

# Findings from the 2023 Yearbook Section on Health Information Exchange

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## Summary

**Objectives:** To summarize the recent literature and research and present a selection of the best papers published in 2022 related to Health Information Exchange (HIE).

**Methods:** A systematic review of the literature was performed by the two section editors with the help of a medical librarian. We searched bibliographic databases for HIE-related papers using both MeSH headings and keywords in titles and abstracts. A shortlist of ten candidate best papers was first selected by section editors before being peer-reviewed by Yearbook editors and independent external reviewers.

**Results:** Major themes of the set of ten articles included factors influencing the organizational adoption of HIE and clinicians' use of the information, use of HIE in non-traditional settings, patients' perspectives on HIE, and outcomes of using HIE.

**Conclusions:** These studies provide suggestions for the research questions, theories, settings, methods, and outcomes that can be fruitfully used for further research on HIE.

## Keywords

Health information exchange; health information; interoperability; data sharing; health information technology; electronic health records

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## 1 Introduction

In the 2022 Yearbook synopsis, the authors discussed how the use of Health Information Exchange (HIE) has followed a similar trajectory to the use of EHRs [1]. The literature on electronic health records (EHRs) and exchange of health information (HIE as a verb) was initially focused on the technical architectures and technological considerations, such as connectivity. This was followed by a focus on providers' implementation of the health information technology (HIT). Once EHRs were more established, there was a shift away from research on adoption of systems to examining the outcomes of use and finally to do clinical and health services research using the vast amount of data within and across EHRs. In 2023, we can see more movement along that trajectory, from development and deployment of systems to use of the information for HIE. The Yearbook 2023 articles that were reviewed showed fewer articles on the technical and organizational issues involved in establishing HIEs and more articles on the use of HIE and the factors influencing that use. Although many of the articles were from the United States (US), there were articles from other countries as well. As a complement to the 2023 synopsis of the candidates for the best of the 2023 articles, the survey paper by Holmgren *et al.* explores the similarities and differences in the development, design, and implementation of HIE in several different countries [2]. The countries vary in degree of current development and use of HIE and the paper describes the different paths and progress HIE has had in each country, as well as the

lessons learned. The paper describes factors impacting and influencing HIEs, in addition to those associated with infrastructure, technical architecture, and technology. In this synopsis, we discuss the themes of ten papers that addressed HIE and were candidates for the best papers of 2022.

## 2 Methods

In January 2023, with the assistance of a medical librarian, the co-editors conducted a PubMed and Embase search using both MeSH headings and keywords in titles and abstracts with a focus on HIE. The publication year was 2022. The search strategy was as follows. A PubMed search was done first using the following search terms: ("Health Information Exchange"[Mesh] OR Health-Information-Exchange\* [tiab] OR Medical-Information-Exchange\* [tiab] OR "Health Information Management"[Mesh] OR "Health Information Management" [tiab] OR Health Information Management Journal [Journal] OR "J AHIMA"[Journal]) AND 2022[dp]. For Embase, the following search strategy was used: ('medical information system'/exp/mj OR 'clinical information system':ti,ab OR 'clinical pharmacy information system':ti,ab OR 'health information exchange':ti,ab OR 'health information management':ti,ab OR 'health information manager':ti,ab OR 'health information network':ti,ab OR 'health information system':ti,ab OR 'health information systems':ti,ab OR 'is-h med':ti,ab OR 'medical information service':ti,ab OR 'health information management journal') AND

(‘article’/it OR ‘article in press’/it OR ‘review’/it) AND [2022-2022]/py. There were 656 articles after eliminating duplicates. The 656 unique articles were rated by both section editors, who excluded articles that were opinion pieces, editorials, reviews, or not relevant to HIE. Each of the two section editors independently judged the relevance and the quality of the articles. Articles that either co-editor rated as not appropriate were excluded automatically. There were 30 articles that both co-editors considered strong candidates, and these were discussed in detail, and disagreements adjudicated to arrive at ten articles that, based primarily on the abstracts, were judged to be of good quality. The full texts of these ten articles were then rated independently by both section editors, two of the Yearbook editors, and several external peer reviewers.

The two ‘Best Papers’ were selected based on factors that included having a high average rating from the reviewers including recommendations for inclusion as one of the best papers, diversity of research approaches or focal area, geographic diversity and setting diversity. They are listed in Table 1. See Appendix to read the description of these two studies.

Below, we discuss the major themes of the ten research papers from 2022 that were candidates for being selected as a ‘Best Paper for 2022’.

### 3 Results

The papers selected for potential candidates for Best Papers reflect that HIE approaches and infrastructures have become more prevalent, but still not universally adopted. HIEs

collect a wide range of data and data access and use vary. With the increased prevalence of hospitals and other healthcare providers using HIE, we have more information to examine about the factors leading to effective use. In addition, HIE is now being implemented in more varied settings and there are more studies examining patients’ attitudes to HIE and finally, the outcomes of using HIE.

#### 3.1 Factors Affecting HIE Use

Four of the ten articles examined factors that affect HIE adoption and/or use. These factors included organizational, policy, regulatory, and clinical factors. Nwafor and Johnson examined whether participation in an Accountable Care Organization (ACO) influences how information is exchanged using information from the American Hospital Association (AHA) survey of US hospitals [3]. This paper was judged to be one of the two best papers for this year and is summarized in detail below. The authors found that ACO membership increased information exchanged within the health system and with patients, but participation in ACOs was not associated with inter-organizational information exchange. In addition, marketplace factors affected the degree to which information was exchanged with patients. Everson and Patel also used the AHA survey data to examine hospitals’ patterns of use and sources of information [4]. They found that most hospitals used multiple sources for outside information including participating in a regional HIE, as well as use of vendor networks. Cross *et al.* used a different national survey to examine differences in adoption of HIE in safety net primary care practices in the US

[5]. Although the safety net practices’ use of HIT was comparable to other primary care settings, their ability to use HIE was more limited.

The studies show that using survey data can provide information on a variety of organizational factors that influence HIE adoption and, to an extent, use, but the surveys, of necessity, rely on self-reported information and often the person who is reporting the data may be a hospital administrator or individual from the HIT department, not the actual clinicians who are using (or not using) the information that is available through the exchange. In contrast to survey data, Mullins *et al.* used EHR log data to examine the actual access and use by clinicians of data from the HIE [6]. This study was also one of the Best Papers for this year, and is summarized in more detail below. The researchers found that despite the availability of the data, it was not always accessed. In fact, it was accessed on less than 20% of the patients for which it was available. In addition, it was pharmacists, not physicians, who accessed the information most frequently and mainly on patients with more complex conditions.

Now that HIE is more established in multiple countries, the research questions have shifted to more studies examining if and how it is used. While the results of these four studies do not provide definitive results, they do provide a range of research questions and diverse methods that can be considered to study them that can guide future research on factors influencing the use of HIE.

#### 3.2 HIE Use in Diverse Settings and with Different Types of Data

Now that many hospitals and ambulatory practices have capabilities for HIE, even if it is not uniformly used, there are more articles examining the use of HIE in different types of settings. Lin and Tunalilar described HIE in assisted living communities [7]. Interestingly, these communities mainly focus on supporting medically frail individuals, in addition to acute care provided by hospitals or primary care physicians. This study, like many of the others, used national survey data on assisted living communities to look at the change over time from 2010 to 2018. The

**Table 1** Best paper selection of articles for the IMIA Yearbook of Medical Informatics 2023 in the section ‘Health Information Exchange’. The articles are listed in alphabetical order of the first author’s surname.

Section
Health Information Exchange
<ul style="list-style-type: none"> <li>Mullins AK, Skouteris H, Rankin D, Morris H, Hatzikiakidis K, Enticott J. Predictors of clinician use of Australia's national health information exchange in the emergency department: An analysis of log data. <i>Int J Med Inform</i> 2022 May;161:104725.</li> <li>Nwafor O, Johnson NA. The effect of participation in accountable care organization on electronic health information exchange practices in U.S. hospitals. <i>Health Care Manage Rev</i> 2022 Jul-Sep 01;47(3):199-207.</li> </ul>

researchers found that the use of EHRs and HIE increased over time, but that EHR use in 2018 was more prevalent than HIE use. The 2018 data is now five years old and it will be interesting to see if there is increased use of HIE in these communities in the future.

Another setting is the use of HIE by school nurses who are responsible for students with chronic illnesses during the school day. A study by Baker *et al.* examined the outcomes of providing access to EHR data from local hospitals to school nurses in the Denver, Colorado metropolitan area [8]. The authors found that there was a decrease in both emergency department visits and hospitalizations after the nurses were provided access. While encouraging, this study was an observational study and did not track the actual use of the system by the nurses, nor the health outcomes for patients. However, it suggests unique uses of HIE and further research questions for future studies, including the ability of community-based organizations (such as schools) to access health data as part of individuals' continuum of chronic care management and real-time care coordination, collaboration, and integration across settings and providers.

In addition to studies of HIE in different settings, there are now studies on the unique exchange needs for different types of data. Nagels *et al.* described some of the unique issues involved in image exchange [9]. In the future, we can expect to see more studies focusing on the use of HIE for different types of data, as well as in different types of settings.

### 3.3 Patients' Perspectives on HIE

Another change that has showed up over the last year is going beyond the hospital or clinician focus on the use of HIE to examine patient attitudes toward the idea of permitting exchange of their own health information across healthcare settings. Two studies in our ten candidate papers examined patient perspectives, one from China and the other from the US. Zhang and Zhang used the theory of planned behavior to study a variety of factors influencing Chinese patients' willingness to opt-in to the exchange of their health information [10]. They found

that while trust in HIE was related to willingness to opt-in to HIE, patients' health status also had an influence. This study used a frequently employed theoretical framework (Theory of Planned Behavior) that could be replicated in other countries to get a more general understanding of the factors that influence patient attitudes to HIE.

Another study by Matthews *et al.* used a different theory, the Unified Theory of Acceptance and Use of Technology (UTAUT), to study the attitudes of a particularly vulnerable population [11]. The Matthews *et al.* study examined how depressed patients in a safety net primary care setting felt about sharing their mental health information. This qualitative study found that the perceived stigma of mental health information made patients cautious about HIE, even though they also understood some of the benefits of all their providers having access to their health information.

Both studies suggest theoretical frameworks, research questions and different methodologies to pursue in order to better understand patients' willingness to have their data shared.

### 3.4 Outcomes of Using HIE

Although there have been more studies of the impact of using HIE on healthcare outcomes, most of those studies have been observational, rather than the gold standard of randomized controlled trials (RCTs). This is understandable and is also the case for studies of the impact of EHRs because EHRs and HIE require a huge organizational investment and RCTs related to their use are not always feasible. One exception is the Veteran's Affairs system in the US, where national policies and systems are similar across different facilities. Boockvar *et al.* did an RCT to determine whether HIE, combined with an additional intervention on care transitions, was superior to HIE alone [12]. They did not find any difference in their primary outcome of readmissions, nor in a variety of secondary outcomes. Although this study was not exclusively an RCT on the impact of HIE, it suggests that efforts can be made to improve the rigor of research designs used to study HIE's impact on patient outcomes.

## 4 Conclusions

The studies on HIE conducted in 2022, of which a sample is summarized here, emphasize the use of HIE, the factors influencing its use, rather than the basic design and technological implementation of HIE systems. They also show that HIE is used in more diverse settings and they have begun to study both patient attitudes to HIE use and the effect of HIE on patient outcomes. While the ten diverse studies need further research to be assured of the generalizability of their results, they can provide suggestions for the research that needs to be done in terms of research questions, theories, settings, methods, and outcomes that can be fruitfully used to pursue the factors that influence HIE use, acceptability and outcomes.

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## Appendix: Content Summaries of Best Papers for the Health Information Exchange Section of the 2023 IMIA Yearbook

Mullins AK, Skouteris H, Rankin D, Morris H, Hatzikiakidis K, Enticott J

**Predictors of clinician use of Australia's national health information exchange in the emergency department: An analysis of log data**

*Int J Med Inform* 2022 May;161:104725. doi: 10.1016/j.ijmedinf.2022.104725

This paper describes a retrospective analysis that explored patient and context-related factors associated with use by emergency department (ED) clinicians in Australia of Australia's national personally controlled Health Information Exchange (HIE), My Health Record. The authors assessed secondary routinely-collected data (all patients who presented between August 2019–2021) to the ED at a not-for-profit hospital in Melbourne (n=48,782 patients). The researchers linked patient level data to the HIE access log-data, and administrative data and conducted multivariable analyses. The results indicated the extent to which the ED pharmacist, physician, or nurse accessed the HIE within three days of the patient presenting to the ED. Nine variables were explored with logistic regression, representing patient (gender, age, diagnosis) and other factors (presentation time, arrival method, referral, acuity/triage, length of stay, admitted into hospital). The study indicated that the HIE was accessed in 17.43% of patient presentations to the ED. Overall, increased HIE access was associated with increasing patient age, with the biggest effect for 75-84-year olds (odds ratio 26.15; 95% confidence interval 15.37-44.50), when compared to < 4 years of age. HIE access was also significantly and positively associated with patients who were later admitted into the hospital from the ED (4.96; 4.61-5.34). The research demonstrates that use of electronic health record (EHR) log data is a good approach and better than surveys

to study use of data. Findings indicate that there was limited use of the information (17.43%) and that use tended to lead to admissions, which increased the costs of care. Other important study findings are the characterization of who used the HIE and for what types of patients. Results suggest that while the clinicians in the ED employ the system to meet their needs, they do not access the information for all patients. The authors suggest that to improve ED patient care, it is important to improve physicians' and nurses' documentation for older people and those suffering from complex medical conditions. The authors indicate some study limitations including those related to generalizability because the study was conducted at one hospital. Additionally, the authors did not provide details concerning the specific data that was accessed and for what clinical problem(s), although since pharmacists were the major users, it can be inferred that medications, or clinical conditions that might influence medication use, were likely of major interest. Countries who are contemplating establishing a national personal health record solution might find the study applicable and informative as would others considering the use of log data for other purposes.

Nwafor O, Johnson NA

**The effect of participation in accountable care organization on electronic health information exchange practices in U.S. hospitals**

*Health Care Manage Rev* 2022 Jul-Sep 01;47(3):199-207. doi: 10.1097/HMR.0000000000000319

There are major efforts within the United States to move away from fee-for-service care toward various alternative payment models (APMs) such as Accountable Care Organizations (ACOs) [13, 14]. ACOs are groups of doctors, hospitals, and other health care providers, who come together voluntarily to give coordinated high-quality care to patients. ACOs, which generate savings for their assigned patient population in a given financial year and meet specific quality benchmarks, are eligible for part of the cost savings. Although ACO incentives are not directly linked to electronic health in-

formation exchange (HIE), ACO proponents believe that the prospect of financial rewards would motivate participants to increase activities that promote the coordination of care including HIE. Given the variations in prior research findings about ACOs and HIE, the authors examined the relationship between hospital participation in ACOs and HIE practices of care with different participants and how these practices vary across market types. Their study is based on the premise that information sharing is a necessary activity for effective coordination. The authors predicted three hypotheses related to dimensions of HIE. The study used a cross-sectional design that draws on secondary data obtained from the following data sets for 2018: American Hospital Association's (AHA) Annual Survey and Annual Health Information Technology Supplement Survey, Centers for Medicare & Medicaid Services cost reports and impact files, Dartmouth Atlas of Healthcare, and the Leavitt Partners' ACO database ultimately resulting in a sample of 1,926 hospitals belonging to health systems.

- Hypothesis 1: the intraorganizational HIE practice levels of hospitals participating in ACOs will exceed those of nonparticipating hospitals;
- Hypothesis 2: the interorganizational HIE practice levels of hospitals participating in ACOs will exceed those of nonparticipating hospitals;
- Hypothesis 3: the provider-patient HIE practice levels of hospitals participating in ACOs will exceed those of nonparticipating hospitals.

Study findings indicated that hospitals participating in ACOs vary in their HIE practices, and attributes of the local market in which ACO participants are located contribute to this variation. The researchers found that hospital participation in ACOs is associated with greater intraorganizational and provider-patient HIE practices, but ACO participation is not related to interorganizational HIE practices. The authors note that although "*the relationship between ACO participation and intra- and interorganizational HIE practices remains unchanged irrespective of the degree of competition in the health care market, the relationship between*

*ACO participation and provider-patient HIE practices holds true only for hospitals operating in noncompetitive markets”.*

These results are interesting in that interorganizational information sharing is foundation to and an essential component and function of HIE. Information exchange and sharing is also assumed to be important to ACO participants, yet there was no statistically significant difference in interorganizational information sharing between ACO and non-ACO participants. It is possible that this result was because the sample only included

hospitals that were part of health systems, and that information exchange outside those systems may be minimal regardless of ACO membership. The authors discuss limitations of their approach and note the challenges of using cross-sectional data to investigate electronic HIE practices that are likely to change over time. The authors believe that their findings offer theoretical and practical guidance to administrators seeking to improve the effectiveness of their ACOs, to researchers who study new forms of healthcare organizations, and to policy-makers who are

developing policies for value-based care. For example, they highlight that although ACO incentives are not directly linked to HIE practices, these incentives may serve to promote greater information sharing with certain participants in the care process. The authors also discuss the need for additional policy interventions to promote greater HIE practices with patients and unaffiliated provider organizations—especially under competitive market conditions.