical error-related deaths and a path to bridge the quality chasm.

One of the critical areas that the IOM reports mentioned was the use of data/information in helping to correct many of the issues that were called into question. However, data/information alone is not the ultimate solution, but part of it. The solution needs to cover all three areas: people, processes, and technology. The clinical informaticists' role and expertise are critical in the realization of a much-improved healthcare system.

The healthcare system is being asked (some would say required) to always move from the volume-based reimbursement models toward a value-based or quality-based one. In a sense, the business of "healthcare," is more a business of "sick care." We are currently reimbursed for the encounters of care and not for the outcome of the care encounter. It is similar to paying your automobile mechanic for a visit even if they could not correct the issue you were having. This might sound like a bad example, as cars are much easier to repair than humans; however, we do perform parts replacement on all models.

Suppose we hope to correct the shortcomings identified in the IOM reports. In that case, it requires the skills and discipline of the clinical informaticists, who can bring their years of clini-

cal knowledge combined with their systems expertise, married with analytical skills, standard project management processes, and continuous quality improvement technique to bear.

The Impact Automation on a Previously Paper-Based Process

Automation alone is not an all-encompassing solution. To err is human, but you can use a computer and still create a mess. The great thing about computerized systems is that once sent into motion, outcomes are typically standard and predictable; this translates that you can create errors in rapid succession.

In the IOM report mentioned earlier [1], one of the causes for patient harm came from the medication ordering/administration processes. There were those that felt that the solution was to rapidly implement Computerized Physician/Provider Order Entry or CPOE in conjunction with a level of Clinical Decision Support (CDS), which would be based upon Evidence-Based Medicine and/or standard protocols or Care Plans. As part of the process stream of ordering medications and administrating them to the patient, there is an array of primary and secondary processes that need to occur correctly for the medication to be delivered accurately and safely to the patient.

There were others that were concerned that even if the task of ordering the medication was automated, there were still ample opportunities for an adverse drug event when the medication was administrated to the patient. Automated medication administration systems utilized by nursing, would be required to close the process loop. However, when implementing solutions, one needs to be sure to consider all of the other systems and/or processes that feed into the primary process. Below is a real case describing the implementation of an electronic medication administration system, which, in the end, was very successful; however, it did not begin on that path. Even in the world of the computerized medication loop, there are several key divisions of labor and processes that need to be given consid-

eration related to how they interact; ordering physicians/providers, Pharmacy, and Nursing.

In the late 1990s, our organization embarked on implementing a closed-loop medication admiration system that was integrated into our EHR (electronic health record) and Pharmacy management system. I use the word "integrated" loosely; in 1998, there were no truly integrated solutions; these were stand-alone applications that were "integrated" by way of internal, custom interfaces that required a great deal of care and feeding. Although they were purchased from the same EHR vendor, these applications were assets from separate software acquisitions that were interfaced to appear as if they were integrated.

The Pharmacy Management system had been implemented years earlier, and the pharmacy department, not unlike other department-based application implementations, designed process workflows that were specific to their methods and procedures. That is not to say that they ignored the requirements of the nursing staff, only that they were in a position to electronically influence or be first to configure frequencies, schedules, abbreviations, and so on. The Medication Administration Records (MARs) were the paper-based document that nursing utilized for medication rounds and documentation; however, I learned that just because the administration times and schedules were printed on the MAR did not mean that nursing was following those schedules.

After the implementation team spent countless hours to ensure that the processes would provide the right medication to the right patient at the right time in the correct dose and the exact route, we still have multiple documented medication adverse events. After a great deal of analysis, it was determined that the grand majority of the adverse events were related to medication administration timing. At the request of the quality committee, the Pharmacy adjusted the administration schedule times that would populate the electronic MARs; unfortunately, that did not resolve the issue; it only exacerbated it. The clinical informatics team worked to identify the root causes of the increased adverse events. They found that the underlying causes were related

more to a nursing process than an actual system issue. We learned that medication administration adherence to the Pharmacy established schedules varied depending upon the nursing unit type. Before the implementation of the electronic MAR, when the paper-based MARs were received on the nursing units (one per patient per shift), the nurse assigned to each patient would manual adjust (write-in) a medication administration schedule that was customized to the needs and/or activities of each patient.

Another finding of the clinical informatics team was that due to the difficulty in identifying early or late dose administration times with a paper-based process, there were really no prior metrics to benchmark against. With the implementation of the electronic MAR and the system's ability to establish standard administration time windows, the system could easily identify and report the early, last, and missed doses as adverse medication events.

With the administration times established in the pharmacy management system and these being entirely out of the control of nursing, a great deal of conversation and departmental friction ensued. During these conversations, it was learned that the administration times established by Pharmacy were really driven around another Pharmacy process; medicine cart fill times, which was driven by staffing, and so on.

To improve the process of medication delivery to patients, the clinical informatics team had to start at the beginning to establish the process drivers and what the future state needed to be. The process redesign encompassed moving the Pharmacy to a unit dose system, which allowed Pharmacy to utilize automation for a high percentage of their daily fill process, moving the patient medications from the centralized medicine carts to secured sections of the in-room nurse-serve closets to allow the appropriate medications to be readily available at the patient's bedside. With the medication fill and patient medication storage processes resolved, the Pharmacy could modify the administration schedules as appropriate to better accommodate the nursing workflow processes; however, in a standardized manner. These modifications allowed nursing to concentrate on the proper administration workflows and provide additional support and education for the nursing staff, which precipitated a significant drop in the associated adverse drug events.

Importance of Appropriate Staff Skill Set

In most Information Systems (IS) or Information Technology (IT) departments, most of the staff had skill sets that were very technical in focus: mainframe or mini-computer operations, terminal wiring (real early), networking, and so on. Later came the client computing era, which required skills around server clusters, redundancy, high availability, and/or fault tolerance, and then there was networking, both local and wide-area. There were also those that understood and practiced the art and science of project management and, in some cases, utilized those skills as change managers.

In the early years, the IS or IT department leadership was very much technically focused to successfully implement and support the computer and network environments that were the plumbing of the systems they oversaw and managed. Early on in the healthcare automation, the technical teams and leadership could more easily adapt and understand the processes and workflows required for implementing the financial and back-office solutions.

Most of the teams led by a Chief Information Officer (CIO) who were technically focused did their best work when they could apply their skills on the inert equipment that were part of their environment; few had good people-skills required to implement and support clinically focused applications. It is no secret that most technically oriented individuals do not make good clinical informaticists. This is not because they lack a lot of the soft skills, but because they lacked the knowledge and understanding that one can only acquire by training and working experience in the clinical areas.

As the saying goes, "one cannot lead others to a place they have never been." It can be inter-

preted in several different ways; it is related to learned experiences in this instance. It is also related to having or earning the trust of those you would lead in a project, who understand that your personal credentials are like their own.

Clinical processes and workflows must be experienced to understand them fully. That full understanding of their interconnected natures is required, especially when one's job is to attempt to modify and/or automate them. An informaticist cannot hope to provide expert guidance in the level of process change that is required unless they can speak with the confidence, language, and knowledge one only acquires from hands-on experience.

In the very late 1990s, our organization realized that we had failed to provide a level of automation for our core business process of patient care. As we planned for that possibility, it was painfully apparent that a different skill set was needed to navigate various clinical processes. If we were to be successful, the IT leadership would need to engage with Nursing and Physician leadership, identity those who had in-depth clinical process knowledge and a willingness to participate, if not led, the change processes. We felt that the technical skills could be better taught to experienced clinicians more appropriately than attempting to teach clinical process knowledge to the technically oriented teams.

Once the staffing was set, the next question was, whom this new team should report to. Both IT and Nursing believed the clinical informatics team should report within their structures; both were right, and both were wrong. We found that the appropriate reporting structure was within the IT department during the initial implementation phase. Once the implementation phase was complete (the applications were in place), the process change management required that the clinical informatics team move to within the Nursing leadership structure, which provided the need for clinical process change management that would be necessary. The majority of the process change was related to nursing processes, which impacted physician processes; these change initiatives were not IT-focused; therefore, nursing leadership was better suited for the challenges that were ahead.

Once this phase of implementation and change management was addressed, the clinical infor-

matics group moved into implementation, change management, and SME (subject matter expert) roles, and these are best managed within the framework of the IT department. The work really never changed, and the internal business partnerships never changed; only the organizational reporting relation changed.

The change management/leadership can be summed up in one focused statement. The changes must be, "Clinically Focused, Organization Led, and Technology-Enabled." This type of thinking always helps understand that technology is a tool, not the solution.

Collaboration Among the Care Silos

Before it became the industry standard, many CIOs were a proponent of using an integrated approach to application implementation. The integration was around core functions such as patient management (registration, revenue, and order management), financial management, and clinical management. However, over the last decade, it has become apparent that all these functions are so tightly interrelated that implementing a solution that does not require external integration or interfacing provides the most efficient and effective solution.

As a CIO. it is important to understand how the various departments/service areas within a healthcare organization must function to provide the highest level of patient care possible. Some organizations have mastered the necessary symbiosis level, and others have not. There is not one single healthcare department that can function as a process island; there are always interdependencies that can be easily identified.

Communication and coordination among the various care teams are just one of the areas when the clinical informaticists are critical to the success of any organization's ability to provide the best possible outcome for the patient populations that they serve. Information can be viewed as the fuel for the engine of health care, and the quality of that fuel determines patient outcomes.

We find ourselves in need of gathering, recording, and presenting information as part of the normal care process. However, each patient is an

individual, and his or her care should be individualized. That is not to say that best practices should be ignored, only that variations between patients should be taken into consideration.

As indicated in the earlier example about the Medication Administration Record (MAR), attempting to automate a paper-based and/or manual process really does not end well; integrated processes and unique information demands require us to consider, with fresh eyes, the inputs and outputs of any processes that are under review/consideration for automation. Patient care is not only in the hospital and physician practice realm. Patient care now occurs in many different and varied care settings. The information/data from those care encounters must be made available and it must be shared among all care encounters if each patient is to receive the most complete and appropriate care possible.

What May the Future Hold?

Many have been predicting the future state of healthcare for years. Unfortunately, healthcare predictions are similar to predictions of a technology-enabled future society, such as predicting that by the year 2000, all of us should have all had cars without wheels that drove themselves. While we are moving closer and closer to driver-assisted technologies, we still have a long way to go.

With the recent response to the COVID-19 virus, we can now see the impact of the technologies that we have been implementing for decades. We can see the effects of the clinical process changes that have been discussed at many different levels. Unfortunately, it took a global pandemic to cause the healthcare industry to begin providing care in a more patient-focused and coordinated manner.

The process change in the clinical settings has required tightly coordinated efforts between the clinical and technical teams, utilizing the skills and knowledge of the clinical informatics professionals, those individuals who have the in-depth process knowledge necessary to implement the required process change quickly.

From virtual visits being conducted to provide routine and follow up care in the ambulatory care settings to "communal rounding" where one or two clinicians are in a patient's room, and others are observing and interacting utilizing a variety of video-enabled and enhanced tools, we have witnessed virtual family visits, virtual patient rounding in both the acute and post-acute care settings. Of more importance is the ability to provide a timelier and coordinated patient discharge process, where all of a patient's care team can interact simultaneously, regardless of where they may be physically located. These are the clinical process improvements that the industry has been predicting for years that will and can have a permanent impact on the way we coordinate and provide care.

The clinical informatics journey has been designed to help the healthcare industry. It utilizes now a tremendous amount of clinical knowledge and technical expertise to continue to usher in the next visions of coordinated patient care.

Summary

Over the last 30–40 years, the role of Healthcare Information Technology (HIT) has evolved and continuously impacted the care delivery and business processes of healthcare. In the early 1970s, healthcare operations and clinical processes were all paper-based (at least in most hospitals). With the changes around how care is reimbursed, the advent of employer-provided healthcare, and an ever-increasing regulatory burden, the business side of healthcare was one of the first areas that applied information technology to automate the processes of patient registration, revenue cycle, and order management. As the digital clinical era was entered clinical processes and workflows had to be understood and the skill set of the staff had to be adjusted to these needs. Communication and coordination among the various care teams are just one of the areas where the clinical informaticists are critical to the success and outcome of patient care. Chief information officers serves as the bridge builder who brings technology, processes and people together.

Conclusions and Outlook

The CIO should function as a partner with the clinical areas to utilize automation as an effective tool in providing patient care. It is imperative to identify the staff with the appropriate clinical expertise and experience to help lead the required changes during the introduction of new tools into the clinical workflows. Within the responses to the COVID-19 crisis, it became apparent that clinical informatics was key in the creation of new and innovative methods of providing high-quality care to our patients in a rapidly changing and stressful environment. The future for the clinical informaticists continues to be written, where the boundaries of technology and innovations will continue to be tested.

Useful Resources

1. "Gartner: Healthcare Provider CIOs" Build Clinical Informatics Leadership to Succeed in Digital Clinical Transformation. March 2020. ID G00464608 https://www.gartner.com/document/3982713
2. HealthManagement.org: Developing the Role of CIO in Healthcare Management: From "then IT Guy" to CIO. Volume 17–Issue 1, 2017 http://healthmanagement.org/c/healthmanagement/issuearticle/developing-the-role-of-cio-in-healthcare-management-from-the-it-guy-to-cio
3. CIO Review: Clinical Informatics and the Promise of Advanced Technologies. https://healthcare.cioreview.com/cxoinsight/clinical-informatics-and-the-promise-of-advanced-technologies-nid-23638-cid-31.html
4. Harvard School of Public Health: The Changing Role of Health IT Leaders: Positioning for Success Moving Forward. https://www.hsph.harvard.edu/ecpe/changing-role-health-cio-leaders/

Review Questions

1. Clinical Informatics lives in the overlap created in the Venn diagram where:
   (a) People, Process, and Information merge
   (b) Technology, Decision Support, and Evidence-Based Medicine intersect
   (c) People, Process, and Technology intersect

   (d) Process, Information, and Clinical Practice interact
2. In the early IOM (Institute of Medicine) reports, which of the following was identified as a leading cause of medical errors:
   (a) Medication ordering and administration processes
   (b) Medication dispensing
   (c) Poor handwriting
   (d) Inability to follow physician orders
3. The CIO's role is to ensure that clinical staff has access to technology.
   (a) True
   (b) False

Appendix: Answers to Review Questions

1. Clinical Informatics lives in the overlap created in the Venn diagram where:
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   (a) True
   (b) False

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2. Institute of Medicine (US) Committee on Quality of Health Care in America. Crossing the quality chasm: a new health system for the 21st century. Washington, DC: National Academies Press (US); 2001.