UPCODING MEDICARE: IS HEALTHCARE FRAUD AND ABUSE INCREASING?

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Abstract

Medicare fraud has been the cause of up to $60 billion in overpaid claims in 2015 alone. Upcoding occurs when a healthcare provider has submitted codes for more severe conditions than diagnosed for the patient to receive higher reimbursement. The purpose of this study was to assess the impact of Medicare and Medicaid fraud to determine the magnitude of upcoding inpatient and outpatient claims throughout reimbursements.

The methodology for this study utilized a literature review. The literature review analyzed physician upcoding throughout present on admission infections, diagnostic related group upcoding, emergency department, and clinic upcoding. It was found that upcoding has had an impact on Medicare payments and fraud. Medicare fraud has been reported to be the magnitude of upcoding inpatient and outpatient claims throughout Medicare reimbursements. In addition, fraudulent activity has increased with upcoding for ambulatory inpatient and outpatient charges for patients with Medicare and Medicaid.

Keywords: billing, charges, fraud, Medicare, upcoding, waste

Introduction

Medicare fraud has been defined by the Centers for Medicare and Medicaid Services (CMS) as submitted or caused to have been submitted, false acquisitions, or misrepresentations of facts that have obtained federal health care payment for which no entitlement would have otherwise existed.[1] In 2011, $2.27 trillion was spent on healthcare, and more than 4 billion health insurance claims were processed in the United States.[2] It has been reported that Medicare lost funds that totaled up to $60 billion by improperly paid use in 2015.[3]

In the United States, Medicare is the health insurance for people ages 65 years or older and End Stage Renal Disease. Also, qualify younger populations with specific disabilities .[4] Medicare Part A has generally covered hospital care, skilled nursing facility care, nursing home care, hospice, and home health services for the beneficiaries.[5] Medicare Part B has paid for a portion of physicians' visits, some parts of home health care, outpatient procedures, ambulance services, rehabilitation therapy, laboratory tests, and X-rays.[6] Part C is the Medicare Advantage Plan similar to a health maintenance organization that provides extra coverage to the beneficiary such as vision and dental insurance.[7] Medicare Part D is a voluntary benefit for prescription drugs for people with Medicare who receive additional plan availability, enrollment, and financing for prescription drugs.[8]

Medicare fraud has been determined throughout billing for unnecessary procedures, falsified claims

or diagnoses, participating in illegal kickbacks or referrals, or providers prescribed unnecessary medication, also known as upcoding.[9] Upcoding occurs when a healthcare provider submits codes for more severe and expensive diagnoses or procedures than the provider diagnosed or performed.[10] A current procedural terminology (CPT) code is a medical code set utilized to describe diagnostic medical and surgical procedures and services a that a physician has performed to allow them to bill insurance companies whether commercial or governmental plans.[11] Evaluation and management codes have been used for patient visits for most family physician practices.[12] The American Society of Anesthesiologists (ASA) reported as "gaming the system" when providers had ASA risk scores.[13] The implementation of an electronic medical record (EMR) has been reported to have improved the efficiency of care and increased the accuracy of diagnoses to patient cases.[14] Furthermore, reimbursements should be accounted for quality, quantity, and complexity of care and eliminated upcoding and under-treatment based on the patients' conditions. Present on Admission (POA) infections reported the method for determination in administrative data between complications that developed pre-existing to the hospitalization or infections that had been developed throughout the hospitalization.[15]

. Bundled payments have been classified as single payments for all services related to a specific treatment or condition and have created incentives for providers to eliminate unnecessary services and reduce costs.[17] The payment system set for the operating costs of acute care hospital inpatients has stayed under Medicare Part A based on a set rate referred to as the prospective payment system (PPS). Under the PPS, each case has been categorized into a diagnosis-related group (DRG) that has a weight assigned to it based on the average resources used to treat Medicare patients in that DRG[18]. Upcoding is a severe problem provoked by employer reimbursement formulae that pay clinicians based on relative value units (RVUs). As a result, clinicians often are concerned that data-based compensation adjustments will lower their pay and thus must be offset by more aggressive coding[16].

ProPublica examined provider billing patterns for routine office visits in Medicare and found more than 490,000 providers billed the program for standard office visits for at least 11 patients in 2015. Of those, more than 1,250 providers billed for every office visit using the 99215 code, which is only to be utilized for visits that require more intensive examination and often consume more time. Furthermore, 1,825 health professionals billed Medicare for the costliest office visits for established patients approximately 90 percent of the time in 2015

The Health Insurance Portability and Accountability Act (HIPAA) was established under the joint direction of the attorney general and the Secretary of the Department of Health and Human Services (HHS), a national Health Care Fraud and Abuse Control Program (HCFAC, or the Program) to

coordinate federal, state, and local law enforcement activities concerning health care fraud and abuse.[19]

The purpose of this study was to assess the impact of Medicare and Medicaid fraud to determine the magnitude of upcoding inpatient and outpatient claims throughout reimbursements.

Methodology

The primary hypothesis of this study was that fraudulent activity has increased with upcoding for ambulatory inpatient and outpatient charges for patients with Medicare and Medicaid. The methodology for this research analysis utilized a literature review of academic sources. The literature review was conducted in three individual stages: 1) developing a search strategy and gathering data for the case study; 2) determining and analyzing the relevant literature; 3) delegating literature to appropriate categories. The five-step approach proposed by Khan et al.[20] was adopted for this research. The approach consists of five necessary steps, which are depicted in **Figure 1**. Formulation of the research question meant the research problem was specified in the questions. Identification of relevant studies included a detailed search of relevant literature that was produced. Assessing the qualities of the studies meant that all studies were analyzed to select the references relevant to fraud, waste, and abuse detected in healthcare[21].

Step 1: Literature Identification and Collection

When conducting this research, critical terms included were: “Medicare” OR “Medicaid” OR “Inpatients” OR “Outpatients” OR “Charges” AND “Upcoding” OR “Fraud” AND “CPT” OR “ICD-10-CM” OR “ICD-10-PCS” OR “Billing” OR “DRG.” These keywords were the criteria for inclusion in the study. The electronic databases of Jamia, Elibrary, PubMed, Medline, and Google Scholar were utilized to obtain academic peer-reviewed literature. Following a PRISMA diagram [ref]the search identified 54 relevant citations and excluded articles (n=31) if they did not meet inclusion principles. Articles were included (n=32) if they described access to Medicare fraud and upcoding charges: articles from other sources such as *The New England Journal of Medicine* and *The International Journal of Health Policy and Management* (n=11) were also included in this search. These 43 references were subject to full-text review, and these 43 citations were included in the data abstraction and analysis. Only 22 references were used in the results section (see **Figure 2**).

Step 2: Literature Analysis

Medicare and Medicaid upcoding has become essential because of its impact on hospitals with inpatient and outpatient charges fraud. Therefore, the literature analyzed focused on the following key areas: Medicare and Medicaid upcoding and fraud; inpatient and outpatient charges; and billing, CPTs, and DRGs affiliated with these charges. In an attempt to collect the most recent data, only sources from 2008-2021 written in English were used. Primary and secondary data from articles,

literature reviews, research studies, and reports written in the United States were included in this research. The literature review included 38 references, which were assessed for information about this research project. W.L., L.N., V.W. conducted the literature search, and it was validated by A.C., who acted as the second reader and double-checked if references met the inclusion criteria of the research study.

Step 3: Literature Categorization

The following subheadings were included in the research: Present on Admission Upcoding/ Hospital Acquired Infections with Upcoding in Hospitals; Diagnosis Related Group Upcoding in Hospitals; Upcoding with Surgeries and Anesthesia; Emergency Department Upcoding; and Insurance Upcoding in Clinics and Hospitals.

Results

Present on Admission/Hospital-Acquired Conditions with Upcoding in Hospitals

Medicare legislation has been directed at improving patient care quality by stopping reimbursement of hospital-acquired conditions; however, this policy has been undermined because providers still upcoded diagnoses for higher reimbursement. One study estimated that 10,000 out of 60,000 claims were reimbursed for POA infections, and 18.5 percent of claims were upcoded hospital-acquired infections, costing Medicare $200 million.[22] Another article reported that POA infections had decreased reimbursement in facilities when the DRG and regulatory steps did not meet specific criteria, which prompted hospitals to upcode to increase reimbursement.[23]

CMS has created a POA indicator used on all claims that involved Medicare inpatient admissions to general inpatient prospective payment system acute care hospitals.[24] **Table 1** displays the indicators, description, and payment for POA factors healthcare facilities have used to report hospital-acquired infections throughout stays. If the patient's diagnosis was present at the time of inpatient admission and the code was Yes (Y), CMS paid for the complication/comorbidity (CC) or significant complication/comorbidity (MCC) diagnosis. If the diagnosis was not present at the time of inpatient admission and the code was No (N), CMS did not pay for the CC or MCC diagnosis. Also, if documentation was insufficient and marked Unknown (U), CMS did not pay for the diagnosis, and if the POA was clinically undetermined and marked Undetermined (W), CMS paid for the CC or MCC diagnosis.[25]

In 2012, the Office of Inspector General (OIG) reported an estimate that 13.5 percent of Medicare beneficiaries hospitalized in October 2008 experienced adverse events, and hospital coders incorrectly reported 3 percent of 5,941 present on admission indicators, which has resulted in at least one incorrect indicator on each of the claims.[26] If the hospital upcoded the diagnosis code with

established complications for the patient, the hospital received an average of $6,398.[27]

Diagnosis-Related Group Upcoding in Hospitals

Some scholars have determined that hospitals have responded by recommended types of admission and treatment plans.[28] **Figure 3** displays the probability of upcoding with chronic conditions in Medicare with fee-for-service versus Medicare Advantage plans by the probability of the patient being coded with a chronic condition comparable to the patient's age.

In 2016, Nie, Mattke, Predmore, and Liu reviewed the likelihood of upcoding for high anesthesia risks and sleep apnea from 2005 to 2013 as upcoding a patient at a high risk ensured increased payment of the claim. They found that Medicare reported paying steadily for medical qualifying high-risk procedures. [29] Furthermore, the ASA risk score increased from 2.9 percent in 2005 to 13.2 percent in 2013. The proportion of patients' risks increased from 11.6 percent to 18.9 percent and high-risk anesthesia increased from 11.6 percent to 18.9 percent. Sleep apnea patients increased from 8.8 percent to 20.8 percent throughout the same period. Also, upcoding could be determined throughout this study with gastrointestinal endoscopy procedures and anesthesia. Furthermore, these researcher reported the extreme progression of pulmonary disease, and sleep apnea to increase revenue within the period; **Figure 4** describes the upcoding with high anesthesia charges, pulmonary disease, and sleep apnea to increase revenue.[30]

In 2014, Duke University settled for $1 million in lawsuits for unbundled cardiac and anesthesia services that had been performed together.[31] A case reviewed upcoding cardiology in Florida, in which the physician was performing unnecessary tests that he knew Medicare would pay more for.[32] Dr. Asad Qamar received $18.2 million in 2012 with reimbursement from Medicare, which was reported higher than other cardiologists in the US, as the second-highest total was $4.5 million in reimbursement.[33]

Diagnosis-Related Group Upcoding in Hospitals

Some scholars have determined that hospitals have responded by encouraging types of admission and treatment plans.[34] Geruso and Layton reported that, in 2014, upcoding could have cost Medicare $10.5 billion, or $640 per Medical Advantage enrollee.[35]

Emergency Department Upcoding

From 2001 to 2009, Pitts reported that emergency department discharge patients have increased by 18 percent annually, but Medicare patients discharged had decreased, with 38 percent of Medicare

emergency department patients younger than 65 years old and 19 percent of ED patients of age for Medicare.[36] In 2008, Baylor Medical Center reported to bill eight out of 10 Medicare patients for the two most expensive levels of treatment in the emergency room; and from 2001 to 2008, the use of the top expensive codes for ED visits doubled from 25 percent to 45 percent, and most cases reported the patients were not life-threatening cases.[37] Furthermore, increased emergency room Medicare billing with more than $1 billion was added to taxpayers' costs.

High-intensity ED visits in non-federal acute care hospitals for elderly beneficiaries grew from 45.8 percent in 2006 to 57.8 percent in 2012, and the most frequently used code was 99285, which was a level five visit, the highest, most comprehensive, and expensive visit for an emergency room.[38] Ahlman et al. 2018 reported five E&M codes for emergency department services depending on the complexity of the visit.[39] The procedure 99285 has been a high-level emergency department visit code for evaluating and managing a patient, which requires comprehensive history, comprehensive examination, and comprehensive medical decision-making. In addition, CPT 99285 represented 39.7 percent in 2006 and 49.4 percent in 2012[40].,

The use of CPT 99281, which is described as an emergency department visit for the evaluation and management of a patient and required three components: a problem-focused history, problem-focused examination, and straightforward medical decision making, increased from 5.0 percent in 2006 to 7.6 percent in 2012.[41]

Burke et al. also reported an observation of a decrease in low-intensity CPT code use, which were 99281 and 99282 CPTs for low-complexity visits.[42] Kliff reported that in 2009, 50 percent of ED facility fee charges were for level four and five codes, which rose to 59 percent of the codes used in 2015.[43] Columbia Hospital Corporation admitted filing false claims to Medicare and other federal programs and reported to pay $1.7 billion in 2000 and 2002 for criminal fines and penalties with the US Department of Justice.[44]

Insurance Upcoding in Clinics and Hospitals

The Tenet Healthcare Corporation reported fraudulent charges in 2006 for $900 million that resulted from assigned incorrect diagnosis codes to Medicare and Medicaid specifically to increase reimbursement, which is a more severe diagnosis than what the patient would actually have.[45] An example of the diagnosis upcoding would be a patient coming in for a cough and fever and the physician assigning J18.9 (pneumonia) when the patient has not been tested for this diagnosis. Also, a psychiatrist was fined $400,000 and was permanently excluded from taking part in Medicare and Medicaid.[46] The psychiatrist billed insurance for 30-60 minutes sessions, but they were only 15-

minute sessions.[47] Medicare has paid E&M codes for new patients at higher rates than established patients, and upcoding has occurred with Medicare when the provider has billed an established patient office visit with a new patient evaluation and management code.[48]

It was discovered that the AmeriGroup in Illinois fraudulently skewed enrollment into their Medicaid HMO program by refusing to register pregnant women and individuals with preexisting conditions. Under the False Claims Act and the Illinois Whistleblower Reward and Protection Act, AmeriGroup paid $144 million in damages to Illinois and the US government and $190 million in civil penalties.[49] Medicare and Medicaid fraud was estimated in 2014 to range from $82 billion to $272 billion and involved spending $1.4 billion to account for it.[50]

Discussion

The purpose of this study was to assess the impact of Medicare fraud to determine the magnitude of upcoding inpatient and outpatient claims throughout Medicare reimbursements. The result of this literature review suggests that fraudulent activity has increased with upcoding for ambulatory inpatient and outpatient charges for patients with Medicare and Medicaid.

In 2009, Garrett reported that when DRG and other regulatory steps did not meet specific criteria, physicians were prompted by the hospital to upcode diagnoses and CPT codes in order for them to keep their high reimbursement. Garrett also reported that hospitals had faced penalties when the reimbursement quota was not met; in addition, the physicians kept upcoding.

In 2018, the National Bureau of Economic Research reported that specific diagnoses were considered more profitable, and hospitals responded by suggesting types of admission and treatment plans that have increased these diagnoses. In 2014, Geruso and Layton examined that upcoding had cost Medicare $10.5 billion, or $640 per Medicare Advantage enrollee; but since the deflator was applied uniformly, upcoders retained a large share of their charge.

In addition to upcoding to avoid penalties, the results showed it was up to physicians to classify the patient's status within the coding system. For example, Nie et al. reported an increase of upcoding a patient's status to ASA high risk to receive higher Medicare reimbursement, and a study determined anesthesia claims had been upcoded to high ASA risk when the patient was not high ASA risk. Pitts also found similar results of high-risk anesthesia upcoding as well as upcoded CPT code ED visits.

Procedure code 99285 was found to be more commonly used because it was coded as a high level (level five) emergency department visit for evaluation and management or a patient that had required comprehensive history, examination, and medical decisionmaking.[51] This procedure code was used more frequently than CPT code 99281, which was for low complexity visits, due to the fact it was a higher intensity and coded the evaluation as high compared to low so the physicians and facility could have a higher reimbursement rate. Newman explored a hospital that openly admitted

filing false claims to Medicare and other federal programs by billing the highest CPT code, which was a level five, for the claim, and found the hospital at fault of fraudulent billing. CMS has stated that upcoding CPT codes for patients as "new patients" have been reported to provide higher reimbursement; therefore, providers have changed their code to a new patient incorrectly to receive higher reimbursement.[52]

Upcoding has been one of the most expensive and pervasive examples of healthcare fraud. Between 2002 and 2012, it was one of the costliest publicly funded medical assistance programs with an estimated $11 billion. These are not victimless crimes, as they place unnecessary strain on a social safety net that many millions of individuals rely on for their essential medical needs.

Limitations

This research study was not conducted without limitations. This literature review was restricted due to search strategies such as distinguishing between keywords, the number of databases accessed, or the sources used, which might have impacted the quality and availability of the research. Also, research and publication bias were a limitation during this study.

Practical Implications

Continual participation with Medicare, Medicaid, and inpatient and outpatient facilities throughout the coming years will provide more data for the future. The reporting measurements have contributed to a lower quantity of fraudulent claims in outpatient and inpatient settings. Further research should include analysis of claims data against provider documentation/coded data to determine the extent of upcoding in inpatient and outpatients claims throughout Medicare and Medicaid reimbursements.

Conclusion

Upcoding Medicare claims to receive higher reimbursement has shown an increase in payments from Medicare. This review has ascertained that upcoding has occurred too often throughout healthcare practices, suggesting CMS fraud and abuse. Continuous training must be performed to healthcare providers to avoid engaging in upcoding. In addition, the current reward system to encourage whistleblowers to disclose this type of fraud should be promoted within the healthcare and patient community.

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THE SYMBIOTIC RELATIONSHIP BETWEEN HEALTH INFORMATION MANAGEMENT AND HEALTH INFORMATICS: OPPORTUNITIES FOR GROWTH AND COLLABORATION

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Abstract

Health information management (HIM) and health informatics (HI) are two similar but distinct disciplines. They share a common goal in terms of using information technologies and information power to improve the quality and efficiency of patient care; contribute to disease prevention and treatment; and increase overall population health. HIM professionals are primarily focused on managing health information, and HI professionals are primarily focused on the technologies and systems that make health information management possible. The right combination of the breadth of knowledge HIM professionals possess and the depth of knowledge HI professionals bring into the various areas constituting the scopes of the two disciplines can strengthen an organization's potential and growth in a complex, fast-changing healthcare environment.

Keywords: health information management, health informatics, information technology, HIM competencies, health informatics education

Introduction

Health information management, health informatics, health information technology, and health information professionals are terms that are commonly used interchangeably. For the purpose of this paper, we are considering health information management (HIM), health information technicians (HIT—the associate degree level of HIM, different from strictly technology services or health IT), and health information professionals as one discipline, and health informatics (HI) as the other discipline. The reason for this distinction will be made clear in this paper through an examination of brief historical aspects of both the disciplines, the similarities and differences between HIM and HI education, the significance of the academic foundation underpinning them both, and recommendations for their growth and collaboration.

What Is Health Information Management?

Health information management has a long history that dates back to the ancient world. The earliest known medical records go back to ancient Mesopotamia.[1] Archaeologists have discovered thousands of records in the form of clay tablets that documented the patient's history, just as we would record a history and physical exam in today's world. There are also more than 30,000 surviving cuneiform tablets that are known to be about medicine and medical practices of the Sumerians.[2] In 4000 BC, Egyptian scribes were the forerunners to our modern-day transcription. They transcribed medical information on scrolls of papyrus, a material that was made from a water plant.[3] Greek and Roman records had descriptions of a patient's mental and physical history; however, the gods are still mentioned as the cause of sickness. Greek and Roman medical records

were transcribed on parchment, which is prone to disintegrating.[4] It is remarkable that even at such a distant time from where we are now, ancient civilizations understood the importance of medical records.

HIM is about managing and protecting a patient's health information, which is important to providing quality healthcare. The modern HIM profession began with Grace Whiting Myers' work organizing themedical records stored at Treadwell Library at MassachusettsGeneral Hospital in Boston. Myers was focused on the centrality and integrity of the patient record, which led to the president of the American College of Surgeons proposing the Association of Records Librarians of North America (ARLNA) in 1928.[5] As the profession became more involved in the administration of federal programs such as Medicare and increased their presence in acute care facilities and other healthcare settings, there was a need to redefine the association. Since being formed, the American Health Information Management Association (AHIMA) has undergone several name changes, from the American Association of Medical Record Librarians (AAMRL) in 1938 and the American Medical Record Association in 1970 to its present name in 1991.

AHIMA defines health information management as the practice of acquiring, analyzing, and protecting digital and traditional medical information.[6]It is a combination of business, science, and information technology.

Patient care has become increasingly driven by data and the great need for quality healthcare data for continuity of care, therefore enhancing the need for healthcare professionals to be highly trained to understand the workflow within healthcare organizations. They are responsible for the integrity and protection of patients' health information. According to the Health Insurance Portability and Accountability Act, electronic health record (EHR) adoption has also placed health information professionals at the forefront of daily operations of healthcare organizations, as they are well versed in understanding the need for accurate and complete patient records. Great opportunities exist for HIM to incorporate data science methods in the use and management of healthcare data.[7]

HIM is also fundamental in addressing the changes in secondary use of patient information. HIM professionals bring their knowledge and skills in EHRs, clinical documentation, coding, and legal and compliance issues,[8] hence making them marketable in different settings, including acute care, physicians' offices, outpatient, and private healthcare organizations. There have also been several opportunities in other non-patient care related areas such that the report for Health Data Management Report from the US Bureau of Labor Statistics predicted an 18 percent increase in health information management jobs by 2028.[9]

The quality of healthcare data continues to be of importance as we focus on healthcare outcomes and value-based care, and HIM continues to be at the center stage in facilitating accurate data

capture both manually and electronically. At the highest levels, HIM professionals manage people, manage health data that is produced within a healthcare organization, and contribute to important financial and compliance aspects.

What Is Health Informatics?

Health informatics (HI) is a subset of informatics, just like construction informatics, visual informatics, intelligence and security informatics, or organizational informatics.[10] The University of Edinburgh considers informatics as the study of the structure, behavior, and interactions of natural and engineered computational systems.[11] For a more thorough understanding of health informatics, it is important to highlight a few historical aspects related to its root: information technology.

Archeologists have found recordings of royal assets and taxes as early as 4000 BC in the form of Sumerian cuneiscript in stone tablets.[12] During circa 1200-1475 AD, in the Andes of South America, a wealthy society called Inca had created a system to measure and account for the products that were delivered in different geographical areas.[13] This system included: 1) a method for recording of data by tying ropes of different lengths, materials, and colors in different distances and frequencies (called quipu); 2) a large and efficient transportation network; and 3) trained information specialists (called chasquis) that remembered what was shared verbally and ran to various distances to deliver the quipu.[14] Identical copies of quipu were kept in order to compare recordings with other parties and assure the integrity of the information as well as fair practices.

Fast-forwarding to the 20th century, Morse code was invented for electric telegraphy in the 1830s, and punch cards and tabulating machines were used for the purpose of US census recordings in the 1890s.[15] In 1930s, right before World War II, the first programmable computer was created in Germany and used for the purpose of military operations.[16] Ten years after, radio detection and ranging (RADAR) technology appeared. These brief historical findings show that our predecessors coded select information by using consistent systems of symbols as needed at the time. The emergence of computers marked the beginning of modern information technology. Efforts to improve information technology led to the study of information technology in academic settings and to the creation of various supporting associations. It was not until the late 1960s and early 1970s that computers were being considered for use in healthcare.[17]

To support that movement, the International Medical Informatics Association and American Medical Informatics Association (AMIA) were established respectively in 1967 and 1988.[18] It was during those years that the framework for education in medical informatics started taking shape. Today, health informatics plays an important role in healthcare. AMIA defines health informatics as the science of how to use data, information and knowledge to improve human health and the delivery of health

care services.[19] The Health Information Management Systems Society states that "Health Informatics is the integration of healthcare sciences, computer science, information science, and cognitive science to assist in the management of healthcare information,"[20] a definition adapted by Saba and McCormick.[21,22] Coiera describes health informatics as the logic of healthcare.[23] Furthermore, he states that "health informatics … is the rational study of how we think about patients and how treatments are defined, selected, and evolved. The tools of informatics are likely to be clinical guidelines, formal medical languages, information systems, or communication systems like the Internet."[24]

Health informatics has also been recognized and referred to as medical informatics, clinical informatics, or biomedical informatics. It includes a number of areas, such as telehealth, telephone triage and telecare, telenursing and remote guidance, teleradiology, teledermatology, medical monitoring, Holter monitoring, automated ECG interpretation, patient registration, digital radiology, PACS, clinical decision support systems (CDSS), computer-aided diagnosis, concept processing (artificial intelligence, machine learning), robotic surgery, cyber knife, or clinical trials.[25] Health informatics delves even deeper into the establishment of an infrastructure that can accommodate use of various technologies in healthcare.[26] The basic distinction among the various types of health informatics is the scope of healthcare technology or information that is being worked with. For example, telenursing is focused on the information systems and technologies used in nursing practice. The scope of informatics specialties tends to be narrow and deep, but from a distant perspective, health informatics is a field that deals with the use of technology to solve complex problems, monitor large-scale data, and improve decision-making processes.

Academic Aspects

Over the years, both HIM and HI have identified a number of domains and competencies that a professional with a degree in each area should possess at the entry level in the workforce. Upon examination of the existing domains and competencies published by AHIMA and AMIA, multiple similarities and some differences are observed between HIM and HI academic education. As seen in **Figure 1**, both HIM and HI professionals need to have a good grasp on domains such as data structure and content, information technology, data analytics, information security, leadership, management, and project management. HIM professionals are also expected to have a strong background in medical coding, healthcare reimbursement and finance, revenue cycle management, health law, risk management, and compliance with various healthcare policies and regulations. HI professionals are expected to have a much stronger technology background and be specialists when it comes to computer science and information technology aspects.

Under the assumption that both HIM and HI professionals are masters of data structure and content, the first observation of those domains indicates that HIM professionals bring to the table their

expertise in clinical coding, business, finance, and compliance, and HI professionals contribute their technical expertise in terms of computer systems and information technology. However, when considering the educational background and work experience, the depth and scope pertaining to each domain reveal more varied scenarios.

Typically, HIM professionals complete bachelor or associate degrees in health information management or technology from programs accredited by the Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM). They are expected to pass respectively, the Registered Health Information Administrator (RHIA) or Registered Health Information Technician (RHIT) certification exams. Graduate programs are being developed for both, building on the undergraduate HIM education and as an entry into practice degree. HIM professionals are expected to master the health data content from the point of inception, including patient registration, insurance, legal consents, and clinical data documented by nurses, physicians, and other care providers. They also are expected to analyze and classify the patient encounter from a medical coding, reporting, compliance, treatment, or clinical protocol perspective. Furthermore, their well-rounded knowledge makes them a valuable party that can bring in perspectives from various aspect of the healthcare organization, and lead or facilitate routine operational activities and special projects that require use of health information.

On the other side, HI programs are currently offered at the graduate level. At the time of this article, degree program accreditation exists for HI, although program accreditation is not associated with a specific HI credential. AMIA is in the process of evaluating Health Informatics Certification, yet, to date, employers do not require a specific certification as essential for entry into the profession. Typically, the HI degree programs require a bachelor's degree in computer science, biology, mathematics, or clinical education such as medicine, nursing, or radiology for admission. Varied backgrounds lead to varied types and levels of specializations among HI professionals, such as computer science specialists better equipped to build health information systems or applications, health data analysts, or clinicians who can understand the information technology aspect better and provide meaningful feedback pertaining to information technologies and systems in their area of expertise (clinical decision support, nursing, etc.).

Significance

Deeper understanding of the educational foundation and background is helpful in better understanding the potential and positioning of both HIM and HI professionals. Academic details discussed above are significant, as they demonstrate that, by academic design, HIM professionals completing accredited programs have a consistent, holistic approach to health information. The multipronged education on the origin and purpose of the health data and the preparation to interpret and work with clinical, administrative, and financial data creates an opportunity for HIM professionals to serve as managers, liaisons, or consultants in any healthcare organization activities that require use of health information. Similarly, HI education leads to diverse, varied, specialized

knowledge of health information, although with a potential for inconsistency based on the differing content of degrees without required accreditation. Such specialized knowledge is valuable when it comes to designing specific types of health information systems and technologies, working with specific health data sets, or other types of health data analysis.

The external healthcare environment in the United States is changing at a much faster rate than before given the new medical treatments and technologies, personalized medicine, information technologies, compliance with changing regulations, and business model changes due to mergers and acquisitions. Investments in health-related technologies and the data derived from them is increasing as well. An industry trends report published by Global Market Insights in April 2019 estimated that the digital health market for US, Canada, Germany, UK, Spain, Italy, Russia, Poland, Japan, China, India, Australia, Brazil, Mexico, and South Africa will reach $504.4 billion in the near future.[27] Further, a Market Watch report in February 2020 stated that the value of the digital health market in North America is projected to reach $219.7 billion by the year 2025.[28] Similar trends are being observed in Europe, Canada, and other countries. Investments of such size demand management by highly skilled professionals that work with health information and health technologies; HIM and HI professionals are very well positioned in that regard.

According to the 2019 data shared by the Bureau of Labor Statistics (BLS), medical records and health information technicians (which represent health information management) occupied 341,600 positions in the US. BLS does not have health informatics listed as one of the occupations;[29] however, there are multiple entries under the category of computer and information technology, and most of those occupations (such as systems analysts, database administrator, network and computer systems administrators) are present in hospitals and large healthcare organizations. In addition, job search engines such as Monster or Indeed show demand for thousands of jobs with a title "health informatics," "data analysts," and other alike terms. While there may be some overlap in the projected job growth between health information management and health informatics, the potential for growth is still relatively high.

The contributions from physician informaticists, nurse informaticists, and other clinician informaticists are very important, necessary, and welcomed. However, given that their primary education, background, credential, and job responsibility is focused on patient care (such as medicine, nursing, pharmacy, etc.), from an economic and financial standpoint, using them primarily for tasks related to health information management and health informatics may not be feasible. In addition, as explained above, the majority of students pursuing a graduate degree in health informatics already have jobs and are using the higher degree and specialization to secure their jobs or seek career growth opportunities. On the HIM side, the number of new HIM professionals depends on the capacity of HIM programs across the country. According to the 2017-2018 reports from the Integrated Postsecondary Education Data System (IPEDS), over 1,200 students graduated with a bachelor's

degree in HIM from CAHIIM accredited programs across the US.[30] With the addition of new programs, this number may go up a little; however, it is still low considering the demand for over 300,000 professionals.

Outlook and Recommendations

Today's healthcare industry relies more heavily than ever on technology and health information. We are faced with large scale health data arising from experiments, clinics, population health centers, pharmaceuticals, community health information systems, portable health devices, wearable technology, and so on. Despite increased automation in health data collection and processing, the complexity of our healthcare system and health issues require human capital.

In the future, wide implementation of health information systems, expectations for greater optimization, growth of digital data, and complexity of working with big data will require both the breadth of knowledge offered by HIM professionals and specialized knowledge offered by various HI professionals. Carroll asserts, "Hyper-growth in knowledge means that every medical profession is becoming ever more specialized and niche-oriented. Add to this the looming baby boomer retirement wave and declining numbers of medical graduates, and it's evident that the war for talent is going to drive much of the agenda of the health care industry in the next few years."[31] Health care organizations are headed to greater optimization of technologies, greater interoperability, increased use of artificial intelligence, and ability to exchange the necessary information among providers, payers, regulatory agencies, and patients.[32,33] The continuing growth of bioinformatics, personalized medicine, and frequency of health data doubling (exponential growth) will create both opportunities for HIM and HI, some of which are listed in **Table 1**.

Opportunities are accompanied with challenges. More and more HIM professionals are finding it necessary to continue their education toward a master or doctoral degree or seek continuous education opportunities in specialized areas of interest, such as data analytics, population health, or data security. Likewise, HIM programs are in an ongoing quest for finding the right balance of teaching the basic expected knowledge, incorporating new technologies, and providing opportunities for deeper learning and greater level of expertise. HI programs are challenged with providing a flexible curriculum that can provide the general concepts as well as opportunities for specialization in specific areas such as artificial intelligence, population health, or risk management.

HIM and HI professionals can play a tremendous role in not only capitalizing on the existing technologies and availability of health data but also optimizing them and growing them. This requires building a workforce that will live up to such challenges. Higher education is responding by opening new programs or updating and strengthening the existing ones, and must continue the quest for innovation in the process of preparing students with the expected skill set and instilling the drive to pursue learning and adaptation beyond the years of formal education.

In looking ahead to meet the challenges of healthcare and grow both HIM and HI professions, each discipline must continue to evolve and adapt. While both professions have some similarities that are generally found in each of the separate disciples. Together, the current skill set of HIM and HI can address a wide range of interconnected needs of a workforce required to adapt and thrive in an efficient and growth-oriented manner to a rapidly changing healthcare environment. As the technology continues to evolve and healthcare continues to adapt new technologies and new approaches to care, the skill sets for both HIM and HI will need to be re-evaluated.

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RHIA CERTIFICATION EXAM SUCCESS FACTORS

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Abstract

This study explored possible success factors for passing the Registered Health Information Administration (RHIA) certification exam. According to the American Health Information Management Association (AHIMA), only 70 percent of first-time test-takers passed the RHIA exam in 2019. A literature review offered insight into factors related to passing certification exams. Sources included existing, relevant peer-reviewed and published literature since 1990 within 87 educational and health/medicine databases and 62 other articles and journal databases available at the University of South Dakota library. A correlational design was used in the study. Data was retrieved from AHIMA, cleaned, and binary logistic regression analysis was completed. A significant relationship was identified between having a prior credential, such as the Registered Health Information Technician (RHIT) credential and passing the RHIA exam. This new information will help improve pass rates, advance the HIM field research base, and help students improve their odds of passing the RHIA exam.

Keywords

certification exam success factors, registered health information administrator, certified health data analyst, health information management

Introduction

This study identifies some factors associated with successfully passing the Registered Health Information Administration (RHIA) exam. The hope is that this information will help improve health information management (HIM) program outcomes and help narrow the expected workforce shortage of more than 72,000 medical and health service managers by 2026.[1] The Commission on Accreditation for Health Informatics and Information Management's (CAHIIM) 2018 Annual Report indicates that there were 1,271 baccalaureate graduates between August 1, 2016, and July 31, 2017.[2] These graduates were eligible to take the RHIA exam. AHIMA's website indicates 1,129 first-time test-takers took the exam and 801 passed on the first attempt.[3] Because not all graduates sat for the RHIA exam, only 63 percent of the students that graduated with baccalaureate degrees successfully obtained the RHIA credential on their first attempt. Two known problems include the number of graduates not attempting the RHIA exam and the RHIA credentialing exam pass rates.

Background

HIM professionals serve a vital role in aligning electronic health record (EHR) documentation systems and clinicians' workflow. HIM professionals understand the data being collected throughout

a healthcare enterprise and the requirements for use and exchange of information for care delivery and decision-making. Changes to EHR documentation and communication methods are being routinely tested to improve continuity of care and communication with patients while decreasing errors and safety concerns.[4-6] A key part of the HIM professional's role is to advance changes that will improve healthcare data quality, improve information-sharing, and improve the use of secondary data in healthcare. Leading these important changes requires development of advanced skills in leadership, data analysis, and data governance.[7.]

HIM programs educate students to be professionally responsible for ethical information practices in healthcare delivery, billing, and secondary data use, and are capable of leading and adapting to change in the HIM profession.[8] Students who graduate from a CAHIIM-accredited HIM program are eligible to sit for the RHIA credentialing exam.[9] The demand for graduates of HIM programs exceeds the supply of existing programs and students.[10] Increasing the number of graduates is complicated by centralization of administrative services in healthcare, which has increased the number of HIM employees working from home while limiting the number of employees available to work with students in hands-on practical training at the healthcare worksite.[11]

One potential solution is to expand the number of RHIAs by increasing the number of students taking and passing the exam on the first attempt. As a possible step in that direction, changes to eligibility requirements have allowed more students with bachelor's or master's degrees to attempt the exam through a temporary proviso. According to the Commission on Certification for Health Informatics and Information Management (CCHIIM), the eligibility criteria to sit for the RHIA certification exam has been amended for individuals who hold the Registered Health Information Technician (RHIT) credential. Individuals who have an RHIT will be eligible for the RHIA exam starting July 1, 2017, through December 31, 2021. This is if they have received a baccalaureate degree or higher from a regionally accredited institution or nationally recognized accreditor; received their RHIT credential on or before December 31, 2018; and have complied with the Standards for Maintenance of the RHIT credential. [12]

The 2018 national pass rate for the RHIA certification exam was 71 percent.[13] Students' failure to pass the entry-level certification has become a pattern for more than four years.[14,15] In 2018, 1,271 new graduates were eligible for the RHIA entry-level exam but only 801 passed (63 percent).[16,17] Students and faculty can benefit from better understanding factors (i.e., possible interventions) that improve pass rates. Thus, the present study tests the relationship between first-time test-taker characteristics, specifically age, highest educational degree, work setting, and additional credentials, and passing the RHIA certification exam. These relationships have been theorized in the HIM

Educational Model,[18] and their empirical exploration will inform the development of helpful interventions and student recruiting strategies.

Literature Review

The Health Information Management Education Conceptual Framework has four components, including students, faculty, curriculum, and resources, that intersect to create successful program graduates who passed the RHIA exam.[19] This framework was applied here. The Community of Inquiry (COI) Model[20] was also used. Both frameworks combined together included key component similarities of students, instructors, and content leading to successful outcomes. Both frameworks were used to strengthen the theoretical models proven in the field of education and HIM and to show the relationships between the two frameworks.

The present study was focused on evaluating student characteristics that predict passing HIM certification exams in general but, more specifically, the RHIA exam.

Registered Health Information Administrator Credentialing Exam

Individuals seeking to obtain the RHIA credential were eligible for the exam by graduating from a CAHIIM-accredited health information administration program, a CAHIIM-accredited health information technology program, or a formerly accredited program. Other eligibility opportunities included completion of a certificate of the degree program, a CAHIIM-accredited master's degree program, or having an RHIT credential and meeting special proviso qualifications. The RHIA exam is an entry-level credential in HIM. At the end of 2018, there were 16,632 RHIA credential-holders.[21]

Methodology

This quantitative research study used an ex post facto correlational design.[22] Data for the study was collected from application and scoring results of first-time RHIA test-takers between January 2015 and December 2019 by AHIMA.

Data Collection

Upon approval by the University of South Dakota Institutional Review Board, the study began. Individual consent was not required for use of pre-existing, archival data. There were 5,300 first-time RHIA takers (January 1, 2015, to December 31, 2019) in the dataset. Participants' dates of birth were converted to year of birth (20-29; 30-39; 40-49; 50 etc.[28]) by AHIMA to ensure confidentiality. Cases with age 70 or greater were considered outliers by statistical and practical definition and were removed. Thus, data from 1,165 cases were removed from the study during the data cleaning process, and 4,135 cases were analyzed here.

Predictors included age; (current) highest educational degree; (current) work setting; (current) job

category; and additional credentials. The criterion variable was passing (or not). Highest educational degree, work setting, additional credentials, and job category data reflected current information rather than the data collected during application for the exam.

Data Analysis

Analyses were conducted using the SPSS Grad Pack 26.0.[23,24] Frequencies were computed for each variable to identify the actual response percent, valid response percent, and cumulative response percent for each year of data and were consolidated after data was cleaned. Logistic regression coefficient estimates, model fit, confidence intervals, and odds ratios were calculated. The level of significance (α) for the study was set to 0.05, and the power to detect an effect at 0.80 and a medium effect size of 0.5 was chosen. G*Power indicated that a sample of 721 students was required to achieve the desired power of .80.[25,26] The sample exceeded 721 by more than a factor of five.

Stepwise regression models were fit to ensure that the best-fitting model was selected. The Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test results were compared to assess model fit. Classification tables were reviewed for the models. The model indicated the highest predicted percentage correct (95.9 percent) for passing the exam with an overall correct prediction rate of 75.1 percent. The Hosmer and Lemeshow Test values for the standard regression model showed a good model fit, $\chi 2(8, N = 4{,}135) = 4.996$, $p = .758$. The -2 Log likelihood (4301.260[a]), Cox & Snell R-Square (0.094), and Nagelkerke R-Square (0.138) results indicated consistency with the model selection and hypothesis testing ensued.

Results

Recall that we posited a relationship between first-time test-taker age and passing the RHIA certification exam. Logistic regression results are depicted in **Table 1** and indicate that age category 30-39 ($p = .015$) and category 40-49 ($p = .015$) were inversely significant predictors of passing the RHIA on the first attempt. First-time test-takers age 50 and older were more likely to pass the exam than those who were 30-49 years old.

Our second question considered the relationship between first-time test-taker highest educational degree and passing the RHIA certification exam. Results are depicted in **Table 2** and indicated that participants with the highest educational level of high school (presumed to be early testers who had not yet earned a bachelor's degree) had a greater likelihood of passing the RHIA exam than those with a master's degree. Participants with the highest educational level of HIM/coding certificate showed an inverse relationship, meaning they were less likely to pass the exam compared to those with a master's degree.

The third question considered the relationship between first-time test-taker current work setting and passing the RHIA certification exam to those first-time test-takers who were unemployed. There

were significant inverse results for participants working in Health Information Exchange organizations (see **Table 3**). In addition, there was significant inverse results for participants working in home health agencies and for participants working in long-term care facilities, and for participants working in other provider settings. In other words, those who were unemployed showed a higher likelihood of passing the RHIA exam than those who worked in healthcare.

Our fourth concerned the relationship between first-time test-taker additional credentials and passing the RHIA certification exam. Logistic regression using current additional credentials including CCA, CCS, CCS-P, CDIP, CHDA, RHIT, CHPS, CHTS-TS, CHTS-CP, CHTS-TR, CHTS-PW, CHTS-IM, CHTS-IS, and CPHI as predictors of first-time success was completed (see **Table 4**). There were significant results for participants with the CCS credential and the RHIT credential. The test-takers with the CCS or the RHIT credential had a high likelihood of passing the RHIA exam on the first attempt.

Serendipitous Results

Job level category data was analyzed (see **Table 5**) to determine if there was a relationship between first-time test-taker job setting (clerical/administrative support, clinician, consultants, directors, educators, executives, HIM technicians, managers/supervisors, and those in technology) and passing the RHIA certification exam. There were significant results for nine different job levels including that being employed in any of the nine job levels of the HIM profession increased the likelihood of passing the exam compared with those who were unemployed.

Further analysis was completed by converting the odds to probabilities for each variable (shown in **Table 6**) for comparison with actual results. The probability for test-takers with other advanced practice credentials (CCS, CCS-P, CHDA, CPHS, and CPHI) indicated higher probabilities in passing the RHIA exam.

The test-takers with the highest probability (50 percent or above) of passing the exam were found to be the following groups: highest degree of baccalaureate, doctorate and high school graduates (early testers who had not received a bachelor's degree) compared with those with a master's degree. Those working in a regional extension center, and those with at least one of the following list of credentials—CCS, CCS-P, CHDA, RHIT, CHPS, or CHPI—had a probability of at least 50 percent or higher in passing the RHIA exam.

Summary of Results

The 2018 national pass rate for the RHIA certification exam was 71 percent, a repeating pattern of at least four years. Only sixty-three percent of new graduates eligible for the RHIA entry-level exam attempted and passed the RHIA exam, which inspired this study focused on increasing pass rates of the first-time test-takers interested in taking the exam. The present study was designed to discern factors of success for passing the RHIA certification exam. The study relied on data collected by AHIMA between 2015 and 2019.

There is limited, available research specific to the RHIA credential to inform this study. The Health Information Management Education conceptual framework and the Community of Inquiry framework underpin the study. Factors for success related to test-takers that have been identified through literature review included: HIM GPA, mean cumulative GPA, admission GPA, grades in coding, and introduction to HIM courses.[27-30]

Several significant predictors for passing the RHIA exam were identified, including the examinees with only a high school diploma (early testers working toward a bachelor's degree) were more likely to pass the exam than those with a master's degree; examinees holding a CCS or an RHIT credential were likely to pass the exam on the first attempt; those individuals currently working either in a clerical role or as a clinician, consultant, director, executive, educator, HIM tech role, manager/supervisor, or a technology role were more likely to pass the exam than those who were not employed in the HIM field; test-takers with the highest education level of HIM/coding certificate program completion were less likely to pass the exam than those with a master's degree; and first-time test-takers working in long-term care, at a home health agency, or a Health Information Exchange organization were less likely to pass the exam than those first-time testers who were unemployed.

High school graduates working toward baccalaureate degrees taking the credentialing exam prior to receiving the degree are successful with early testing. Findings in this study are consistent with other disciplines, where individuals who experience a high-stakes exam, such as the RHIT exam, gain critical experience in taking another second important exam, such as the RHIA exam. This may improve confidence and reduce testing anxiety levels, while better preparing candidates for the additional high-stakes exam.

The exam results did indicate that test-takers 50 years of age or older were more likely to pass the RHIA exam than younger, first-time test-takers. The first assumption would be that individuals who are older have more life experience. Interestingly, those with a master's degree were more likely to pass the exam than those with a baccalaureate degree. Considering the results where those 50 years of age and older and those with higher education levels were more likely to pass the exam leads one to a conclusion that the exam may be better classified as an advanced practice exam. Yet, those with a high school degree without a baccalaureate degree (early testers) are more likely to pass the exam than those with master's degrees, indicating some other unknown factors may be impacting pass rates (e.g., the time allocated to studying each week; lack of multiple roles; not being employed while undertaking education; having better test-taking skills; having less anxiety while taking exams; completing courses on campus as full-time students; or even having the initiative and time to seek faculty tutoring).

Probabilities indicate the likelihood that those individuals with advanced credentials requiring experience in the profession will perform well on the RHIA exam, yet only one advanced practice credential is significant in passing the RHIA exam in this study. There is a limitation in the ability to

interpret the findings due to the lack of separation of current member data from data collected at the time of application for the RHIA exam. The usual practice within the profession is to obtain an entry-level generalist credential first followed by the advanced practice credentials.

In order to increase the number of candidates taking and passing the RHIA certification exam, early testing successes and the importance of taking and passing a high-stakes exam, such as the the RHIT exam, prior to taking the RHIA exam should be widely communicated throughout the HIM profession. Incentives such as testing discounts or bypassing academic exit exams should be considered for students. Including the cost for the RHIA exam within a required preparation course is one idea that could increase the number of students taking the exam.

RHIA exam eligibility criteria could be expanded to include those professionals with RHIT or CCS credentials and significant managerial/supervisory experience and those individuals with a CHDA or CHPS credential and experience in the HIM/HI or data analytics fields. Adding this incentive for RHIT, CCS, CHDA, and CHPS credential-holders to gain an RHIA credential could help in advancing the HIM field forward and open new paths to the RHIA credential. An alternative approach might be for academic programs to transparently offer and market prior learning credit for individuals with any of the four credentials and supervisory or other appropriate experience to encourage those same individuals to enroll in the bachelor's HIM program. Probabilities explored during this study show that individuals with this type of preparation have a higher than 50 percent probability of passing the RHIA exam.

Future research should explore the value of the RHIA credential by students and employers. Further investigation of why students are not taking the RHIA exam after obtaining a bachelor's, post-bachelor, or master's degree is also warranted. Additional studies might probe additional factors, such as years to program completion, the multiple hats of students, the amount of time dedicated to study during pursuit of the bachelor's degree and the impact on passing certification exams and learn what is understood by students about the early testing option and study the proportion of students taking advantage of that option and the likelihood of passing exams. There also are additional unknown factors that could be identified and studied to provide insight into passing the RHIA exam.

Limitations

Limitations include unknown confounding factors, e.g., the amount of time a student has worked in a particular type of employment setting prior to completing the exam or having prior certification exam experiences. The dataset used for the study included four variables that could have been updated by the AHIMA member after the exam was initially attempted. The four variables included: highest educational degree, work setting, job category, and additional credentials held. This is the only dataset available on a national scale to study the RHIA student factors for success on a longitudinal basis and of sufficient sample size. An additional limitation is the use of an ex post facto,

correlational design in which causal relationships between the independent (predictor) and dependent (criterion) variables cannot be asserted.[31-34] However, the temporal relationship between the independent and dependent variables does, perhaps, imply causality to some degree. And future studies may include experimental or mixed-method designs, which can more strongly identify causal relationships. There was a prior exam calibration issue[35] that caused no apparent limitation during data analysis. Researcher bias may have impacted the study by selecting ex post facto variables from the first-time RHIA application without incorporating a qualitative component to identify additional confounding success factors. Workforce needs in HIM rapidly changed and caused several updates to educational curriculum requirements followed by exam outline changes with periodic lags in exam updates. Results of this study can be generalized only to the RHIA certification exam in HIM.

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PATIENTS' AND PHYSICIANS' PERSPECTIVES ABOUT USING HEALTH INFORMATION TECHNOLOGY IN DIABETES MANAGEMENT IN IRAN: A QUALITATIVE STUDY

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By Haleh Ayatollahi

Abstract

Introduction: Diabetes mellitus is known as a major chronic disease that has a number of consequences affecting individuals' health conditions and socioeconomic aspects of life. These challenges require innovative interventions, such as self-management to improve patients' health condition and reduce the economic burden of healthcare systems. The current research aimed to identify patients' and physicians' perspectives about the use of health information technology in diabetes management in Iran.

Methods: This was a qualitative study conducted in 2019. In order to collect data, semi-structured interviews were conducted with eight patients and 10 specialists in an endocrine and metabolism research center and in a teaching hospital. The interviews were digitally recorded and transcribed verbatim. Finally, data were analyzed by using framework analysis method and MAXQDA version 10.

Results: According to the results, both patients and physicians believed that while using health information technology can improve access to healthcare services, the high cost of technology may hinder its usage. Factors such as government and health system support can motivate users to use the technology, and factors such as lack of user training and technical problems may have a negative impact on technology usage.

Conclusion: As a number of motivational and inhibitory factors may influence the use of health information technology in diabetes management, it is imperative to take each of these factors into account before designing and implementing new technologies, especially for diabetes management.

Keywords: health information technology, health informatics, remote healthcare, disease management, self-management, diabetes mellitus

Introduction

Diabetes is known as one of the most common chronic diseases in developed and developing countries.[1] According to the literature, more than 336 million people were diagnosed with diabetes in 2016, and this figure may rise to 552 million by 2030. The most common complications of diabetes are blindness, renal failure, ischemia, cardiovascular diseases, and amputation. Moreover, diabetes imposes a high cost on patients and their families, as well as the healthcare system.[2-4]

Similar to other developing and developed countries, the prevalence of diabetes is increasing in Iran, and this imposes a great responsibility on those in charge of controlling the disease. It has been reported that over 4 million people have been diagnosed with diabetes in Iran in 2017.[5] According to the World Health Organization (WHO), this number will rise to 7 million in 2030 if no effective action

is taken.[6] It seems that patient empowerment can be a solution to manage the disease.[7] In fact, empowering patients can help them to control their health behaviors, and their needs for the healthcare support will be reduced, which may lead to decreasing healthcare costs.[8,9]

Today, with the advancement of information and communication technology and greater access to telecommunication services, the use of modern technologies in empowering patients with chronic diseases such as diabetes has received more attention than before.[10] Moreover, the distribution of the disease in different geographical areas has encouraged healthcare providers to use virtual methods for training, patient education, and follow-up visits to control the disease.[11]

Accordingly, patients have been engaged in the process of treatment and follow-up of their health condition by using different types of technologies.[11] For example, a variety of health information technologies have been offered to empower patients with diabetes.[12-16] However, the development of technology is different from the actual use of it, and a number of motivational and inhibitory factors should be taken into account.[17] Some of these factors are concerns over privacy and confidentiality, usability of technology, users' access to the internet, physical and cognitive disabilities of patients, inadequacy of computer and health literacy, unfamiliarity with the jargon and technical terms, and uncertainty about the availability of information.[18,19] Laxman et al. highlighted the role of other factors, such as legal barriers, internet speed and connectivity, cost, resistance against change, insurance reimbursements, and a lack of technical support.[20]

In order to facilitate using technology, introducing the potential advantages of health information technology to the users, training, creating a suitable and user-friendly interface, reassuring users about security and privacy, and focusing on the motivational factors have been suggested.[21]

It is notable that although a number of previous studies have investigated the topic of health information management and health information seeking behavior among patients with different diseases such as diabetes, the use of technology among these patients was not the main focus of many studies.[22]

Currently, the advancement of technology has changed the management of health information and information-seeking behavior. As patients with chronic diseases such as diabetes need obtaining health information and staying informed for maintaining self-care, their perspectives about using health information technology needs to be investigated to improve patient outcomes and promote healthcare services.[23] Moreover, the traditional role of health information management professionals has been affected by changes in the health care environment due to the increased use of health information technology. For example, entering patient data into different applications and systems

creates many opportunities for health information management professionals to be involved in improving data quality, privacy, confidentiality, and information governance within digital health.[24] Therefore, this research aimed to identify patients' and physicians' perspectives about the use of health information technology in diabetes management in Iran.

Methods

This qualitative study was conducted in 2019 after obtaining the ethics approval from the ethics committee of Iran University of Medical Sciences in Iran (IR. IUMS.REC.1396/9411304003). The participants included 10 physicians and eight patients with diabetes (n=18). The settings of the study were two endocrinology and metabolism clinics, and the convenience sampling method was used to recruit the participants. For recruiting patients, they should have experience of using any kind of applications and health information technologies in the field of diabetes management. All interviews were conducted in the clinics and in a quiet place with the interviewee's permission. Before conducting interviews, two interview guides (one for patients and one for physicians (see **Appendix I**)) was developed based on the literature review.[25-31] Then, the participants signed an informed consent form, and in-depth semi-structured interviews were conducted by one of the researchers (ZD) until data saturation was reached. The interviews were digitally recorded, and the audio files were transcribed verbatim. To analyze the data, the framework analysis method was used. This method has five steps, including orientation, or becoming familiar with the text of the interviews; identification of a conceptual framework; indexing and tabulation; and analysis and interpretation of the data. According to this method, the interview transcripts were studied several times by one of the researchers (ZD). During the orientation stage, the main concepts related to the aim of the study were extracted and, finally, a conceptual framework was identified by the first researcher (ZD). The interviews were coded by using MAXQDA version 10. After coding the transcripts, the themes, subthemes, and categories were summarized into a table, and the final interpretation was provided. The qualitative findings were reviewed by other researchers independently to avoid any misinterpretation in reporting the results.

Results

According to **Table 1**, most of the physicians were men (n=6; 60 percent. The highest frequency belonged to the age range of 30-39 years for both physicians (n=5; 50 percent) and patients (n=3; 37.5 percent).

Having analyzed the data, five main themes emerged, which are summarized in **Table 2**. To report the direct quotes of physicians (MD) and patients (P), their initials were used followed by the number of the interviewee.

Theme One: Information Sources Used by Patients With Diabetes

The findings indicated that patients used various information sources for the management of

diabetes. This theme included physicians, trusted people, mass media, and printed media. Most of the patients expressed that the first and the safest way to obtain information was communication with their physicians. Similarly, their physicians noted that the best way that patients could receive information was consulting with their own physicians. One of the physicians said:

"Definitely, for a person who first notices his/her disease and enters the treatment path, it is the physician that can tell him/her about diabetes and its complications." (MD6)

Similarly, one of the patients noted:

"I have been suffering from diabetes for 13 years. I didn't know much about diabetes at the beginning, and every time I visited the physician, he would explain diabetes and its complications." (P5)

A small number of the interviewees considered their families, relatives, and other patients with diabetes as sources of information. Some expressed that if something happened to them and they could not get in touch with a physician, they would receive their needed information from trusted people. A majority of the interviewees cited the internet, social networks, and television as other sources of information. A few physicians believed that some patients use printed media, such as newspapers, magazines, educational brochures, and books, to obtain more information about the disease. However, none of the patients mentioned printed media as their source of information.

Theme Two: Advantages of Adopting Health Information Technology in Diabetes Management

The advantages of utilizing health information technology in diabetes management were divided into four subthemes: economic benefits, improving equity in the healthcare system, responding to the patients' needs, and improving patients' health status. In terms of economic benefits, many participants declared that the use of technology can reduce travel costs as well as the visit payments. In this regard, one of the patients declared:

"We have to spend a lot of money to visit a physician; from commuting costs to the doctor's visit payment. If we use these technologies and the internet, we can save a lot of money." (P4)

Most of the participants stated that adopting technologies could improve health equity. Furthermore, follow-up visits could be performed easier and faster by using technology. For instance, when the physician is abroad, patients can be still in touch with their physician. From the interviewees' perspectives, an increased access to healthcare services, especially for those living in remote areas, can be another advantage of technology. Ultimately, technology helps patients to be informed about new treatment methods.

According to the majority of the interviewees, another advantage of using health information technology in diabetes management was responding to the patients' information needs and group therapy by using the experiences of other physicians and patients. Some of the patients believed that they could obtain their required information using diabetes management applications before visiting their own physician. Finally, diabetes complications can be reduced in the long term and

self-management skills can be promoted by using health information technologies in diabetes management, which may help to improve patients' health status.

Theme Three: Disadvantages of Using Health Information Technology in Diabetes Management

According to the interviewees, financial issues, uncertainty about the accuracy of information, and the large volume of information presented to the patients were among the disadvantages of using health information technology for diabetes management. Some of the interviewees believed that the high cost of setting up and applying the technology were serious disadvantages of using the technology. Many patients were concerned about the accuracy and reliability of the information on the internet and other technologies. For instance, one of the patients mentioned:

"I don't know how scientific this information is. They might give me false information and I may use it; it is very bad. It may happen to me, as I frequently use these channels." (P3)

Another patient said:

"I read on the internet that ginger is helpful for diabetes, but when I asked the physician, he said that it might have negative effects on the kidneys and added that the texts on the internet are not very reliable. So, in my opinion, it is a great shortcoming, since I don't know which text is reliable and which one is not." (P5)

Most of the interviewees were also concerned about the large volume of information on the internet and stated that this excessive volume of information may confuse the patients.

Theme Four: Motivational Factors Influencing the Use of Health Information Technology in Diabetes Management

Generally, motivational factors were divided into organizational, economic, and technical subthemes. Organizational factors consisted of government and health system support, cultural readiness for technology, training and introducing the technology prior to use, and physicians' support. One of the physicians mentioned:

"The government and health system support of these technologies can be very effective. If the government first designs these technologies according to the needs of patients and implements them for several years, and then makes it obligatory, it can surely bring about good results." (MD3)

Most of the interviewees stated that if the technology was introduced by the physician, the usage rate would probably increase due to the patients' trust in the physician. Some patients noted that the use of the technology would probably increase if it was introduced by a patient who had used it before. For example, one of the patients said:

"If the physician introduces a good source that I know contains reliable information, I would surely use it." (P2)

Most of the interviewees discussed the importance of cultural readiness for technology and providing the patients and healthcare providers with adequate training prior to use it. Economic factors were mainly related to providing free healthcare services to the patients. Most of the interviewees expressed that effective use of technology may increase if free-of-charge technologies and applications are provided for the patients. Technical factors consisted of designing a user-friendly technology, verifying and validating the content by the specialists, and getting access to the up-to-date information. Regarding user-friendliness of technology, one of the patients said:

"I use technology if it is simple and beautifully designed, since I easily get tired when I use mobile phones. If the application and the page are appealing and contain pictures and films, I use it more." (P7)

Regarding the verification and validation of information and the content of technology by the specialists, one of the physicians noted:

"Technology can be effective if a think tank is considered beforehand to create these applications and technologies, and experts in each area are consulted so that the technology is approved by the health specialists." (MD5)

Theme Five: Inhibitory Factors Influencing the Use of Health Information Technology in Diabetes Management

Inhibitory factors were divided into organizational, economic, technical, and individual subthemes. Organizational factors included the lack of government and health system support, the lack of user training, and the lack of long-term plans. Economic factors mentioned by the interviewees included the high cost of technology and the financial status of the technology users, especially the elderly. One of the physicians stated:

"The first thing is that these applications should be free for the patients, especially for the elderly. Unfortunately, the elderly do not have good financial conditions, and this is something that worries us about following up their treatment. Therefore, if applications are free, they will be very effective." (MD9)

Most of the interviewees believed that technical problems, inaccessibility of the internet and mobile phones, and the lack of user-friendly technology were among the technical factors hindering the use of health information technology in diabetes management. From the interviewees' point of view, problems with having access to the internet and mobile phones were other major issues that could limit the use of technology. According to one the physicians:

"In some parts of our country, for example in villages and rural areas, we still have difficulty in establishing access to the internet; it may even be impossible to have access to a smartphone due to economic and social conditions." (MD5)

Some interviewees also indicated that the lack of user-friendly technology and the complexity of design may limit the use of technology. The individual factors hindering the use of health

information technology in diabetes management included old age, low level of education and income, ethnic and cultural differences, lack of health and computer literacy, physical problems, and patient preferences. As a physician mentioned:

"In my opinion, cultural, social, and economic conditions of the society have an impact on this issue. Illiterate patients who do not have a good income are reluctant to use these technologies; on the other hand, if they are forced to use them, we will surely face resistance." (MD7)

Discussion

Recently, the use of health information technology has increased mainly due to limited resources, increased healthcare costs, and a change in population and healthcare data. This technology has several benefits for patients, particularly patients with chronic diseases such as diabetes. For instance, patients can monitor their health status without having face-to-face visits with their healthcare providers. Although the use of health information technologies can change patients' behaviors and improve their health status, there are several factors that may influence their usage.

The findings of the current study revealed that economic benefits, improving equity in healthcare services, responding to the patients' needs, and improving patients' health status were some of the advantages of using health information technology in diabetes management. Similarly, Nundy et al. showed that mobile health improved the health status of patients with diabetes. In their study, internet-based interventions had a positive impact on patients' health by providing them with their needed information at the right time.[32]

The results also showed that financial issues, uncertainty about the accuracy of information, and the large volume of information presented to the patients were among the disadvantages of using health information technology in diabetes management. The results are in line with the finding reported by Maniam et al. In their study, factors such as fear of sharing private information when using technology and the large volume of information that might be unreliable were regarded as the disadvantages of using health information technology in diabetes management.[33]

According to the findings of the present study, factors influencing the use of health information technology in diabetes management can be generally divided into two categories of motivational and inhibitory factors. Motivational factors influencing the use of health information technology in diabetes management were: organizational factors (e.g., physicians' support, cultural readiness for technology), economic factors (e.g., providing free-of-charge healthcare services to the patients), and technical factors (e.g., user-friendly technology and up-to-date information). These motivational factors have been highlighted in other studies as well.[34]

Sun et al. showed that physicians' approval and support influenced the acceptance of health information technologies in diabetes management.[35] Moreover, in the study conducted by Boodoo

et al., patients mentioned that training on the new technology before actual use, providing user manuals, paying attention to the mental and psychological requirements of patients with diabetes when designing the technology, and receiving socioeconomic support would promote the use of technology.[36] Huygens et al. reported that factors such as technology portability and reliability can influence technology utilization. According to their findings, technology should be easy to use and suitable for the elderly who are unfamiliar with the internet and modern technologies.[37] In other studies, availability of reminders and alerts, exchanging messages with healthcare professionals, social support, and low cost of technology have been discussed as other motivational factors.[38-40]

Physicians who participated in the current study believed that the inhibitory factors influencing the use of health information technology in diabetes management included organizational factors (e.g., the lack of support from the health system), economic factors (e.g., high cost of implementation and use of technology), technical factors (e.g., problems with getting access to the internet and mobile phones), and individual factors (e.g., old age and low level of education). From the patients' perspectives, economic factors (e.g., high cost of technology), technical factors (e.g., getting access to the internet and mobile phones), and individual factors (e.g., lack of health and computer literacy, low level of education, and low level of income) were the most important inhibitory factors.

In Kruse et al.'s study, the violation of patients' privacy, increasing workloads, willingness to communicate with healthcare providers in person, and the high cost of setting up and using the portal were the factors deterring patient portal utilization.[41] Similarly, in a study conducted by Tieu et al., concerns about the lack of privacy and security, limited technology skills and limited health literacy, and interest in having in-person and face-to-face communication with physicians were found as barriers affecting the use of patient portal.[42] Moreover, the results of the study conducted by Duke et al. showed that, from the patients' perspectives, low socioeconomic status, cultural and language differences, and low interest in and awareness of technology were among the deterrents to the use of technology by patients.[43] Although the present study focused on the utilization of health information technology in diabetes management, it seems that the findings are in line with the results of other similar studies.

Given the variety of factors and their impact on the use of health information technology, it is imperative that healthcare providers pay adequate attention to each of these factors to promote use of the technology. In so doing, it can be expected that the developed technologies are used more effectively and the quality of healthcare services is enhanced. Future studies are recommended to evaluate different types of health information technologies in diabetes management from the perspective of patients and their physicians.

Research Limitations

The current research had some limitations. First, the number of participants, especially patients, was limited. The reasons for that might be related to the personal interests of eligible people to take part in the study. Moreover, as the interviews took place in the clinics in which patients were visited, most of them were not interested to stay more to take part in the interviews. Overall, physicians were more interested in taking part in the interviews than patients. However, as the interview guides and questions were relatively similar for patients and physicians, the results were presented for all participants together, and we did not separate them. So, we can claim that data saturation was reached. Another limitation of the study might be related to the limited number of clinics. In fact, due to limited time and resources, we could not reach other settings. As a result, more research to validate the current results in a larger sample is suggested.

Conflict of Interest

The authors declare that they have no conflict of interest.

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A MIXED-METHODS EVALUATION OF STANDALONE PERSONAL HEALTH RECORD USE BY PATIENTS WITH TYPE 2 DIABETES

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Abstract

Background: Self-management of diabetes is key for achieving positive clinical outcomes, with personal health records (PHRs) proposed as a patient-centered technology for facilitating self-care. However, few studies have described patient engagement with a PHR, including facilitators and barriers to use from the perspective of actual users.

Objectives: To compare use of a standalone PHR by patients with Type 2 diabetes to usual care through assessment of self-care behaviors, and short-term impact on social cognitive outcomes and hemoglobin A1c (HbA1c).

Methods: A mixed-methods design combining a comparative effectiveness pilot with qualitative interviews was used. Qualitative interviews explored the primary outcome of changes in self-care behaviors, while quantitative data obtained from health records and a survey focused on social cognitive and clinical outcomes.

Results: A total of 117 participants completed the study (intervention group = 56, control group = 61). Only 23 individuals used the PHR at least once after baseline. Five themes emerged from the qualitative analysis describing participants' experiences with the PHR and identifying reasons for lack of engagement. Quantitative findings supported qualitative results with no significant changes in HbA1c and only a significant increase in diabetes knowledge in the intervention group.

Conclusions: Study findings revealed low PHR uptake and minimal impact on study outcomes, including lack of communication and information-sharing between patients and providers. Future research should explore the fit of PHRs within the context of other self-management tools, integration with provider workflow, and the need for enhanced functionalities beyond an information repository to optimally support patient self-care.

Keywords: health information technology, mixed methods, patient engagement, patient portal, personal health record, type 2 diabetes

Introduction and Background

Currently 26.9 million people are diagnosed with diabetes in the United States. An individual with diabetes experiences excess yearly medical costs on average of $9,601 directly attributable to their condition.[1] This problem can be addressed by patients becoming more engaged in their diabetes self-care. Personal health records (PHRs) prominently emerged in the early 2000s, highlighted by a seminal paper in 2003 by Tang, which defined it as a patient-centered technology designed to empower patients and facilitate an active role in self-care.[2] The PHR was unique in that it was a patient-controlled technology to facilitate self-tracking and management of health information and

subsequent sharing and exchanging of this information with health care providers.[3,4] There were two primary types of PHRs: standalone, which were often offered by non-health care entities (e.g., Google, Microsoft, WebMD) and required the patient to enter and maintain all data in the PHR on their own; and tethered, which were connected to the provider-based electronic health record (EHR) and allowed the patient to import some of their health data into the PHR.[5] Within the context of diabetes care, PHR use was hypothesized to lead to improvements in self-care behaviors and, subsequently, positively impact clinical outcomes.[6-8]

Despite these proposed benefits, the PHR was never widely adopted, with estimates as low as 10 percent of US consumers in 2012.[9] Identified barriers to PHR use included, costs, security and privacy concerns, inconvenience, design shortcomings, and lack of interoperability across health care systems and organizations.[10-12] Additionally, the limited research examining the impact of PHR use on clinical outcomes of diabetes demonstrated inconsistent findings.[13-19]

As PHRs transitioned out of use, patient portals rose to take their place, supported by federal initiatives such as meaningful use and subsequent programs.[20] Patient portals bear resemblance to tethered PHRs with their connection to the provider-based record and typically allow patients to make medical appointments, refill medications, and securely message their providers.[21] However, most are not patient-controlled. Patient portals have demonstrated variable adoption levels, with a systematic review and meta-analysis finding a mean adoption rate of 52 percent.[22] Similar to PHR-based studies, a literature review of patient portal use in patients with diabetes found variable impact on clinical outcomes.[23]

Given the lack of universal adoption of patient portals and inconsistent findings regarding impact on clinical outcomes from both the patient-controlled PHR and the provider-controlled patient portal, there is an ongoing need to understand how and why patients are engaging with these technologies to better support efforts for adoption and sustained use.[24-28] Additionally, learning about standalone PHRs is still important, as it is estimated that 13 percent of office-based physicians still do not have EHRs, meaning that only the few remaining standalone PHRs are available to patients receiving care from these physicians.[29]

The objective of this study was to describe how patients with Type 2 diabetes engaged with a standalone PHR to manage their diabetes-related health information. Primary outcomes were social cognitive measures of diabetes knowledge, modifying factors, and self-efficacy, with a secondary outcome of short-term impact on HbA1c.

Methods

This study used a mixed-methods design combining a quantitative comparative effectiveness pilot with qualitative in-depth interviews.[30] Given the primary outcomes of the study, emphasis was placed on interview findings and quantitative social cognitive responses. The clinical outcome was of secondary focus, as the short study period for each participant (three to six months) was likely insufficient to demonstrate measurable HbA1c change resulting from PHR use. Still, it was important to measure clinical outcomes to help set a realistic context for the potential short-term impact of a PHR or other patient-centered health technologies on diabetes outcomes. This study was approved by the authors' university institutional review board (IRB #09-15470).

Study Setting and Time Frame

The study was conducted in three ambulatory care clinics (two internal medicine practices and one endocrinology practice) with a total of 13 providers (11 internal medicine physicians, one endocrinologist, and one nurse practitioner). This study was conducted from June 2011 through August 2012.

Participant Recruitment and Randomization

Medical record review was used to identify patients meeting the inclusion criteria: Type 2 diabetes diagnosis with an HbA1c value of ≥7.0 percent; no diagnosis of impaired cognitive function (e.g., dementia); English-speaking; and self-reported access to and comfort with using a computer. Participants were randomized to either the control group, which received usual care, or the intervention group, which was provided in-person training for using the PHR to manage their diabetes-related health information. Based on the clinics' patient population, it was determined that a convenience sample of 140 participants was achievable. Participants were enrolled using unequal randomization (73 in the intervention group and 67 in the control group) to ensure similar numbers in each group, assuming more drop-outs from the intervention group.[31]

Study Intervention

For the purpose of this study, the PHR was operationalized as online, patient-controlled, and not offered by a specific health care provider. Selection of the study PHR (Microsoft HealthVault) followed a previously published evaluation focusing on PHRs that were free and met a majority of patient-desired PHR features identified through an in-depth literature review.[32]

Participants in the intervention group received hands-on PHR training, guided by a step-by-step instruction manual with screenshots and written directions, which was provided to them for personal use. Participants were required to demonstrate the ability to enter the following information: birthdate, height, weight, medical condition(s), medication(s), blood glucose, blood pressure, HbA1c, low-density lipoprotein (LDL) cholesterol, and dates of their last eye and foot exams. Participants were directed to use the PHR in any way needed to help manage their diabetes-related health

information.

Conceptual Framework

This study utilized a conceptual framework built on social cognitive theory (SCT), which states that self-efficacy is a primary determinant of a person's decision to establish and maintain effective self-management behaviors.[33] This study hypothesized that PHR use would directly enhance self-efficacy and self-care, while simultaneously indirectly enhancing self-efficacy through modifying factors and diabetes knowledge.

Modifying factors include perceived barriers, diabetes education, and social support. Providing diabetes education and having appropriate social support will assist patients in understanding the actions needed to manage their diabetes care. Understanding the perceived barriers that interfere with self-care will help patients to identify facilitators of self-care, generate workable strategies for overcoming those barriers, set realistic outcome expectations, and improve self-efficacy.

Diabetes knowledge is necessary for understanding the clinical improvements that will result from self-care behaviors such as maintaining appropriate diet and exercise and being adherent to prescribed medication therapies. Providing patients with a tool to systematically track their health information over time will allow patients to see changes in diabetes-related outcomes based on behaviors taken, leading to improvements in self-efficacy.

Diabetes Care Survey

The Diabetes Care Survey (DCS) was constructed as a 127-item hybrid instrument by: 1) extracting items from previously validated instruments; 2) using an unpublished instrument measuring knowledge of medical conditions and prescription medications; and 3) developing new items.[34-36] Items for the three social cognitive concepts (modifying factors = 18 items; diabetes knowledge = 16 items; and self-efficacy = 41 items) were constructed using a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree). Responses were summed and averaged to calculate a score for each concept. The remaining 52 items addressed diabetes self-care behaviors, access to various aspects of diabetes care, and demographics.

Qualitative Interview Protocol

An interview protocol was developed to explore the central guiding question: "How have you used the PHR to manage your diabetes-related health information?"[37] Interview questions are displayed in **Table 1**.

Clinical Data Collection – Baseline

All participants completed the DCS and had the following data abstracted from the EHR at baseline: age; year of diabetes diagnosis; body mass index; the most recent values for HbA1c, blood pressure,

blood glucose, LDL cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, and serum creatinine; presence of diabetes-related complications; current medical conditions and medications; presence of diagnosed depression; date of last eye and foot examinations; date of last influenza and pneumococcal vaccinations; smoking status; and alcohol consumption. Current medical conditions were used to calculate a Charlson Co-Morbidity Index score, which is a tool to predict one-year mortality or hospitalization for patients with various chronic conditions.[38] It was used in this study as a proxy to measure extent of additional chronic diseases in each patient beyond Type 2 diabetes.

Participants in the intervention group also received the study intervention training.

Clinical Data Collection – Follow-up

Follow-up visits were conducted three to six months after the baseline visit, corresponding to typical intervals for diabetes care visits.[39] At follow-up, participants completed the DCS and had data abstracted from the EHR. All intervention group participants also completed interviews, guided by the interview protocol. This purposeful sampling procedure was used to ensure that data saturation would be achieved.[40,41] Interviews typically took 15-20 minutes to complete and were conducted in person at the follow-up visit, or by telephone. Interviews were audio-recorded and transcribed.

Qualitative Data Analysis

Qualitative transcripts were analyzed iteratively, using a process of reading through each transcript multiple times to immerse the researcher in the participants' perspectives.[42] This data immersion allowed for a reflexive process of understanding the impact of the researchers' biases on the data analysis and interpretations drawn.[43] Each transcript was individually analyzed using memoing and *in vivo* coding (which uses the participants' own words and phrases as codes) to most accurately capture participants' experiences with the PHR.[44] After all transcripts were coded, categories were identified that grouped together codes with similar meaning. Cross-category analysis through comparing and contrasting represented ideas led to the emergence of themes that that reflected patients' use of the PHR to manage their diabetes-related health information.

Quantitative Data Analysis

Demographic data, diabetes self-care behaviors, and access to various aspects of diabetes care were compared at baseline between the control and intervention groups to ensure that the randomization process was effective. Independent samples t-tests were used to analyze continuous variables, and chi-square tests were used to analyze categorical variables, with a significance level set at $p \leq 0.05$.

To compare changes within the control and intervention groups from baseline to follow-up for social cognitive outcomes, paired samples t-tests were used with a significance level set at $p \leq 0.05$. The

same analysis was used to compare changes within the control and intervention groups from baseline to follow-up for the clinical outcome of HbA1c. Additionally, independent samples t-tests were used to compare control and intervention groups at follow-up. In the sub-analysis, PHR use logs were examined, and any participant using the PHR at least once after baseline was classified as a PHR user. Clinical outcomes for users and non-users were compared using the same process for the intervention and control groups.

Mixed Data Analysis

Mixing in this study occurred during data interpretation. Qualitative themes from participants about their PHR use and self-reported behaviors were interpreted within the context of the quantitative findings (social cognitive outcomes, and secondarily, change in HbA1c).[45]

Results

A total of 117 participants completed the study: 61 members of the control group and 56 members of the intervention group. The 23 participants who did not complete the study either asked to be removed from the study or did not return for a visit within the study time frame. Within the intervention group, few participants were PHR users (n=23).

Demographics

Table 2 displays the demographic characteristics for the overall sample. Participants were on average 59 years old, and the majority were female (54.7 percent), white (76.1 percent), married (59.0 percent), unemployed (53.0 percent), had less than a college education (62.4 percent), and had a yearly income less than $70,000 (68.5 percent). There were no statistically significant differences for any of the demographic variables between the control and intervention groups at baseline.

Qualitative Findings

Five themes emerged from the qualitative analysis. Each theme is described along with a representative participant quote.

Theme 1: Few people use the PHR more than once or twice.

Most intervention group participants did not use the PHR more than once, and only one participant indicated that they enjoyed using it. Reasons for lack of use fell into two major groups: 1) technical problems with hardware, internet access and speed, or computer comfort of the user; and 2) not identifying a clear value for use. One participant stated that, “My A1c has been steady. So I didn’t feel like I really needed to use it as often … that wasn’t particularly useful for me.”

Theme 2: PHR users are individuals who are already tracking information.

PHR users reported that PHR use did not change their self-care behaviors, as many were already using other strategies for tracking information (e.g., paper records, glucometers, or Excel

spreadsheets). One user shared, “Being able to average and get my blood sugars in Excel is what I am used to.”

Theme 3: PHR users find value in self-management.

PHR users reported engaging with the PHR to support their diabetes self-management and described PHR use in ways that reflected self-motivation. A PHR user shared that, “I like that I can track my glucose level and I can see what I’ve been doing, and if food was what was causing me to have highs or lows.”

Theme 4: PHR users do not proactively share the information with their providers.

PHR users were already oriented to self-care. While some reported that an advantage of PHR use was maintenance of information in a central location, users did not associate this idea with sharing information with their providers. Additionally, some users had the perception that, “The doctor already has all of my information.”

Theme 5: Providers who knew patients were trained in PHR use did not ask for the information.

Providers continued to only ask participants for traditional sources of information, such as glucometer readings, diaries and log books, and recall of information despite knowing that the PHR was introduced to patients.

Quantitative Findings – Social Cognitive Outcomes

Qualitative findings were corroborated by the quantitative results. No significant changes were observed in the control group for any social cognitive outcomes: modifying factors (3.78±0.53 to 3.70±0.48, p=.204); self-efficacy (3.77±0.39 to 3.80±0.43, p=.317); and diabetes knowledge (4.13±0.53 to 4.19±0.52, p=.254). In the intervention group, no significant changes were observed in modifying factors (3.78±0.48 to 3.84±0.48, p=.379) or self-efficacy (3.82±0.37 to 3.84±0.39, p=.657); however, there was a significant improvement in diabetes knowledge (4.11±0.49 to 4.25±0.37, p=.029).

No significant changes were observed in PHR users for any social cognitive outcomes: modifying factors (3.92±0.43 to 3.99±0.44, p=.322); self-efficacy (3.89±0.29 to 3.97±0.33, p=.105); and diabetes knowledge (4.14±0.54 to 4.35±0.31, p=.098). Similarly, no significant changes were observed in PHR non-users: modifying factors (3.69±0.50 to 3.74±0.50, p=.740); self-efficacy (3.77±0.42 to 3.75±0.40, p=.498); and diabetes knowledge (4.09±0.45 to 4.19±0.40, p=.168).

Quantitative Findings – Clinical Outcomes

At baseline, participants’ average HbA1c was 7.69 percent (control = 7.53±1.53, intervention = 7.86±1.96), with a non-significant differences between groups (p=.301). At follow-up, participants’ average HbA1c level was 7.86 percent, (control = 7.75±1.22, intervention = 7.98±2.01). There was no significant difference between groups at follow-up for HbA1c (p=.455). A paired samples t-test revealed no significant change in HbA1c from baseline to follow-up for either the control (p=.252) or

intervention group (p=.535).

Examining just the intervention group, PHR users had an average HbA1c of 7.46±1.72, and non-users had an average of 8.14±2.10 at baseline, a non-significant difference (p=.204). At follow-up, PHR users had an average HbA1c of 7.78±1.94 and non-users had an average of 8.12±2.07, also a non-significant difference (p=.546). A paired samples t-test revealed no significant change in HbA1c from baseline to follow-up for either the PHR users (p=.338) or non-users (p=.901).

Mixed Findings

Participants did not change their health information tracking behaviors to include PHR use—evidenced by only 23 individuals in the intervention group (41 percent) using the PHR more than once after baseline, and the qualitative themes that revealed users were either already utilizing other tracking mechanisms, did not see added value for their self-management, and/or experienced technical or computer literacy problems. As many of the PHR users were already self-tracking, no greater incremental change in quantitative outcomes was reasonably expected. Indeed, this was manifested in the lack of significant change to HbA1c and nearly all social cognitive outcomes. This finding is further supported by the qualitative themes, which revealed no paradigm change in patient-provider communication about self-monitoring; no additional information sharing with their diabetes care provider; and no solicitation of information by the provider themselves.

Discussion

Implications for Patients

Most patients used the PHR infrequently, if at all. Exposing the patient to the PHR possibilities for self-care and providing technical training for use was insufficient to impact short-term HbA1c or most social cognitive outcomes, indicating that the intervention was a "failure" despite education and training to maximize use. Individuals who used the PHR most frequently were already tracking their information using other tools (e.g., paper records, Excel), and non-users were non-trackers regardless of mechanism. Even while qualitative themes revealed that participants recognized value in the PHR for self-management, this resulted in minimal use. Additionally, with an average of 12 years since initial diagnosis, many participants had likely established routines for self-care tracking. This suggests there may be benefit in offering this type of tool to newly diagnosed individuals who have not yet established behavioral habits.[46]

Diabetes knowledge did improve in the intervention group. However, given the overall lack of PHR use, this finding may be more appropriately explained by the education and training component of the intervention. This conclusion is also supported by the fact that while both PHR users and non-users increased their diabetes knowledge score (4.14 to 4.35; and 4.09 to 4.19, respectively), neither increase was significant. Thus, robust training and education with ongoing support may be an

important strategy for stimulating patient adoption of new self-management tools.[47] Future studies may be able to use this study's training framework and approach during initial implementation of such tools.

Implications for Providers

Qualitative themes revealed the PHR did not stimulate interactions between patients and providers. Despite providers being aware of the study and one provider documenting that their patient was participating in the "PHR study," the introduction of a PHR did not create a common communication framework for provider and patient. This is problematic as providers are recognized as a crucial stimulus for adoption and use of self-management tools, and may need education about the potential that PHRs hold for enhancing patients' self-care behaviors.[48-51] Future research should address effective strategies for educating providers about the benefits of these tools and identifying how use of the PHR or similar technologies might fit into provider workflow.

Implications for PHR Vendors

To produce clear value for patients with various needs, the PHR will require enhanced functionalities. There is increasing focus on patient-centered clinical decision support tools such as identification of drug-drug interactions and preventive care reminders that advance its use beyond an information repository.[52-54] Similarly, patient portals often include additional features such as secure messaging with health care providers, refill requests, and appointment scheduling. Recent studies of patient portals found that sustained use of secure messaging and refill requests can lead to improvements in glycemic, blood pressure, and lipid control.[55,56] Combined with appropriate positioning of the PHR in patient's self-care, these enhanced functionalities may stimulate adoption and use resulting in positive effects on health outcomes.[57]

Limitations

As noted in the methods, the study time frame made it unlikely that clinical change would be observed. Future research should consider longer studies (i.e., minimum of one year) to assure adequate time to demonstrate HbA1c change and facilitate more in-depth exploration of potential benefits associated with PHR use.

Detailed information about PHR use (e.g., number of logins, number of times viewing a specific section within the PHR) was not obtainable. Thus, the simple measure of whether a patient used the PHR even once after baseline was used to classify PHR users and non-users. While this resulted in limited understanding about users' actual PHR behaviors, the overall lack of use made it unlikely that access to this data would have led to significantly different interpretations of the study findings.

Finally, given the incidence of Type 2 diabetes across various patient populations, there was an

underrepresentation of males and minority study participants, which may limit generalizability to these groups.

Conclusions

PHR use in this study demonstrated no significant impact on most social cognitive outcomes (the exception being a statistically significant improvement in diabetes knowledge that was likely not explicitly tied to PHR use), and no impact on clinical outcomes. The PHR did benefit some patients in ways that did not result in clinical changes; however, there remain numerous limitations to this technology that inhibits adoption and sustained use. In their current form, there is little that makes standalone PHRs an attractive option for patients. However, much of this learning can still be applied to similar technologies such as patient portals. Future research should focus on how to optimize the design of these technologies, communicate its usefulness to patients, identify optimal ways to integrate use into provider workflow, and facilitate patient-provider communication that will lead to positive impacts on social cognitive and subsequently, clinical outcomes.

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FROM NASA TO HEALTHCARE: REAL-TIME DATA ANALYTICS (MISSION CONTROL) IS RESHAPING HEALTHCARE SERVICES

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By Jessica Schlicher, MD, MBA; Matthew T. Metsker, PA-C, MPAS, MHA, FHM, CMPE; Hitul Shah, MS; and Haluk Demirkan, PhD

Abstract

This is a case study of the implementation of a data and analytics-enabled Mission Control at one of the largest healthcare service providers in the state of Washington. Using data analytics and artificial intelligence, CHI-Franciscan (one of the largest healthcare organizations in state of Washington) is able to coordinate patient care more effectively and efficiently, improving safety for all its patients. This case study demonstrates tangible evidence from quantitative and qualitative analysis for return on investment for such a large project.

Introduction

A revolution in healthcare is occurring as a result of changes in the practice of medicine and in society. These include increasing costs; lack of performance compared to other nations spending less on healthcare as a percentage of the economy; changing demographics and diseases; new tools, techniques and solutions; changes in healthcare delivery; increased patient empowerment and autonomy; an emphasis on outcomes; and changing professional roles. Today, healthcare providers have many complex and unique challenges as well as opportunities to improve the patient care experience.

Coordination of patient care is one of the most complex and important services that every large healthcare organization needs.[1] This involves deliberately organizing and managing patient care activities, sharing timely information among all of the participants concerned with a patient's care, and making the right decisions in a timely manner. The patient's needs and preferences must be known ahead of time. Conditions are being monitored with live data feeds, and this information must be used intelligently to provide safe, appropriate, and effective care to the patient.

In this paper, we discuss the successful implementation of data analytics in our artificial intelligence-enabled Mission Control at one of the largest healthcare service providers in the state of Washington.

Although the need for care coordination is clear, there are many factors that can either impede or facilitate the work of care coordination:

- Current health care systems and electronic medical records are often disconnected.
- Specialists may have inadequate information on previous tests and treatments.
- Sharing medical records among providers is essential to coordinated care, but the promise of seamless digital exchanges is still far from reality.

Data analytics and artificial intelligence-enabled smart healthcare systems, coupled with electronic

health records (EHRs), live streams of patient data, and the emergent mobile solutions demonstrate unprecedented potential for delivering highly automated, intelligent, and sustainable healthcare services.[2]

From NASA to Healthcare: Mission Control

Inspired by NASA, in 2019, CHI Franciscan launched its Mission Control Center, the first in Washington state and only the fifth globally to use artificial intelligence (AI) and advanced analytics to enhance its services, coordinate and optimize patient care, and increase capacity to serve more patients throughout eight of its acute care hospitals. The 1,300-bed health system, one of the largest in the state, sees nearly 325,000 emergency department visits and over 300,000 inpatient days each year. CHI-Franciscan is part of CommonSpirit Health, the second largest nonprofit healthcare organization in the United States.

Built in collaboration with GE Healthcare, the Mission Control Center collects and harness data with advanced machine learning (ML) and AI algorithms to:

- Coordinate patient care and resources across the entire health system.
- Streamline care delivery.
- Allow care teams to proactively solve problems.
- Reduce patient risk and improve health outcomes.

Core functions of the CHI-Franciscan's Mission Control include:

- Transferring patients between and from outside the facility
- Placing patients in the appropriate bed the first time
- Chasing down care delays to eliminate them
- Providing appropriate staffing across all facilities

The center houses an 18-screen video wall with 12 data analytic tiles, or apps, that provide actionable, real-time data from each hospital. For example, one tile, called Care Progression, scans and detects care activities falling behind schedule. The tile prompts a response without delay and helps to avoid false alarms before alerting the staff.

It is well known that patients with long waits in the emergency department after the decision to admit experience heightened mortality risk.[3] Mission Control analyzes real-time data and address potential delays to reduce the amount of time a patient waits in the emergency department or a post-anesthesia care unit for a bed to be available. Economically, hospital crowding is directly correlated with left without being seen and lost case rates.[4]

Value of Collaborative Intelligence: Physician on Duty + Mission Control

One of the critical success factors for CHI-Franciscan's Mission Control Center is a program called Physician on Duty (PoD). Every day, the center has a practicing physician leader in the providing proactive clinical leadership. Over the 12 months prior to the launch of Mission Control, CHI-Franciscan worked to recruit a team of leaders in hospitals, emergency medicine, and surgical specialties for the PoD role. Core recruiting criteria included:

- High level of trust with medical staff colleagues and nursing staff
- Ten years of clinical experience, preference for current service line medical directors
- System perspective and operational experience
- Willingness to take risks to advocate for the highest quality of clinical care
- Ability to be a good coach in a new department and atmosphere of change

At launch, they had recruited 14 physicians, 12 of whom were divided equally between emergency physicians and hospitalists; the cardiovascular and general surgery service line chiefs took the last two spots. Ten were service line and medical director leaders.

Continuing education is also key because of rapidly changing technology and health service practices. Training was performed over the first three months to determine the correct standard work for the team, with the goal of preventing lost cases, improving patient safety, reducing delays, and balancing system capacity. As of November 2020, they are on the 14th iteration of standard work for this team in the first 16 months of the program. Daily PoD program standard work is:

- *System awareness.* The physician uses current and historical capacity data to make a capacity projection for each hospital for the coming day. This work is done in collaboration with Mission Control Center staff in patient placement, transfer center, and nurse staffing. The team reaches an agreement on what the plan of the day should be in terms of capacity for the next 24 hours.
- *System communication.* From this projection, after verifying the data is correct and with input from the team, the physician notifies all hospitals of available system resources and projected deficits.
- *Lost case prevention.* The physician serves as a clinical resource and facilitator to improve communication among medical staff colleagues.
- *Algorithm looks forward*. The PoD communicates what is happening now and what is going to happen over the next 24 hours. They facilitate additional direct admissions by leveraging collegial relationships.
- *Identifies greatest need of each patient placement team throughout the shift*. This expedites discharges, obtains downgrades, and reduces boarding a care delays.
- *Expert clinical reviews of all transfers into their tertiary and full hospitals* to ensure clinical appropriateness; facilitates equivalent alternative plans (for example, a specialist may see the patient at the sending facility by telemedicine rather than transfer all patients needing consults to the tertiary facility).

- *Reroutes.* The physician actively scans the emergency departments of full hospitals to identify patients who qualify to be admitted at sites who both have capacity and are projected to have space. We take care to anticipate incoming demand of their hospitals so as not to worsen overcrowding.
- *Wait list reviews.* The physician works to ensure that patients are admitted to their hospitals in a timely manner to prevent lost cases.
- *Hospice care facilitation.* When transfers are requested that contain an opportunity to have a goals of care discussion, the physician can facilitate this if it has not yet occurred.
- *COVID-19-specific tasks* include:
    - Lead critical resource triage team drills (abstract patient data, to be used only if resource allocations should become necessary due to scarcity).
    - Patient reviews. All admitted COVID-19 patients are reviewed daily to assist in transfers/cohorting at their designated coronavirus hospital.
    - Facilitate specialty consultations to reduce the risk caused by transferring patients with COVID-19.
    - Facilitate skilled nursing facility discharges of both COVID-19 positive and negative patients.
    - Serve as the expert to answer questions from bed placement and transfer center regarding isolation, testing, bed placement, and stewardship of negative pressure rooms.

Benefits in Less than a Year

With information that is being provided by Mission Control, the team of physicians on duty recorded their daily interventions with medical record numbers in order to quantify and validate their impact. In order to preserve data integrity, a standardized set of inclusion criteria was applied; interventions that did not meet these criteria were not included to prevent lost cases, create tertiary capacity and strategic beds, and improve patient safety.

It is almost impossible to adopt a standard technology to manage healthcare services. Of course, GE's Mission Control technology needed interventions and customizations to be adopted for the CHI-Franciscan's processes. During the first year of implementation, each physician was required to lead a resource capacity-related project in addition to the standard work noted above. Samples of these projects included:

- Tertiary emergency department medical director (also a PoD) temporarily repurposed a part of his emergency department for stress testing when a community hospital's nuclear medicine devices were recalled, preventing outmigration of many additional patients (not counted in official metrics).
- System cardiovascular service line physician director (also a PoD) implemented best practices in same-day discharge of procedural patients after lab procedures. Significantly more same-day discharges were observed throughout the health system for these patients.

- System general surgery chief (also a PoD) reviewed lost surgery cases to identify opportunities and bring feedback to his group.
- Writing and implementing a system transfer back agreement to create tertiary space when patients no longer had a need for their tertiary care center.
- Physician leaders, including the chief of neurosurgery and cardiology, asked Mission Control to contact them, day or night, if a case was going to be lost due in their service line.

As a result of successful co-development, implementation, and management of Mission Control, in less than a year, the following improvements were seen*:

- Through additional admissions and prevention of lost cases alone, the physician-driven program created a contribution margin equal to for 74 percent of its labor cost in the first year of operations.
- When considering the additional tertiary capacity created with transfers and reroutes away from their full tertiary center, if that capacity were entirely utilized, the contribution margin of that capacity creation is estimated at $3.6M, with a total program return on investment of 12:1.
- Writing and validating a unique capacity algorithm for Mission Control, used daily in their operations, that was found to be accurate within 1.9 percent in predicting "tomorrow's demand" at their tertiary sites.
- Lost cases were reduced by 20 percent in the first six months of the year.
- Reduced boarding, on average, by 54 percent, as measured daily at 5 a.m. This data was pulled from two independent data sets, including transfer center capacity data audits and emergency department nurse staffing data.
- Balanced system capacity. Since the launch of Mission Control, we have been able to achieve significant shifts in occupancy from their busiest hospitals into smaller sites with inpatient capacity.
- From a core clinical service perspective, the PoD intervened on 142 critical patient safety cases, highlighting the need for physician leadership at the forefront of complex integrated health systems (see **Table 1**).

**Note: Regarding lost cases, boarding data, and admission volumes: Only the first six months of data of the 2019-2020 fiscal year was included, as volumes dropped so precipitously following the COVID-19 pandemic that subsequent changes could not be credibly attributed to interventions at Mission Control.*

The leadership team had to two major challenges during this project that needed to be addressed urgently to reach the project goals. Recruiting was a challenge that required investing in people (time) for a full year prior to launch. Physicians already in leadership roles and highly trusted across the organization were being asked to work on their few days off. Regular listening sessions with desired candidates required understanding their ongoing deep concerns about patient safety and system capacity, and presenting them with fact that this role was a real opportunity to improve

patient care. The second challenge was about processes. Standard work was generally known but had to change throughout the initial months of the program. Our team needed to see what should be done and change to meet those challenges. Actively coaching and teaching the other teams in Mission Control (patient placement, transfer center, and staffing in particular) became a core competency. We discovered that successful physicians on duty had to be skilled facilitators and negotiators, advocating for patient care in areas (like nurse staffing) not traditionally involving physicians.

Lessons Learned

CHI Franciscan is not the only health system with a Mission Control—others include Johns Hopkins and Oregon Health Sciences University. University of Pittsburgh Medical Center's SmartRoom technology is another sample analytics and AI-enabled smart healthcare system. This consists of two major components: a patient screen, which lets patients identify their caregivers, see a list of the day's activities (scheduled lab tests, etc.), and access educational materials; and a caregiver screen, which gives clinicians access to essential information, including allergies and medication regimens. This system also lets nurses and aides quickly document vital signs and complete basic tasks on a touch screen. The system is intelligent enough to give different sets of patient data to different categories of providers. For example, an aide responsible for turning a patient would be told that the patient is allergic to latex and get reminded to put the bed rails up.[5]

There are three areas that any smart hospital (e.g., Mission Control) addresses: operations, clinical tasks, and patient centricity. Operational efficiency can be achieved by employing building automation systems and smart asset maintenance and management solutions, along with improving internal logistics of mobile assets, pharmaceutical, medical device, supplies and consumables inventory, as well as control over people flow (staff, patients, and visitors). Patient flow bottlenecks, when addressed, improve efficiency, allowing more patients to be "processed" through the system and allowing for more revenue opportunities at lower costs.

When we see how many tech giants have made big bets on healthcare and experienced big failures in the past several years (such as Microsoft HealthVault, Google Health, Apple Watch, and IBM Watson Oncology) while trying to disrupt an extremely complex industry, this makes people nervous to co-develop and implement a solution like Mission Control to manage healthcare services.

The key learnings can be summarized as following:

- Hire the best possible technology provider who already has healthcare knowledge and experience.
- Hire the most clinically trusted and influential, organizationally and operationally literate, and verbally articulate physicians possible. Patient care efficiency and safety can be improved, but influencers must be at the helm to ensure new processes keep patients safe.

- Hire people willing to endure and adapt to change. Be willing to change the standard work to adapt to evolving needs. The entirety of Mission Control's COVID-19 related work was developed contemporaneously with the evolution of the pandemic.
- Hire data science engineering and science experts who have healthcare knowledge.[6]
- Hire and cultivate the engagement of physicians who have a "whatever it takes" attitude to provide the best possible health service.
- Learn from each other. CH-Franciscan was very fortunate to have a highly experienced and trusted team of registered nurses, coordinators, and staffing experts in Mission Control with a deep well of clinical, relational, and operational knowledge.

Limitations

As with all case studies and action research, one of the limitations of this study is the examination of a single healthcare organization. There are a number of healthcare organizations working on similar data and analytics-healthcare information management solutions globally. Depending on the types of health services that they provide and the size, each organization may have different needs. Of course, the success of this project depends on people, right processes, and technology that collects, stores, and analyzes data to support right and timely decision making. AI is a growing area that enables decision-making in healthcare.

Conclusions

Many healthcare service providers are working on various data and analytics-enabled solutions to increase outcome of their health services. This is one of the few studies that demonstrates tangible evidence from quantitative and qualitative analysis for return on investment for such a large project. Coordinating patient care with real-time data and being able to take speedy decisions bring so much value to the healthcare services.

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FACTORS FOR SUCCESSFULLY PASSING CERTIFICATION EXAMS: A SYSTEMATIC REVIEW

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Abstract

This study explored possible success factors for health information management certification exams. Based on the American Health Information Management Association (AHIMA) website, in 2018 and 2019, only 70 percent of first-time test takers passed the Registered Health Information Administrator (RHIA) exam; 26 percent passed the Certified Health Data Analyst (CHDA) exam in 2018; and only 10 percent passed the Certified Health Data Analyst exam in 2019. A quantitative systematic review and meta-analysis offered insight into factors related to passing certification exams. Sources included existing, relevant peer-reviewed and published literature since 1990 within 87 educational and health/medicine databases and 62 other articles and journal databases available at the University of South Dakota library. Outcomes from the systematic review include illumination of factors for passing health information management, healthcare, and education certification exams. Ultimately, this new information will help improve pass rates on certification exams.

Keywords

certification exam success factors, registered health information administrator, certified health data analyst, health information management

Introduction

During the past 10 years, implementation of electronic health records (EHRs) has dramatically changed how patients experience care, how healthcare professionals document and exchange patient information, and how health information is managed and maintained. Further, challenges such as data quality, interoperability, and usability continue to provide opportunities for improvement in healthcare work and decision-making.[1-5] According to Cyganek et al.,[6] "electronic health records should be considered as one of the most complex data objects in the information processing industry." In 2018, only 63 percent of new graduates eligible for the Registered Health Information Administrator (RHIA) entry-level exam sat for the exam and passed, and only 26 percent of first-time test-takers passed the Certified Health Data Analyst (CHDA) exam.[7,8]

Considering the educational risk and cost, along with the expected workforce shortage, it is concerning that few people attempt the certification exams, and college graduates are frequently unable to pass competency exams on the first attempt. This motivated the present investigation. The following systematic review covers empirically demonstrated factors associated with successful completion of certification exams in healthcare and education professions. These hypothetical factors are consistent with literature review suggestions for further study with the goal of applying findings to study additional related health information management (HIM) certification exams in the

future.

Certification exams are utilized to assess knowledge and proficiency in HIM after completion of relevant education.[9] Many careers require certification and ongoing maintenance to ensure the currency of practitioner skills. A credential is commonly awarded to an individual who has passed a certification exam with the requirement to complete continued education on an ongoing basis. The credential signifies valuable knowledge in the medical workplace,[10] and credentials are routinely held by professionals in healthcare settings.

Background

Maintaining a sufficient number of well-trained workers is problematic in the healthcare information industry because professionals are expected to frequently learn new technologies and to synthesize larger amounts of data.[11] Jobs are evolving as workers develop those skills in preparation for new roles, which commonly require additional credentials. Factors that predict passing scores on certification exams in the HIM profession are not well understood at present, evident by a lack of research studies.

First-time test-taker pass rates for the RHIA exam average 72.4 percent for the five-year period of 2014-2018,[12,13] with pass rates ranging between 69 percent and 75.8 percent (**Table 1**). The same time period shows an average pass rate of 48.4 percent for the CHDA exam with a pass rate range of 26 percent to 61.2 percent (**Table 2**).[14,15] In 2018, first-time test-taker pass rates for the RHIA and CHDA certification exams are 71 percent and 26 percent, respectively.[16,17] In 2018, 63 percent of new graduates eligible for the RHIA entry-level exam attempted and passed the exam, 71 percent of 1,129 first-time test-takers passed the exam, and only 26 percent of first-time test-takers passed the CHDA exam.[18,19] Students, professionals, and faculty may benefit by understanding factors that improve pass rates on the exams and possibly addressing any concerns. The study described will identify and synthesize current, relevant theoretical and empirical research to answer what factors predict passing healthcare and education certification exams have thus far been identified.

Literature Review

This section includes an exploration of published literature regarding success factors for completion of HIM, healthcare, and education professional certification exams. The University of South Dakota (USD) Library was utilized to access results from education, healthcare/medicine, and ProQuest databases. Keywords used for searches were “certification,” “exam,” and “success factors.” Existing knowledge of theoretical models, frameworks, and success factors related to student and educational programs were identified in the literature in addition to critical gaps.

The theoretical model informing this study included the Community of Inquiry (COI) model (**Figure 1**),

in which students, faculty, and content intersect to reflect the conceptual space defining the highest level of educational experience.[20] Certificate exam scores indicated student levels of learning on the topics being assessed. The next section will discuss important HIM certification exam predictors of success described in literature.

Dolezel and McLeod[21] found that a students' cumulative grade point average (GPA), HIM course grades, and online course delivery predicted success in passing the RHIA credentialing exam. More than 80 percent of online students passed the certification exam on the first attempt, compared to less than 60 percent of campus-based students. McNeill and Brockmeier[22] predicted passing using several educational program features, including total program expenditures; student-to-faculty ratio; faculty degrees earned; teaching experience; course didactic, laboratory, and professional practice hours; comprehensive examination requirement; and student mean cumulative college GPA on admission. However, the authors included only two years of data and reported no statistically significant relationships between each hypothetical predictor and the pass rate. Condon and Barefield[23] found that a post-baccalaureate certificate program is an alternate method to address the workforce shortage.

Key insights on barriers to passing the Registered Health Information Technology (RHIT) credentialing exam provided insight that may be applied to the RHIA credentialing exam. Ellis[24] found that a lack of confidence in test-taking and knowledge of exam content may play a part in eligible students not attempting certification exams. Farroll[25] noted that grit and deliberate practice play significant parts in predicting which students persevered on credentialing exams. Preparation for certification exams included repeated experience of completing comprehensive exams using several types of exam prep tools, as well as other factors noted in literature from other related healthcare and education professions.

The RHIT exam is similar in the type and format of the RHIA exam. With the integration of technology and considering that credentialing exams are online, a prototype for a mobile application to better prepare students was developed.[26] However, no studies of student results utilizing the mobile application appear to have been reported. There were only a few related, completed studies specific to the RHIA exam, and none are identified for the CHDA credentialing exams. The Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM) requires educational program directors to monitor and report student success rates and pass rates on the corresponding credentialing exams as a part of the CAHIIM accreditation process. In 2018, 63 percent of new graduates eligible for the RHIA entry-level exam attempted and passed, 71 percent of first-time test-takers passed, and only 26 percent of first-time test-takers passed the CHDA exam.[27,28]

Noblin, Walden, and Safia[29] reported mixed results, as only half of the examinees passed the RHIA exam after waiting an average of seven months between the completion of a prep course and taking the exam. The prep course workshops were sponsored by the American Health Information Management Association (AHIMA) and were offered four different times throughout the study.

Interestingly, Noblin, Walden, and Safiar[30] reported that some of the test-takers passing the exam had earned at least one additional credential prior to passing the RHIA exam. McNeill[31] reported that students graduating from associate degree HIM programs with a comprehensive exam at the end of coursework were more likely to pass the certification exam.

Other healthcare and education certification examination literature provided insight about additional variables that could be studied to determine application to the HIM profession. Highlights from the studies are described below in the following order: medical licensing/residency program; physical therapy assistant; nurse anesthetist; athletic trainer; registered nursing; internal medicine; medical technologists; prosthetics; nursing wound, ostomy and continence certification; paramedic; and National Asthma Education Certification Board. Findings from the medical licensing/residency program studies are presented below.

According to Gohara, Shapiro, Jacob, Khuder, Gandy, Metting, and Kleshinski,[32] and Gullo, McCarthy, Shapiro, and Miller,[33] performance on required medical school courses predicted success on medical licensing exams better than pre-admission models using the Medical College Admission Test (MCAT). It is critical to understand factors that help students on first-time exam attempts, such as practice exams or other high-stakes exams, informed by an extensive review of literature. The in-service examination was used by most residency programs as a measure of progress during residency training. Bedno, Soltis, Mancuso, Burnett, and Mallon[34] found that "the in-service examination was a way to assess the program and resident likelihood of success on the board certification exam" (p. 641). There was a moderate correlation with student performance on the in-service exam and performance on the board certification exam. Student GPAs also were important factors, with a significant correlation to passing the certification exam. Adding to the body of research, Schmitz and Bailey[35] recommend a larger study to validate findings that in-training periodic exams predict certification results. Insights from the physical therapy assistant literature are highlighted next, followed by the Certified Registered Nurse Anesthetist (CRNA) exam and the Certified Athletic Trainer exam findings.

Completion of prior high-stakes exams improved the licensure exam scores. Findings were consistent with the National Physical Therapy Exam for Physical Therapist Assistants, where Schengel[36] found correlations between grades received in anatomy, physiology, and overall GPA with the score received on the national exam. Hoversten[37] tested four variables to predict success on

the CRNA exam. Only age predicted passing scores reliably, showing that the younger the student, the higher the score on the first attempt of the exam. Other variables that failed to predict success on the certification exam included the setting for prior work experience and the number years of experience working in critical care. According to Bruce,[38] variables that predicted success on the Certified Athletic Trainer exam included GPA, GRE performance, and completion of a calculus course. Other predictors studied by Bruce included the following: undergraduate GPA; percentile rank on GRE verbal, quantitative, and analytic writing scores; Biderman's formula; the Basic Carnegie Classification; undergraduate institutional type setting (private or public); the academic profile of undergraduate institutions; whether the student completed higher level science, math, and advanced athletic training coursework during undergraduate education; and the student residency class. One very strong predictor of success identified by Bruce[39] was Biderman's Formula Score, which incorporated the GPA and GRE scores. Individual predictors, including the GPA, GRE performance, and students taking an undergraduate calculus class, were positive indicators for successfully passing the certification exams. According to Krieger, Thomas, Banaszak, and Schlabach,[40] a student's cumulative athletic training program GPA and self-efficacy were strong positive predictors of success on the credentialing exam for athletic trainers. The cognitive development variable did not show correlation with passing the exam. The test anxiety variable showed an inverse relationship, making test anxiety important for further study. In a later study, Frashah and Blomquist[41] found self-efficacy as a strong predictor of success on project management certification exams. Registered Nursing certification exam and results from the American Board of Internal Medicine certification exam literature are described below.

Beeman and Waterhouse[42] successfully identified variables that predicted passing the National Certification Licensure Examination for Registered Nurses. Seven significant predictors were identified, including the number of grades of C+ or lower in nursing foundation, theory, and application courses. Atsawarungruangkit[43] studied pass rates for the American Board of Internal Medicine certification exam using 69 residency program factors. This exam is high stakes and is only offered once a year, so being prepared to take the exam is important. The characteristics of residency programs studied were specific to a residency program, and most do not merit inclusion specifically for comparison. The characteristics that may be beneficial to the present comparisons included program size and type, percentage of full time female faculty, faculty ratio to students, percentage of females, weekly number of hours worked, average hours per week of lectures, formal mentoring program availability, formal program in place to foster teamwork, continuous quality improvement training, additional training beyond the accreditation required length, student evaluation system, and having a process in place to assess graduation rates and performance scores. One region reported statistically significantly higher pass rates than the others. However, the program location variable was discarded because no data other than pass rates were reported.

Three additional significant predictors were the faculty-to-student ratio, availability of a mentoring program, and competitiveness among students. The significance of GPAs in the medical technologist exam and significant results in prosthetic certification exams are described next.

Predictors for passing the MT(ASCP) Board of Registry Examination and the CLS (NCA) examination for medical technologists were the final GPA and the program comprehensive exam score.[44] Miro sought to determine if relationships existed between the ABC prosthetics certification pass or fail rates and seven variables, including written multiple-choice exams, written simulation exams, clinical patient management exams, gender, Carnegie ranking of the educational institution, and use of an extending credential. Credential extension occurs if the certified orthotist credential was obtained and the prosthetist (CP) credential was added to the professional credentials.[45] Credential extension was the only variable in the study that was significantly associated with passing the ABC prosthetics certification. The nursing wound, ostomy, and continence certification exam variables of GPA, four course scores, three self-assessment scores, and a comprehensive exam score were studied by Beitz[46] and found to be consistent with other certification exams for which the entry-level GPA and grades in coursework is the highest predictor for successfully passing the certification exam. One successful method found in online environments for exam prep was having virtual, facilitated study groups.[47] Erickson[48] identified an important point: Students struggled to pass certification exams if there are changes in requirements and course material that fail to cover the content of the new requirements on a timely basis. With the importance of high-quality content comes the discussion on the importance of assessing the quality of program faculty.

The National Asthma Educator Certification Board Inc. (NAECB) evaluated the professional competence of asthma educators and may be a useful model to benchmark in the future when assessing improvement in pass rates in the HIM profession.[49] Shaw, Gordon, Howard, Maldonado-Daniels, McClain, and Pehrsson[50] evaluated differences between respiratory therapy education programs with the best and worst outcomes in order to identify factors to predict success on certification exams. Weak program outcomes were found to indicate a misalignment of curriculum requirements with exam content. Using the COI model, program requirements for curriculum content should be aligned with exam testing content, and faculty are competent to teach the required content. Theoretically speaking, the COI model requires that students be fully engaged in learning the content. The paramedic certification exam study and one additional study note the importance of optimal preparation of students for certification exams.

For the paramedic certification exam, Fernandez, Studnek, and Cone[51] found that programs at least 1.6 years long better prepared students to pass the certification exam. Jenkins, Greene, Moore, and Putnam[52] identified a correlation between student scores on the mock exam and national

certification exam at one university in the Southern United States. Because of a negative correlation of the time gap between taking the mock and certification exam, students were encouraged to attempt certification exams soon after completing coursework and the mock exams. All students may not have the opportunity to complete a mock exam prior to taking the certification exam.

This literature review provided valuable information about factors related to passing HIM and related health and education credentialing exams. GPA commonly predicted success on summative certification exams for several disciplines,[53-62] In addition, other important factors have been tested for related healthcare certifications. Review of HIM literature results were similar to other discipline credentialing exam success factors for the RHIA exam, but the list is much smaller and included the following student factors: cumulative GPA and HIM course grades. Education program factors for success were online course delivery and use of mock exams. Based on comparisons of healthcare factors for success and HIM factors that have been tested, several variables have not been tested for predicting success on the RHIA and CHDA credentialing exams being studied.

Methodology

A multi-step systematic review process was used to identify empirical and theoretical studies in peer-reviewed publications. Prior to searching the literature, a strategy and methods protocol for the review was created to increase the validity and merit of the research process, to reduce the risk of bias, to promote completion of a systematic process, and to improve the reliability and usefulness of the review by others.[63] The key objective was to conduct a comprehensive search of literature to identify sources that contained success factors for passing certification exams that might be generalized to HIM certification exam pass rates. Qualitative peer-reviewed literature that contained evidence-based education or health care certification exam success factors were included. The initial search of literature included key education and health/medicine databases: Education Research Complete, the Education Resources Information Center (ERIC), MAS Ultra School Edition, PsychINFO, SocINDEX, CINAHL Complete, Health Source, Medline, PubMed Central, and SAGE Journals. ProQuest theses or dissertations were also included, as well as hand-searched HIM peer-reviewed professional journals and internet publications. A meta-analysis quantitative approach was used. Quantitative research designs using logistic regression to identify factors that predict passing a certification exam were used in many of the studies referenced here. Results were synthesized in a detailed matrix that identified gaps in the literature.

Data Collection

A comprehensive search strategy was used. This systematic process searched key words including credential exam success factors within subject headings of education and health/medicine. Literature not related to health care or education disciplines, not available in English, published prior to 1990, or duplicates were excluded. Initially, the title for each item was screened for relevance, and non-relevant articles were excluded from further review. Next, the abstracts were briefly reviewed

to assess whether each study addressed the factors for success on a certification exam. Articles not meeting criteria were excluded from further review without being tracked further. A flowchart of the selection process was created utilizing the PRISMA flowchart method (**Figure 2**) to enable process replication.[64,65]

Abstracts that aligned with study intent were entered into a matrix[66] with a chronological number assigned to each item. The matrix contained the article number, citation, abstract, positive or negative factors identified, certification exam category, and ranking for each item. The ranking of 1 indicated the item aligns well with this review, while items with designations of 2 or 3 were not utilized here. Finally, the matrix was sorted using the ranking column. Items with a ranking of 1 were utilized to create a detailed matrix. Columns in the detailed matrix included the author-assigned article number, discipline or profession, positive variables, negative variables, certification exam, and categorization of entry-level or advanced practice exam type for data analysis.

Data Analysis

After separating the 42 articles included for review into categories by discipline, a listing was compiled of positive and negative statistically significant findings. Each variable was then further categorized into student or program level variables.

Results

The listing below contains student-level (**Table 3**) and program-level (**Table 4**) variables that have been found to predict passing credentialing exams in several other healthcare professions, related most commonly to clinician credentials. Student factors for passing certification exams included: admission GPA, cumulative GPA, overall GPA, course grades, completion of preparatory courses, age, grit, deliberately practicing, participating in a mentoring program, and GRE performance. The following education program factors have been recognized as strongly associated with certification success: online program delivery; periodic testing; mock or comprehensive exams; availability of preparatory courses; availability of formal student mentoring programs; and credential extension.

Many studies have been completed by healthcare and education disciplines to identify factors for improving pass rates on high-stakes certification exams. The studies focus primarily on students, faculty, or program variables that result in identification of an almost equal number of negative and positive factors for success. The HIM profession has few published studies found during the literature review to inform strategies for increasing pass rates. The HIM profession publishes practice briefs created from HIM professional consensus in addition to research articles. Advancement of the profession is dependent on developing a larger quantity of researchers contributing to growth of the HIM body of knowledge and development of professionals willing to undertake education to acquire new skill sets to meet evolving workforce needs. The timing for development of doctoral degrees in the HIM profession is both optimal and critical to success.

This systematic review provides other healthcare and education professional disciplines an opportunity to review results from several disciplines holistically. This study identifies factors for further study and suggestions for strategies for improving certification pass rates. This study is informed by several studies; few are systematic reviews.

The Health Information Management Education Conceptual Framework[67] was identified during the systematic review screening process. The framework describes four components for achieving success on the RHIA certification exam, including curriculum, students, faculty, and resources.

This study identifies several important factors for successfully passing certification exams that have not been studied in the HIM field. HIM professional study results indicate positive relationships between student cumulative GPA, overall GPA, online course delivery, and completion of a mock exam with passing the RHIA exam.[68, 69] The Prosthetic Association[70,71] and National Asthma Education[72] studies show positive results for having a prior credential. The RHIA study that follows will analyze whether having a prior credential in HIM is a positive factor for helping students to successfully pass the exam.

Future research should explore the gaps in the HIM literature that indicate potential for empirical investigation, including periodic testing; comprehensive exam scores; completion of prep courses; impact of failing one key major course; and student variables, including grit, age, credentialing extension, participation in formal mentoring programs, and the impact of test anxiety.

Research showing the number of academic programs utilizing a mock exam or prep course, supporting materials, and correlation with corresponding pass rates could inform strategies for all academic programs in HIM. Students in the academic setting are allowed to ask for American with Disabilities Act (ADA) accommodations for additional test-taking time, etc., to better support student needs. Students that need the additional time or breaks may not be asking for the needed accommodation when sitting for the credentialing exam, even though the testing organization does allow testing accommodations. A study evaluating the student awareness and use of ADA accommodations would better inform academic programs' need for better informing students of the availability of ADA accommodations during the exam.

The use of annual year-end exams could be utilized and studied to determine if student content retention increases and impacts passing HIM credentialing exams or levels of test anxiety. Another important student support mechanism in the academic setting is the advisor. The advisor is an influential formal mentor while the student is taking classes, but that level of one-on-one mentorship may decline after a student graduates. Assessing how and whether students remain in contact with the academic program after graduation may be vitally important in the student's decision about when and whether to take the certification exam.

Suggested future research opportunities include the following listing: student skills and comfort with

computers; financial impact of earning the credential versus not passing the exam; demographic and academic variables; comprehensive exams; effect of prior healthcare or related work experience; effect of having other certifications, such as the RHIT; time students wait to take the exam after graduation; longitudinal study to measure perceptions and validation of the profession; number of professional practice hours; perceived value of learning using asynchronous discussion posts; impact of working in HIM-related function while attending school; demands on full-time faculty other than teaching; pre-admission standards; analysis of performance on individual questions on the credentialing exam to assess alignment with workforce needs and curriculum requirements; comparison between RHIT and RHIA program resources, faculty, and curriculum; analysis of decline in RHIA first-attempt numbers; meaningful analysis and comparisons between more variables; motivation for testing (i.e., job requirement); exam preparation methods; overall high school GPA; student perception of competency; assessment instruments used by programs to measure student learning; and mobile applications for test preparation.

With the vast amount of knowledge gained from other healthcare and education studies, it would be timely to re-evaluate pass rates for students attending school part-time that extend program completion time to understand the time period pertinent content can reasonably be retained without sacrificing passing the exam. The combination of online delivery methodology and part-time student status should be studied to assess additional factors at play in passing certification exams (i.e., student engagement). Evaluating the types of professionals undertaking certification exams and the corresponding highest level of academic education, credentials held, years of experience in the field, and jobs they perform would provide insight into first-time test-takers. Thus, the present study can begin to fill gaps in literature related to successfully passing HIM, healthcare, and education certification exams.

Limitations

This study is limited to identifying success factors for passing certification exams in healthcare and education using peer-reviewed publications available through 87 education and health/medicine databases and 62 other articles and journals available through the University of South Dakota Libraries and published between 1990 and the present. There may be additional success factors that have been identified by other professions. Future strategies may include using a broader base of professions in the systematic review to identify additional success factors. Results of the systematic review can only be generalized to healthcare and education-related professions that utilize certification exams.

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EVALUATION OF A TELEHEALTH APPLICATION (SEHHA) USED DURING THE COVID-19 PANDEMIC IN SAUDI ARABIA: PROVIDER EXPERIENCE AND SATISFACTION

Posted on November 10, 2021 by Matthew

Category: Fall 2021

By Mohanad M. Alsaleh, MS; Valerie J.M. Watzlaf, PhD, MPH, RHIA, FAHIMA; Dilhari R. DeAlmeida, PhD, RHIA; and Andi Saptono, PhD

Abstract

Introduction

COVID-19 has drastically transformed healthcare delivery and forced many to utilize telehealth. This study aimed to comprehensively evaluate the telehealth service "Sehha" used during COVID-19 in Saudi Arabia and assess the provider experience and satisfaction with Sehha.

Methods:

A questionnaire was distributed by the Ministry of Health (MoH) to 362 physicians using Sehha. The questionnaire items were adapted from previous studies and then tested for content validity and reliability ($\alpha = 0.88$).

Results:

The findings showed that most of the physicians improved their experience in telehealth because of COVID-19. The majority of the physicians (67.6 percent) reported being satisfied with Sehha. However, the most commonly perceived challenge by the physicians was difficulty in providing accurate medical assessments.

Conclusion:

COVID-19 has remarkably uncovered numerous benefits of telehealth. Therefore, telehealth should remain a permanent model of healthcare delivery with consideration of further telehealth development initiatives.

Keywords: telehealth; mHealth; Sehha; provider; satisfaction; experience; COVID-19; Saudi Arabia; MoH

Introduction

The novel coronavirus disease (COVID-19) pandemic has dramatically altered the operation of many industries, including healthcare across the world. In the Kingdom of Saudi Arabia (KSA), the first case of COVID-19 was reported on March 2, 2020, which led to 362,549 confirmed cases of COVID-19, including 6,214 deaths as of December 31, 2020.[1] Consequently, the Saudi officials and highest authorities established strict regulations and movement restrictions across the country to stop the spread of the virus.[2] Thus, it has been found that many healthcare organizations have either adopted or activated a telehealth system to virtually provide healthcare services so that the virus can be contained and healthcare services continue to be provided.

Telehealth is defined as the use of electronic information and telecommunication technologies to

deliver and support health-related services remotely. Telehealth services can be provided in two forms: synchronous "real-time, interactive virtual visits" and asynchronous "store-and-forward."[3] Also, telehealth is one technology that has the potential to increase access to healthcare services, reduce healthcare costs, and sustain the continuity of care.[4]

During the COVID-19 pandemic, the Saudi Ministry of Health (MoH) progressively utilized digital health technologies such as telehealth to provide care virtually. One of the telehealth applications used in Saudi Arabia is called Sehha. The Sehha app, which translates to "Health," is a telehealth application primarily designed to provide telehealth services such as teleconsultation, e-prescription, and telediagnosis through the MoH's accredited doctors via chat, voice, or video calls.[5] This telehealth service is available to all Saudi citizens and non-Saudi citizens at no cost.

This particular app holds great promise for increasing healthcare access, cutting healthcare costs, and improving healthcare outcomes. Thus, evaluating the Sehha app and the provider experience and satisfaction with Sehha during such a global health crisis may create new telehealth initiatives and developments based on the user's experience and eventually facilitate the adoption of telehealth systems across the country.

Background

In the era of COVID-19, many countries worldwide have heavily relied on digital technologies, including telehealth services, to combat the spread of COVID-19, ensure the economy does not collapse, and continue offering education and health-related services for individuals. For example, China has enabled telehealth technologies and activated virtual care to be utilized by healthcare professionals to provide health services. The West China Hospital of Sichuan University, in collaboration with ZTE China, has been utilizing 5G technology to provide remote healthcare services and treatment.[6]

In the United States, the government has facilitated the use of telehealth, in which several policies were waived or reduced, such as HIPAA, so that healthcare organizations and patients could utilize virtual care instead of traditional (face-to-face) care. On March 17, 2020, the Centers for Medicare and Medicaid Services waived 1,135 requirements and policies to expand telehealth coverage for all Medicare patients during COVID-19.[7] Although privacy and security rules were relaxed, healthcare organizations were advised to implement and utilize a HIPAA-compliant platform to provide a secure connection between providers and patients, thus protecting patient data privacy.

Similarly, the Kingdom of Saudi Arabia (KSA) has been proactively developing e-health and telehealth applications to achieve its strategic objectives: increasing access to care, promoting public health, and improving health outcomes. However, the MoH has partnered with other governmental agencies such as the Saudi Authority for Data and Artificial Intelligence (SDAIA) and

developed multiple mobile apps and platforms aiming to attend to the needs of the public and mitigate the risk of COVID-19.[8] The most commonly utilized mobile applications and services during COVID-19 are Tabaud, Tawakkalna, Sehhaty, Call Service Center (937), and Sehha (see **Appendix 1** for a summary of apps used during COVID-19 in KSA).[9,10]

Although the Sehha app was developed early in 2018, no scientific studies assessing the provider experience and satisfaction with the Sehha app have been conducted according to the literature review. Also, the effectiveness, ease of use, usefulness, and challenges of the Sehha app from a provider's standpoint have not been examined since the pandemic hit KSA. Consequently, this study aimed to:

- Assess the provider experience and satisfaction with the Sehha app during COVID-19 in KSA.
- Examine the challenges faced by the provider using telehealth technologies such as Sehha.
- Identify areas requiring improvement in the Sehha app.

However, this study's findings may significantly contribute to the future developments of telehealth across KSA. Also, determining the impact of COVID-19 on the provider's perception and experience in telehealth would offer valuable insights to the government regarding the use of telehealth. Since telehealth is a promising model of healthcare delivery and a robust approach to increase access to care and cut healthcare costs, it is imperative to ensure telehealth stays effective and efficient post-COVID-19.[11-13]

Methods

A cross-sectional descriptive study was performed using an online questionnaire to evaluate the provider experience and satisfaction with the Sehha app during COVID-19 in KSA. To collect data, a 5-point Likert scale (where 5= strongly agree; 4= agree; 3= neutral; 2= disagree; 1= strongly disagree) was applied to all questionnaire items except for the following parts where multiple-choice items were formulated with a blank text box in case the participants wish to report anything other than the given choices:

- Participant Demographics and Characteristics
- Perceived Challenges and Concerns
- Areas of Improvement

Data Collection Instrument Development and Validity

The questionnaire items (25) were obtained from different sources and related studies focusing on the provider experience and satisfaction with telehealth.[14-18] In addition to that, questionnaire items developed by other researchers to assess the system usability and acceptance, satisfaction, and future use (e.g., Technology Acceptance Model (TAM), Telehealth Usability Questionnaire (TUQ), and

Telemedicine Satisfaction and Usefulness Questionnaire (TSUQ)) were adapted as well (see Appendix 2).[19-21] The questionnaire items were sectioned and coded as follows:

- Participant demographics and characteristics (6 questions)
- Perceived impact of COVID-19 on provider experience "PIC" (5 questions)
- Perceived usefulness "PU" (3 questions)
- Perceived ease of use "PEU" (3 questions)
- Perceived effectiveness "PE" (3 questions)
- Satisfaction and future use "SFU" (3 questions)
- Perceived challenges and concerns (1 question)
- Areas of improvement (1 question)

From December 2020 to January 2021, the MoH sent the questionnaire to a list of clinical staff containing 362 physicians known and identified to be utilizing the Sehha app. On December 3, 2020, a pilot study was conducted to measure the questionnaire's validity and reliability, wherein the questionnaire was sent out to five family physicians at the MoH who voluntarily agreed to participate in the pilot study. The pilot participants were asked if they understood the questions, wanted to include or exclude a question, and if they wanted to add other comments.

The returned feedback and notes from the pilot respondents were considerably obtained, and the questionnaire was amended accordingly. Based on the notes and responses, none of the pilot respondents suggested including and excluding any questions, and they found the questions understandable and feasible to the study's subject. The questionnaire was validated using face and content validity methods, and the reliability of the questionnaire was calculated using Cronbach's alpha coefficient ($\alpha = 0.88$).

Statistical Analysis

Non-parametric tests (e.g., Mann-Whitney, Kruskal-Wallis, and Spearman's correlation) were performed using the Statistical Package for Social Sciences software (SPSS v.27.0) to test the following null hypotheses at a statistical significance of $p \leq 0.05$:

- There are no significant differences in the participant demographics (e.g., age, gender, nationality, years of experience, medical specialty, and physician's rank/grade) in relation to satisfaction with Sehha and preference for telehealth visits over traditional visits during COVID-19.
- There is no impact of the variables (ease of use and usefulness) on provider satisfaction.
- There is no relationship between the level of satisfaction and preference for telehealth.

Ethical Considerations

This research study was approved by the Institutional Review Board at the University of Pittsburgh

(IRB: STUDY20100022) and by the Central Institutional Review Board at the MoH (IRB: 20 –17 8E). All participants were informed about the purpose of the study, and their consent for participation was taken. To ensure the confidentiality and privacy of the data, all questionnaires were recorded anonymously, and no personal nor identifiable data were collected.

Results

Among all received responses from the questionnaire (138), only 114 responses were considered complete and valid, while 24 returned questionnaires were excluded due to incompletion and invalidity. Since the questionnaire was distributed to 362 physicians and only 114 physicians completed the questionnaire, the response rate was 31 percent.

About half of the participants were men (56.1 percent), in the age group of 31-40 years (51.8 percent), and were of Saudi nationality (72.8 percent). Regarding the medical specialty, the majority of the respondents were family physicians representing 75.4 percent of the study sample. Regarding the physician's rank/grade, about 47.4 percent were consultants (see **Table 1** for the participants' characteristics).

However, the COVID-19 pandemic seemed to positively impact the physician's perception of and experience in telehealth. The majority of the physicians (84.3 percent) stated that their experience in telehealth has improved. About 80 percent of them reported an enhancement in their understanding of telehealth because of COVID-19. When it comes to preference, 43.8 percent of the respondents stated that they preferred telehealth visits over traditional visits, 35.1 percent of the respondents did not prefer telehealth over traditional care, while 21.1 percent of the respondents neither agreed nor disagreed "neutral" regarding the preference for telehealth. Most of the respondents (88.6 percent) strongly agreed or agreed that more telehealth services would be utilized in the future in KSA, as telehealth has proved its significance in providing care for patients living in remote, underserved, and restricted areas (see **Table 2**).

In this study, the perceived usefulness of the Sehha app was measured to identify whether or not the physician perceived it to be useful for providing telehealth services. Fifty-two percent of the respondents stated that Sehha helped them achieve their patients' needs more quickly compared to face-to-face visits. Also, the majority of the respondents (83.3 percent) strongly agreed or agreed that Sehha would increase access to care (see **Table 3**).

Regarding the ease of use, 82.4 percent of the physicians found Sehha easy to use, and more than half of the respondents (59.7 percent) felt comfortable interacting with their patients through Sehha. However, the majority of the respondents (75.4 percent) stated that they could not easily access their patients' medical records/electronic health records while using Sehha (see **Table 4**).

Moreover, this study's findings showed that about 58 percent of the physicians believed that the quality of care provided via Sehha was not as good as in-person care. Overall, 68.4 percent of the respondents believed that the Sehha app was acceptable for virtually providing healthcare services

(see **Table 5**).

One of this study's main objectives was to measure the physician's satisfaction with the Sehha app. The majority of the respondents (63.2 percent) would use telehealth technologies such as Sehha to deliver virtual care and telehealth services in the future. Overall, 67.6 percent of the respondents were satisfied with the work they have done through Sehha (see **Table 6**).

Regarding the challenges and concerns, about 74 percent of the physicians selected inaccurate medical assessments as their primary concern using the Sehha app. Also, about 71 percent of the physicians cited overlapping of medical consultations as a significant concern, in which past and current medical consultations would overlap and cause disruption in patient care. The physicians also reported other concerns (10 percent) such as increased workload, trust issues between the physician and the patient, and connection failure (see **Table 7**).

However, the findings showed that the Sehha app had multiple areas requiring improvement. According to the study's findings, 86.8 percent of the physicians indicated integrating the Sehha app with other electronic systems as the most significant area requiring improvement, followed by involving other medical specialists (81.6 percent), and then increasing access to patient data (78.1 percent) (see **Table 8**).

The Kruskal-Wallis test showed a statistically significant difference between the age groups and satisfaction with Sehha ($p= 0.005$), which means that the older the provider is, the less satisfied they are with Sehha. Also, the Kruskal-Wallis test showed a statistically significant difference between the medical specialty groups and preference for telehealth visits with a p-value of 0.011, which indicates that medical specialties could impact preference for telehealth visits over traditional visits. However, no other significant differences were found among the other groups concerning the preference for telehealth visits and satisfaction (see **Table 9**).

However, the impact of the two variables (usefulness and ease of use) on provider satisfaction was measured by conducting the Kruskal-Wallis test to identify any significant impacts. The Kruskal-Wallis test showed statistically significant results with a p-value of 0.001 for all items concerning the ease of use ($H= 52.204$, $H =17.810$, $H =38.341$) and usefulness of the Sehha app ($H= 60.019$, $H= 35.431$, $H= 49.313$) in relation to provider satisfaction (see **Table 10**). Also, the Spearman's correlation coefficient showed a strong positive correlation between preference for telehealth and provider satisfaction ($R= 0.709$) with a p-value of 0.001. This correlation signifies that the providers who prefer telehealth visits over face-to-face visits are also satisfied with the telehealth services they provide via Sehha.

Discussion

To the best of the authors' knowledge, no comprehensive scientific studies have covered the provider experience and satisfaction with the Sehha app pre- and during the COVID-19 pandemic. Moreover, the effectiveness, ease of use, usefulness, and challenges of the Sehha app have not been examined from a provider's perspective since the app was first introduced in 2018.

Also, the Sehha telehealth app is one of its kind that is governmentally supported, free of charge, available to everyone (citizens and non-citizens), and able to conduct audio-visual "virtual" visits. Therefore, it was vital to assess such an app to promote and improve telehealth in Saudi Arabia. Even though other mHealth apps developed by the MoH offer various healthcare services, Sehha is the only government-operated mHealth app primarily designed to provide telehealth visits for everyone.

Although COVID-19 has negatively altered our economy, society, and healthcare system, this study showed that COVID-19 positively impacted the provider's perception of and experience in telehealth and redefined the practice of telehealth and virtual care.[22] The findings showed that about 80 percent of the physicians improved their telehealth experience and understanding during COVID-19. More importantly, COVID-19 has revealed the precious core of telehealth and exposed numerous benefits of telehealth.

Regarding the quality of care, one study showed that 78.6 percent of the providers believed that the quality of care provided by telemedicine was excellent,[23] while this study showed that 57.9 percent of the Sehha users did not perceive the quality of care provided via Sehha as good as traditional care. Multiple factors might be the reasons behind the reported low quality of care, including inefficient workflows of conducting a telehealth visit and insufficient quality monitoring strategies. Also, since the physicians using the Sehha app stated that there was a lack of access to patient data at the point of care, inaccurate medical assessments and diagnoses could be made, leading to poor-quality healthcare services.

In terms of the provider satisfaction with telehealth, multiple studies reported acceptable to high levels of provider satisfaction with a telehealth system.[24-26] For example, a study conducted by Becevic et al. (2015) showed that 86 percent of providers were satisfied with the work done through telehealth.[27] Those previous studies endorse the findings of this study, in which the majority of the providers (67.6 percent) were satisfied with the Sehha app.

According to one study, an inaccurate and unreliable medical assessment is one of the major telehealth concerns faced by providers,[28] which aligns with the findings of this study, in which 73.7 percent of the physicians stated that they were mainly concerned about the accuracy of their medical assessments while using the Sehha app.

Another study conducted by Van Kuppenveld et al. (2020) stated that real-time access to patient data enables the physician to provide better medical assessments, thereby improving health outcomes.[29] However, the findings showed that 75.4 percent of the physicians were unable to access patients' medical records while providing care via Sehha; thus, the majority of the physicians (78.1 percent) emphasized the need for increased access to patient data. Inability to access the patient

data might be due to a lack of integration and interoperable infrastructures.

Limitations and Future Work

Even though the researchers strived to recruit as many as possible for the study, the response rate was low (31 percent). This might be due to multiple reasons such as ineffective distribution of the questionnaire, lack of interest in the research subject, and skipping the questionnaire due to time constraints. Since the MoH has multiple mHealth apps designed for specific purposes, it is vital to assess the Sehha app's feasibility of integrating with other systems so that a more centralized, comprehensive app is developed and can be used to offer more than just a telehealth service.

Conclusion and Recommendations

This study aimed to evaluate the aspects of the Sehha app, the provider experience and satisfaction with the Sehha app, and identify the challenges faced by the provider to pinpoint possible opportunities for the development of telehealth in KSA. The findings showed that about 80 percent of the physicians stated that their experience in telehealth has significantly improved because of COVID-19. The results showed that more than half of the physicians (67.6 percent) reported being satisfied with the Sehha app. The findings also revealed a strong positive correlation between preference for telehealth visits and provider satisfaction.

However, this study discovered that the Sehha app lacked integration with other electronic systems, had limited access to patients' medical records, and lacked diversity in medical specialties. The Sehha app comes with multiple challenges and concerns. The difficulty in providing accurate medical assessments was the most perceived challenge by the physicians. Last, COVID-19 has notably accelerated the adoption and use of telehealth and revealed numerous benefits that were not even realized before the pandemic. Thus, telehealth should remain sustained after the era of COVID-19, and healthcare leaders should reconsider the status of telehealth.

Based on the findings of the study and participants' responses, 13 key recommendations have been articulated for the current telehealth platform "Sehha" and any future telehealth systems that the MoH or other healthcare organizations intend to develop:

1. Integrate the Sehha telehealth platform with other electronic health systems such as electronic health records and mobile health apps available within the MoH for more effective communication, improved productivity, and increased interoperability.
2. Involve other medical specialists in the Sehha telehealth platform (e.g., dermatologists, dentists, psychiatrists) for better accuracy of medical assessments and quality of care.
3. Implement a user agreement policy as a standard requirement for all users (patients and providers), outlining the users' rights and responsibilities and defining the rules, terms, and conditions for using the platform.
4. Monitor and audit the visits and interactions conducted within the platform between patients

and providers for quality improvement purposes.
5. Enable accessibility to patient data and promote sharing of health information for improved continuity and coordination of care.
6. Balance the workload and number of consultation requests to avoid overlapping of consultations and disruption of patient care.
7. Boost awareness of the telehealth benefits and encourage people and providers to leverage this technology by advertising the uses and benefits of Sehha through social media platforms and mass media.
8. Ensure the providers' devices and networks are secure and safe to protect data privacy and confidentiality.
9. Establish security and privacy protocols that align with the national standards to support patient privacy, control the flow of patient data, delegate access to the data, and enable interoperability with other electronic systems
10. Provide a demonstration/tutorial video of how the app can be effectively optimized so both providers and patients can refer to it if needed.
11. Enable the platform to be downloaded and functional not only on smartphones but also on personal computers and laptops to increase its utilization and flexibility.
12. Ensure the Sehha telehealth platform is regularly maintained, updated, and sustained post-COVID-19.
13. Identify use cases to locate errors and gaps in the process and design for improving the efficiency and effectiveness of the Sehha telehealth platform.

Last, telehealth has the potential to solve the most pressing issues of healthcare, including access to care, quality of care, and cost. The COVID-19 pandemic has impacted various industries, specifically the healthcare industry, and revealed numerous benefits of telehealth that were not even realized before the pandemic. Telehealth can be the new norm of delivering healthcare services and a key enabler of digital transformation, wherein quality healthcare services will be available at a modest cost.

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DEFINING THE MEDICAL RECORD: RELATIONSHIPS OF THE LEGAL MEDICAL RECORD, THE

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Abstract

Not so long ago, defining the "medical record" was simple. It was the paper chart—volume upon volume that captured the serial, dutifully recorded events of a person's health care at a hospital or physician's office. Entries were typically handwritten, dated and timed, and signed in ink with title (i.e., authenticated). Errors were easily identified by an authenticated strike-through. Similarly, the paper chart was synonymous with the legal medical record (LMR). In other words, a patient's paper chart was that patient's LMR by definition, even if critical data was omitted or irrelevant data was included.

Fast-forward to 2021 and the use of technology for capturing the record of a patient's care. Technology has brought new challenges as well as successes. For example, pervasive and persistent mythologies include that 1) a patient's electronic health record (EHR) is the LMR, and 2) patient-specific EHR printouts to paper or disc—or displays on monitors—are necessarily equivalents to the paper chart of the 1980s. Neither are true. We now must define at the outset what is included in the LMR/designated record set to ensure the accuracy of what is retained and released.

Introduction

For leaders in health information management (HIM), the mission of protecting the integrity of the information within the medical record, as well as ensuring accessibility and availability, is frequently challenged by competing priorities. In fact, the electronic system technologies that are embraced to solve many of the historic HIM issues have other layers of complexity. These include 1) quality-of-care alerts and explanations; 2) layers of data and other information that are needed for regulatory or reimbursement purposes; and 3) information not specifically related to care, intrinsic to the technology itself, and records of system settings and changes. How can an organization address potentially competing priorities within a framework that accurately conveys the patient's story? How can an organization ensure that the preserved record of care meets current and future legal requirements? The 2011 AHIMA brief titled "Fundamentals of the Legal Health Record and Designated Records Set" has served as the guide for health information professionals as well as those in legal and compliance.[1] The current challenge is to continue to build on this framework to meet the ever-expanding complexities in HIM.

"To be or not to be" became the catchphrase at our academic medical center (AMC) when the journey to redefine the legal medical record (LMR) and designated record set (DRS) began. This phrase was used on an almost daily basis as part of the "deep dives" into the complexities of business relationships in healthcare and the subsequent accumulation of data in the Electronic

Patient DataStore (EPDS). According to the Health Insurance Portability and Accountability Act of 1996 (HIPAA),[2] personal health information must be secured to protect patient privacy while preserving the integrity of the information as a record of the patient's care. In South Carolina, state law does not provide definitive guidance, giving only a broad definition of the "medical record" or DRS in the context of preservation.[3] Is the goal to preserve for legal and compliance use? Or as a business record? Beyond the basic guidelines, the specifics of how each organization defines the components of the record is institutionally determined, reflecting critical details in institutional policy and procedures.

For many people, all information contained in the electronic health record (EHR) is synonymous with "medical record" or even "legal medical record." This is an erroneous concept in today's electronic world of bits and bytes. Rather, the EHR is a "datastore" for each patient—a set of patient-specific data elements. Most are collected through the course of care, but some are data from other organizations—only some of which is relevant to the patient's current care. Other elements are software system data, and while patient-specific, are utilized only to ensure proper system function. During the struggle at our AMC to more clearly understand the complexities of the EHR, the initial focus was to address what data "fit" the LMR and DRS definitions.

Given the complexities introduced by the competition between the free flow of information in an electronic record and the need to segregate certain elements of this record from the legal medical record, a stakeholder task force was created. This group consisted of representation from 1) health information services (medical records); 2) the information medical director group; 3) the chief medical information officer; 4) the chief research information officer; 5) the university, practice plan, and hospital compliance offices; 6) the office of general counsel; 7) the Institutional Review Board; 8) the clinical and translational research award regulatory knowledge and support core; 9) the provost's office; 10) radiology; and 11) pathology. Use cases were contributed by members based on actual cases encountered during the transition to an integrated electronic record or hypothetical cases. Each record type was designated to (a) records set(s) based on discussions and input from stakeholders. The task force made consensus recommendations, with final approval coming from the compliance offices and general counsel. Use cases were also presented at national health record and health informatics meetings to receive input from stakeholders at other institutions.

Types of Patient Information Within the Electronic Patient DataStore (EPDS)

The Designated Record Set and Legal Medical Record

The DRS is defined by HIPAA in 45 CFR 164.501[4] as "a group of records maintained by or for a covered entity …" The LMR is further described by AHIMA as "generated at or for a healthcare organization as its business record and is the record that would be released upon request … and is a subset of the entire patient database."[5] The state of South Carolina specifies the minimal elements to

be included in the DRS; these are listed in **Table 1**.[6]

Our AMC policy defines the LMR as the primary documentation of direct patient care provided by the organization in its own health care facilities. "Facilities" includes modalities such as telehealth and provider and patient web portals, as well data collected using mobile applications. Meanwhile, the DRS includes all elements of the LMR in addition to supporting documentation. For example, a patient's legal medical record may include the summary of findings from a recent endoscopy. The DRS may also include an expanded version of the documentation—the summary of findings and also images from the procedure. In this example, the endoscopy equipment is considered a "source system"; its PHI is secured and accessible as required by HIPAA and is maintained in alignment with the record retention policies of the organization.

The other major type of patient information contained within the EPDS is termed "Other Patient-Specific Information" (OPSI).

Other Patient Specific Information (OPSI)

OPSI is a large and diverse set of information found within the EHR that does not meet the definition of the LMR nor the DRS. We termed this OPSI, which is a subset of the EPDS and is defined as information potentially related to the patient's current health. Our AMC OPSI includes but is not limited to:

- Never finalized or temporary patient information (e.g., original/ unsigned transcription, pended orders, or notes never utilized for care)
- Best practice alerts for medication dosing and other guidelines or references stored within the electronic health system
- Aggregated patient information such as quality improvement and population management reports
- Nursing worklists and provider handoff communications (e.g., Kardex®, which is discarded after patient discharge)
- Psychotherapy notes, which, in accordance with HIPAA, are not a part of the LMR/DRS. While certainly OPSI, psychotherapy notes may be within the EPDS (or not) and have entirely separate security and access protocols.

As the complexities surrounding the EHR continued to evolve, our AMC developed a visual to aid in the understanding—a framework—which is shown in **Figure 1**. In the beginning, the framework portrayed a simple concept, the larger circle of the DRS with the smaller LMR circle contained within. This clarification of the relationship between the DRS and LMR and OPSI also informed HIM policy, especially about the release of information (ROI) and retention of PHI.

Results: Derivative Foundations for Institutional Policies and Procedures Using This Framework

1. All care provided directly to patients at the institution's care locations, including via electronic portal and remote devices, must be appropriately documented within specific time frames established in policy within the electronic health record, if available.
1. Every piece of patient data is classifiable as one of the patient data type (i.e., LMR (within the DRS), DRS or OPSI).
1. Our AMC recognizes that some elements of a patient's DRS (including LMR) might not originate within the AMC EPDS. Nevertheless, by policy, such information must be transferred to the EPDS as soon as practicable, so that the information is accessible to patients, providers, and other authorized persons. Meanwhile, there is no requirement that OPSI be included in the EPDS.
1. Patient healthcare data that is received from external, unaffiliated sources are automatically considered OPSI. This includes, for example, unsolicited patient data that may be available electronically via "interoperability" mechanisms. A member of the medical staff may designate any external data element for inclusion in the AMC DRS, as indirectly supportive of care.
1. Clinical research data that is or impacts current clinical care is a part of the LMR/DRS. The research principal investigator, with advice from clinical partners and with oversight from the Institutional Review Board (IRB), determines what research data within a given study meets this criterion. All clinical research data is governed by applicable federal and state law, including potential "certificates of confidentiality."
1. All patient data within the EPDS, in all classes, may be discoverable except: 1) LMR/DRS information protected by a clinical research certificate of confidentiality; and 2) any psychotherapy notes. Note, however, that law, regulation, and institutional policy allow data in specific classes of specific "age" to be removed from the EPDS.
1. All LMR/DRS data must be authenticated and maintained in congruence with applicable state and federal laws and organizational policies.
1. Documentation that is never finalized in the EHR, such as pended orders and notes, is OPSI. Organizational policy will dictate whether this is retained or expunged after the care encounter is closed.
1. Quality of care initiatives and reports is OPSI, are protected by law, in South Carolina. See S.C. Code Ann. 40-71-10-20 (the Peer Review Statues) and S.C. Code 44-7-392 (2012), the Patient Safety Quality and Improvement Act of 2005, 42 U.S.C. 299, and the Patient Safety and Quality Improvement Final Rule, 42 CFR Part 3.

Results: Use Cases for the EPDS Framework

The use cases below are identified in **Figure 2**.

Psychotherapy Notes

HIPAA makes clear that psychotherapy notes, defined as below, are not a part of the LMR or DRS.

Psychotherapy notes are defined as those notes recorded by a health care provider who is a mental

health professional documenting or analyzing the contents of conversation during a private counseling session or a group, joint, or family counseling session and that are separated from the rest of the individual's medical record. Psychotherapy notes excludes medication prescription and monitoring, counseling session start and stop times, the modalities and frequencies of treatment furnished, results of clinical tests, and any summary of the following items: diagnosis, functional status, the treatment plan, symptoms, prognosis, and progress to date.[7]

In our AMC model, psychotherapy notes are classified as other patient-specific information. These notes are almost always contained within the EPDS but managed with strict privacy and security controls in accordance with HIPAA and, by policy, are accessible only to the authoring therapist and to hospital counsel in emergencies unless there is specific patient consent.

External, "Unauthorized" Patient Information

Like most large academic medical centers, our AMC has struggled with the volume of outside patient information that comes into the organization, including that which appears "automatically" from unaffiliated organizations using EHRs. Some organizations readily accept these outside records as part of their organizational DRS. Our AMC regards this practice as dangerous because 1) the accuracy and relevance of the external information to our care is often questionable; 2) the external information may not be complete and up to date; 3) the time and effort required to review all information is often overwhelming; and 4) an automatic inclusion into our DRS could be viewed as an assumption of liability for all content.

Therefore, using our AMC model, this outside information falls into the OPSI category. The best example in this category is patient records that are unsolicited and come from an external source. Easily recognized as an example of OPSI are the large amounts of patient data that may include years of history, notes, and test results, most of which are not pertinent to the current care of the patient. Our AMC policy requires the receiving provider to "designate" which pieces of external documentation, if any, are to be included in the DRS, as supportive of the clinical care our AMC provides.

Student Documentation

Although CMS has no jurisdiction in defining the LMR/DRS, many AMCs have prohibited student documentation in the EHR due to complex CMS billing language and concerns regarding documentation in the record by non-licensed trainees. This negatively impacted student interaction with preceptors and was detrimental to student learning since students were not learning how to document care in the electronic health record.

In 2012, the Alliance for Clinical Education (ACE)[8] published a statement recommending that students have the opportunity to document in the EHR. AMCs took different approaches in addressing this

educational need. For example, some schools created a mirror version of the EHR for students to practice documentation and decision-making.

At our AMC, a multidisciplinary committee was convened in 2017 to discuss how to improve the student learning experience while maintaining quality of care. The key factors were the framework presented here, and the realization that the EHR is not equivalent to the LMR/DRS. A student note could, in fact, exist within the EHR but by definition not officially be part of the DRS/LMR. As a result, students gained full access to their patients' records, could pend orders for licensed provider review and approval, and create OPSI notes distinguished by an automatic header of "for training purposes only." Student notes were filed to a separate tab within the EHR.

In January of 2018, CMS amended its regulations,[9] which became effective March 2018 and allowed medical student documents as support for professional billing. The caveat is the presence of the resident or attending physician, with the latter personally performing key elements of the service. The final element is authentication of the student note by the resident or attending.

Subsequently, EHR functionality at our AMC was modified to allow the teaching physician to addend a student note. Again, congruent with our AMC's medical record framework, the original student note remains in the EPDS as OPSI, while the addended (potentially greatly edited) note authenticated by the attending physician is LMR. This change allowed medical students to take a more active role in the visit. Meanwhile, teaching physicians are focused on a review of the student documentation for training purposes and also can incorporate portions of the student note into their own notes. This improves student education, makes note authentication more timely and less burdensome, and reduces documentation time for the attending.[10]

Starting in 2019, CMS further loosened regulations in a continuing effort to reduce physician burnout. The new regulations allow the physician to use the notes of a nurse, resident, or medical student as long as the physician was present and observed the care or provided the care that is documented. In addition, if one of the care team attests to the teaching physician's presence, then the workflow required by the physician is simplified to require only a review and approval of the documentation noted by a signature. Starting in 2020, Medicare allowed billing physicians, advanced practice nurses (ARPNs), physician's assistants (PAs), and therapists to use the documentation of other physicians, APRNs, PAs, therapists, as well as nurses and students in medical, PA, or APRN programs. The billing clinicians must review and verify that the documentation is an accurate reflection of the service the billing clinician personally provided or observed.[11]

Clinical Research Data

Research is another domain of documentation that can potentially impact an organization's EHR. The important distinction defined by our institution is that research documentation becomes part of the

LMR if it is pertinent to clinical care. At a minimum, pertinent records include problems, medications, and allergies. Laboratory results obtained as part of clinical research but pertinent to medical care would be included in the LMR unless otherwise prohibited. Our AMC model for defining the medical record (**Figure 1**) illustrates the complexity of information in a research study. Some aspects of the documentation may be LMR, some DRS, and some OPSI, depending on the organizational policies. Conceptually, if the patient is part of a confidential study, the same patient could have two distinct MRNs, with the non-research medical record containing no link or identifying information related to the confidential study. If a certificate of confidentiality and an IRB-approved consent dictate that certain LMR information not be included in the medical record, then our AHC decided to document information pertinent to care with such an alias record. The confidential study LMR/DRS could have study-specific information such as medications or problems that are related to direct patient care but without identifiers. The patient alone has the option to reveal the alias from the de-identified record to care givers if they wish.

Occupational Health Records (OHR)

Healthcare organizations are often contracted to provide occupational health services to local employers. Such services may either by documented within an OHR that is owned by the employer or in the context of occupational health visits within the LMR of a contracting healthcare organization.[12] This distinction is critical. The latter follows usual direct patient care documentation and HIPAA regulations, with the twist that certain data elements are automatically available to the employer, who also pays for work-related care and health evaluations. However, an employer owned OHR is governed by OSHA; if this occupational data is maintained within the EPDS of a contracting health care entity such as OUR AMC, it must be kept separate from the same individual's LMR/DRS by that provider, with different rules for information access.[13]

Discussion

The use cases described in the results section illustrate the utility of the EPDS framework. Its utility is discussed below as legal/compliance guidance as well as clinical value.

The clinical goal of the EPDS framework is to underpin the accessibility of all care-relevant information to the care team (including the patient) as decisions are made about the patient's ongoing healthcare. The converse is also critical: to avoid "flooding" providers with patient data that is inaccurate and/or irrelevant to current care. That is the challenge of interoperability, whether for sharing data with our colleague down the hall about today's outpatient visit, or with an unaffiliated provider, distant in space and time.

However, today, interoperability of healthcare data is mandated by federal law (e.g., the 21st Century Cures Act), and both EHR vendors and healthcare organizations and providers are prohibited from interference. Interoperability means sharing patient data between data systems, often via a portal or

link. In more developed systems, external data may be viewable within the EHR of a partnering facility, ideally notated so that the originating facility and other metadata might be available. Sharing certain data types (e.g., problems, medications, allergies) is required and supported by the use of mandated vocabularies within EHRs, including SNOMED and RxNORM.

Conclusion

The vast and increasing amount of patient healthcare data in the electronic age has produced new questions about cost, meaningful access, long-term storage, and liability of patient information. Legal teams are struggling with the very real challenge of e-discovery. What PHI must be maintained for the purpose of patient care and legal requirements, and what data in the system is not needed? The challenge for each organization is to define clearly in policy and procedures the organizational goals regarding the maintenance, storage, and destruction of OPSI.

Defining the components of the legal medical record and the designated record set on an organizational level are clearly only the tip of the iceberg. Introduction of EHRs, thought to be the panacea for health information management, has brought additional layers of complexity. The introduction of electronic technology has allowed the capture of copious amounts of data for a patient's record, but what continues to be a challenge is the ability to segregate data elements based on policy definitions. As work progresses in the standardization of important policy, hopefully technology can prove once again to be critically adjunctive in this complex equation.

We suggest that our AMC framework presented here outlining the relationships between the LMR, DRS, and EHR can inform similar work in policy and operations by other organizations.

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CHDA CERTIFICATION EXAM SUCCESS FACTORS

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Abstract

This study explored possible success factors for passing the Certified Health Data Analyst Administration (CHDA) certification exam. According to the American Health Information Management Association (AHIMA), in 2019, only 10 percent of first-time test-takers passed the CHDA exam. Literature review offered insight into factors related to passing certification exams. Sources included existing, relevant peer-reviewed, and published literature since 1990 within 87 educational and health/medicine databases and 62 other articles and journal databases available at the University of South Dakota library. A correlational design was used in the study. Data was retrieved from AHIMA, cleaned, and data analysis was completed using binary logistic regression analysis. The CHDA study results indicate that candidates between ages 30 and 49 are less likely to pass the exam than those ages 50 and above, and those candidates with a master's degree are more likely to pass the exam than those with an associate or bachelor's degree. This new information will help improve the exam pass rates, provide a foundation for CHDA exam research, and add new knowledge in the HIM professional body of research.

Keywords

certification exam success factors, certified health data analyst, health information management

Introduction

The purpose of this study is to identify success factors for passing the Certified Health Data Analyst Administration (CHDA) exam. The CHDA credential has been available for 10 years and is intended to communicate the ability to effectively analyze healthcare data.[1] It was developed to respond to the workforce needs of healthcare providers following the implementation of electronic health records (EHRs). Healthcare providers need to use large volumes of EHR data to make better decisions[2,3] and are developing business intelligence departments to incorporate interactive dashboards and other data analytics reporting capabilities.[4-7]

Background

The healthcare data analyst role is pivotal in helping healthcare organizations use data in new ways (e.g., research).[8-10] The analyst commonly works with interdisciplinary teams to solve problems using health information management (HIM) skills and familiarity with healthcare datasets. According to Spears,[11] "the qualities of an excellent data analyst should include core competencies such as

understanding relational databases; having knowledge of structured query language (SQL) and basic statistics; being able to tell the story of data through visualization techniques; understanding project management principles; and competencies including soft skills, such as curiosity, analytical thinking, flexibility, principled, passionate, and able to communicate effectively" (p. 36).

Literature Review

Predictors for passing certification HIM credentialing exams included cumulative grade point average (GPA), overall GPA, and course grades; while other disciplines studied additional factors of success, including completion of preparatory courses; age; grit; deliberately practicing; participating in a mentoring program; and GRE performance.[12-23]

The conceptual theoretical model for this study reflected the four unique characteristics of the advanced practice certification exam test-taker (**Figure 1**): prior work experience, current work setting, prior credentials and prior learning.

The HIM advanced practice certification exam model framework depicts the primary success factors tested during the study to determine impact on passing the CHDA certification exam. With there being no prior studies on the CHDA exam, the research team thought best to start at the point of data collection, the application to sit for the exam, to create a foundation for future studies.

Methodology

The study design was quantitative with an ex post facto, correlational approach.[24] Data included 11 years of information that was collected from first-time test-takers on the American Health Information Management Association (AHIMA) CHDA certification exam from January 1, 2009, to December 31, 2019.

Data Collection

Upon approval by the University of South Dakota Institutional Review Board, the study began. Individual consent was not required for use of pre-existing, archival data. There were 1,032 first-time CHDA takers (January 1, 2009, through December 31, 2019) in the dataset. Cases with age 70 or greater were considered outliers by statistical and practical definition and were removed. Data from 214 cases were missing or unknown and were removed from the study during the data-cleaning process, with 818 cases used for data analysis.

Predictor variables included age, (current) highest education, prior credentials, (current) work setting, and (current) job category. The criterion variable was a dichotomous pass-or-fail result on the certification exam, which was also collected from AHIMA. Age was segmented into the following response categories: Less than 20; 20-29; 30-39; 40-49; and over 50.[25]

Data Analysis

Data analysis was carried out using the SPSS Grad Pack 26.0.[26-28] Categorical variables were automatically re-coded to allow comparisons across all variables in the study in one block. Pass rates for each year were validated by comparison of published AHIMA reports. Descriptive statistics were created for each variable to include percent, valid and cumulative percent of responses for all years of combined data after data was cleaned. Data analysis continued with binary logistic regression.[60,61] Regression coefficient estimates, model fit, confidence intervals, and odds ratios were calculated. The level of significance (α) for the study was set to 0.05; the power to detect an effect at 0.80, and a medium effect size of 0.5 was chosen prior to receipt of data. G*Power analysis showed that a sample of 721 students was required for the study to achieve the desired effect.[29,30]

Stepwise regression models were calculated to ensure the best fitting model was selected. The categorical study variables with multiple response levels were automatically recoded by SPSS26 to allow comparison across the study variables in one block. The Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test results were compared. Classification tables were reviewed for all three models. The standard model indicated the highest predicted percentage correct (60.4 percent) for passing the exam with an overall correct prediction rate of 63.7 percent. The Hosmer and Lemeshow Test values for the standard regression model showed a good model fit, $\chi 2(8, N = 818) = 4.369$, $p = .822$. The -2 Log likelihood (1020.471[a]), Cox & Snell R-Square (.125), and Nagelkerke R-Square (.167) results indicated consistency with the standard model selection. Hypothesis testing of individual predictors followed model selection.

Results

Recall that we posited a relationship between first-time test-taker age and passing the CHDA certification exam. Logistic regression results are depicted in **Table 1** and indicate that age category 30-39 results and age category 40-49 results were inversely significant. Individuals 30-49 years old were less likely to pass the exam compared with test-takers aged 50 and above.

Our second question considered the relationship between first-time test-taker highest educational degree and passing the CHDA certification exam. Results are shown in **Table 2** and indicated statistically significant inverse relationships for those who had a master's degree. Test-takers with a master's degree were more likely to pass the exam than those with an associate or baccalaureate degree.

The third question considered the relationship between first-time test-taker work setting and passing the CHDA certification exam. Analysis showed no relationship between passing the CHDA exam and the work setting of the test-takers compared to those who were unemployed (shown in **Table 3**). Those who were unemployed in the study were as likely to pass the exam as those working in any of the job settings evaluated.

The fourth question concerned the relationship between first-time test-taker additional credentials and passing the CHDA certification exam. The regression results for AHIMA credentials (CCA, CCS, CCS-P, CDIP, RHIT, CHPS, RHIA, CHTS-TS, CHTS-CP, CHTS-TR, CHTS-PW, CHTS-IM, CHTS-IS, and CPHI) as predictors of first-time success showed inversely significant results for participants who had the CCA credential. The results are shown in **Table 4**. Having an entry-level or advanced practice HIM credential did not increase the likelihood of passing the CHDA exam. Having the CCA credential decreased the likelihood of passing the exam.

Serendipitous Results

Job level category data was analyzed (see **Table 5**) to determine if there was a relationship between first-time test-taker current job level and passing the CHDA certification exam. Binary logistic regression showed no relationship to passing the CHDA exam. The job titles evaluated in the study, in comparison to those who were unemployed, showed that having a job in the HIM field did not increase the likelihood of passing the exam.

The probability of passing the CHDA exam was calculated based on the odds ratio and is shown in **Table 6** for comparison with actual results. Based on the model accuracy rate of 63.7 percent, the probability for passing the exam was higher than the test-takers actually experienced. The test-takers with a doctorate degree were expected to be more likely to pass the exam than those with a master's degree. Test-takers working in the HIM field were expected to be more likely to pass the exam than those who were unemployed. The test-takers with credentials including CCS, RHIA, CHTS-CP, CHTS-PW, CHTS-IS, and CPHI were expected to be more likely to pass the exam than the actual results experienced in the study.

Summary of Results

This study was conducted to identify success factors for passing the CHDA exam. In 2018, the pass rate for the CHDA certification exam was 26 percent. This study utilized a quantitative, ex post facto, correlational approach.[31] Data included 11 years of information collected from first-time test-takers on the AHIMA CHDA certification exam from January 1, 2009, to December 31, 2019. The data was analyzed to discern factors for success on the CHDA exam.

While the amount of research conducted on the topic in the HIM field is limited, many disciplines have completed studies identifying factors for success consistent with HIM studies, including cumulative GPA; overall GPA; course grades; and completion of preparatory courses and frequent testing.[32-34]

Binomial logistic regression was used to explore the relationship between first-time examinee age, (current) highest educational degree, (current) work setting, and having additional credentials with passing the CHDA certification exam. Eligibility for the exam was modified at least one time during the years studied, with the associate degree having been removed from eligibility criteria by the

Commission on Certification for Health Informatics and Information Management (CCHIIM). Current job category data was included in the data received from AHIMA and was included in data analysis, as well as several additional other HIM credentials for which exams have been discontinued. Highest educational degree, work setting, job category, and credentials variables included test-taker current information rather than information on date of the exam since the member database is always available for updates by members. The age variable was re-calculated by the research team to reflect the age at exam testing. The exam has been modified throughout the time frame of the data used for the study.

Results indicated that candidates between ages 30 and 49 were less likely to pass the exam compared to those age 50 and above. Those with the highest level of an associate or bachelors' degree were less likely to pass the CHDA exam compared with those who held a master's degree or above. Candidates that earned a CCA credential also had lower chances of passing the exam. Candidates current job level did not have a significant relationship with passing the exam compared with those who were unemployed.

Summary

Years of experience data for first-time test-takers was unavailable and may have revealed important information about the necessary amount and type of experience required to pass the exam. Having only an associate degree or bachelor's degree appears to decrease the odds of passing the exam, indicating more education is required. There is question about the alignment of learning resources available to test-takers to learn exam content at the depth required on the exam.

The historically low pass rates on the CHDA exam may have limited the identification of statistically significant factors for exam success in this study. Fifty-four percent of first-time test-takers failed the exam during the 11-year study time frame. Higher pass rates may show statistically significant findings within the variables studied. Thus, a replication study including data with higher pass rates (70 percent) on the exam, consistent with AHIMA exam pass rates, may reveal additional predictors.

There is no prior research published on the CHDA exam, and a limited amount of research on HIM factors for success on credentialing exams that apply to an advance practice credentialing exam. Identified success factors important in passing exams for multiple disciplines included GPA, overall GPA, and having the experience of passing a critical exam prior to taking a certification exam. The CHDA exam is not directly associated with a specific educational degree or certificate program offered by universities, making the GPA and overall GPA variables irrelevant for this advanced practice credentialing exam.

As the pass rate on the exam increases, all aspects of the proposed conceptual framework model should be studied further for confirmation or modification and potential addition of other important factors. The study results confirmed that the exam is an advanced practice exam that requires a master's degree or above education level, confirming the prior learning component of the proposed

HIM advanced practice model is a significant indicator for passing the exam. The probability calculations for passing the exam indicate the advance practice model is accurate in identifying key factors for passing the CHDA exam even though test-taker results were different in this study.

With the low pass rates, the eligibility criteria for the CHDA exam should be re-evaluated to assure alignment with the workplace skill needs. Realignment may include restricting the exam to those candidates who have a master's level education and above. An alternative strategy may be adjusting the exam questions and the psychometrics to provide those who meet current eligibility criteria with a higher likelihood of passing the exam. There is a need for additional support mechanisms by potential test-takers who are less than 50 years old or who have less education than a master's degree. Internship opportunities, mentoring by those performing the job duties of a healthcare data analyst, and additional or adjusted exam preparation materials may need to be incorporated to support the growth of the health data analyst skill set needed by the workplace.

Future research should include a study of the amount and type of work experience needed for the health data analyst role including a better understanding of the variety of work settings hiring these professionals. With the changing healthcare environment, it is likely that the skills of a healthcare data analyst have changed drastically since implementation of EHRs. The content outline and support materials need to be analyzed to determine alignment with the CHDA exam and workforce needs. Additional topics may include the following list:

1. Understanding the training tools and testing strategies utilized to successfully pass the exam.
2. Understanding whether internships or on-the-job training have an impact on passing an advanced practice exam.
3. Understanding the role, utilization, and impact of mentors.
4. Determining whether having non-AHIMA credentials can increase the likelihood of passing the exam.
5. Comparing jobs requiring the RHIA credential and health data analyst jobs to evaluate potential critical gaps in data analysis skills on the RHIA credentialing exam.
6. Studying other variables to assess and modify the advanced practice framework model.
7. Repeat the CHDA study in the future using data after 2019 to re-assess the exam pass rate predictions after adjustments to the exam and the psychometrics have been completed.

There appears to be a significant psychometric, cut score, or other issue evidenced by the extremely low pass rates on the CHDA exam that needs to be investigated further. The workforce is hiring health data analysts, so identifying the issue is critical to further the development of this credential. Ensuring alignment with the Registered Health Information Administrator (RHIA) exam data analytics content should ensure a foundation for skills development for passing the CHDA exam. The high probability that those individuals with the CCS credential and experience can pass the exam causes concern that the exam contains (or at one time contained) too much content focused on diagnosis coding and claims related data analysis questions rather than covering

analysis of the entire healthcare record dataset. There is a very small percentage of AHIMA members with an HI/HIM master's degree or a doctorate degree eligible for this exam. There is a gap between the exam eligibility criteria and the types of individuals that are able to pass the exam. It is important to expand the number of first-time test-takers to ensure it remains financially viable. While it is evident that experience is a requirement to pass the current exam, exactly how much remains unknown. A large portion of first-time test-takers included certified coders, Registered Health Information Technician (RHIT), and RHIA professionals, without success. Perhaps the content within those certification exams needs better alignment with the CHDA exam in order to prepare the foundation for advancement. Probability calculations show those with 50 percent or better probability for passing the exam have at least one of the following characteristics: experience in the HIM field; master's degree; doctorate degree; CCS credential; or an RHIA credential. Eligibility criteria should be modified to better align with candidates that have a predicted probability of 50 percent or better for passing the exam. The eligibility criteria recommended to be removed until the exam has been revised includes the following: RHIT with three years of healthcare data experience.

Limitations

A limitation of the study may be unknown confounds. A future approach may include a qualitative component to identify these confounds. A second limitation may be the amount of time a test-taker has worked in a specific type of current work setting prior to the exam. A third limitation is the use of an ex post facto, correlational design through which causal relationships cannot be firmly asserted.[35-38] A strategy for future study may be to utilize an experimental or mixed-methods design. However, ethical considerations may make this difficult, if not impossible. Researcher bias may impact the study by selecting six ex post facto variables from the first-time CHDA application without incorporating a qualitative component to the study to identify additional confounding success factors. An additional limitation in the study is receiving test-taker data updated by AHIMA members rather than data collected at the time of the first attempt from the test-taker. The sample size is not a limitation of the study. The sample includes data collected over an 11-year period to attain adequate study power.

The information gained in the research process is applicable only to the AHIMA CHDA certification exam and cannot be directly generalized to other HIM, healthcare, or education professional certification exams.

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