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Barriers and facilitators to exchanging health information: a systematic review

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Abstract

Objectives—We conducted a systematic review of studies assessing facilitators and barriers to use of health information exchange (HIE).

Methods—We searched MEDLINE, PsycINFO, CINAHL, and the Cochrane Library databases between January 1990 and February 2015 using terms related to HIE. English-language studies that identified barriers and facilitators of actual HIE were included. Data on study design, risk of bias, setting, geographic location, characteristics of the HIE, perceived barriers and facilitators to use were extracted and confirmed.

Results—Ten cross-sectional, seven multiple-site case studies, and two before-after studies that included data from several sources (surveys, interviews, focus groups, and observations of users) evaluated perceived barriers and facilitators to HIE use. The most commonly cited barriers to HIE use were incomplete information, inefficient workflow, and reports that the exchanged information that did not meet the needs of users. The review identified several facilitators to use.

Discussion—Incomplete patient information was consistently mentioned in the studies conducted in the US but not mentioned in the few studies conducted outside of the US that take a collective approach toward healthcare. Individual patients and practices in the US may exercise

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the right to participate (or not) in HIE which effects the completeness of patient information available to be exchanged. Workflow structure and user roles are key but understudied.

Conclusions—We identified several facilitators in the studies that showed promise in promoting electronic health data exchange: obtaining more complete patient information; thoughtful workflow that folds in HIE; and inclusion of users early in implementation.

Keywords

health information exchange; users perceptions; barriers; attitude to computers

1.0 INTRODUCTON

Patients in the US often receive care from multiple providers who practice in unaffiliated organizations. The result is that the patient's clinical record can be fragmented and incomplete in any one given location. Health information exchange (HIE) is the process of electronically exchanging clinical information across organizational boundaries and seeks to remedy this fragmentation.[1] This exchange occurs among health care providers, across the boundaries of health care institutions, health data repositories, states and countries, typically not within a single organization or among affiliated providers, while protecting the integrity, privacy, and security of the information. Some projections have estimated that HIE effectiveness may be manifest in billions of dollars of savings per year all the while improving quality of care.[2] Outside of the US, HIE is also important in other countries with advanced health care systems.[3, 4]

The US government as well as other national governments are making substantial investments to further the growth of HIE. Many local governments and individual health organizations are also following suit. As part of the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, substantial funding for the creation of HIE was made available and there has been marked growth in HIEs in the US.[5]

Since 2009, the number of hospitals and providers exchanging data has sharply increased but perceived barriers to use has not been well described.[6] While organizational involvement and capacity for HIE are increasing, the data about actual use of accessible HIE have been limited and suggest that HIE is still not integrated into usual care.[6] Health professionals are the primary users of HIE systems but little is known about their perceptions of such systems and the barriers they face.[6] A system that the users find slow, confusing and awkward is likely to see little adoption by front-line providers. This article expands on the work conducted as part of a larger systematic review conducted under the auspices of the Agency for Healthcare Research and Quality (AHRQ) and registered as PROSPERO Registry No. CRD42014013285.[6] The purpose of this article is to describe the current evidence on perceived barriers/facilitators to HIE use. Prior reviews focused on barriers to HIE adoption and implementation, primarily in the US.[7-9]

2.0 MATERIALS and METHODS

HIE was defined as the *electronic* sharing of clinical information among users to facilitate care coordination and transitions across settings. This excludes exchange of predominantly paper-based information.[6] A standard protocol for the review was developed that incorporated input from key informants and a technical expert panel.[10] Detailed methods and search strategies for the larger review can be found in the technical report.[6] We used the bibliographies of prior reviews[7-9] to verify our search strategy and identify additional studies. We considered the findings reported in the prior reviews as we developed groupings of barriers and facilitators.

2.1 Data sources and searches

A research librarian conducted electronic database searches using combinations of terms related to HIE (e.g., health information exchange, healthcare information, medical records linkage, clinical data exchange) to identify relevant articles published between January 1990 and February 2015 in MEDLINE (Ovid), PsycINFO, CINAHL, and the Cochrane Library databases (see Appendix A of the main report).[6] This search was peer reviewed by a second librarian. We also searched reference lists, table of contents of journals not indexed in the databases searched, and consulted experts in the field.

2.3 Study selection

English-language studies that contained data on facilitators and barriers to use of implemented HIE systems were included. We included studies performed both in the US and in other countries. Studies describing HIE that was in the planning phase or that described HIE systems at a single site without providing information related to barriers and facilitators to use were excluded. We also excluded studies that described simple remote access in which a clinician in one healthcare system logged into the separate system of another healthcare organization without electronic system-to-system transfer of information. Two investigators independently evaluated each study to determine inclusion eligibility. Disagreement was resolved by consensus with a third investigator making the final decision as needed.

2.4 Data extraction and risk of bias assessment

One investigator extracted detailed information from included studies, and a second assessed for accuracy and completeness of data. Details extracted included study design, setting, geographic location, characteristics of the HIE implementation, evaluative data, analysis, and results. When sufficient detail was provided, two investigators assessed the methodological strengths and weaknesses of each study based on the following: whether the sampling strategy was reported (Yes/No) and appropriate, meaning likely to produce a sample representative of the population of interest (Yes/No); whether the response rate was reported (Yes/No) and then listed response rate in percent) and acceptable given the type of study (e.g., over 70% for targeted interviews; over 20% for general mail surveys) (Yes/No); whether the characteristics of the respondents were reported (Yes/No); whether the development process for the questions was reported (Yes/No) and rigorous (e.g., used existing validated measures or attempted to validate or test the reliability of the questions)

(Yes/No), and whether the analysis was appropriate given the type of data (Yes/No). A risk of bias rating was then determined. Studies that didn't meet three or more criteria were assessed as high risk of bias, potentially invalidating results. High risk studies were included in the **eAppendix Tables** but are not discussed further.

2.5 Data synthesis

In the included studies, evidence relating to barriers and facilitators to HIE was not amenable to quantitative synthesis due to the heterogeneity of interventions studied and outcomes reported. We therefore performed a content analysis and qualitative synthesis of findings from included studies. Each paper was reviewed by the first author (KE, an informatics specialist with systems science background) to identify concepts related to barriers and facilitators of HIE implementation or use. The concepts were sorted into thematically related groups and common themes were identified. A second author (SK, physician and informatics specialist) reviewed the groupings and themes. The two investigators used an iterative, open coding approach to refine the grouping and themes until consensus was achieved. A third author (PG, physician and informatics specialist) reviewed these results and made minor refinements to achieve final results.

2.6 Role of the funding source

AHRQ funded the review but had no role in study selection, quality assessment, or synthesis. The investigators are solely responsible for the content.

3.0 RESULTS

We identified nine multiple site case studies,[11-19] 11 cross-sectional studies,[20-30] and two before-after studies[31, 32]. Figure 1 depicts the search selection process for the full report[6] and the lower levels of the figure focus on the subset of studies that addressed facilitators and barriers to use (n=22). All but five[21, 25-27, 32] of the studies described experience with exchanging health information in the US. In total, 292 health professionals (non-clinicians) and 402 clinicians in the US were surveyed, interviewed or participated in focus groups sessions.[12, 15-20, 22-24, 28-31] The settings in these studies often included exchange between emergency departments, ambulatory clinics and/or hospitals making stratification by setting difficult. Two additional US-based studies also provided perspective from patients about willingness to have their own data exchanged.[11, 12] The international studies provided survey data that included responses from over 11,000 clinicians from 31 European countries[21, 25, 26, 32] and Australia.[27] The largest (n=9196) of these international studies was a survey focused on eHealth that also reported on barriers to HIE use gleaned from two focus group sessions.[21] The studies are described in **eAppendix: Table A**.

Because of the mix of surveys, multiple site case studies, and before-after studies that reported on barriers and facilitators to HIE, it was difficult to assign an overall strength of evidence assessment to the literature. Instead, the risk of bias for each study was assessed (see **eAppendix Table B**). Eight of the 22 studies met all criteria and were considered low risk of bias.[16, 18, 21, 23, 25, 26, 28, 29] Eleven studies were rated moderate risk of bias (did not meet 1-2 criteria or did not report the information on the criteria, **eAppendix Table B**).[11, 14, 15, 17, 19, 20, 22, 24, 30-32] Two multiple site case studies were considered high risk of bias.[13, 27] One study did not provide sufficient detail to rate the study for risk of bias.[12] Results from these three studies[12, 13, 27] were included in the **eAppendix Tables** but are not discussed further (see **Figure 1**, included studies, n=19). Response rates in the cross-sectional and before-after studies ranged from 19% for an online survey of physicians[20] to 70% for an emailed survey of health professionals[23] (see **eAppendix: Table B**).

3.1 Perceived facilitators and barriers to use

We identified 15 barriers and 20 facilitators to the use of HIE in the included studies (**Table 1**). These were identified from several types of sources (e.g., interviews, focus groups, and observations). Four evaluations of the MidSouth e-Health Alliance (MSeHA) provide evidence on barriers and facilitators of use[14, 18, 19, 23] but other studies echoed similar issues.[11, 15-17, 21, 22, 24-26, 28, 29, 32] Barriers and facilitators to use fell under three broad themes: completeness of information, organization and workflow, technology and user needs (**Table 1**).

3.1.1 Completeness of Information—One commonly reported finding was not enough information in the HIE system to warrant use (**Table 1**).[11, 15, 17, 18, 20, 22, 24, 28-30] Several barriers contributed to incomplete information: patients did not participate because of concerns about privacy[20, 28, 30] or they received care outside of the HIE catchment area;[15] a poor patient matching process.[11, 24] Providers stopped using the query-based system when they could not find patients or new information on patients[15, 18, 20, 24, 29, 30] (**Table 1**). Incomplete information was found to be a key issue in studies conducted in the US but was not mentioned in studies conducted outside of the US. Underlying reasons for incomplete information can include that HIE systems do not integrate all important sources of data, perhaps over concern of losing referrals to competition.[18] Patients concerned with privacy and security may not understand the benefits and/or may not consent to have their data shared with other providers. Even when patients do consent, they may not be properly matched to existing data.[11, 24] Also, patient match rates can vary by population and setting; for example, the match rate for providers practicing in a homeless center was lower, but the match rate for emergency department physicians was higher.[24] Some providers reported legal concerns about sharing patient data and may choose to not participate.[18, 30] The end result is that providers searching for patient information may grow frustrated if they take the time to search, do not find useful data and then they may stop using the system.

To increase the availability and usefulness of patient information, several approaches have been suggested to create more complete patient information. These include addressing concern about privacy with policy and training,[22, 31] careful consideration and design of the consent process,[11, 15, 30] and creation of a process for educating patients.[15, 30] To address patient and provider concern about privacy, organizations should create clear policies and promote understanding about privacy and data sharing among all stakeholders (providers, patients, non-clinician partners) prior to implementation of any data exchange.

[31] In planning for electronic health exchange, it is important to decide whether to have an opt-out or opt-in consent process for patients as this effects rates of participation and ultimately, completeness of information.[30] We identified one organization that used an opt-out protocol and documented the opt-out rates (MSeHA).[14, 19] Patients had the option to opt-out at every encounter. The opt-out rate across all sites was 1 to 3%,[14] which is slightly better than programs with an opt-in protocol that lose 3 to 7% of patients who do not consent.[20, 29] The percentage of consented patients can be increased with a workflow that includes front line staff members being trained and able to educate and consent patients as they first arrive.[15] Finally, different approaches for identifying patients, e.g., use of a probabilistic matching algorithm, may improve the success rate for finding new information on patients.[11]

3.1.2 Organization and Workflow—Differences in how an organization incorporated HIE into workflow based on role and daily operations also affected use in studies conducted in the US,[14-20, 23, 24, 28, 29, 31] Finland,[25] Austria,[26] and Denmark.[32] Workflow that included separate logins and too many clicks to get to the information proved a barrier to use.[15, 18, 19, 23, 25, 29, 30] Additionally, some organizations made it difficult for providers to get privileges to access exchanged data so those with privileges were called upon to look up information for those without access.[18] By contrast, use of non-physician proxies (e.g. nurses, admitting clerks) in accessing the HIE system was a facilitator and led to greater use of the system.[14] Proxy use was described as a way to save provider time or address needs of limited users without privileges.[18, 24, 29]

An ethnographic qualitative study of the MSeHA identified two role-based workflow models: physician-based and nurse-based.[19] Users varied in how they used the exchange based on role, with nurses seeking information generally at the point of triage with infrequent access at other times. Additionally, the nurses focused primarily on seeking information related to recent hospitalizations. In the nurse-based model, if a patient mentioned a recent hospital visit, the triage nurse or medical assistant would search for data primarily looking for summary documents related to recent hospital visits, such as a discharge summary, but rarely searched for other medical history. The nurse then printed off the information for use by the provider. In contrast, the nurse practitioners and physicians accessed the HIE at multiple points during the care timeline. These providers browsed online medical history for purposes of decision-making.[19] Finally, another evaluation study of the MSeHA reported that use dropped significantly after a new policy prohibited registrars and nurses from searching the system at the start of a visit.[14] Initially registrars and nurses would print off a summary sheet of available data. Providers then queried the system, based on the summary sheet. When this policy was changed, use declined.

During implementation several other strategies were mentioned related to changing current workflow: single login,[14] providing training and adequate technical assistance to support the new workflow,[17-19, 23, 24, 26, 29, 32] addressing needed culture change,[14, 18, 32] and having champion users.[15, 19, 28] One physician expressed that exchanging health data “is a difficult habit; it's a culture and physicians get bogged down [with exchanging health information] and just want to see patients.”[18] Introducing new technology requires addressing the need for social change that goes along with changing technology and the resistance that may exist.[17] These studies also encouraged sites to manage expectations up front[31] and have a pilot implementation prior to launch so users are not disappointed.[14, 24] Finally, collecting ongoing data on provider access and user feedback should provide insights on ways to increase HIE use.[14, 29]

3.1.3 Technology and User Needs—We examined whether certain functions of the HIE technology (direct exchange or push vs. query-based exchange) reduced barriers to use. Directed exchange is provider-to-provider electronic exchange of patient information to coordinate care.[7] In this type of exchange, the data are electronically sent to the recipient's electronic health record (EHR) or clinical inbox.[20] In query-based systems, the user accesses an exchange system, queries for information on a particular patient and pulls data from multiple healthcare organizations.[20] This is important particularly for unplanned care (e.g., patient comes into the emergency department).[33] Because almost all of the studies described query-based exchange (see **eAppendix: Table A**), comparison of barriers across studies with directed exchange was not possible.

We found only one study that directly compared exchanging health information using query-based (pull) or direct exchange (push).[20] In this comparison study, clinicians had access to “pushed” health data (laboratory and radiology) through certified EHRs; physicians who ordered tests could designate other physicians to receive the test results. The physicians in this study could also query (pull), using a secure web portal, for test results, patient demographics and transcribed reports provided by physicians, hospitals, laboratories, and radiology centers across the greater Buffalo and Rochester areas of New York. More providers reported using electronically pushed data exchange (80%) than pulled exchange of health information (53%). A greater proportion of physicians reported using pushed data exchange always or most of the time (68%) compared with pulled exchange (19%, $p=0.001$). The physicians were more satisfied when data were pushed than pulled ($p<0.05$). This suggested that the function of pushing data facilitated HIE use.[25, 26]

We also attempted to evaluate if type of architecture facilitated use (e.g., whether the query-based system used a centralized or federated model). The centralized models include a central data repository that users can query. In federated models, the users query data sources managed by different organizations[34] but this can be a barrier if providers need to log into multiple systems.[19] However, few publications provided the level of technical detail needed to make this comparison. Additionally, the authors used a variety of terms and descriptions of the HIEs which made it difficult to classify barriers to use by architecture across studies. Details on HIE architecture, where provided, are included in **eAppendix: Table A**.

Several factors created perceived barriers to the use of exchanged information in the US; [15-17, 19, 25, 28, 29, 31] in Europe.[21, 26] While HIE users understood why clinical notes were not exchanged for confidentiality reasons, this lack of context made the information less valuable.[25, 29] Similarly, the lack of standardization for data entry made the information less useful.[18, 21] Some users wanted more information and other users wanted shorter reports to avoid having to scroll up and down, click on many pages or go to another task.[15, 16, 19, 26] Some complained that the exchange contained too much information that was not filtered enough to be meaningful for providers.[15, 16] They reported that reading a paper report was much faster than reviewing the exchanged information.[16] This finding was echoed by another study that recommended the main findings should be sent first in a brief report[14, 16, 26] or by an alert.[18] The design features could be addressed by including more providers during the planning and design phases.[14]

Some users expressed concern about the timeliness of patient information and found it more efficient to go directly to the partnering clinic or hospital portal for information than to rely on information in the exchange to be current.[16, 17, 19, 28, 29] Systems that automatically integrate with the providers' EHRs may reduce this concern and also reduce need for users to have to login into multiple systems.[18, 25, 26]

4.0 DISCUSSION

As part of a systematic review we included 19 studies evaluating perceived barriers and facilitators to HIE use. We found three main themes that hindered or facilitated HIE use: completeness of information, organization and workflow, technology and user needs. Incomplete patient data was consistently mentioned in the studies conducted in the US but not mentioned in the few studies conducted outside of the US. Culturally, individualism and privacy is more highly emphasized in the US than in other countries that have a more a collective approach toward healthcare. Individual patients and practices in the US currently may exercise the right to participate (or not) in HIE. This same behavior may be present at the institutional level. In the US, some hospital systems remain hesitant to exchange health data with competitors because they are concerned about losing patients and market share. Although this barrier was only mentioned in one study,[18] it may be underreported as it is mentioned in two prior systematic reviews.[8, 35] While countries with national health systems may not face barriers related to competition, more evidence is needed to examine barriers to HIE outside of the US.

A key challenge in identifying barriers and affiliated facilitators to exchanging health data is the changing nature of HIE locally. For example, in the process of rolling out an exchange system, hidden inefficiencies in the workflow may emerge. Once the workflow is revised to incorporate HIE, the workflow will become more efficient. The opposite can also be true, as time passes some features of the HIE may become less efficient.[36] For example, as more data are added to the exchange, providers may find themselves overwhelmed by the volume of information and require tools to focus their search. This changing relationship among the users, the information systems, and the organizational contexts of use fit well with view of health information technology as sociotechnical systems characterized by dynamic interdependence and co-evolution of technologies and the social contexts in which they are used.[37] More research is needed to better understand this relationship.

A second key challenge in understanding use is the lack of standard HIE classification and terminology. A recent evaluation of the state HIE agreement program reported that fewer grantees (68%) had query-based features,[38] however this was the predominant type of HIE found in our systematic review, as well as in another recent review.[7] Similarly, that same evaluation of the state HIE agreement program[38] reported that by 2013, 79% of grantees had directed or push exchange available, while our review found few studies that evaluated this type of HIE. In order to identify functions and architectures that facilitate HIE use, it will be necessary for the development and research communities to agree upon standard classification and description of system architectures and features, as well as what constitutes complete and detailed descriptions in publications.

A third challenge is the lack of a consistent or coherent theoretical framework underlying the implementations or evaluations of HIE. To improve on current levels of use, we need more careful examination of the user, task, tool, and the environment.[39] If we change any of these factors, the use needs will change. With the exception of one study, which used the Technology Acceptance Model as the basis for the design of their evaluation,[23] the studies included in our systematic review made no mention of whether the exchanges studied had been developed using an underlying theory or framework for user-system interaction. Findings such as role-based differences in use by triage and registration personnel compared with bedside clinicians might make better sense, or even be predictable if understood in the light of carefully constructed use cases or models of the tasks, workflows and environment involved. It may be expected that more will be learned from future evaluations of HIE if the underlying theoretical framework for HIE and information use is made explicit at both the implementation and evaluation stages.

4.1 Limitations

The evidence we found on barriers and facilitators to use of HIE focused on the end-user perceptions of their experience, but did not include formal usability engineering studies. Most barriers and facilitators we present are not unique to HIE but could also apply to use of other types of health information technology. While we did not give a formal strength of evidence rating, the details in the methods of included studies (**eAppendix: Table B**) suggest the potential for biased samples, either due to deliberative sampling of stakeholders for interviews or due to the low response rates to surveys. Additionally the risk of bias assessment we made focused on measures for evaluating surveys (e.g., response rates). We acknowledge that this approach may not have provided the best assessment of bias in multiple site case studies and ethnographic studies. More work is needed to provide criteria for assessing bias in these study designs. Future reviews could benefit from clear methods on how to evaluate studies that provide primarily descriptive data without a comparison. Despite this, the results of the studies were consistent, particularly in identifying similar barriers and facilitators.

5.0 Conclusions

Barriers and facilitators fell under three broad themes: completeness of information, organization and workflow, technology and user needs. Sites with proxy users (e.g., nurses, registrars) in the workflow reported the highest HIE use. The evidence was inadequate to compare barriers to HIE use by type of function (query-based or pull vs. directed or pushed exchange) or by type of architecture (centralized or not). Understanding optimal functionality of HIE is challenged by the lack of consistent classification and terminology of

HIEs and the changing nature of the sociotechnical systems involved. While the evidence is currently incomplete there were several facilitators that showed promise in promoting electronic health data exchange: obtaining more complete patient information; thoughtful implementation and workflow; and including users in identifying key functions for HIE use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- HIE that did not meet provider needs and poor workflow hindered use.
- Incomplete patient data was consistently a barrier in US studies.
- Highest HIE use was in sites with proxy users supporting clinicians.
- Thoughtful workflows and inclusion of users early in HIE design facilitated use.

Summary Points

What was already known on the topic

- The number of hospitals and providers exchanging healthcare data has increased significantly since 2009.
- Prior systematic reviews of HIE focused on barriers to adoption and implementation, primarily in the United States.

What this study added to our knowledge

- This systematic review expanded the scope to include studies outside of the United States and focused on perceived barriers and facilitators to actual use.
- Perceived barriers and facilitators fell under three broad themes: completeness of information, organization and workflow, technology and user needs of exchanged information.
- Sites that incorporated workflow in the design of the HIE and identified proxy users reported the highest use.
- Incomplete patient data was consistently mentioned in the studies conducted in the US but not mentioned in the studies conducted outside of the US.
- Some barriers could be addressed by including more providers during the planning and design phases to identify key functions and requirements of exchanged information.

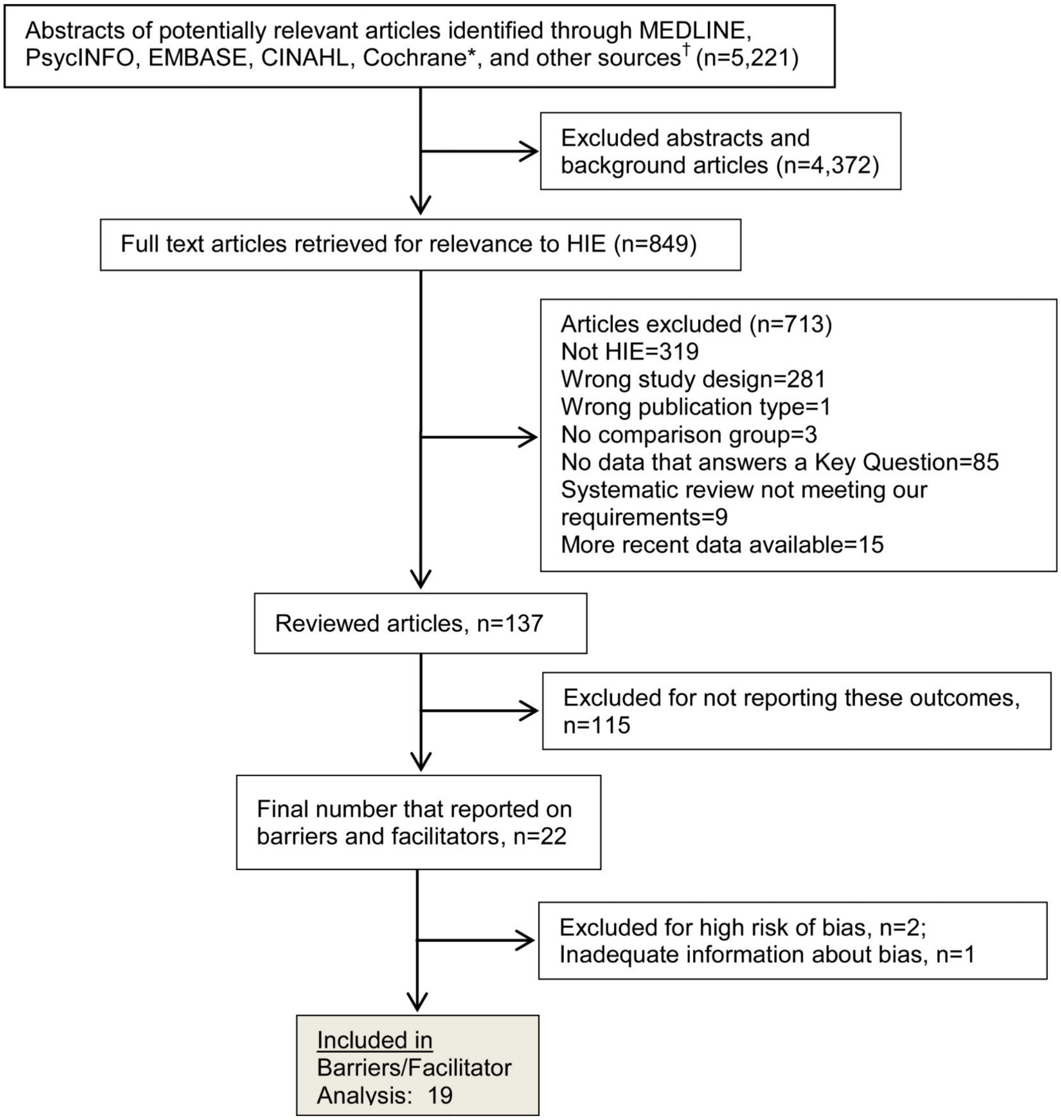

Figure 1. Literature Flow Diagram

Description: This figure depicts the number of abstracts found and reviewed for inclusion; full-text articles reviewed and the number of articles included for the whole report and the included articles focused on barriers and facilitators to use (n=19).

*Cochrane databases include the Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, Database of Abstracts of Reviews of Effects, and National Health Sciences Economic Evaluation Database.

†Identified from reference lists, hand searching, suggested by experts, and other sources.

Table 1

Perceived barriers and facilitators of actual HIE use grouped by theme

Barriers	Facilitators
Completeness of Information	
• Patients and providers concerned about privacy and security.[20, 28, 30] • Patients outside of the HIE catchment area.[15] • Poor matching of patients.[11, 24] • Providers stop using query-based system when they can't find patients or needed information. [15, 18, 20, 24, 29, 30] • Health system competition.[18] • Providers don't exchange over concern about liability, malpractice.[18, 30]	• Robust policy and training about privacy and security.[22, 31] • Consider opt out vs. opt in for the consent process.[30] • Obtain consent at registration or with online patient authorization.[11, 15] • Educate patients on HIE.[15, 30] • Use probabilistic matching algorithm.[11]
Organization and Workflow	
• Disruptive login, or separate login & password to portal – too many clicks.[15, 18, 19, 23, 25, 29, 30] • Policy that prohibits proxy users.[14] • Need for more technical support.[18, 23, 24, 29] • Need for culture change about practice and need to not use free-text.[14, 18, 32] • Need to enter data in EHR and the HIE.[31]	• Single login.[14] • Take a sociotechnical approach.[17] • Provide ongoing training for providers and proxy users.[14, 18, 23, 29] • Collect feedback from users in ongoing manner.[14] • Monitor metrics of provider access and contribution.[29] • Manage expectations of new HIE.[31] • Develop thoughtful workflow and interface for providers and proxy users.[14, 15, 17-19, 23, 24, 28, 29] • Have champion HIE users.[15, 18, 28] • Have sufficient technical support.[26, 32]
Technology and User Needs	
• Reports in exchange may not meet needs of the provider, too much information, not legible. [15, 16, 19, 26] • Lack of notes to set context in patient information.[25, 29] • Lack of data standards.[18, 21] • HIE competes with existing hospital portal with more complete information.[16, 17, 19, 28, 29]	• Consider when to push and when to pull data.[20] • Ability to send brief report before full access.[14, 16, 26] • Provide alerts for when HIE is available.[18] • Share contextual notes.[14] • Automatic integration with existing provider systems.[25, 26] • Include providers and proxy users in design of interface.[14]

HIE= Health information exchange; vs. = versus.