

Readability and Suitability of Information Presented on a University Health Center Website

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Abstract

This study evaluated the readability and suitability of a university health center public website. Readability formulas estimated the reading grade and age required for comprehension of health information. The Suitability Assessment of Materials (SAM) instrument determined adequacy of the webpages for the intended audience. Readability showed the reading grade level, representing the youngest reader able to process the material, ranged from 10.1 to 14.6, averaging 12.5 (midway through 12th grade in the US educational system). Full comprehension required higher education levels, up to postgraduate. Suitability scores for some webpages indicated deficiencies in readability, motivation to learn, and instructions for healthy behavior changes. Content on the website may be difficult for some students to comprehend based on the reading grade level, but overall suitability results are satisfactory. All webpage updates should bear these parameters in mind to ensure content is fully accessible to college students, faculty, and staff.

Keywords: readability, suitability, health literacy, college students, health center, college website

Introduction

Health literacy requires the ability to find, understand, and use information to manage health and health-related decisions about oneself and others.¹ Several groups are generally considered to be at high risk for low health literacy, including immigrants, the elderly, certain ethnic groups, and people with lower education levels.² In the US, 21 percent of English-speaking adults aged 16 to 65 have low literacy skills and are challenged by tasks such as comparing and contrasting information and paraphrasing.³ People with low health literacy are limited in their ability to access and understand health information and are at higher risk of having poor health and poorer health outcomes than those with higher health literacy.⁴⁻⁶

College students would not typically be considered a group at risk for low literacy. However, college students are unique in that although they have high educational achievement, they may lack experience navigating the healthcare system on their own. Newly responsible for meeting their own healthcare needs, college students are especially inclined to look to the internet for answers to health concerns. Research indicates, however, that they struggle with understanding health information and recognizing credible online sources.^{7,8} As they progress in college from freshman to senior, students' health literacy improves.⁹ This may be due to better critical-thinking skills that enable students to find, understand, and use information to manage health.¹⁰ Nevertheless, the National Assessment of Adult Literacy (2005) indicates that 3 percent of people with a college degree have below basic health literacy skills.¹¹

Serving adults with literacy challenges includes ensuring that health information is understandable, that is, it places a low health literacy demand on the readers.¹² This

responsibility on the part of health-related organizations to provide easy access to comprehensible healthcare resources patients can use to manage their health is termed “organizational health literacy” (OHL).¹³ Sectors included in the efforts to improve OHL include not only public health and healthcare, but also education.¹⁴ Organizational health literacy includes writing health information at a level that patients low in health literacy can understand; making the purpose of materials clear and actionable; effectively employing font, color, white space, and graphics; and creating accessible and navigable patient portals and websites.¹⁵ In general, these issues can be divided into two concerns: readability and suitability.

Background

A reasonable goal for most health care instructions is a sixth-grade reading level.¹⁶ Federal plain language guidelines,¹⁷ however, clarify that this depends on the audience and the type of information. In health information, medical terms can be confusing to patients and can skew readability scores to a higher level.¹⁸ The Joint Commission (2010) recommends that health-related materials be written in a manner equivalent to a fifth-grade education level.¹⁹

Readability is the ability to read easily and is typically measured by the number of syllables, words, and sentences within the text to obtain a US school grade reading level as a reference.²⁰ To improve readability, medical terms may need to be eliminated and replaced with less precise terms. If larger words cannot be replaced with a simpler term, a definition should be provided, or links provided to definitions housed elsewhere.²¹ Simple sentences should be used, and complex information avoided.^{22,23}

Suitability is the appropriateness of material for a given audience and looks at several variables to determine how well information can be read and understood, such as clarity of purpose, layout, and use of visuals.²⁴ Users pay more attention to nicely displayed information they can find easily, and graphics are an important tool for helping readers interpret health information.^{25,26} Inconsistent text readability levels as well as variability of content quality of the websites promotes difficulty in navigating already confusing information.²⁷

Although little is known about the readability of university student health center websites specifically, reviews of websites for lung cancer, breast cancer, heart attack, and stroke have been found to have significantly high reading levels (“fairly difficult”), which are considered inaccessible to people with low literacy.²⁸ Even higher, “difficult,” reading levels have been noted on websites targeting younger adults, such as those containing information about anorexia nervosa.²⁹ Given the complex interaction of college students’ high educational attainment but low experience navigating the healthcare system, readability scores based on grades beyond high school may not accurately reflect the ability of college age students to access and use health information. Campus resources, such as student health centers, should be geared to college students in their early academic years to ensure understanding is achieved.³⁰ This is a relevant concern for campus student health centers, which typically provide online materials through their websites to assist students with a variety of health issues. These websites may be one of the first places students look for health information, especially for treatment and provider options.³¹ Understanding the college student audiences, including those with possible literacy challenges, is one way to improve understanding of a website’s content.

The purpose of this research is to provide information about readability and suitability of existing health information on one university website for student health services. We posed the following questions: 1) Are the university student health center webpages presented at appropriate readability levels for college student understanding? 2) Are the university student health center webpages suitable for college students?

Methods

Readability Assessment

Four clinical webpages located under the “Services” tab from a university student health center were analyzed at the request of student health center administrators. The request was part of an ongoing quality improvement program to ensure webpage information, particularly clinical information, is useful and understandable by the university students. The review looked at four webpages focused on clinical services: Primary Care, Pharmacy, Dental Center, and Specialty Care.

The Primary Care webpage includes topics such as general health care, gynecological care, stress management, immunizations, and victim services. In addition to prescription medications and over-the-counter drugs, the Pharmacy webpage includes information on asthma education. The Dental Center webpage includes information on exams, cleaning, fillings, bridges, and crowns. The Specialty Care webpage includes topics such as international health and travel clinic, sports medicine, dietitian, psychiatry, physical therapy, and referral services. Each webpage was loaded into Readability Studio software version 2019.3 for Windows³² for readability score output. Analysis of the readability output was conducted by three researchers using the results of three measures, as described below.

Readability was measured with three formulae: Flesch-Kincaid Grade Level (F-KGL), Flesch Reading Ease (FRE), and Simple Measure of Gobbledygook (SMOG). Flesch-Kincaid Grade Level uses the number of words, sentences, and syllables within the text to derive a reading grade level based upon US school grade as a reference. The mathematical “yardstick” created by Flesch (1946) is a valuable tool for evaluating resources in a variety of media.³³ The Flesch Reading Ease uses the average words per sentence and the average syllables per word to determine a readability score.³⁴ The range is 0 (very difficult to read) to 100 (very easy to read). Average documents should be within the 60-70 range, as this would indicate that eighth and ninth graders can easily understand the contents.³⁵ A readability formula developed by McLaughlin (1969), the Simple Measure of Gobbledygook (SMOG), estimates the years of education a person needs to fully understand a piece of writing.³⁶ It is based on the number of syllables in a group of sentences. Higher numbers of polysyllabic words in a passage converts to a higher grade level. For this analysis, incomplete threshold was set at eight words as the minimum length allowed for an incomplete sentence to be considered valid. This ensures inclusion of bulleted points, which lack punctuation, found on some of the webpages.

Suitability Assessment

Suitability was evaluated using the Suitability Assessment of Materials (SAM) instrument.³⁷ This evaluation pinpoints areas that may need further clarification or instruction. The SAM evaluates materials with scores of 0 (not suitable), 1 (adequate), or 2 (superior) for each of 22 subcategories. A total (adding all points) is then calculated to determine suitability, with a score determined after dividing by the maximum points of 44. A total score of 70 percent or above is considered superior, 40-69 percent is adequate, and 39 percent and below is not suitable.³⁸ Unsuitable ratings would then be the focus for specific revisions of the materials. Six areas are assessed:

1. Content: Readers should understand the purpose of the materials.
2. Literacy demand: Includes readability, writing style, sentence construction, vocabulary, and topic captions.
3. Graphic illustrations, lists, tables, and charts. Includes type of illustrations, relevance, and captions.
4. Layout and typography: Fonts, layout, and subheadings are included.
5. Learning stimulation and motivation: Includes interaction, desired behavior patterns, and motivation to learn.
6. Cultural appropriateness: Includes logic, language and experience, cultural image and examples, and suitability for the population.

Two student reviewers (authors KT and RP) who were interested in health literacy research volunteered to participate in the reviews, which were done in February and March 2021. The students were sophomores majoring in biomedical sciences, one female and one male. The students conducted independent reviews of the webpages within the Services Tab using the SAM criteria after they were trained on usage of the instrument. Thus, coders were of similar characteristics as the target audience, as recommended by Manganello and colleagues.³⁹ Disagreements were resolved through discussion and consensus agreement.

Results

Readability

Based on the results in **Table 1**, the Specialty Services webpage shows the highest grade level requirement for both the Flesch-Kincaid and SMOG, as well as the most difficult reading content on the Flesch Reading Ease. The Flesch-Kincaid indicates the Specialty Services webpage content is suitable for a college sophomore with the sixth month of class completed. The Flesch Reading Ease score of 26 indicates the text is difficult to read. This is below the standard recommended range of 60-70.⁴⁰ The SMOG, which tests for 100 percent comprehension, indicates that the Specialty Services webpage is suitable for a college senior with the second month of class completed. (It should be noted, however, that the Specialty Services webpage included information about a wide range of specializations, making it difficult for content creators to avoid introducing new medical terms into each section, which inevitably raised readability scores.)

As a comparison, the Pharmacy webpage is suitable for a high school sophomore with the first month of classes completed according to the Flesch-Kincaid. The Flesch Reading Ease score is

higher than the Specialty Services webpage but did not attain the recommended range of 60-70. The SMOG indicates the reading comprehension to be at a college freshman level. Dental and Primary Care webpages readability scores fell between these two extremes.

Suitability

See **Table 2**.

The reviewers felt the Dental Services webpage was adequate or better with the exception of “desired behavior patterns,” which may be too general (scored 0, not suitable). Total SAM score for the Dental webpage was 62.5 percent (adequate). The Pharmacy webpage was considered superior in most of the subcategories, with an overall SAM score of 80 percent (superior). The Primary Care webpage also received several superior scores but scored as not suitable for “motivation” where students may not feel confident that the tasks are doable (scored 0). The overall SAM score is 75 percent (superior). Specialty Services was considered adequate in most of the subcategories with two inadequate for “reading grade level” and “motivation” (scored 0) and an overall SAM score of 65 percent (adequate). As noted, the Specialty Services webpage shows the highest grade level requirement for readability due to the wide range of specializations and medical terms used.

Cultural appropriateness was scored N/A on all of the webpages in the Services tab. The student reviewers found the SAM instrument difficult for rating cultural appropriateness of a website designed for a highly diverse and large student body. The need to interpret cultural variations in analysis of the webpages, including logic and experiences from the student body viewpoint, added to the student reviewers’ hesitancy, and they did not feel they had adequate understanding to provide an accurate rating. However, neither of the reviewers felt this detracted from the suitability of the health-related information in this tab. In other words, generally they found the content to be culturally appropriate for a university student audience. The SAM creators do allow for the ability to use N/A for a category if it is not applicable to the material, and those points are subtracted from the total points to result in 40 possible points (rather than 44 points).⁴¹

Research Questions

Are the university student health center webpages presented at appropriate readability levels for college student understanding? There are mixed results, with the reading levels ranging from 10.1 to 14.6 reading grade level requirements. The SMOG tested for understandability, with results showing a range from 13 to 16.2 grade level requirements for full comprehension of the material. This could mean freshmen and sophomore students will struggle with the content.

Are the university student health center webpages suitable for college students? The SAM results are overall adequate, with a few subcategories scoring at not suitable. In addition to readability improvements as noted above, the category of learning stimulation and motivation with specific behavior and skills that students believe they can achieve should be considered to improve suitability.

Discussion

College students, overall, are not in a high-risk literacy category due to their academic attainment. Most have adequate health literacy.^{42,43} However, this literacy may not extend to ability to find and use health information from the internet, including from health services websites.⁴⁴ Therefore, even health literature aimed at college students should be comprehensible at lower levels than is indicated by reading grade level scores. Although the authors are not aware of specific guidance for this audience, it is reasonable to assume that health information should be geared at least two grade levels lower than other information, in line with Joint Commission (2010) recommendations for general audiences.⁴⁵ One of the university health center webpages we analyzed was written at the 10th grade level, but others were higher, suggesting that information may be difficult for a minority of students to fully comprehend. This is not unusual, as McInnes and Haglund (2011) conducted research looking at websites of numerous health conditions and found those ending in the URL extension “.edu” were the most difficult to read and required more than a 12th grade education.⁴⁶

The two student reviewers who provided input for this research anecdotally noted a preference for pictures and other visual tools to make finding and comprehending material faster. As evaluated by these members of the target audience, layout, although adequate, was a low scoring element across all four webpages. This is at least partially due to the graphics and design constraints placed on the Student Health Center webmaster due to university-wide website guidelines. The same situation is likely to pertain at other institutions. Nevertheless, our findings suggest that as university health center resources are updated or added, assessing web-based resources for readability and suitability is a worthwhile endeavor. Many readability tools are readily available in common word processing software or free web-based calculators.

Limitations

The use of two reviewers for suitability scoring, although common practice in such studies,^{47,48} is a limitation. A larger, more formal focus group of freshmen level students could have provided more in-depth suitability information. Additionally, reviewers found the cultural appropriateness category difficult to apply to a university website intended for a broad audience as opposed to a specific ethnic group, so information about that aspect is limited. This issue can be addressed more in depth in a focus group format as well.

Finally, this study investigated four key webpages of a single university health center website. Generally, all other university health center webpages visited by the researchers varied greatly in the content organization, with no consistent layout or categorization of topics. This makes direct comparisons difficult; therefore, we provide information about one school’s webpages as a basis for readability assessments by other academic institutions. Thus, findings cannot be generalized to health information on websites at other universities.

Conclusion

People with low health literacy are limited in their ability to access and understand health information and are at higher risk of having poor health than those with higher literacy. Although college students are not at high risk for low literacy, they may struggle with health websites that require a high reading level for comprehension. Reviewing student health websites

for readability and suitability gives a focus and baseline for improvements in understandability of content.

University health center websites have the opportunity to provide prefiltered peer reviewed information relevant to the student body.⁴⁹ High quality health information is important for college students who rely on these websites for reliable guidance for health concerns. As expectations have risen in the Healthy People 2030 report to include organizational health literacy, academic health centers are obligated to carefully review their websites and other resources to meet the needs of the students they serve.⁵⁰

Notes

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Supporting HIM Professional Practice Experience Through Interprofessional Collaboration on Preceptor Orientation and Training

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Introduction

The health information technology program at Southern New Hampshire University prepares students at the baccalaureate level for a career in health information management (HIM). The program is accredited by the Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM). To meet CAHIIM's curricular standards, students must complete an externally supervised professional practice experience (PPE).¹ Part of the challenge is placing students with preceptors prepared to serve in this role. Even though preceptors have the content expertise to train students, they may not be comfortable with the teaching aspects of precepting.² The HIM program decided to address these concerns by developing an orientation and training program for the preceptors. The program was developed through a collaborative effort among faculty, the career services internship team, and the nursing professional development team.

Southern New Hampshire University (SNHU) Nursing is accredited as a provider of nursing continuing professional development by the American Nurses Credentialing Center's Commission (ANCC) on Accreditation.³ The Nursing Continuing Professional Development (NCPD) team at SNHU was developed to provide relevant professional development activities to the university faculty and those in healthcare in the SNHU community of stakeholders and student preceptors who are considered integral members. Before the HIM Preceptor Orientation and Training proposal, an asynchronous activity was created and published by the NCPD team to orient the preceptors of nursing students in the Master of Science in Nursing (MSN) Clinical Nurse Leader or Nurse Educator tracks. The content, format, and evaluation process for this activity was shared with the HIM team. This provided a shared understanding of the functionality of the activity and the type of content presented in a related activity.

This shared understanding motivated the unique interdisciplinary collaboration that generated, presented, and continues to maintain the HIM preceptor orientation and training program. The disciplines involved in collaboration included nursing, counseling, and health professions faculty and various administrative associates from the clinical experiences team and the career services internship team within the university. This interdisciplinary collaboration is part of the NCPD team's commitment to the presentation of "high-quality virtual synchronous and asynchronous, interdisciplinary educational activities to a diverse audience of learners in healthcare and education."⁴

Since the HIM program at SNHU includes students across the country and is delivered entirely online, the PPE must be managed differently than traditional programs. For these reasons, the university's career services internship team works closely with students responsible for finding their PPE site. The internship approval process begins once the student secures a PPE site, as shown in **Figure 1**. At that point, the career services internship administrator guides the student

through an approval process. Students begin by creating three learning objectives to be accomplished during the PPE. They also identify the activities they will complete to meet the learning objectives and determine how they will measure their success. The preceptor, career services internship administrator, and HIM program director must approve these learning objectives. The career services internship administrator, student, and preceptor must also sign an internship agreement outlining everyone's responsibilities during the experience. Some sites may require an affiliation agreement with the university. The career services internship administrator works closely with students to meet the affiliation agreement requirements.

In light of the desired student outcomes and to ensure preceptors have a positive experience, a preceptor orientation and training program was developed with input from key university stakeholders. As a result, preceptors are prepared for their preceptor role and will ensure students meet their pre-established learning objectives and goals. Once the approval process has been completed, the career services internship administrator sends the preceptor instructions to complete the orientation and training program.

Design and Development

The orientation and training program was designed using a narrated PowerPoint presentation that includes a downloadable PPE guidebook for preceptors to keep once the training is complete. The content consists of information about precepting, the theory behind experiential learning, and the purpose for completing a supervised PPE in HIM. To emphasize the importance of the preceptor role, the benefits of precepting are covered at the beginning of the training. The benefits explored within the training center on the preceptor's ability to develop their leadership skills and contribute to the profession, participate in reciprocal learning, and earn continuing education units.⁵⁻⁸ For example, AHIMA awards HIM preceptors up to five continuing education units (CEUs) per year for serving in this role.⁹ The purpose of the PPE is explained so that preceptors understand the importance of students completing this requirement and the value they are serving in the preceptor role. A program overview is included in the orientation and training so that preceptors understand the student's knowledge base. The PPE structure is described, which consists of a course and an on-site component. Students glean hands-on practice in a simulated electronic health record (EHR) and submit a final project in the course component. Tips for best practices for preceptors to consider for offering virtual experiences are included, as well.

Next, the importance of early and frequent communication between the preceptor, career services internship team, instructor, student, and pertinent staff is covered. Also, an overview of expectations for preceptors and students and how vital the preceptor's role is in modeling professional behaviors is addressed. To ensure student success, tips are shared on preparing for the student's first day, such as meeting and greeting the staff to help them feel welcome. Moreover, preceptors are encouraged to allow students to shadow them at meetings to glean a glimpse of a typical workday. The training includes examples of engaging students by including hands-on activities such as coding a chart or collecting data for a report. Lastly, techniques for giving constructive feedback to strengthen the student's growth potential are provided.

Ensuring preceptors are prepared for potential student conduct issues is vital. Expectations and conduct of students are addressed, including how to address any problems. Using this proactive approach may mitigate potential issues. Equally important, the expectations for preceptors are covered, including any deliverables, such as the completed timesheet and student evaluation. The orientation and training conclude with a resource page containing contact information and a downloadable resource manual.

Implementation

In anticipation of approval of the activity for one contact hour of credit, the NCPD team assigned a nurse planner to guide the process of proposal, approval, and development of the content and format. The determination was quickly made that an asynchronous activity that was presented with similar functionality and evaluation strategy to the MSN Nursing Preceptor Activity would be valuable. Objectives were outlined for the activity, and the nurse planner assisted in periodic review of the content as it was developed to maintain objectivity. This format included using a narrated PowerPoint presentation that was reformatted to MP4 (video) with closed captioning manually provided by the nurse planner upon final review. This format was replicated in the HIM activity. A knowledge check was utilized with three questions with unlimited attempts to reinforce the activity's objectives. The NCPD evaluation tool captured feedback about the audience's characteristics, response to the activity, and reported intent to change practice among participants.

The HIM preceptor content was built and housed within a continuing education platform utilized by the NCPD Team. This platform provides a place to host videos and complete the required knowledge check and evaluation. Using this platform, preceptors can seamlessly self-enroll in the continuing education activity, participate in the activity asynchronously, complete the evaluation, claim credit, and download a certificate of completion. The administrators of this activity benefit from the platform as well. An automated monthly report is emailed to the career services internship administrator to monitor the completion of the orientation and training. Additionally, the platform provides an easy avenue for evaluation results to be reviewed through a dashboard or spreadsheet.

Evaluation

To receive a certificate of completion and contact hour, participants must complete an evaluation of the orientation and training activity. The evaluation includes an attestation statement that participants have completed the training in its entirety. Additionally, the evaluation asks participants to verify that the learning objectives were achieved and that the presenters were knowledgeable in providing the information. Participants are also asked to provide their thoughts on the absence of bias in the content and delivery of the information. The evaluation also offers the opportunity for participants to share information about their content knowledge and to identify any potential areas for improvement. The evaluation concludes with a final assessment question inviting participants to share how they will apply knowledge and skills gained during the training session.

Summary

Since the inception of the preceptor orientation and training program, 68 preceptors have been invited to participate in the training. A total of 22 preceptors have completed the HIM preceptor orientation and training module and received credit since the launch date, yielding a 32 percent participation rate over eight months, reflecting a consistent enrollment of preceptors congruent with past enrollment volume.

All participants identified no bias in the presentation and indicated that the learning objectives were met. **Figure 2** shows that all participants agreed or strongly agreed that the presenters were knowledgeable and effective in presenting the content. **Figure 3** illustrates that 15 participants strongly agreed or agreed that their knowledge or skills had changed due to the presentation, and eight participants reflected a neutral change. Open-ended comments exploring the knowledge and skill change described participants' increased understanding of healthcare issues and preceptor resources. Also, participants provided additional insights on how they intend to change their practice while precepting in **Table 1**. The preceptors' observations from the orientation and training indicate that they better understand how to ensure students meet all of the learning outcomes and internship requirements.

Assuring that HIM preceptors are prepared for their role is crucial. By setting clear expectations and offering orientation and training, preceptors will be confidently precepting students. Moreover, students will complete the PPE successfully and be ready to enter the HIM workforce.

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The Natural History of CDI Programs: A Metric-Based Model

By Howard Rodenberg, MD, MPH, and James D. Campbell, MD

Abstract

The success or failure of a clinical documentation integrity (CDI) program is often evaluated using a designated set of metrics. However, these metrics change over time, and an understanding of these changes is critical to properly judge the efficacy of the CDI effort. The authors propose a model of the natural history of a CDI program based on commonly used CDI metrics. The authors believe that this model can assist CDI leaders in anticipating and understanding the course of CDI performance over time.

The Natural History of CDI Programs: Metrics and Models

Clinical documentation integrity (CDI) programs assist clinicians in proving complete documentation of patient status within the medical record. Complete documentation enhances the accuracy of measures of illness severity, the patient's needs for care, and the provider's effort on their behalf. The efficacy of a CDI program is often judged by reviewing a designated set of metrics. Common metrics used in the evaluation process of traditional inpatient-based CDI efforts include Case Mix Index (CMI), query rate, and provider query response and agreement rates. The growth of ambulatory CDI programs into the ambulatory care space brings newer measures such as Hierarchical Categorical Condition (HCC) content and Risk Adjustment Factor (RAF) scores into the mix.

While CDI metrics are often assessed in isolation, in practice they are intimately linked and often follow a predictable course as a CDI program grows from erratic infancy to high-performing maturity. However, healthcare executives not attuned to the intricacies of CDI work may have an incomplete understanding of these metrics. A key role for CDI leadership is to anticipate these perceptions and "set the table" to for appropriate administrative expectations, assuring that CDI program performance is assessed on a rational basis.

The authors of this paper propose a metric-based model of the natural history of a CDI program illustrating the expected course over time of specific inpatient and ambulatory care CDI metrics. The authors believe this model can assist CDI leaders to assess the maturity of their identify their CDI program, and to provide healthcare executives with reasonable expectations for assessing the impact of CDI work.

The Metrics Model

The authors propose a metric-based model of the natural history of a CDI program. While many of the general concepts for inpatient and ambulatory CDI metrics are held in common, the authors will use separate illustrations for each setting in order to avoid the confusion of multiple overlapping trendlines within a single graphic. It should also be understood that these models are built on qualitative measures, and not on absolute ratios, percentages, volumes, or values.

The authors also acknowledge two additional considerations underlying the model. First, the model presumes that the patient, provider, and CDI staff populations driving these metrics are static. In reality, factors such as changes in service line offerings and provider turnover may undoubtedly impact individual metrics, especially in the quantitative realm. But as qualitative projection, the authors hold that the model remains valid.

Finally, the authors recognize that specific elements of the model (e.g., CMI) are based on the United States Center for Medicare and Medicaid Services (CMS) Medical Severity – Diagnosis Related Group (MS-DRG) and HCC/RAF systems. However, the authors believe that the model is applicable to any non-fee-for-service payer scheme. Other elements such as query rates and provider response/agreements rates are payer-agnostic.

Inpatient CDI Metric Model

The model begins with “Perfect CMI” (**Figure 1**). CMI is the calculated average of the Relative Weights (a numerical measure of illness severity) associated with the DRG assignments of each patient within a specified clinical population. The “Perfect CMI” is the value achievable with full and complete provider documentation of every clinically recognized Principal and Secondary Diagnosis within each inpatient record. It is a flat line, as the DRG system itself has an inherent ceiling; no matter how many Secondary Diagnoses appear on the record, only one Complication/Comorbidity (CC) or Major Complication/Comorbidity (MCC) is needed to maximize the DRG assignment and the associated Relative Weight.

Two other lines within Figure 1 correspond with the CMI. The first is the “CMI Before Queries.” (Written or verbal queries are the primary means by which CDI staff ask providers to document for clarity and specificity within the medical record). This metric serves as a measure of provider education within the CDI effort. At the start of CDI work, there will be a significant gap between the “Perfect CMI” and the “CMI before queries.” Over time, as physician educational efforts result in enhanced documentation habits, this gap should close. Persistent failure to narrow the gap should prompt early reassessment of the provider-focused CDI educational program.

By way of contrast, the “CMI After Queries” is a measure of CDI program performance describing the end product of CDI-generated provider queries, provider response rates, and provider agreement rates. This metric will begin life closer to the “Perfect CMI” than the “CMI Before Queries” line, as the “ask-and-answer” queries often have a more immediate impact upon CMI than the longer-term educational work. This metric should also gradually trend upwards with the growth of overall CDI efforts. Initially, a wide gap is expected between the CMI pre-and-post query metrics; over time, as targeted clinician educational efforts take root, the gap between the pre-and-post query CMI should narrow. The authors propose that tracking this progression, using CMI values in association with CMS Base Rates to estimate additional reimbursement, is key to giving a tangible value to otherwise intangible CDI processes.

The authors also introduce in Figure 1 the “Executive Expectation Line,” or the EEL. Healthcare executives unfamiliar with the built-in “ceilings” within the DRG-based systems may not understand that, even in a perfect world, CMI is limited given a static patient population. The ceiling may rise from time to time with changes in services offered by the facility (for example, the addition of cardiovascular surgical care), but even then the concept of the “ceiling” still remains. Over time, as the actual CMI approaches the “Perfect CMI” metric, rises in CMI will continually decrease in magnitude and eventually plateau. Administrators with only a superficial understanding of DRG-based systems may view CMI as an infinite pathway, especially following dramatic improvements in this metric, as seen in the youth of a CDI effort. It is important for CDI leadership to assist other executives in limiting unreasonable expectations.

“Query Rate” is another key metric within our model (**Figure 2**). At the onset of a CDI program, one anticipates a great many opportunities for query. However, as the program matures (and

especially with effective clinician education), the query rate should fall. Where the query rate does not fall, or even rises, it should prompt the CDI leader to evaluate the efficacy of the query process.

It is also of import to note that not all queries produce the same result. Queries that simply add clinical specificity or address quality measures may result in no changes to CMI or other “hard” measures. Accordingly, the authors introduce the metric of “CMI Impact Query Rate,” which serves as a more specific means to trend queries by type. Even if overall query rate rises over time due to the expansion of CDI work into new areas of opportunity, the evolution of the CDI program and its accompanying educational efforts should decrease the proportion of queries focused strictly on reimbursement.

Ambulatory CDI Metric Model

The ambulatory CDI metric model is similar to that on the inpatient side, although the RAF score takes the place of the CMI as the index measurement. In value-based healthcare purchasing plans (such as Medicare Advantage), providers are reimbursed based on the risk profile of their patient population. The risk profile for any given patient is a mathematical amalgamation of the patient’s age, sex, and current health conditions; the calculation is known as a RAF score. The health conditions are documented as HCCs, which are clinical issues considered to contribute to the patient’s current health status. These conditions are established through clinician documentation within the medical record. If the RAF score may be considered analogous to the inpatient CMI, HCCs can be thought of as the clinical diagnoses within the inpatient record that drive DRG assignment.

In this aspect of the model, the authors once again see an ideal in the “Perfect RAF” (**Figure 3**). This is the RAF score if all HCCs were completely and correctly documented in all patients served by an ambulatory care provider, practice, or network. The authors also find trend lines similar to the inpatient model for “RAF Before Queries” and “RAF after Queries” in Figure 3.

The ambulatory model also features an Executive Expectation Line (EEL, Figure 3). While the “Perfect RAF” ceiling is undoubtedly more flexible within the RAF/HCC scheme than in the MS-DRG system (the more medical issues documented per patient within the population, the higher the RAF score can go), this flexibility may lead to the conclusion that RAF scores may infinitely rise. However, there is a natural limit to how many medical conditions any one individual might have, and as more patients have complete documentation of their HCCs, HCC opportunities will approach organic limits and begin to taper off. The effect is likely not as pronounced as one might see in CMI-based metrics, but it is nonetheless incumbent upon CDI leaders to prepare upper-level executives for this transition.

Figure 4 illustrates the anticipated trends over time for “Query Rate” and “Queries with RAF Impact.” These metrics have similar implications for provider educational efforts and overall ambulatory CDI program performance as their inpatient counterparts. However, in the ambulatory space, provider education and query efforts are focused on the documentation of HCCs rather than inpatient diagnoses. Depending upon the scope of the ambulatory care project, queries may be directed toward quality measures and care gap closures; however, the authors believe that this form of query is quantitatively much less common in the ambulatory space.

Provider CDI Metric Model

Finally, the authors would propose a final metric-based model for tracking the effectiveness of the CDI program with clinicians (**Figure 5**). The authors would establish a flat line “Perfect Response/Agreement Rate,” where every clinician always responded to the CDI query and always agreed with the optimal CDI suggestion. The “Provider Response Rate” and “Provider Agreement Rate” would be anticipated to start low and rise over time. The authors would not expect the “Provider Response Rate” to reach the level of perfection, as even within the most reliable medical staff there are vacations and turnover; similarly, the authors would not expect the “Provider Agreement Rate” to reach perfection, as clinical care is rife with judgment calls that result in unanticipated query answers or responses indicating clinical uncertainty. However, as clinician acceptance and adherence to a CDI program matures, trendlines for both Provider Response and Agreement Rates should rise, and the gap between response and agreement rates should narrow. The authors believe this model of provider-focused metrics is equally applicable to inpatient and ambulatory settings.

(Please note, the authors use the term “provider” in this document simply to reflect that, in some jurisdictions, nurse practitioners or physician assistants may practice independently and assume primary responsibility for patient-focused clinical documentation, including CDI query response. In practice, the authors feel strongly that physicians, by virtue of experience, training, and expertise, should be distinguished from other healthcare providers.)

CDI Metrics and Business Cycle

In “The Age of Paradox,” Charles Handy proposes that an S-shaped “Sigmoid Curve” underlies every type of human activity or system (**Figure 6**). The curve encompasses experimentation and learning, growth and development, and an inevitable downward turn. In the context of a business, the Sigmoid Curve graphically represents the life cycle of an enterprise. The business or project starts with enthusiasm but quickly learns what it doesn’t know; this is followed by a period of exponential expansion as the effort eventually finds its way. However, if things do not change and innovation stops, eventually the work plateaus and then declines. Ideally, leaders aware of this cycle will intervene while things are going well, before any peak or decline, developing new products or services to begin another cycle of learning and growth. (This period of “re-orientation” is illustrated by the segmented line in Figure 6.)

The authors see a distinct parallel between Handy’s model of the business cycle and the natural history of a CDI program. In the early stages of a CDI program, as the initial enthusiasm of the startup is challenged by the recognition of the potential scope of work, the depth of the issues encountered, and the breadth of knowledge required to meet these challenges, productivity transiently falls. Once a focused work plan is developed and implemented, growth and productivity occur at an accelerated rate. However, over time, the current effort will have yielded its maximum benefit, and further work at this high level does not add to a positive outcome, but leads to staff exhaustion and burnout as intensive work no longer shows the same results.

The authors believe that the use of metrics as a model for the natural history of a CDI program can assist CDI leaders in anticipating the apex of the sigmoid curve, and in doing so preventing likely downturns in program efficacy. As CDI metrics within the model become static, or gaps between measures become fixed, CDI leaders can use these trends as indicators of the need to establish a new origin point along the sigmoid curve and reorient the CDI program into new areas of work such as documentation for patient safety indicators (PSI), hospital readmission rates, or inpatient quality measures. Using the metric model to identify times of transition insures

the constant upward momentum of the CDI program and helps the CDI team manifest a growing footprint within the organization.

Utility of Other Metrics in the Model

A model is only as good as it reflects reality, and only as it can account for the multiple influences upon the metrics used to assess its validity. As the authors look at other metrics that may be applied (in whole or in part) to CDI efforts, the authors find them more problematic for inclusion in this model. As the specific metric is less dependent upon clinical documentation alone and reflects variances in provider care patterns, patient needs, or community resources, the number of variables contributing to the metric grows in an exponential fashion.

An easy way to think about this difference is to consider inpatient provider query rate versus inpatient length of stay. The variables underlying query rate are fairly straightforward, focused on physician documentation habits and the efforts of CDI staff. While there are clearly variances in both of the practices (some clinicians document better than others, and individual CDI staff may have different skill sets), both are amenable to CDI efforts.

If you look at length of stay (LOS), however, it's a different scenario. It's true that excellence in clinical documentation can promote optimal DRG classification; each DRG is associated with a specific geometric mean length of stay (GMLOS). But CDI efforts do not actually impact real-time length of stay, merely the anticipated length of stay associated with the patient's documentation-based DRG assignment. Actual inpatient length of stay is dependent upon the care provided, socioeconomic status of the patient, placement needs, and a host of other factors outside the control of CDI work. It seems unreasonable to use LOS as a metric specific to CDI.

The same is true (to varying degrees) for measures such as readmission rates, observed to expected mortality ratios, patient safety indicators (PSI), hospital-acquired conditions (HAC), and other quality measures. While CDI efforts may reinforce that the documentation within the medical record properly includes or excludes patients for categorization in these measures, or insure the chart best reflects the patient's severity of illness, CDI work does not impact any of the multitude of other facility, provider, or patient-centered factors which contribute to these indices. Accordingly, the authors find it difficult to chart these parameters in any simple, concise, and consistent fashion within the model. CDI programs that use these metrics as part of their reporting process must be careful to develop a mechanism that distinguishes the influence of the CDI effort from the remainder of other clinical factors that impact upon the metric, and must set reasonable expectations for the magnitude of change in these parameters attributable to CDI efforts alone.

Conclusion

The authors believe their metric-based model provides a theoretical basis for CDI leaders to evaluate the evolution and efficacy of a CDI program over time. When combined with the concept of the business cycle sigmoid curve, the authors hope this model may serve as a roadmap to the continued expansion, relevance, and impact of CDI efforts within healthcare institutions and systems.

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Healthcare Breaches During COVID-19: The Effect of the Healthcare Entity Type on the Number of Impacted Individuals

By Martin Ignatovski, PhD

Abstract

The COVID-19 pandemic led to an increase in cybersecurity attacks on organizations operating in the healthcare industry. Health information professionals and health executives are unable to limit the impact of data breaches on records their organizations handle. While current research focuses on prevention strategies and the understanding of the causes of data breaches, it failed to address how to mitigate the impact of successful cybersecurity attacks. This quantitative research paper examined the effect the healthcare entity type has on the number of impacted individuals for healthcare data breaches that occurred during the pandemic. Health information professionals will be able to mitigate the number of breached records based on their organizational type. Some of this paper's findings include the call for implementation of organizational frameworks aimed to protect patient information, and the call for further research to understand how other factors might affect the impact of healthcare data breaches.

Keywords: cybersecurity, healthcare, data breaches, patient information, PHI

Introduction

The COVID-19 pandemic generated unique challenges and opportunities for organizations operating in the US healthcare industry. Health providers struggled providing non-pandemic care to their patients due to the overwhelmed healthcare system and large number of COVID-19 diagnosed patients who needed immediate attention.^{1,2} To overcome restrictions that were the direct result of the pandemic and the associated lockdowns, organizations were forced to enable hybrid and remote work environments so they could continue with their daily operations. The use of current and new technologies such as electronic health record systems (EHRs), telehealth platforms (TH), and remote collaboration tools opened opportunities and additional vectors that could be exploited for cybersecurity attacks to harm organizations handling protected health information (PHI).^{3,4} The implementation of appropriate controls meant to protect the security and privacy of PHI did not keep up with the new attack vectors created by the newly implemented technologies.⁵ The US healthcare industry saw a 25 percent increase in successful cybersecurity attacks during the pandemic.⁶

The Office of Civil Rights (OCR) within the US Department of Health and Human Services (DHHS) oversees the implementation of the Health Insurance Portability and Accountability Act (HIPAA) regulation. The HIPAA regulation consists of three primary rules: HIPAA privacy rule, HIPAA security rule, and HIPAA breach notification rule. The HIPAA privacy rule defines the controls and procedures that need to be implemented to protect the privacy of PHI. The HIPAA security rule is focused on defining administrative, physical, and technical controls required for the protection of the security of PHI. Finally, the HIPAA breach notification rule sets the standards under which data breaches affecting PHI need to be reported. According to the HIPAA regulation, healthcare entities (HE) are required to report all data breaches that impact at least

500 individuals. The archive of all reported data breaches is publicly shared and available on the US DHHS website.

Executives and cybersecurity professionals within the healthcare industry lack full understanding of the HIPAA regulation requirements⁷ and strategies on how to mitigate the effects of data breaches in their organizations.⁸ Healthcare entities struggle to implement appropriate level of controls to meet the vague, but still needed, requirements of the HIPAA security rule.⁹ An area of concern are the defined requirements for access of PHI.¹⁰ Inappropriate access levels to PHI records could lead to impermissible disclosures and data breaches. Additionally, healthcare entities are not prepared to withstand cyberattacks due to the complexity of newly implemented technologies and their integration with old legacy systems and devices.¹¹ Some of those systems and devices are provided and managed by third-party vendors or business associates to the healthcare-covered entities.

Current research focuses on strategies and techniques to prevent data breaches from happening in healthcare organization.¹²⁻¹⁵ Prevention strategies allow organizations to stop malicious actors by closing the “door” to their system and avoiding intrusion that could lead to impermissible disclosures of PHI. What happens once a breach occurs? There is a specific need to understand the factors that have a significant effect on the number of breached records.¹⁶ Based on the data reported on the US DHHS website, it is safe to assume that it is no longer a question whether a breach will occur, but when will it occur. Health information managers and the healthcare entities they work for need to be prepared by implementing mitigation strategies to minimize the impact their entity type has on the number of breached records, once a data breach occurs.

Inappropriately protecting PHI could lead to violation of the three main HIPAA principles: confidentiality, integrity, and availability.¹⁷ Successful cybersecurity attacks, especially ransomware, render PHI unavailable and unreadable,¹⁸ thus causing inability of EHRs and other systems to access current and historical patient data.¹⁹ The inability to access data leads to significant disruptions in patient care that could negatively affect patient outcomes and patient safety.²⁰ This research paper analyzes the relationship and the main effect the HE type has on the number of impacted individuals in healthcare data breaches. Exploring how the HE type affects the number of impacted individuals will allow health information management (HIM) professionals to understand how to implement controls that will mitigate the impact of healthcare data breaches within their specific organizational structure.

Research Question

Due to lack of current research on how to minimize the number of records that are impacted in data breaches targeting healthcare entities, and with an aim to expand the research body and contribute to future research, the research paper addressed the following research question: What is the effect, if any, the healthcare entity type has on the number of impacted individuals in healthcare data breaches reported by healthcare organizations within the US?

To address the research question in detail, the author set the following hypotheses:

- H0: There is no effect of the healthcare entity type on the number of impacted individuals during the 27 months of the COVID-19 pandemic.
- HA: There is significant effect of the healthcare entity type on the number of impacted individuals during the 27 months of the COVID-19 pandemic.

Method

The purpose of this research is to identify and analyze to what extent, if any, the healthcare entity type contributes to the number of individuals impacted in a healthcare data breach (**Figure 1**). This research utilized quantitative analysis by performing a one-way ANOVA analysis, with post-hoc test, using the number of impacted individuals as the dependent variable, and the HE type as the independent variable. One-way ANOVA is robust and informs whether three or more independent groups within the independent variable have significant differences when it comes to the effects on the dependent variable. This quantitative analysis was performed on secondary data of reported data breaches by HEs, as presented on the US DHHS website. For the purposes of this research, the author decided to use the entire population of the data set, which eliminates any sampling bias. The only intervention was the removal of duplicate data entries reported by the same entities (reporting date, entity name, number of impacted individuals). The entire data set includes 1,587 reported data breaches impacting at least 500 or more individuals per occurrence.

The two variables examined in this research include the HE type and the number of impacted individuals per data breach occurrence. The HE type is an independent variable that contains four categories: healthcare provider, health plan, healthcare clearinghouse, and business associate. Healthcare providers, health plans, and healthcare clearing houses are covered entities. Business associates are typically vendors used by covered entities and act as third-party vendors (**Figure 2**). The number of impacted individuals in a healthcare breach is the dependent variable, and it is measured on a continuous scale.

The author of the research did not collect the data directly from the HE types that reported the data breaches, but rather performed a quantitative statistical analysis on a secondary data set. The author implemented a five-step process to identify, obtain, and protect the integrity of the secondary data set reported on the US DHHS website. The first step included the identification of the website that stores the data set, thus determining that the US DHHS is a reliable website with its data used in many research articles.^{13,21,22,23,24,25} As part of the second step, the author extracted the entire data set and saved it into a comma-separated values file. Next, the author examined the data and filtered it to include only the data breaches reported between April of 2020 and June of 2022. The selection of these dates corresponds with the pandemic lockdowns and the continued battle against the COVID-19 virus. In the fourth step of the process, the author encrypted the data set and created password protections so it could not be edited. Finally, the last step included loading and analysis of the data into statistical software, SPSS.

Results

Prior to conducting the one-way ANOVA with post-hoc analysis, the author ran comparison of data breaches and the number of impacted records prior and during the pandemic. The analysis included 27 months of data breaches reported during the pandemic, and 27 months of data breaches reported prior to the pandemic. The initial comparison shows that breaches that occurred during the COVID-19 pandemic accounted for 100,474,829 breached PHI records, which is 39,783,652 more breached PHI records than data breaches that occurred during the same time span prior to the pandemic.²⁶ (**Figure 3**)

As part of the data analysis, the author first examined the independent variable: healthcare entity type. Of the 1,587 records, 1,176 of the reported data breaches were by healthcare providers, followed by business associates with 208, and health plans with 200 data breach occurrences. The least amount of data breaches was reported by healthcare clearinghouses: three (**Table 1**). Additionally, the author ran descriptive statistics of the dependent variable, which had a mean value of 63,311.17 and standard deviation of 247,507.79 (**Table 2**).

The next step of the data analysis included running the one-way ANOVA function. According to the ANOVA results (**Table 3**), there was a significant main effect of the healthcare entity type on the number of impacted individuals for the data breaches reported during the COVID-19 pandemic, $F(3,1583) = 8.997, p < 0.001$. The results show that we can reject the null hypothesis that there is no significant main effect of the healthcare entity type on the number of impacted individuals, and accept the alternate hypothesis, showing there is significant main effect of the healthcare entity type on the number of impacted individuals. Since there was a significant main effect of the healthcare entity type on the number of impacted individuals, the results of the Tukey's function (**Table 4**) will be interpreted in the discussion portion of this article

Discussion

The results of the one-way ANOVA analysis show significant main effect of the independent variable (HE type) on the dependent variable (number of individuals impacted by data breaches). The analysis clearly shows that the number of breached records depends on the HE type that is handling the patient data. To further analyze the effect the author performed Tukey's post-hoc analysis on the data (**Table 4**). The post-hoc analysis revealed that breaches that occurred in business associates affect significantly larger number of individuals ($145,491.88 \pm 491,440.33, p = 0.002$) when compared to breaches that occurred in health plans ($57,026.85 \pm 275,853.51, p = 0.002$). Similarly, breaches that occurred in business associates affect significantly larger number of individuals ($145,491.88 \pm 491,440.33, p < 0.001$) when compared to breaches that occur in healthcare providers ($49,965.1 \pm 160,887.19, p < 0.001$). Additionally, Tukey's analysis also revealed that breaches in healthcare clearinghouses do not affect significantly more or less individuals than health plans and healthcare providers. Finally, Tukey's analysis reveals that breaches in health plans do not breach significantly more or less individuals than healthcare providers.

It is intuitive, and supported by the one-way ANOVA analysis, that business associates breach more records than health plans and healthcare providers. As we saw in **Figure 2**, business associates act as third-party vendors to covered entities, intuitively handling information on behalf of multiple organizations. Business associates provide various array of services to covered

entities, including but not limited to cloud hosting services,²⁷ help with the transmission of data, and handle sensitive information on behalf of the covered entities.²⁸ Additionally, business associates, unlike covered entities, could have primary operations in industries outside of healthcare. Operating outside of the healthcare industry, coupled with the fact that controls for protecting healthcare data are not clearly defined, create an opportunity for business associates to lack in the implementation of appropriate security and privacy frameworks and controls that protect PHI, thus leading to larger impact on the number of breached records. HIM and cybersecurity professionals need to focus on implementing sound data protection controls, implementing appropriate organizational culture, and educating employees how to protect PHI records. Operating in other industries and having lack of understanding of the HIPAA requirements does not excuse the lack of data protection controls given the amount of data business associates handle. HIM and cybersecurity professionals need to implement frameworks that go above and beyond the HIPAA requirements.

Since there is no true way to ensure alignment and compliance with the HIPAA regulation, HIM and cybersecurity professionals who work for business associates should implement the NIST Cybersecurity Framework (CSF) or the HITRUST Common Security Framework (CSF) to mitigate the effects of successful data breaches.²⁹ NIST CSF and HITRUST CSF incorporate multiple requirements that are aligned with HIPAA and cover controls across various domains, including but not limited to information protection, access control, physical security, vulnerability management, and data protection and privacy. On the other hand, covered entities (healthcare providers, health plans, and healthcare clearing houses) need to implement third-party (vendor) risk management programs that appropriately and continuously assess the vendors (business associates) they work with. A comprehensive program would allow HIM and cybersecurity professionals to appropriately assess the risk for each of their business associates and mitigate the effects of data breaches caused by those relationships.³⁰

This research, just like other research articles and studies, has limitations. The first limitation of the study is relating to the understanding of the HIPAA legislation by the organizations operating in the healthcare industry; specifically, the author assumes the organizations' knowledge of the HIPAA Omnibus and Breach Reporting Rule that requires them report all data breaches to the US DHHS including at least 500 records. The lack of understanding of the legislation could have caused some healthcare entities to not report their data breaches, thus rendering the data set potentially incomplete. The second limitation of this research is the US DHHS requirement to only report data breaches that impacted 500 or more individuals. Not reporting breaches that impact less than 500 individuals could skew the results and create uneven distribution of the reported breach instances. The third limitation is related to the accuracy of the data. While the US DHHS audits the documentation of all reported data breaches, not every healthcare entity is audited to ensure accurate representation of the breached number of records.

This research paper sets a foundation for cybersecurity and HIM professionals to understand what contributes to the number of impacted individuals, once data breaches occur. Based on the US DHHS dataset, additional research can be performed to consider the effects of other variables such as the type of data breach, the location of data breach, and the geographical location of the HE type.¹⁶ The understanding of the relationship of these variables and the effects it has on the number of impacted individuals can inform researchers and HIM professionals on how to better

mitigate and reduce the impact breaches have on PHI. Further research, qualitative or quantitative, could offer mitigation strategies that focus on minimizing the impact data breaches have on individuals. Mitigation becomes prevention when the breach, after it occurs, affects zero individuals.

Conclusion

The author of this research paper focused on understanding what affects the number of impacted individuals in successful data breaches. Through quantitative analysis, using one-way ANOVA, the author was able to determine that the healthcare entity type has a main effect on how many records healthcare organizations breach once a breach occurs. More specifically, the author found that business associates breach more information when compared to health plans and healthcare clearing houses. This paper could serve as a foundational piece for future research and change the focus of HIM professionals, which is mostly on how to prevent data breaches, to a combination of prevention and mitigation. Appropriate implementation of cybersecurity frameworks within business associates that go above and beyond the HIPAA regulation requirements could minimize the impact of data breaches and ultimately lead to prevention. Finally, the author calls for additional research that will include additional factors and their effects on the number of impacted individuals.

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Determinants Affecting the Health Information Sharing Management and Practice for Patient Referral in Thailand: The Perceptions of Patients and Healthcare Professionals

By Veerawan Aumpanseang, Kamonchanok Suthiwartnarueput, and Pongsa Pornchaiwiseskul

Abstract

Despite the cooperative sharing of health information exchange (HIE), various distinct limitations and barriers are found (i.e., substantial time and resources are being used to achieve health information). This paper investigates the limits of healthcare information sharing policy implementation for patient referral systems in Thailand. Mixed-methods research methodology, both quantitative and qualitative mechanisms, are conducted. The study results present the correlation between the current HIE among the hospitals in patient referral systems and the limitations of implementing the HIE policy, composed of technical, economic, political, and legal barriers. The statistical test reveals that these four main barriers could limit information sharing or impede Thailand's standard healthcare information-sharing policy and practice development. Predominantly, it is further found that there is no standard for data collection and data archiving systems; unclear guidelines, practices, and procedures; and a lack of standard practice due to fragmented administration. Foremost of all, the data ownership of any competent authorities or related regulators could cause any constraints in information sharing (e.g., complexity and processing time). This paper's findings will be beneficial to stakeholders, such as policymakers interested in achieving meaningful use, facilitating the adoption and implementation of HIE at a national level to ensure patients' safety and enhance healthcare quality.

Keywords: healthcare information, patient referral systems, data sharing, barriers, HIE, health information exchange

Introduction

Health information exchange (HIE) is the electronic transfer of health-related information between organizations or healthcare providers (e.g., patient and medical information).^{1,2} HIE contains several benefits, including improving care coordination and healthcare quality; explicitly enhancing patient safety by reducing medication and medical errors; and eliminating redundant or unnecessary testing, handling, and paperwork.^{3,4} At present, HIE appears in several transaction forms. However, the primary purposes of facilitating the availability and retrieval of clinical data to patients and healthcare providers are securely sharing a patient's vital medical information electronically, seamless patient transfer, and safety. For instance, the direct exchange with accessibility and visibility to patient information between care providers will support coordinated care in the patient referral systems. On the contrary, the query-based dialogue for patient referral usually involves delivering unplanned care (i.e., in emergency cases). Implementing HIE will enhance the ability of care providers to find or request information about patients from other persons or institutions.⁵⁻⁷

Despite the cooperative HIE, some distinct limitations and barriers exist. For example, electronic data in the prevailing electronic health records (EHR) systems come from multiple sources in different interfaces, technical specifications, and capabilities. It causes interoperability, which is a significant challenge since substantial time and resources are needed to achieve health information. In addition, healthcare information sharing seems to be asymmetric, resulting in inadequate information sharing between healthcare organizations

under concerted consent management.^{8,9} Likewise, some patient information disclosure is required. The benefits of medical data sharing for patient care and other secondary purposes may be harmful. The most significant ethical concerns about breaches of confidentiality have arisen in situations in which third parties are involved during the patient's referral processes. Therefore, healthcare information must be shared effectively, covering its traceability to provide visibility in the healthcare system.

While collecting and storing patient and medical data is essential in healthcare, securely distributing information remains a global challenge.¹⁰ Although interoperability in the healthcare industry becomes critical in adopting or implementing integrated health information systems,¹¹ standard practice for health information exchange would be a pathway to establish interoperability between various organizations and systems. In conclusion, health information sharing at the national level must consider the accessibility, sharing with the regulatory mandates, standard policies, and technology platforms to initiate all forms of HIE to ensure interoperability for successful policy implementation.

This paper will investigate the limitations and barriers of healthcare information sharing for patient referrals. This paper's findings will benefit stakeholders interested in the effort to achieve meaningful use, facilitating the implementation and adoption of EHRs, and HIE.

Literature Review

HIE refers to the technologies, standards, and governance that enable the electronic exchange and transfer of clinical and administrative information between the information systems of various health care stakeholders. In addition, HIE will facilitate the related work and accelerate health information integration. Similarly, interoperability is essential to patient care, as vital patient data should be available and shared with the right people at the right time and place, leading to fewer medical errors, unnecessary tests, and more efficient decision-making.

The Challenges for Health Information Exchange in Thailand

The research by Health System Research Institute (HSRI) on the HIS/eHealth situation in Thailand addresses the challenges of national health information system (HIS) and health information technology (HIT) development in Thai health systems. It revealed the country's inadequately developed health information standards.¹² Though the government agencies are actively preparing their organization to be e-government to provide a better service, the investment in information systems and interoperability primarily related to health information standards seems insufficient. From the implementation of some pilot projects under e-government, the transformation has been under apathy for four main reasons: unavailable national data standards, lack of best practices to follow, unclear guidelines for how to start and monitor the project, and a lack of a proactive mindset.¹³

Health informatics professionals in Thailand have encouraged the adoption of health data standards; however, there are hindrances, such as a lack of human resources in health informatics, lack of awareness, and unfamiliarity with the potential benefits of using standards and terminologies in healthcare among high-level policymakers and healthcare professionals.¹⁴ All stakeholders in the healthcare supply chain need accurate and consistent information to efficiently respond to the demand and support in both clinical and logistics activities.¹⁵ It is important to note that the demand for healthcare information is significantly rising, especially in unforeseen and emergent circumstances. For instance, a robust set of

patient identifiers supports automated patient identity matching and workflow integration in a growing epidemic.¹⁶ According to the eHealth Strategy in Thailand, Ministry of Public Health (2017 – 2026), there is an attempt to enhance the use of computational technologies and analysis techniques, intelligent devices, and communication media to support healthcare professionals and patients on healthcare services and tackle the related risks management, as well as promote health and well-being. Conclusively, the lack of interoperability, improving health literacy, and health data standards remain significant challenges in Thai health information systems development.

The Development of Health Information Exchange in Thailand

In 2021, a campaign called “Health Link” was launched, which aims to strengthen the HIE system in Thailand. Health Link has been successfully implemented and could serve over 50 hospitals in 2021. This first HIE nationwide platform is keen to improve interoperability, privacy, and security by implementing Fast Healthcare Interoperability Resources (FHIR), pseudonymization, and access control, respectively.¹⁷ After implementing Health Link, the authority anticipated escalating the accessibility and visibility of health information. First and foremost, Health Link will be beneficial for healthcare providers to access and retrieve health information. By extension, it will be convenient for healthcare receivers to improve patients’ experience in healthcare, particularly the service time and treatment cost. However, HIE in the prevailing systems is still available in medical terminology. Thus, it will be difficult for patients to understand, and the adverse result may cause confusion or misinterpretation. For this reason, the health information for patients should be simplified and understandable when giving consent.

Barriers and Limitations to Health Information Sharing

In general, the healthcare organizations’ benefits of information technology are perceived and agreeable. The development of nationwide data exchanges with specific criteria can stimulate the adoption of EHRs and facilitate information sharing among healthcare providers.¹⁸ However, due to insufficient capital, complex systems, and lack of data standards that enable clinical data exchange, privacy concerns, and legal barriers appear to be obstacles to implementing the practices.

Notably, there is an increasing demand for an interoperable healthcare data system. The essential data should emerge standardized and clear to any healthcare providers involved, irrespective of the location or person or their original affiliation. Nonetheless, cross-organizational collaboration seems not fully compliant with evidence-based, patient-centric, timely, and safe practices. The data redundancy occurs in one hospital database, and ad hoc data collection occurs upon the visit, as the critical information is not available on time. As a result, it affects the continuity of care, and patient care becomes fragmented. Worse, individuals receiving care are often under-supported in their right to access their health data. Thus, essential elements such as a minimal data set, information technology architecture, and legal governance are required.¹⁹ Over the past decade, many potential and actual barriers to public health data sharing have been recognized.²⁰ As described above, the barriers to health information sharing can be summarized in six categories, as illustrated in **Table 1**.

Undeniably, the interactions between the above tangible and intangible barriers at different levels can be rather complicated and severely limit the effectiveness of segregated solutions. Primarily, the concrete walls include technical, motivational, and economic obstacles; these are profoundly inlaid as massive challenges to health information system capacity, particularly in

low- and middle-income countries. Solutions such as infrastructure development, capacity building, and efficient financing have been considered and are currently at the outset of the significant international initiatives.^{21,22} In addition, the factors consist of leadership, trust and commitment, and organizational culture for HIE adoption would be manipulated by organization-specific approaches in three themes (i.e., HIE participation, HIE assessment, and coordination strategies).²³ Political, legal, and ethical barriers seem more ethereal and require a different approach. Principally, international agencies (e.g., the World Intellectual Property Organization (WIPO), the World Health Organization (WHO), the World Trade Organization (WTO), countries, development and funding agencies, and experts in ethics and law need to provide outline and present for dialogue together with resolution across sectors. Also, this information requires an intensive discussion to develop a consensus concept, (e.g., strategic plans, reinforcements, or mandates), which should be agreed upon by the majority of stakeholders.²⁴ As a result, the centralized mechanism and governance body should take a significant role in monitoring, mediating, and facilitating information sharing among diverse stakeholders to ensure fair and efficient use of data to advance population health.

Research Methodology

A mixed-methods study, namely an in-depth interview and quantitative analysis, would allow for a deeper understanding of existing healthcare information systems, limitations, and requirements for healthcare information sharing in patient referral systems.

Data Collection

Some previous studies on healthcare information sharing explored and summarized limitations to the related policy implementation. The existing barriers from those papers compose of technical barriers, economic barriers, political barriers, legal barriers, and ethical barriers. For the primary data collection, the development of in-depth interview questions relies on these attained barriers. Furthermore, the interviewees' responses enables us to generate the questionnaire to ideally understand and affirm the limitation of healthcare information sharing in a Thailand healthcare system.

Nonetheless, in our questionnaire's development, the expert argued that the motivational barrier was likely to be a specific issue or task-related. Hence, we excluded the motivational barriers from the questionnaires to the respondents from the patients' group. We indicated the given score of current healthcare information sharing as a dependent variable. For internal consistency, the multiple-question Likert scale surveys for both patients and healthcare professionals are reliable based on Cronbach's alpha at 0.78 and 0.91, respectively.

According to the widespread outbreak of COVID-19, online questionnaires were distributed to both groups of respondents. The questionnaires enabled the respondents to control their personally identifiable information by giving a declaration of data collection purpose and requesting consent to use attained data for research analysis, which authors virtuously intend to understand barriers to HIE policy implementation and how to handle the disputes. In addition, the data collected in this study does not seem to contain any sensitive biological information about respondents in the groups of patients and healthcare professionals. After respondents consent to participate in this survey, the authors shall not discover or publish all respondents' identifiable information. Additionally, respondents may refuse to participate or to stop the form filling at any time without any loss of health care benefits that they are otherwise receiving. Consequently, the authors considered that this study should not lead to apparent immediate hazards to the participants.

Sample Selection and Size

The population in healthcare services seems quite broad; this study identified two relevant groups: 1) healthcare professionals and 2) patients and relatives. Notably, the selection criteria for the in-depth interview, identified by the sample size, were 20 physicians from different fields of specialties or diseases. In addition, the age range was 41 to 50, with at least 10 years of working experience in patient care. This interview would help to identify determinants affecting health information sharing in Thailand's patient referral systems. During the conversation, we drilled down their perspective on the current information exchange in patients' referral systems toward smooth patient referral processes for patient safety.

In the following step, we established the quantitative research. In the survey, we defined healthcare professionals as physicians or nurses who may have experience giving healthcare services through the patient referral systems, especially those involved in healthcare information sharing. Therefore, this group of people would possibly reveal their understanding, perception, and expectation for healthcare information exchange in patient referral systems.

Meanwhile, the patients and relatives group refers to any participants aged below 25 and over 55 years old (i.e., adolescents to older adults) who received healthcare services through the patient referral systems. Alternatively, they presumably were patients or ones taking care of their family members in the hospitals. This group of samples can expose their experience and perception in exchanging healthcare information, affecting the diagnosis or treatment process for themselves or family members. Therefore, the typical exclusion criteria concerning the properties of the study sample are to exclude any patients or healthcare professionals without experience in patient referrals from the current study.

The sample size determination for our survey was selected based on Yamane's formula for healthcare professionals and relied on Roscoe for patients and relatives. According to the Medical Council of Thailand data, around 29,897 physicians live in Bangkok. With this given number at a confidence interval of 95 percent or a P-value of 0.05, our sample size for the healthcare professional would be 397 respondents as a minimum ($29,897 / 1 + (29,987 * 0.52)$) (Yamane, 1973). The population of patients and relative groups seems quite large, so we calculated the sample size using the infinite population method (Roscoe, 1969), based on this method with a P-value of 0.05 and a population standard deviation equal to or not more than 10. Then, 384 respondents are the minimum requirement ($N = (Zc\sigma/em)^2 = (1.96 \times 10)^2 = 19.62 = 384.16$). Therefore, we reached 903 people as the actual number of participants in the survey, consisting of 479 people and 424 people from the patients and healthcare professionals groups, respectively.

Data Analysis

In this study, we examined the attained data by using multiple regression analysis (MRA) to assess the correlation between an outcome or the current healthcare information exchange among the hospitals in patient referral systems (Y= dependent variable) and the limitations of implementing the HIE policy (X= independent variables) composed of technical barrier, motivational barrier, economic barrier, political barrier, legal barrier, and ethical barrier.

Results

From the literature review, the existing barriers to information sharing in other countries could also occur in patient referral systems in a Thailand-specific context.

A total of 20 physicians from different fields participated in the in-depth interview, including allergists, emergency care specialists, infectious disease specialists, internists, neurologists, pediatricians, psychiatrists, and trauma surgeons. Moreover, some of the interviewees had a role as executive management members in the medical school hospitals. This interview is not only to identify the current interoperability landscape, assess cooperative information exchange between the hospitals over time, and verify the barriers that have been listed earlier, but also helped to develop a guideline for the standardization of healthcare information's conceptual design. During the conversation, we drilled down their perspective on information exchange in patient referral systems under two purpose categories: smooth patient referral processes for patient safety and the basic set of data for better care services quality.

Most of the interviewees asserted policy and practice guidelines were not clear and adequately designed; it became limitations of policy implementation and led to unsuccessfully healthcare information sharing between hospitals presently. Two-thirds of them revealed the lack of national standard practice. Considerably, based on their aspects and personal experience, the suspecting barriers had been identified, as shown in **Table 2**.

The actual survey consisted of 903 subjects, including 424 respondents from the healthcare professionals group and 479 respondents from the patient group. First, all respondents were asked to evaluate the current HIE and cooperative relationship among the hospitals in patient referral systems. Then, from the previous section, we identified the independent variables according to the list in Table 1, including technical, motivation, economic, political, legal, and ethical.

The question items representing each barrier in the questionnaire are illustrated as follows;

Technical Barrier: The participants would help assess current health information systems from their own experiences on the following items;

Presently, the appropriate data collection, good data archiving, and storage. For example, with the rapid data accessibility and retrieval, patients do not need to repeat form filling for every hospital visit.

The web-based platform used by either patients or healthcare professionals is user-friendly and understandable, or if the systems adequately provide a basic guideline or technical solution for end users and system administrators to create a mutual arrangement.

The national databases and data repositories appear in similar language and coding for comprehensible use.

The data source is identifiable to add information or data correction purposes.

Motivation Barrier: Only the healthcare professionals to confirm the following statements:

There are adequate personal and institutional incentives to generate healthcare information databases or prioritize data sharing over other pressing duties.

Less workload and stress conditions so staff can concentrate on developing health information databases and systems maintenance.

The existing organizational policies or solutions (e.g., public relations strategies and practices also conflict management for both individuals and organizational levels) help prevent or oppose possible criticism caused by data usage or sharing.

Economic Barrier: Each statement will reflect respondents' perception on whether, for further development, the current health information system receives adequate support on infrastructure, competent personnel, institutional incentives, and resources. Also, if it is agreeable that data sharing (e.g., daily statistics of admitted patients in a particular hospital with COVID-19 or a case of wrong or delayed diagnosis) may cause an impact on organizational reputation and corporate standing. Literally, it may result in an overall national GDP falling and lead to economic crises.

Political Barrier: The statements will refer to the organizational governance, standard policy, and practice that similarly apply in different hospitals, regardless of public or private. Public relations or shared database initiatives would enhance the patient experiences while ease and allow healthcare professionals to faster data accessibility, less complexity, and avoid time consumption.

Legal Barrier: Given statements will describe the centralized administration and governance at the national level to evaluate whether policies, standard practices, and procedures are available and lucid for practical uses. For example, ad-hoc guidelines to prevent and control data breaches are typically available and depicted.

Ethical Barrier: Each statement will evaluate the current concern on adequate proportionality if there is careful deliberation in assessing the risks and benefits in regular practice. The respondents' outlooks on the sufficiency of reciprocity and to verify whether data sharing practices are often for mutual benefits.

Next, the participants will run through a statement of possible barriers to identifying the most likely determinants affecting the current healthcare information sharing in patient's referral based on their experiences with a 5-point Likert scale (1 = strongly disagree, and 5 = strongly agree).

Having the statistical analysis, we formulated the following hypotheses for MRA analysis as follows:

Hypothesis A (H_0): All given determinants affect the willingness to share healthcare information equally among hospitals/care providers.

Hypothesis B (H_1): Any given determinant will increase or decrease the willingness to share healthcare information among hospitals/care providers.

Study Results from Patient Group

From the survey, a total of 479 participants from different sectors of Bangkok, which ages ranged from below 25 to over 55 years, with 36.3 percent identified the experience in patient referrals between divisions within the same hospital, 51.1 percent patient referrals between hospitals in Bangkok, and 12.5 percent patient referrals for cross-province hospitals. We discovered the participants' perspective on the current healthcare information sharing in patient referrals is mostly at neutral at 36.7 percent, and 32.8 percent for information sharing is sufficient, but accessibility may take some time. At the same time, 17.7 percent of respondents identified that healthcare information sharing between hospitals is limited ($M = 3.38$, $SD = .9304$). See **Table 3**.

In the following step, using t-test and Sig. to examine the correlation between predictor variables and response variable ($t = b_1 - 0 / SE(b_1)$) include Technical (β_1) = .679 $t = (.679 - 0) / .054 = 12.670$ at significance value = .000 (B = .549) and Political (β_3) = .168 $t = (.168 - 0) / .056 = 3.010$ at significance value = .003 (B value = .148). These two barriers are associated with increasing the willingness to share health information. This study will rise by 0.679 when the technical drawbacks such as lack of standards, data quality, and data archiving system are steadily manipulated and increase by 168 if political barriers (e.g., the lack of standard practice guidelines, unclear policies and procedures) are solved. Concurrently, strategic movement and reinforcement should positively impact the development of the standard practice by increasing information sharing.

On the contrary, we accepted H_0 for economic (β_2), legal (β_4), and ethical (β_5), which means these determinants are irrelevant to the response variable; in addition, this result implied no multicollinearity because the VIF value is less than 10, and the tolerance value is higher than 0.25.

From **Table 4**, the model summary presented that the R-value presents the correlation between dependent and independent variables at 0.676 or 67.6 percent. Implicitly, there are probably other determinants that could affect the willingness of information sharing among hospitals or a way to develop the standard practice for information sharing in patient referral.

According to the Anova statistic, the statistic value shows $F = 79.223$, and the significance value is 0.000, or below 0.05 (H_0 is rejected), so we may conclude that any of these five determinants would affect the willingness of information sharing among hospitals or the development of standard healthcare information systems in patient's referral.

Study Results from the Healthcare Professionals Group

The 424 participants in the survey were care providers (e.g., physicians including primary care physicians, specialist doctors, nurses, referralists) and some of them are executive members of medical school hospitals, and ranged in age from below 25 to over 55 years with working experience starting from 11 months up to 45 years ($M = 15$, $SD = 11.468$). From the survey, 51.9 percent of respondents identified the experience in patient referrals between divisions within the same hospital, 26.4 percent patient referrals between hospitals in Bangkok, and 21.7 percent patient referrals for cross-province hospitals. We discovered the participants' perspective on the current healthcare information sharing in patient referral. Most of them, or 40.6 percent, agreed that information sharing is sufficient, but accessibility may take some time, and 24.8 percent are satisfied with the current cooperative healthcare information sharing. Likewise, 24.5 percent rated at neutral ($M = 3.79$, $SD = .9450$).

Based on the multiple regression analysis (**Table 5**), the t-value and corresponding p-value confirm that the three determinants, including technical, economic, and legal barriers, are significant. The β value of these variables will correlate with the degree of willingness to information sharing or standard practice development. They include technical = 0.495 (P-value = 0.000), economic = 0.112 (P-value = 0.022) and legal = 0.136 (P-value = 0.033). In the multiple regression model, VIF should be <10 or tolerance >0.25 for all variables, which

they are. Given the result in **Table 6**, motivation, political and ethical barriers are not significant P value (0.881) >0.05, p. (694)>0.05, and p. (784)>0.05, respectively. In other words, the regression model for a group of healthcare professionals' respondents includes technical, economic, and legal. However, motivation, political, and ethical contribute less to explaining the willingness for information sharing or standard practice development.

In **Table 6**, the R-value presents the correlation between dependent and independent variables at 0.671 or 67.1 percent. Similar to the result from the patient group, other possible determinants could affect the willingness for information sharing among hospitals or a way to develop the standard practice for information sharing in patient referral.

The F-value in the Anova (**Table 6**) tests whether the overall regression model is a good fit for the data, which the independent variables statistically predict the dependent variable, $F(6,417) = 56.909$, $p(<0.001) <0.05$. Therefore, the regression model is a good fit for the data. Furthermore, it is concludable that the perspectives of healthcare professionals on any of these six determinants would affect the willingness of information sharing among hospitals or the development of standard healthcare information systems in patient referral.

All barriers in this study were considered essential and would impede or facilitate information sharing. However, some barriers may present a higher weight or more substantial impact than others. The statistical results showed that both respondents agreed that one common barrier, technical, could be a critical reason for the unsuccessful policy implementation for healthcare information exchange. This result reflects the lack of national data standards, data collection, and quality, especially in the data silo in various fragmented systems.

In addition, the healthcare professionals mentioned two other barriers, economic, which represent relatively insufficient resources, inadequate competent human resources, and organizational reputation. Then, legal refers to the national level's lack of standard regulation and ad-hoc guidelines. Whereas, the patients indicated another significant barrier, political, which would signify that different hospital policies can lead to the diverse services experience that could be compared and classified in numerous ways, especially in patient referral process.

In this study, the economic barrier represents an adequate resource, and organizational reputation would affect the willingness to information sharing. Therefore, the patients' and healthcare professionals' perspectives on economic barriers may be perceived differently. In particular scenarios, such factors may not impact their decision-making during hospital visits (both regular and emergency cases) since the patients would first consider their health conditions, especially for time-sensitive diseases or injuries from accidents. If the P-value > 0.05 but the coefficient shows a negative value, the current investment in infrastructure and resources seems sufficient. However, regardless of organizational reputation, healthcare information is proprietary. The less concerned about corporate standing, the patient's perspective, the more willing to share. Eventually, this will benefit the patients in terms of treatment accessibility. Data attained from the literature, in-depth interviews, and survey results showed potential barriers. Besides, it would elaborate on the details of disputes that interrupted the information sharing and policy implementation of standard healthcare information, even smooth patient referrals and safety.

Discussion

A comparison between the findings of this study and previous studies reveals that all studies present several impediments to information sharing in healthcare; nevertheless, this paper

assesses Thailand's healthcare information sharing practice through patients' and healthcare professionals' perspectives, particularly in patient referrals. The four barriers consist of technical, economic, political, and legal being identified and manipulated. The researchers anticipated the relevant competent authorities to have regulatory mandates and reinforcement initiatives that would lead to the successful policy implementation for HIE based on a shared or centralized database-driven.

For instance, a single standard platform for data collection will increase data accessibility and visibility. Escalation of the strategic movement and governance of national eHealth systems are the most essential and critical. Adopting EHRs with meaningful use can improve the quality of care, treatment, and medication quality under the supervision of cybersecurity. In improving healthcare information sharing processes, the development of the national standard of healthcare information, the strategic movement, and governance of national eHealth systems are the most essential and critical parts. As for the regulatory landscape, the governing body should be established and empowered by the related government departments in Thailand (e.g., the Ministry of Public Health or the Ministry of Digital Economy and Society). Such governing body that has authority to control the adoption of standards should announce the mandates.

Further to legislation setting, in terms of sustainable development, the legislative process should include policy evaluation and amendment after a certain period. Given collaborative administration, the commitment from all stakeholders is a necessity. Having a clear roadmap for the designated standards to be implemented and interoperable in the healthcare system is critical.

Meanwhile, advocacy on the potential benefits of using data standards and communication between the organizations and the users greatly benefits from controlling or manipulating the possible conflict and misunderstanding. Above and beyond, the standards maintenance and revision processes are part of the compulsory components of successful implementation and the acquiring resources and personnel in the specific related field. Furthermore, cultivation, incentives, services mindset, and capacity building are essential.

The previous studies noted the positive effect of information sharing on the efficiency of the supply chain. In addition, the advancement of information technology in recent years has empowered healthcare organizations to improve their service flow and the information flow via efficient mechanisms. For instance, information technology and data visibility will increase patients' accessibility to safe, quality, and appropriate health services and treatment. Therefore, well-organized information sharing will enhance supply chain performance similar to other industries. In addition, it will prevent redundant transactions and unnecessary costs and allow enterprises to refine their supply chain management strategies to evolve service quality and maximize patient benefits. This study draws a possible implementation approach and practice for healthcare information sharing from the previous section. Beyond being the supportive technology for enhancing secure interconnectivity and a secure information-sharing platform of healthcare data, innovative information management such as blockchain delivers health-related data to support decision-making in the care process. Even though stakeholders might run into the emerging conditions, this will remain state of the art about cybersecurity.

Initially, the data collection of this study is supposed to be nationwide to move toward a national innovative management; however, the authors unfortunately narrowed the data collection area in Bangkok according to the coronavirus pandemic. Consequently, the result of this study phase may not well represent standardization. Nonetheless, this phase of the study focuses on healthcare information sharing. Furthermore, surveying Bangkok would also

minimize the adverse impact caused by the delay in getting the response from respondents. In addition, some barriers in this survey may not be what patients and healthcare professionals can conceive or experience; however, as the bottom-up approach to policy evaluation, the authors believe this survey data will be beneficial in reflecting the overview of current HIE policy implementation. Therefore, from the end user's perspective, operators' feedback would deliver thoughtful comments and constructive remarks to policymakers or shareholders for consideration and enable them to stipulate top-down policy and mandates. To reflect the current interaction and future cooperative platform, the authors proposed expanding the scope of analysis in a future study to cover all stakeholders in the healthcare supply chain (e.g., suppliers, society, regulators, and administrators, including The National Health Security Office (NHSO) and insurance companies).

Conclusions and Further Research

Thailand is a leading medical tourism hub and plans to transform into an Asia-Pacific medical hub; however, the initiative policy management and strategic movement remain a current and forthcoming challenge in Thailand's health system development. The main objective of this study is to determine the potential barriers to implementing a health information sharing policy in Thailand's patient referral systems. Furthermore, the study proposed conceptual healthcare information management for patient referrals to ensure the critical patients and healthcare information available when needed through the manipulated and standardized process, regardless of time and distance. In this paper, technical, economic, political, and legal are the four determinants influencing the implementation of healthcare information sharing policy and significantly affecting the practice.

The personalized feedback from healthcare professionals and patients would benefit from identifying the specific ways they could offer alternatives for improvement and development in the healthcare system. The driving force of the influential regulators or the decisive direction from the public health policymakers is an imperative component.

Nonetheless, prosperous and sustainable healthcare information systems require the central body to earnestly consider the distinct level of health information literacy and competencies. Therefore, further research on the distinctive health information literacy on an individual level will help address and contribute to developing health information literacy and competencies in Thai citizens.

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Fall 2022 Introduction

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