

BEFORE FORMATTING

1 Literature Review

This literature review focuses on background literature for studying how health care organizations can reconcile and integrate external clinical data into their EHRs. For this study, the primary concept is HIE with two sub-literature streams: (1) realized benefits and considerations, and (2) data format and standards. I researched this concept using library databases Web of Science, Business Source Ultimanium, and PubMed to search for academic articles and practitioner-focused articles. In total, the selection includes 16 papers. Appendix 3 provides a summary of literature concepts and streams, [unclear What are the streams?] as well as identified areas of concern.

1.1 HIE

1.1.1 Benefits and Considerations

Prior literature outlines the benefits of HIE (Ayabakan et al., 2017; Zwaanswijk, 2011). Specifically, HIE benefits include a reduction in duplicate testing, which also results in cost savings, in addition to increased efficiency, quality care, expedited communication, and access to more up-to-date information (Zwaanswijk, 2011). Results, however, are mixed (Dobrow et al., 2019; Menachemi, et al., 2018; Sadoughi, et al., 2018). For example, one study evaluated the impact of data exchange on duplicate testing. Using 39,600 patient visits from 2005-2012 that cover 68 outpatient clinics, the results indicate that HIE will reduce duplicate testing, which in turn reduces overall health care cost, patient exposure to unnecessary radiation, and additional blood draws related to laboratory testing (Ayabakan et al., 2017). This estimated economic benefit from information sharing or data exchange is 13.7% avoidance of test duplication, because previous testing showed that providers can access because of HIE, can save \$31.8 billion annually (Ayabakan et al., 2017). Sadoughi et al. (2018) completed a systematic literature review; that indicated [accurate?] 60% of the studies found positive financial benefits, and 64% positively impact quality. Another study did not find statistically significant evidence of cost-saving related to HIE or

reduction in duplicative testing; instead, this study suggests savings may result from positive clinical outcomes (Ross et al., 2013). In summary, the literature concludes that cost savings are limited to imaging studies and lab tests. The research did not identify significant financial impacts on overall hospital resources, such as a reduced length of stay or quantity of outpatient visits (Sadoughi et al., 2018). In addition, researchers note that little is known about the data exchange of physician notes, including consultation reports. Physicians note that exchanging addresses proves the necessity of addressing overall disease prevention and total cost reduction. Dobrow et al. (2019) drew a similar conclusion in a systematic literature review noting positive results receive more considerable attention and evaluation, suggesting that HIE aspects not frequently studied would benefit from some rigorous research. Sixty percent of the reviewed study designs involved cohorts, and studies found overall quality of the studies to be low. Additionally, the published studies represent only four countries with the United States being the most common, followed by South Korea, Finland, and China (Sadoughi et al., 2018). Another systematic literature review reported similar findings where 76.2% of the analyzed studies were from the United States, with the remaining 23.8% representing four other countries. However, location is not statistically significant in identifying the benefits of HIEs (Menachemi et al., 2018). Dobrow et al. (2019) suggest that comprehensive research is needed in Canada to assess the impact of related health information. Additionally, Sadoughi et al. (2018) note that more research is needed on chronic disease conditions, since this topic has limited research. Menachemi et al.'s (2018) systematic literature review focused on distinct outcomes of HIE's, and in total, analyze 24 validated, high-quality studies with 63 analyzed results. The systematic review found 48% of the organizations studied experienced health care resource utilization benefits from HIE's, while 77.8% reported financial help, and 90% experienced quality benefits (Dobrow et al., 2019; Menachemi et al., 2018; Sadoughi et al., 2018). Another systematic review found 57.1% positive outcomes, with quality and productivity ranking highest (Dobrow et al., 2019).

Literature also focused on adopting and accepting HIE. In Sadoughi et al.'s (2018) systematic literature review, nine studies reported HIE adoption, ranging from 79% to 15.7% in various care settings. All care settings (ambulatory clinics, emergency departments, hospitals, long-term care facilities, etc.) demonstrated adoption of HIE and a corresponding increase in utilization; however, most presented only one-way data exchange (Sadoughi et al., 2018). Organizations should integrate their EHR with two-way HIE data exchange capabilities to capitalize on its benefits, as literature demonstrated that HIE participation is higher in those organizations (Sadoughi et al., 2018). One study researching HIEs in California identified that the HIE design, or presentation to the provider, influenced adoption (Miller, R., 2012). Providers expressed that HIE data must be accessible via their EHR, rather than viewing and synthesizing it from different web browsers or electronic information portals (Miller, R., 2012). A systematic literature review affirmed that data presentation and layout were identified as variables yielding more negative than positive outcomes on the impact of HIE utilization (Dobrow et al., 2019). Patient-specific data—such as medications, allergies, chronic diseases, histories, lab results, and radiology reports—can be more efficiently synthesized by providers when integrated with the EHR (Miller, R., 2012). Another factor influencing the extent of use for care included data-sharing methods that "fit" with provider office workflow—mainly electronic data exchange interfaces that enables easy viewing within EHRs (Miller, R., 2012). Other considerations influencing adoption and utilization include confidentiality and safety of the received HIE information and the data accuracy and timeliness (Dobrow et al., 2019; Zwaanswijk, 2011). Zwaanswijk et al. The 2011 study Zwaanswijk et al. researched three Dutch health care settings and used case studies and interviews to allow HIE respondents to share their perceptions. All parties noted they believed in the value of HIE and its benefits; however, they documented concerns such as data accuracy and quality of received external clinical data, including pertinent information such as date, time, and test(s) performed (Zwaanswijk, 2011) Does that citation need to say et al., like it does above with the same year? Others perceived receiving too much or

become overloaded with information. Additionally, when the receiving provider is not familiar with the external provider, they must blindly trust and accept responsibility for the data, which is challenging (Zwaanswijk, 2011).

Another concept related to general use of HIE technology includes providers' recognized value of the external clinical data. Providers need to give proper importance to the received data. Miller (2012) explored providers' demonstration of value using accountability. One concept studied asked how organizations processed, accessed, or utilized the received external health data. In conjunction with organization policies that foster accountability, this utilization could realize the benefits of HIE or the utilization of external clinical data. The results of the study suggest that the benefits of medical data exchange are not yet being realized (Miller, R., 2012). When Kuperman et al. (2013) evaluated underlying concerns associated with HIE regarding the value of exchanged medical data, this research echoed other points regarding external data exchange:

- Data, when exchanged, includes elements previous providers felt to be relevant. Therefore, the completeness of the data remains uncertain.
- The timeliness of data—specifically how far back the data point originated—is sometimes unknown.
- Presentation of data to receiving clinicians doesn't offer non-standardized records due to mapping the data from one source to another. [Still accurate?]
- The research deduces that HIE may not be a helpful resource if providers do not have sufficient timely data or confidence in the data.

1.1.2 Data Formatting and Content Standards

The data format, which refers to the way clinical data is electronically exchanged and made available to providers and health care organizations for integration into the EHR, is sometimes reported to be unusable for clinical care (Miller, R., 2012; Vest, J., 2013; Walker, et al., 2021). There is a lack of

data standards for the exchanged medical data (Walker et al., 2021). The lack of standardization prevents clinical users from integrating, using, and in some cases understanding the data (Vest, J. R., et al., 2019). [Need consistency in referring to this reference] The lack of standardization also increases the cost and time to receive and present electronically external clinical data (Walker et al., 2021). A California case study by Miller (2012) focused on concepts including "Universal Design, Accessibility, and Interoperability." This research included interviews with the most knowledgeable HIE staff, including staff from participating organizations and state and local leaders. Several interviewees highlighted the expense and organizational challenges when exchanging clinical data from different EHR vendors. The interviewees noted that the current framework, or standard formatting, allows for co-existing standards and organization-specific data standards interpretation. Therefore, increased complexity, delivery time, and cost of exchanging data prohibits integration into the EHR. [Still accurate, please?] A documented theme of the study presented standards to allow EHR vendors to individually interpret and consequently increase the time and money required for health care providers to receive, use, and integrate external clinical data (Miller, R., 2012). Other research observed varying degrees of success with electronic exchange of medical data among communities and providers nationwide. [Do we need a reference/citation?] The research affirms the general theme of variability in data standards and points out that foundational aspects of exchanged data cannot be fundamentally compatible (Vest, J. R. et al., 2019). The study results, which focus on efforts in the state of New York, found extensive financial expenditures from the upfront cost required to make external data and technology solutions work together (Vest, J. R. et al., 2019). One interviewee, a federal agent, noted that one of the biggest problems includes the lack of a universal design or standards for how organizations control and utilize the data (Vest, J., 2013). [Should we add an "R" to that citation? Previous similar citations say Vest, J. R.?]

Additionally, technology for bridging variability remains expensive and involves scarce resources (Walker et al., 2021). That research (Walker, et al., 2021) studied the PI objective of public health reporting; similar to other studies, they found that meaningful use initiatives positively influenced overall EHR adoption. However, in 2012, fewer than half of the reporting hospitals failed to meet the public health reporting requirements, while the 2015 data showed improvement with more anticipation for successfully meeting the requirement (Walker et al., 2021). The study results identified challenges hospitals and public agencies face in meeting requirements: technology, specifically interface issues between data exchanges, were common due to a lack of standardization (Walker et al., 2021). Public health reporting agencies, who receive HIE data from health care providers, reported interoperability concerns due to inconsistent data standards, the cost of developing infrastructure to support the exchange, and the cost of staff to implement and support ongoing exchange (Walker et al., 2021).

1.1.3 HIE Conclusion

In conclusion, prior research discusses the complexity of electronic exchange of clinical data and providers' perceptions of benefits and other considerations related to the exchange of clinical data.

Prior research indicates that additional studies will be necessary to establish nationwide and global data formatting, including medical data exchange standards versus the existing regional or statewide approach (Vest, J., 2013). ONC is responsible for the current established standards; there is a required additional examination to determine the best roadmap and ensure it aligns with the identified barriers.

Additionally, the literature highlights cost as one of the barriers to valuing electronic data exchange, based on set-up and on-going IT support costs (Miller, R., 2012; Vest, J., 2013; Walker et al., 2021). [Add

an R? to Vest?] The literature suggests that mandating additional policies and standards should eliminate, or mitigate, this barrier (Miller, 2012; Walker et al., 2021).

Also of importance is the value, as seen by the provider. Literature affirms this must be addressed. Zwaanswijk et al. (2011) concluded that future efforts must focus on user preferences and

minimizing problems associated with HIE, including evaluating the providers' EHR integrating patterns and striving to ensure quality and reliability of received and combined external data. In alignment with this opportunity, this research seeks to identify ways a provider or health care system can improve reconciling and integrating external clinical data. Table 3 below summarizes the literature concepts and impact HIE adoption.

Table 3: HIE Benefits, Consideration, Data Formatting and Content Standards

Description	Impact
Benefits and Considerations	<ul style="list-style-type: none"> • HIE Adoption benefits include increased efficiency, quality care, expedited communication, and access to more up-to-date information. • Literature empirically confirms cost savings for imaging and lab studies; however, further evaluation is needed to ascertain impact of data exchange on quality and other metrics such as length of stay. • Current literature is predominantly United States focused. • Providers’ question data timeliness, quality, and accuracy, as well as the presentation for realizing imported benefits.
EHR Vendors, Health Care Providers, and Other Health Care Entities Interpretations and Variability	<ul style="list-style-type: none"> • Variability in interpretating standards, thus prevents clinical users from integrating, using, and understanding the external clinical data. • Exchanged data is not fundamentally the same, so the industry lacks a universal design with how organizations control and utilize the data.
Expensive Technology	<ul style="list-style-type: none"> • Increases cost and time to receive and present electronically external clinical data. • Expensive cost of developing infrastructure to support the exchange of external clinical data. • Expensive cost for staff to implement and support ongoing [add “HIE” or “information” here for clarity?] exchange.

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2 Literature Review

This literature review focuses on background literature for studying how health care organizations can reconcile and integrate external clinical data into their EHRs. For this study, the primary concept is HIE with two sub-literature streams: (1) realized benefits and considerations, and (2) data format and standards. I researched this concept using library databases Web of Science, Business Source Ultimanium, and PubMed to search for academic articles and practitioner-focused articles. In total, the selection includes 16 papers. Appendix 3 provides a summary of literature concepts and streams, [unclear What are the streams?] as well as identified areas of concern.

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2.1.1 *Benefits and Considerations*

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