



Guide to Evaluating Health Information Exchange Projects



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HEALTH IT



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None of the investigators (i.e., Eric Pan, M.D., M.Sc.; Colene Byrne, Ph.D.; David Damico, M.A.; or Mary Crimmins, M.A.) has any affiliations or financial involvement that conflicts with the material presented in this document.

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Introduction

Purpose of This Guide

This guide is designed to assist you in evaluating a health information exchange (HIE) project and creating an evaluation plan. The guide offers information to assist you in all steps of the HIE project evaluation planning process. The guide is designed to be useful to HIE project evaluation novices, experienced health IT evaluators who are new to the HIE field, and individuals who have assisted in HIE project evaluation efforts but have never led such an evaluation. If you are a more experienced HIE project researcher or evaluator, this guide can enhance your understanding of the evaluation process. Depending on your level of experience and expertise in evaluation, you may wish to focus on specific parts of the guide, as below in the section “How To Use this Guide.”



Why Is HIE Evaluation Important?

HIE, also known as health data exchange, refers to the electronic movement of health-related information among organizations using nationally recognized standards.¹ The electronic exchange of health information has the potential to improve quality of care, including patient safety, effectiveness, and efficiency of care; facilitate communication among providers; improve public health surveillance; and decrease health care costs.²⁻⁷

An HIE project evaluation can serve multiple important purposes. The evaluation can be a continuous process that serves to guide the HIE project and provide a thoughtful assessment of the HIE project’s impact on health care. Findings from the evaluation can guide the data exchange process as a whole, thus improving the quality of data exchange and increasing the likelihood of intended positive outcomes. The findings also can point to barriers or unanticipated consequences of implementing the HIE project, and guide efforts to address such issues. An evaluation also can help assess the longer term clinical and financial impacts of an HIE project, and demonstrate return on investment.

Your evaluation has the greatest likelihood of significant impact on your HIE project if it is planned during the early phases of the HIE organization, and if it focuses on outcomes directly related to your HIE project’s functions and objectives.

How To Use This Guide

This guide was developed to help you understand what is needed to develop a realistic and achievable HIE project evaluation plan. Not every evaluation planner will need to consult each and every portion of the guide. Start by reviewing the table of contents so you are familiar with the contents of the guide. If you are relatively new to HIE project evaluation, you may want to review and follow the sequence of steps outlined in the guide. The guide also may be useful for educating and communicating with your evaluation team and stakeholders.



Many of the guide's sections offer carefully selected resources as suggested reading, to aid in your evaluation plan development and execution. These annotated resources provide more in-depth information than can be presented in the guide. Most of the resources are publicly available.

The guide is divided into the following six sections and appendixes:

- **Section 1: Selecting Your Evaluation Team.** Provides guidance regarding the roles and expertise of an ideal HIE project evaluation team as well as information to help you plan for the skills and expertise needed to successfully conduct your evaluation.
- **Section 2: Characterizing Your HIE Project.** Prepares your team to create the evaluation plan by describing the overall HIE project, identifying stakeholders, and articulating the project's goals and objectives. This is needed to ensure that the evaluation aligns appropriately with the HIE project.
- **Section 3: Assessing the Value of HIE.** Discusses the rationale and requirements for assessing the value of HIE and provides an overview of relevant issues.
- **Section 4: Developing Your Evaluation Plan.** Provides an overview of how to use a step-by-step process to develop an evaluation plan that meets stakeholder needs. Also provides practical suggestions and insights from other HIE project evaluations and highlights the skills needed in the evaluation planning and implementation process, so that you may supplement your evaluation team's expertise as needed.
- **Section 5: Creating Your Dissemination Plan.** Offers guidance on how to create a plan to disseminate the results of the evaluation to your stakeholders and highlights key requirements for effective dissemination.
- **Section 6: Examples of Evaluation Measures.** Provides examples of measures that you might use in an evaluation, based on measures reported in the literature and other HIE project evaluations. For each measure, the tables provide suggested data sources and practical notes. The measures, which are organized into three categories that align with the stages of HIE project development, are to evaluate (1) the process of creating an HIE organization, (2) specific types of data exchange, and (3) clinical processes and outcomes.
- **Appendixes.** Provide additional resources to help you capture the information required for the development of your HIE project evaluation plan.
 - Appendix A provides a step-by-step workbook that guides you through the key evaluation planning steps and helps to document evaluation priorities, decisions, and candidate measures. You are encouraged to download a fillable PDF of the Appendix A workbook at <http://healthit.ahrq.gov/hieevaluationguideworkbook.pdf>
 - Appendix B is a sample literature search strategy (discussed in Section 4, "Identifying Potential Evaluation Measures") that you could use to identify potential measures.
 - Appendix C provides tips on brainstorming (discussed in Section 4, "Identifying Potential Evaluation Measures") as a way to generate potential measures.



- Appendix D includes a sample calculation and discussion of the importance of sample size (discussed in Section 4, “Determine Sample Size for the Measure”).
- Appendix E offers a glossary of key terms used in this guide.
- Appendix F provides an annotated list of resources for sections of the guide.





Section 1: Selecting Your Evaluation Team

This section describes how to start a successful HIE project evaluation by assembling your evaluation team with expertise in the following areas:

- Technical implementation
- Health care operations
- Clinical care
- Research methodology
- Project management
- Health care consumer (patient) perspective

The first step in conducting a successful HIE project evaluation is selecting your evaluation team. Depending on the number of organizations exchanging health information, the volume of data being exchanged, the evaluation duration, and the evaluation plan complexity, the expertise may need to be provided by (1) team members who are working full-time or part-time on the evaluation, (2) affiliates who join the evaluation team as needed, or (3) consultants. Together, the needed expertise provides a strong foundation for your HIE project evaluation.



The ideal evaluation team includes individuals with expertise in the following areas:

- **Technical Implementation.** These are information technology (IT) experts who specialize in health IT implementation, ideally with experience in HIE projects, health IT and HIE standards, and clinical data warehousing. A technical implementation expert can help you to determine what is technically possible to measure. Your evaluation team needs to understand the technical infrastructure of the HIE system, the standards it uses, and the types and sources of data being exchanged, in order to determine what data are available for the evaluation and to estimate the effort required to collect and process the data. Your evaluation team also needs to have the technical expertise and authority to demonstrate the feasibility of your evaluation plan to project stakeholders.
- **Health Care Operations.** These are individuals with a detailed understanding of the administrative and business side of health care operations. This expertise is needed to document health care workflows pre- and post-HIE, in order to determine efficacy and to measure impact. While technical expertise enables data exchange and captures the raw measurement data, health care operations expertise is needed to understand how the data can be used to create meaningful measures. A health care operations expert can communicate with organizational staff and administrators, represent their needs to the evaluation team, and help determine what health care organizations and stakeholder need to measure. In addition, health care operations expertise will help determine the validity of measures for financial assessments of HIE costs and savings, such as reduced utilization of services.



- **Clinical Care.** These are individuals with clinical understanding and expertise, preferably well-respected clinicians in your community who understand the challenges faced by local clinicians and can serve as your clinical champions. HIE projects nearly always have a stated goal of improving clinical outcomes. Also, clinicians' acceptance of HIE and the evaluation outcomes will be major determinants of the success and sustainability of your HIE project. Therefore, a clinician's presence on the evaluation team is essential to ensure that the clinical measures selected for your evaluation effort are appropriate and meaningful to your local community. It would be ideal to find an evaluation team member with both clinical and health care operations expertise to help balance the two perspectives, such as a senior clinician with administrative experience.
- **Research Methodology.** These are individuals with experience designing and conducting health care studies, preferably from a public health or population-level perspective, and with training in biostatistics. Research methodologists, who often have academic affiliations, can help determine which measures are reasonable and appropriate to capture in the context of resource and methodological constraints. Based on your technical expert's determination of what can be measured, and your health care operations expert's recommendation of what is important to evaluate, your research methodologist can help you determine which measures are feasible and relevant, and the corresponding data and sample size requirements. The methodologist will help determine the appropriate study design and data collection tools, and can analyze quantitative data and interpret study results. An experienced methodologist also is needed to manage oversight over the evaluation, human subjects' protection, patient privacy, and compliance with the Health Insurance Portability and Accountability Act of 1996 (HIPAA).⁸
- **Project Management.** These are individuals who have demonstrated project management expertise, preferably with experience in multiorganizational experience, and ideally health IT experience. Evaluating an HIE project is a complicated effort, and experienced project managers can help your team develop and manage the evaluation work plan. The evaluation team typically needs to manage data collection from multiple organizations, and coordinate activities across organizations and their stakeholders. An experienced project manager can serve as the bridge among these parties and the evaluation team, and help to ensure timely completion of disparate tasks across many participating organizations, helping to support a successful evaluation.
- **Health Care Consumer (Patient) Representation.** These are individuals who are patients or their caregivers, and who can represent the patient perspective to the evaluation team. Ideally, the patient representative should be influential and well-respected, familiar with the health care consumer experience in the HIE community, and able to share first-hand experiences of being a patient or caregiver. Even though almost everyone is a patient, it is preferable to have a dedicated patient representative, rather than to ask other team members to represent multiple perspectives.

Although you might be able to conduct a successful evaluation with a team that lacks some of these areas of expertise, the absence of these professional skills and knowledge has limited many HIE project evaluation efforts. Therefore, it is strongly recommended that you assemble a team with all of the core expertise listed above prior to developing an evaluation plan.



Section 2: Characterizing Your HIE Project

This section describes background work that needs to be done to prepare for developing the evaluation plan by—

- Describing the HIE project
- Identifying the stakeholders
- Articulating the HIE project goals and objectives

Describing Your HIE Project

The first step in understanding your HIE project is to gather a description of the HIE project that you are evaluating. This may come directly from the HIE strategic plan, project plan, proposal, or other documents outlining the vision, mission, goals, and objectives of the project.

A strong project description clearly identifies the stage where the HIE project will be during the evaluation. The stages of an HIE project are often broadly characterized as planning, testing, or fully operational.⁹⁻¹³ An evaluation can be conducted during any or all of these stages. If feasible, conduct your evaluation over several phases of the project to identify issues and improvements, as well as to inform decisions about the system.

Identifying Your HIE Project Stakeholders

The next step in understanding your HIE project is to identify the stakeholders involved. The list of stakeholders includes all of the organizations accessing the HIE, as well as funding sources, patients, and any other groups interested in and impacted by the project.

You should identify each stakeholder's motivations, needs, and requirements for HIE. Ask the following questions to help you identify stakeholders and their concerns:

- Who is connecting to the HIE system? Who is interested? Who is impacted? Who is paying for it?
- What do stakeholders, including patients, hope to accomplish and gain by using the HIE project services?
- Do funding sources expect written reports?
- How will you present findings to the stakeholders?
- How can you be accountable and demonstrate specific benefits?
- How will you share what you have learned with others?



Articulating Your HIE Project Goals and Objectives

Once you have developed a description of your HIE project and identified the stakeholders, the next step is to articulate the project's goals and objectives.



HIE Project Goals and Objectives

Goals are general guidelines that describe the strategic results that an organization wants to achieve. Objectives define specific steps to attain the identified goals, are measurable, and usually have a defined completion date. The HIE project goals are statements that describe the intended strategic outcomes that the project stakeholders seek to achieve. The corresponding HIE project objectives then specify how to determine whether the goals are achieved by a particular date. (See example in Figure 2-1). Your project goals may already be documented. To ensure a comprehensive listing of your goals, consider the following questions:

- What does your project hope to gain from the electronic exchange of health information?
- What do your HIE stakeholder organizations (i.e., the institutions and individuals who will participate in the HIE organization) expect to gain from participating in the project?
- What would make your stakeholders consider the project a success?
- Are there any specific goals that your funding sources (e.g., local hospital or State funding the project) have established for your project?

Part of articulating your HIE project's goals and objectives involves assessing how well your project's stated goals support the mission of stakeholder organizations. This process of goal alignment involves ensuring that stakeholders' interests are consistent with the HIE project vision (as in the example offered in Figure 2-1). In thinking about your stakeholders' interests, consider your project's governance model and decisionmaking process. Ask yourself the following questions as you assess goal alignment.

- Which HIE project goals support the value and mission of your stakeholders?
- What role do your stakeholders play in decisionmaking?
- What measurable objectives could you use to document the accomplishment of these goals?

Figure 2-1. Example of HIE goal versus objective and goal alignment

Goal: To improve the quality of care provided to patients by successfully exchanging laboratory orders and results between ambulatory care providers and laboratories in the tri-State area.

Objective: To exchange at least 85 percent of laboratory orders and results electronically by the end of the initial 12-month period after going live in the tri-State area.

Example of goal alignment: Our HIE project's focus on reducing the number of paper lab results sent by fax or mail aligns with the local hospital laboratory's interests in improving workflow, faster and more dependable return.



Section 3: Assessing the Value of HIE

The ability to demonstrate value to stakeholders is critical to HIE projects. This section describes key considerations in assessing the value of HIE:

- The need to assess the value of HIE
- The relationship between HIE usage and value
- Approaches to estimating the value of HIE

HIE projects have been developed with support from various funding sources, stakeholders, and technical architectures. The information that is being exchanged, and the number and type of users, affect how HIE value might be perceived and assessed. Stakeholders are usually most interested in financial and clinical value. Financial benefits may include additional revenue or reductions in costs, such as savings achieved when staff no longer needs to support paper-based processes. Clinical value may include both process and outcome measures, such as increased utilization of preventive care or reduced rates of hospital readmission.



Importance of Assessing HIE Value

To demonstrate its value to the health care system, an HIE project needs to demonstrate its impact on factors such as patient safety, quality of care, and cost.^{3, 4, 14-22} Your evaluation plan must take these factors into account. To increase participation in HIE and to sustain HIE services, the HIE project must be able to describe its value to current and potential users. Demonstration of value is critical to stakeholder satisfaction and sustainability of the HIE project. The next section describes the interdependent relationship between the number of users and demonstrated value.

Relationship Between Usage and Value

Users of HIE are generally interested in obtaining patient data from other sources.^{15, 18} As a result, the perceived value of an HIE project is often based on the amount of data available and the comprehensiveness of that data. The financial value derived from an HIE intervention is generally expected to increase along with growth in the amount of clinically useful data and in the number of users. Adding providers, services, and transaction capacity will improve data sharing and make HIE more valuable to providers, payers, consumers, and policymakers. It is important for project evaluators and stakeholders to understand that it takes time for HIE projects to obtain patient participation, add exchange partners, train users, and accumulate data for exchange; all of those factors are important to efforts to demonstrate the value of the HIE project.

Approaches to Estimating the Value of HIE

When estimating the value of HIE, the two primary approaches are (1) demonstrating financial value through cost savings or increased revenue, and (2) demonstrating improved clinical processes or outcomes. To assess the value of an HIE project, consider the following:



- Who uses the information from the exchange?
- What information do they use?
- How do they use that information?
- How does that usage differ from usage in a setting without access to HIE?

The answers to these questions will help your evaluation planning team to identify options for measuring value.

Financial Value

One approach to estimating the value of your HIE project is to compare the financial benefits of having access to and using HIE data, compared with not having access to HIE data.^{14-15, 21} This can be done by collecting data prospectively before and after HIE project implementation, or, if historical data are available, comparing historical data with data collected after HIE project implementation. An alternative approach is to conduct a prospective case-control study of the effects of exposure to HIE information during clinical encounters. Section 4, Evaluation Design, provides information on these types of evaluation study designs. Finally, a less-rigorous alternative is to ask participants to estimate the impact of HIE implementation on relevant benefits and costs.

You may wish to demonstrate return on investment by reporting on costs and financial returns. To effectively apply this concept in working with your stakeholders, consider defining with each stakeholder the parameters for both the costs and the returns. Obtaining agreement on those parameters at the outset will help to reduce variability, and may help to control the scope of stakeholder expectations.

Clinical Value

HIE has the potential to deliver significant clinical information from multiple care settings to inform patient care.^{3-4, 16-17, 19-20, 22} The expectation is that patient care management and health care outcomes will improve when providers have access to shared clinical information provided through HIE, including comprehensive medication lists, laboratory values, radiologic images, and other reports.

Clinically focused stakeholders are interested in providing high-quality care to their patients.¹⁷⁻¹⁸ Value is dependent upon the context for each type of user. For example, primary care providers may place high value on having lab results delivered quickly so they can improve patient care, or on receiving hospital discharge summaries to enhance care coordination. Emergency department providers may ascribe value to medication lists, radiologic results, and other data to help inform care management.^{3, 14, 16, 22}

The process of identifying and prioritizing your HIE evaluation goals and objectives can begin once the evaluation planning team has considered how to assess the value of the HIE project. The next section describes the steps required to complete the evaluation plan.



Section 4: Developing Your Evaluation Plan

This section describes ten steps for developing an evaluation plan:

1. Defining evaluation goals and objectives
2. Identifying potential evaluation measures
3. Designing the evaluation study
4. Identifying data sources
5. Identifying candidate evaluation measures
6. Considering the impact of data collection strategy on relative cost and feasibility;
7. Developing your evaluation plan based on selected measures
8. Completing your evaluation plan
9. Reviewing your evaluation budget
10. Finalizing your evaluation plan.



Each step is described in detail in the following subsections.

Defining Evaluation Goals and Objectives

This subsection describes the method to define proposed evaluation goals and objectives by—

- Discussing evaluation goals with your governing group
- Operationalizing the goals with evaluation objectives
- Considering the need for institutional review board (IRB) review of your evaluation

In Section 2 of this guide you determined the goals and objectives of your project. The next step is to determine how your evaluation can help demonstrate the attainment of these goals and objectives. Evaluation goals may range from mitigating risks to proving efficacy and benefits. (See Figure 4-1 for examples.) The goals will vary depending upon your stakeholders and funding sources. It is recommended that you seek guidance from your HIE project governance group when selecting the goals. Discussions with the governance group provide an opportunity to articulate the potential goals of your evaluation, and to define goals as you draft the evaluation plan.

Figure 4-1. Examples of HIE evaluation goals

To demonstrate improvement in care delivery for the senior population as set forth in the HIE project goals.

To continuously monitor early user reactions during the implementation process to minimize risks of poor adoption.



Once you have established your evaluation goals, operationalize what you want to accomplish by defining your objectives (measurable steps and deadlines). To begin developing a set of evaluation objectives that assess goal attainment, consider the following:

- How would you break your goals down into measurable steps (objectives)?
- How would you prioritize those steps?
- If all of these objectives were met, would you attain your goal(s)?

Figure 4-2 offers examples of objectives that could correspond to the goals in Figure 4-1.

Next, it is important to determine whether your evaluation is considered research and involves human subjects. An IRB and its representatives may be helpful in determining whether your project falls into either of these two categories.

Research is defined as “a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge” (45CFR46.102[d]).²³ A human subject is defined as a “living individual about whom an investigator (whether professional or student) conducting research obtains (1) data through intervention or interaction with the individual, or (2) obtains identifiable private information” (45CFR46.102[f]).²³

Factors that may influence whether your project requires IRB review include project type and funding source (e.g., the study may receive support for operations activities under contract with a Federal agency); funding source requirements for IRB review (common for grants); whether the study’s purpose will involve contributing to generalizable knowledge by expanding the knowledge base of a scientific discipline (or other scholarly field of study); whether you or others plan to publish findings (many journals will not publish studies without IRB approval or exemption); and your own organization’s requirements.

Your evaluation team should not make the determination as to whether your evaluation requires IRB review. If your evaluation involves any data collection such as surveys, focus groups, and interviews, or possible access to data that include identifiers of persons, it is best to contact your organization’s IRB to see if the evaluation study description and protocols should be submitted to the IRB for determination of whether full IRB review is required. The organization funding your evaluation also may be able to advise you. If your organization does not have an IRB or a relationship with one, you should check with your organization’s legal counsel or privacy office.

Figure 4-2. Examples of HIE evaluation objectives

Enable providers to access glycosylated hemoglobin (HbA1c) test result history in at least 85 percent of the senior diabetic population by the end of the first year after implementation.

Conduct at least three user satisfaction surveys during the implementation period, and present summarized reports to implementers, trainers, and stakeholder representatives.



Identifying Potential Evaluation Measures

This subsection discusses the identification of potential evaluation measures by (1) performing a literature review and (2) conducting a brainstorming session.

The next step in developing your evaluation plan is to write down evaluation measures that you could use in assessing your HIE project. You can engage in brainstorming sessions with your team and conduct literature reviews to identify useful measures.

Literature Review

A literature review involves identifying relevant materials in peer-reviewed or gray literature (information that falls outside the mainstream of published journal and monograph literature), reading those materials, and analyzing the information provided. To conduct a literature review, the research methodologist in your team can work with a librarian to develop search parameters. If he or she has the experience and expertise, the research methodologist can also develop procedures for conducting the review, including what terms to use, which sources to search, how to select articles for inclusion, how to summarize the results, and how to use the results in your evaluation. The HIE field is relatively young and the body of research is small and growing, so it may be helpful to start with more recent articles and technical reports that include a review of HIE evaluation studies or frameworks. See Appendix B for a sample literature search strategy.

Brainstorming

Brainstorming is a group collaboration designed to generate ideas using an open and receptive environment for group discussion. Brainstorming guidelines include encouragement of all ideas and suggestions, withholding and postponing any judgment of ideas, and building on ideas put forward by others.²⁴ It is important that key stakeholders and all members of the evaluation team participate in a focused brainstorming session, with ample time set aside for discussion.

For effective brainstorming, you should outline the purpose and goals of the session, which are to identify and prioritize evaluation measures. Depending on the stage of your HIE project, measures may include assessments of process, clinical outcomes, patient and provider attitudes and adoption, efficiencies, and workflow impact. Brainstorming discussions for identifying evaluation measures may include many aspects of the project, such as whether the “groundwork” for the project was successfully completed. This groundwork may include developing a governance structure, coming to a consensus on how to handle privacy and security issues, or developing a sustainability model. For example, was the HIE organization able to agree on a minimum data set to exchange? Was the organization able to deliver results to participating organizations at an agreed-upon rate of exchange? See Appendix C for additional information on brainstorming.

During brainstorming, consider quantitative and qualitative approaches, keeping in mind that it is premature to discuss specifics, such as how the data will be collected, statistics, sample size, and logistics around data collection. It is helpful to discuss everything that is considered





important to measure, without regard to feasibility, in order to generate as many ideas as possible. Capture all ideas, preferably by writing them down in a prominent place.²⁴

Collate the ideas and distribute them promptly to the group. Emphasize that anyone who has any additional thoughts or ideas should share them with you or the group.²⁴ The results of the brainstorming session and literature review, by identifying potential evaluation measures, will guide the subsequent steps.

Designing the Evaluation Study

This subsection describes evaluation design considerations, including—

- Formative and summative evaluations
- Prospective and retrospective evaluation designs
- Qualitative versus quantitative methodologies

Now that you have identified potential measures for your evaluation, the next step is to design the evaluation to be able to collect and analyze data in order to produce each measure. The considerations discussed below will serve as a foundation for your study design.

Types of Evaluation

Evaluations are commonly conceptualized as either formative or summative, depending on the purpose of the evaluation:

1. **Formative evaluation** is an iterative assessment of a project's implementation and how well it meets defined benchmarks.²⁵ Formative evaluations strengthen or improve the program being evaluated—they help inform it by examining the delivery of the program or technology; the quality of its implementation; and the assessment of the organizational context, personnel, procedures, and inputs.^{15,26}

Within the category of formative evaluation, there are two subtypes that are most relevant to HIE project evaluations—implementation evaluations and process evaluations:

Implementation evaluation monitors the fidelity of the program or technology delivery—the extent to which it was implemented or delivered as intended. An implementation evaluation enhances the likelihood of success by providing indications of what happened and why. This type of evaluation focuses on information that will help document a project's evolution, and continually assess whether modifications and changes in the evolution are connected to goals, relevant contextual factors, and the needs of the target population.²⁷ Section 6 includes several examples of HIE project implementation measures.

Process evaluation investigates the process of delivering the program or technology, including alternative delivery procedures. A process evaluation focuses on describing the course and activities of a program. Section 6 includes many examples of HIE project process measures.²⁷



2. **Summative evaluation** examines the effects or outcomes of some program and technology such as implementation of an HIE project. A summative evaluation describes what happens subsequent to delivery of the program or technology, assesses whether the object can be said to have caused the outcome, determines the overall impact of the causal or contributory factors (e.g., introduction of HIE, clinician training) beyond the immediate target outcomes, and estimates the relative costs associated with the object.²⁶ Three summative evaluation types may be applied to HIE project evaluation:

Outcome evaluation attempts to attribute changes in high-level outcomes (intended and unintended, positive and negative) to a particular program or intervention. These outcomes include clinical changes, such as changes in receiving preventive care or chronic care management; health care utilization, such as hospitalizations and laboratory work; and workflow changes, such as time spent accessing patient information.

Impact evaluation is broader and assesses the overall or net effects—intended or unintended—of the program or technology as a whole.

Cost-effectiveness and cost-benefit analysis addresses questions of efficiency by standardizing outcomes in terms of their dollar costs and values.

Section 6 includes examples of clinical measures and other summative evaluation measures.

Determining Research Design

Your evaluation may be a formative as well as a summative evaluation. In fact, both approaches can study the same types of outcomes, but for different purposes. Both types of evaluation can serve important roles during each phase of an HIE project. An example of an evaluation framework that was developed to formatively evaluate an HIE organization as it matured had five evaluation dimensions: implementation, technology choices, policy issues, data to be shared, and value derived from the data. The formative evaluation questions addressed matters such as how national policies affected the local HIE project, what technology choices were made, what technology and policy barriers were encountered and how they were overcome, the amount of data exchanged, and the completeness and accuracy of the data.¹⁵

HIE projects involve many organizations, stakeholders, and other individuals across implementation phases. This adds to the complexity of conducting an effective evaluation. Because of this complexity, and because many HIE organizations are still in early phases of implementation and not fully operational, experts have recommended formative evaluation of HIE projects, which allows evaluators to continually use and apply what is learned during the evaluation.²⁸ Early formative evaluation activities increase the likelihood that implementation activities are linked to the intended outcomes, and help staff and stakeholders to stay focused on the expected effects of the HIE project, such as improved health care quality and efficiency.

One formative evaluation approach is the “smallball” model that is based on established IT implementation phases, with appropriate evaluation dimensions linked to each phase so as to incrementally capture and report data relevant to the impact and value of a technology such as HIE.²⁹



In later phases of HIE project maturity, an effective summative outcome evaluation is critical to achieve the following:

- Demonstrate the effectiveness of the HIE project and make a case for its continued funding, or for expansion/replication.
- Answer questions about what works, for whom, and in what circumstances, and how to improve program delivery and services.
- Determine which implementation activities and contextual factors support or hinder outcomes and overall program effectiveness.²¹

Evaluation Design

Other types of study design may be used in your evaluation. Evaluations that use an experimental design can be conducted (1) *prospectively*—looking forward to collect and analyze new data as they are collected, or (2) *retrospectively*—looking back to collect and analyze data from the past. These designs apply primarily to summative evaluations. Many evaluations do not use experimental designs, such as the ones discussed previously in this subsection.

The following discussion is not meant to be a substitute for hands-on guidance from a trained research methodologist, but rather to provide a high-level overview of potential prospective and retrospective evaluation methods and approaches.

Prospective studies ask a question and look forward. The studies are designed before any information is collected. Study subjects are identified and followed forward to see if the outcome of interest occurs. This outcome is assessed relative to the intervention factor (HIE project).

Randomized controlled trials, which are considered the gold standard of study design, are prospective studies. They can provide evidence of cause-and-effect relationships and can support changes in clinical practice or workplace interventions. In a randomized controlled trial, subjects are randomly assigned to receive the intervention or control treatment, and outcomes are evaluated after the intervention period. The control group receives standard care, no intervention, or a placebo.³⁰ In an HIE project, the researchers would randomly assign the patients or health care settings into two groups: one that participates in the HIE project and the other that does not. These two groups would be followed over a period of time, and the outcomes of the groups would be compared.

Retrospective studies look backwards and examine factors in relation to an outcome that is established at the start of the study. These studies use information that is usually collected for reasons other than research, such as administrative data and medical records. Therefore, the outcome of interest will already have occurred (or not) by the time the study is started.³⁰

For example, researchers might turn to hospital administrative data. They might retrieve hospital admission data for patients seen in the emergency department, for hospitals that used the HIE system and those that did not, in order to look for associations.





Case-control studies are considered to be the highest quality of retrospective studies, because they seek to approximate a control or comparison group. Depending on the study design, a retrospective study may include making inferences about outcomes in groups that have been exposed to an intervention (e.g., use of an HIE system for a given period of time) compared with similar groups that were not exposed to the intervention during the same time period. A retrospective study may also include reviews of paper or electronic health record (EHR) system data.

Section 4, “Considering the Impact of Data Collection Strategies on Relative Cost and Feasibility,” discusses data collection strategies and provides more information, considerations, and resources for using retrospective and prospective study designs, such as those that use control groups. Manual record review and data mining of administrative data are examples of data collection methods that might be used for both types of study designs. Surveys are another data collection method that can be used for both types of studies.

Table 4-1 below lists typical study designs and data collection methods for prospective and retrospective studies. More examples and resources are provided later in this section.

TABLE 4-1. COMMONLY USED STUDY DESIGNS AND DATA COLLECTION METHODS FOR PROSPECTIVE AND RETROSPECTIVE STUDIES

	Prospective studies	Retrospective studies
Study Designs		
Prospective Cohort Study	✓	
Case Series		✓
Randomized Controlled Trial	✓	
Retrospective Case-Control Study		✓
Pre-Post Study	✓	✓
Meta-Analysis	✓	✓
Non-Experimental Designs	✓	
Data Collection Strategies		
Manual Medical Record Review	✓	✓
Data Mining of EHR Data	✓	✓
Instrumentation of EHR System to Capture Clickstream Data	✓	✓
Surveys (Paper/Electronic)	✓	✓
Expert Review	✓	✓
Phone Interview	✓	✓
Focus Group	✓	✓
Direct Observation and Field Notes	✓	



Qualitative and Quantitative Methods and Data

Evaluation methods and the data they produce are grouped into two basic categories—quantitative and qualitative. In general, quantitative methods produce “hard numbers,” while qualitative methods capture more descriptive data. The method(s) you choose are determined by the purpose(s) of your evaluation and the resources you have to design and conduct it. It is widely recommended that evaluations combine quantitative and qualitative techniques (sometimes called “mixed method” evaluations) to produce a richer and more comprehensive understanding of a project.^{27, 31}

Examples of quantitative data collection methods include administration of tests and questionnaires, including pre- and posttests; analysis of existing data sets (e.g., administrative data, medical records); nonparticipant structured observations; structured and formal interviews; experiments; survey research; and quasi-experiments. All of these methods yield data that can undergo statistical analyses. Examples of quantitative data often used for HIE project evaluation are number of laboratory reports exchanged, number of immunizations submitted, number of patients with data in the HIE system, and the number of providers with access to the HIE system. An example of a study that would use quantitative measures is a prospective study that compares these outcomes before and after the introduction of the HIE system, for persons exposed to the HIE system and for a control group of persons not exposed. More information on some of these quantitative data collection methods—record review, data mining, and surveys—is provided in Section 4, “Considering the Impact of Data Collection Strategies on Relative Cost and Feasibility.”

Examples of qualitative data collection methods include observations, unstructured and informal interviews, focus groups, field notes (informal observations about how a study is proceeding), and document and artifact collection. Examples of qualitative data are themes from interviews or focus groups; attitudes and opinions expressed during interviews; analyses of documents such as HIE organization governance plans, legal and partner agreements, HIE organization sustainability plans, and other plans and policies; training and meeting notes; and privacy and confidentiality policies. These documents can help in the assessment of HIE project maturity or implementation stage. Section 4, “Focus Group Planning and Execution,” provides additional information and resources for focus groups.

The use of only quantitative approaches for an HIE project evaluation will provide only a partial picture and can lead to conclusions about your HIE project that miss the larger picture. Therefore, qualitative approaches are often used to help interpret a quantitative outcome. Quantitative and qualitative data can effectively complement one another.

For example, in one practice the HIE system began delivering results electronically, which were then printed for providers. A quantitative satisfaction survey revealed that providers were unhappy with the system, but did not assess why they were unhappy. During a focus group, providers reported that the system affected their workflow because it printed one result per page along with some ancillary information, making it difficult to review results. These qualitative findings were then used to refocus the design of the intervention. Without the qualitative evaluation, the HIE project team would not have known about the difficulties users were having with the HIE system. Therefore, it is important to consider using both quantitative and qualitative methods as part of your evaluation.



Figure 4-3. Example of a “lesson learned” from qualitative techniques

You observe early on in the project that the electronic exchange of laboratory test orders between ambulatory practices and commercial laboratories is not meeting important milestones (e.g., 60% of all laboratory test orders will be transmitted electronically by 6 months post-implementation). You want to evaluate why the milestones are not being met and identify any barriers. You conduct in-person semistructured interviews with the stakeholders involved, and learn that representatives of several of the commercial laboratories were concerned about an increase in workload if they began accepting orders generated using different EHR systems. You report this finding to the design and implementation teams, and determine that the best course of action is to ask the State medical society to convene a joint meeting with the major EHR vendors and commercial laboratories so the parties can better understand each other’s requirements.

This approach is successful in helping the laboratories see that workload demands should decline, not increase, with electronic exchange. A key lesson learned is the need to consider and communicate in advance with key stakeholders about their concerns about HIE, such as impact on workload. A small pilot study of HIE impact on workflow of a commercial laboratory would have been helpful in understanding the impact before going live with all laboratories. Another lesson is to monitor use of the HIE system, and not assume that stakeholders will use the system once implemented.

Qualitative techniques such as field notes can help to identify and understand any unanticipated consequences (both positive and negative) of the HIE system’s implementation, as well as other factors that may influence the success of an HIE project. These can result in valuable lessons learned. Qualitative methods can help to identify negative consequences of implementation, such as disruption of workflow for providers and staff, which can help explain why users may not be using the HIE system. Evaluators may use field notes, for example, when observing clinician trainings around the HIE system, noting things such as how the presentation was received, what kinds of questions were asked, and if there was any active resistance to the HIE project.

This approach is successful in helping the laboratories see that workload demands should decline, not increase, with electronic exchange. A key lesson learned is the need to consider and communicate in advance with key stakeholders about their concerns about HIE, such as impact on workload. A small pilot study of HIE impact on workflow of a commercial laboratory would have been helpful in understanding the impact before going live with all laboratories. Another lesson is to monitor use of the HIE system, and not assume that stakeholders will use the system once implemented.

Qualitative techniques also can help monitor barriers and facilitators to the HIE project or evaluation, and any steps that were taken to overcome barriers. These techniques can yield important lessons learned. (See Figure 4-3 for an example.) Barriers may include organizational barriers, technology barriers, security and privacy barriers, financial barriers, legal barriers, and others. Qualitative methods can help to document effective ways to overcome barriers, such as strong leadership, strong clinical champions, high-quality training, strong support for early stages of implementation, and buy-in from users and other stakeholders.



Lastly, qualitative results, in the form of quotations or anecdotal stories, can provide immediate evidence of benefits to stakeholders long before long-term quantitative evaluations are completed.

Identifying Data Sources

This subsection describes how to identify data sources by considering the following:

- Currently available data that could be used for each measure.
- Technology that can be leveraged to assist in the evaluation process.
- The type of data-sharing agreement that is appropriate for your evaluation

Identify the sources from which you will obtain data. Potential sources of data include the following:

1. Primary field-based data collection
2. Paper medical records
3. Paper or electronic logs (e.g., phone, fax, mail logs)
4. Electronic data repositories and EHR system databases
 - a. Laboratory system
 - b. Pharmacy system (including pharmacy logs)
 - c. Billing system
 - d. Registration system
 - e. Radiology information system
 - f. Pathology information system
 - g. Health information exchange system
 - h. Personal health record system
 - i. EHR data
 - j. Administrative systems
 - k. Disease registries
 - l. Prescription review databases
5. Real-time capture from medical devices (e.g., barcode readers)
6. Specific programs at participating institutions (e.g., hospital quality control program)
7. HIE server log files of transactions
8. Systems that track patients opting in and opting out of the HIE system
9. HIE master patient index of patients whose information can be exchanged



Once you have identified currently available data sources for the measures you have identified thus far, you should identify and document other measures that can be readily obtained from members of your HIE organization. You should also investigate what technology would be used by these sources in order to generate these measures (e.g., HIE vendor turning on system logging and generating log reports, data mining of EHR database files) and determine how technology can support your evaluation process.

HIE Organization Members as Sources for Measures

It is likely that teams within your HIE organization's participating groups are already collecting data that might be useful to you. Reach out to these groups to learn what information they are collecting, and determine whether that information can be used as an evaluation measure. (See Figure 4-4 for an example.) Stakeholders in your HIE organization that may be able to assist you with measures may include the following:

- Clinicians
- Laboratory services
- Pharmacies
- Hospitals
- Payers
- Intermediaries
- Claims processors
- Public health departments

These and other HIE partners probably collect a tremendous amount of data for multiple purposes. Your HIE project's ability to re-use and re-purpose existing data may be an important value to your stakeholders, and a useful evaluation measure.

Identifying Data Sources From Participating Organizations

Contact the participating organizations in your HIE organization to learn the reporting capabilities of their current software programs. There may be opportunities to leverage those reporting capabilities for your evaluations. For example, asking the following questions can identify potential opportunities to capitalize on data available from your HIE organization partners.

- Do your participating laboratories already monitor phone calls from clinicians requesting results?
- Are the participating pharmacies already evaluating customer satisfaction?
- Could your evaluation team work with another project team or participating organization that is abstracting medical records to gather additional information needed for your evaluation?





Figure 4-4. Example of how to identify a data source for a measure from HIE project participants

Measure: E-prescribing (electronic exchange of prescription information) will reduce the number of phone calls between prescribers and pharmacies to clarify prescriptions.

Identifying existing data sources for this measure: Your team contacts the participating pharmacies to ask about any reports generated on a routine basis and finds that all of the participating pharmacies actively monitor and document the number and types of phone calls they make to physicians to clarify information on prescriptions. You can add this measure to the evaluation plan to determine whether the HIE project has an impact on the number of clarifying phone calls between pharmacies and physicians.

Ensure That Data-Sharing Agreements Support the Evaluation

The types of data-sharing agreements needed for an evaluation will vary based on the types of data being shared and the evaluator’s relationship to the HIE project. First, it is important to ensure that the health care organizations have approved the use of HIE data for evaluation. Language about the use of HIE data for evaluation may be found in data-sharing agreements (e.g., the Data Use and Reciprocal Support Agreement [DURSA]) or user participation agreements). These agreements should clearly define the purposes of the agreement and the permitted uses of the data. Commonly permitted uses related to evaluation include, but are not limited to, studies to assess HIE network activity, reduction of costs, improvement of health care operations, improvement of the quality and efficiency of health care, and the appropriate and secure exchange of electronic data in compliance with applicable laws. If the existing user participation agreements do not permit the use of data for evaluation purposes, you must not start your evaluation until proper legal authorization is obtained. Failure to do so can lead to suspension of evaluation efforts or substantial delays.



If the evaluation team will have access to data sources with sensitive information (e.g., identifiable information or budget data) and is not directly affiliated with the organization providing the data, additional data-sharing agreements that define the terms and conditions for data sharing may be needed. Consult your legal counsel or privacy office to determine the type of agreement that is appropriate for your evaluation. Possible options include a business associate agreement (BAA), data use agreement (DUA), or nondisclosure agreement (NDA), depending on the type of data being shared and the purpose of the data sharing.



Prioritizing Candidate Evaluation Measures

This subsection describes how to narrow the list of candidate measures by—

- Ranking each measure based on feasibility and potential impact
- Understanding the relative importance of each measure to different stakeholders

You should evaluate each potential measure that you identified in Section 4, “Identifying Potential Evaluation Measures” to narrow down to a set of candidate measures before you assess their feasibility and relative cost. In this section, through brainstorming and literature reviews, you were instructed to cast a wide net and identify potentially useful measures without much constraint. In selecting the candidate measures from the collection of all potential measures, the first question is whether you expect your HIE project to impact the measures, and if so, how? You may find that this exercise eliminates some measures from your list because they will not be affected by your HIE project. You should now have a list of potential measures that will be affected by your HIE project.

The next step in developing your plan is to rank each potential measure in terms of feasibility and importance to your stakeholders. To do so, you may use the methods described below.

1-2-3 Ranking and Quadrant Analysis Method

This type of assessment includes the use of a simple scale to assign priorities to each measure along the dimensions of importance and feasibility. You then combine the two dimensions in a quadrant analysis.

Importance

The first step is to review the potential measures with your stakeholders to understand the relative importance of each measure to different stakeholders. HIE projects typically have a variety of stakeholders, across many types of facilities, and may have different goals and priorities. It is best to recognize this up front and maintain your impartiality as best as you can. If necessary, you can bring all the players to the table and together determine what is most important to the HIE organization as a whole.

Another approach to determining the importance of measures is to consider any requirements that your HIE organization has to meet. For instance, if an organization is required to be exchanging a given percentage of data by a particular date, this may be prioritized as a “very important” measure to evaluate.

The importance scale is defined as follows:

- 1 = Very important.** These measures are required for your HIE project, and are considered most important by your stakeholders.
- 2 = Moderately important.** These measures are required for your HIE project, or are considered important by most of your stakeholders.
- 3 = Not important.** These measures are not required by your HIE project, and are not considered important to most of your stakeholders.



Feasibility

The next step is to determine which measures are feasible for you to evaluate. Be realistic about the resources available to you. Teams frequently are forced to abandon evaluation projects that are labor-intensive and expensive. Focus on what is achievable and what needs to be measured to determine whether your HIE project implementation has met its goals.

Determine Sample Size for the Measure

The feasibility of measuring a specific outcome or process measure often depends on the minimal sample size you need. In a typical evaluation project, you will be interested in examining whether your HIE project has impacted a measure of interest. In general, if the measure is capturing rare or infrequent events, perhaps because HIE usage is low for certain types of users is low (e.g., if considering a measure related to HIE usage in an emergency department), you will need to make many observations in order to observe a sufficient number of events to draw meaningful conclusions. Also, if the impact of the HIE project is small, you will need to make more observations in order to say with confidence that any measured impact is truly due to the HIE project itself and not due to random chance.

You should become familiar with how to determine sample sizes, particularly if you have chosen to include quantitative measures in your HIE project evaluation. If your team does not possess the needed statistical expertise, you may want to acquire the help of a statistician to help you estimate the number of data points you will need for each outcome or process measure. Large sample size requirements might lead you to exclude certain measures from consideration. Appendix D offers an example to illustrate the importance of sample size.

The feasibility scale is defined as follows:

- 1 = Feasible.** These measures are readily available from your data sources, without significant additional work, and any sample size requirements can be met.
- 2 = Feasible with moderate effort.** The measures can be derived from your data sources with some data manipulation or data entry/data capture efforts, and any sample size requirements can be met.
- 3 = Not feasible.** These measures cannot be captured from your existing data sources, and sample size requirements cannot be met.

For example, you might want to know whether your implementation reduces adverse drug events. Your stakeholders may consider this measure very important, but if you have neither the funds nor the resources needed (e.g., staff time) for medical record abstraction, the evaluation for this measure will likely fail. Rate these types of measures as not feasible. Remember to focus on what can be achieved.

Once you have ranked measures on the 1-2-3 scale based on importance and feasibility, you can conduct a quadrant analysis. A quadrant analysis is a measure assessment that uses a simple numeric scale to assign priorities to each measure along two different dimensions. This method uses a table to visually present the ranking of each dimension as a way to group information and guide decisionmaking. You may use this technique to group measures in terms of their feasibility and importance using a quadrant analysis table like the one shown below (Table 4-2). Colors can be added to the table, often called heat maps, to provide visual cues for your team.



TABLE 4-2. QUADRANT ANALYSIS TABLE

		Feasibility scale		
		1: Feasible	2: Feasible With Moderate Effort	3: Not Feasible
Importance Scale	1: Very Important	(1)	(2)	
	2: Moderately Important	(3)	(4)	
	3: Not Important	(5)		

Using the importance and feasibility ratings, place your measures into the cells identified in the table, and determine their overall ranking based on the number associated with the cell in which they fall. These rankings, or quadrant analysis values, are then used to rank the measures to identify your primary measures. For example, if you rated measure A as “very important” on the importance scale and “feasible” on the feasibility scale, you would place the measure in the box created by the intersection of the first row and first column. Measures falling into this box receive an overall rank or analysis value of 1. Likewise, if you rated measure B as “not important” on the importance scale and “feasible” on the feasibility scale, you would place the measure in the box created by the intersection of the third row and first column. Measures falling into this box receive an overall rank or quadrant analysis value of 5.

Those measures that fall within the heavily shaded zone (i.e., measures with a score of 1, considered very important and most feasible) are measures that you should include in your evaluation plan. Measures in the lightly shaded zones, with scores of 2 to 5, are measures that you can undertake based on their quadrant analysis scores. Finally, measures in the white zones of the table, with no numerical score, probably should not be included in your evaluation plan.

Using the results of the quadrant analysis, create a short list of four to five primary measures to evaluate in your HIE project evaluation plan. If you want to evaluate other measures and you believe that you will have the required resources available to you, list those as secondary measures.

Considering the Impact of Data Collection Strategies on Relative Cost and Feasibility

This subsection describes how to refine the data collection strategy by—

- Determining whether it is feasible to collect data for a given measure
- Considering whether the selected data collection method and design are feasible with regard to time and expense



Now that you have chosen your primary measures, the next step is to consider data collection methods. In deciding whether it is feasible to collect data for a given measure, it is important to consider the cost of the methods required to collect the data, as well as any challenges involved. There are two general methodological approaches for evaluation research design—retrospective and prospective. Measures collected using these methods are either qualitative or quantitative. Both the methodological approach and the measure type factor into the feasibility of a given measure.

The discussion below describes commonly used study designs for qualitative and quantitative data collection, along with relative cost considerations, to provide you with strategies to address potential challenges. Determination of method feasibility may lead you to exclude some of the measures that you identified and ranked in the previous step.

Survey Instrument Development Cost Implications

Surveys can provide both quantitative and qualitative data, and can be used for prospective study designs. For example, a survey can be used to assess clinicians' satisfaction and experience with HIE. Developing your own survey can be time-consuming. If you are conducting rigorous evaluations, you also will need to validate the survey, especially if it is scored, which can add additional time and expense.

Focus Group Planning and Execution

Focus groups are a qualitative data collection method. Focus groups require planning, and the logistics can become complicated when busy participants are invited to attend. The methodology for data analysis from focus groups requires the expertise of a qualitative researcher to analyze free-text data. A well-designed focus group is much more than a group of individual interviews, and facilitating such a session requires considerable skill. Focus groups can yield rich data in a short time, but it is important to carefully select the right participants, encourage everyone to be heard, carefully steer the discussion so it stays on track, and focus on just a few main questions.²⁸

Manual Medical Record Review

Manual medical record review is usually a quantitative data collection method. This method can be time-consuming and expensive, depending on how many medical records need to be reviewed or how many data elements need to be abstracted from each record. Common difficulties with the use of medical record reviews include unintentional data omission, manual data entry errors, or accessing medical records that may be incomplete. In addition, reviewers can easily become fatigued from the tediousness of the work.

Data Mining

Data mining, another quantitative technique, is “an iterative process of selecting, exploring and modeling large amounts of data to identify meaningful, logical patterns and relationships among key variables. Data mining is used to uncover trends, predict future events and assess the merits of various courses of action.”³³ You may need to have access to experienced programmers or statisticians to extract data, model and analyze patterns within a data set, and interpret the findings. However, identifying care patterns from clinical data warehouses or utilization patterns



from billing databases could give evaluators and stakeholders rich insights into the health care system and suggest critical quality improvement initiatives or business strategies.

Other Study Designs

Time and Motion Studies

Some prospective studies can be conducted in a fairly efficient and quick manner. For example, non-interventional studies that make use of well-established methods such as time and motion studies can be quickly conducted using research assistants or students.

Randomized Controlled Trials

Other types of prospective studies, such as experimental studies (e.g., randomized controlled trials) and quasi-experimental studies are more complicated and expensive. Studies that are designed to make inferences based on causality require the use of statistical inferences, statistical induction, or inferential statistics procedures that can be used to draw conclusions from datasets. Although such study designs may provide the most accurate and valid data of all, they are also very expensive to undertake.

Case-Control Designs

Other study designs (e.g., case-control studies) require the use of a group of subjects (e.g., cohort or control group) that is similar to those participating in an HIE project, in order to evaluate the outcome in question. Identifying cohorts or control groups can pose a challenge.

Developing Your Evaluation Plan Based on Selected Measures

This subsection describes drafting and reviewing an evaluation plan and includes a measures review template.

Once you have considered the impact of study design, data sources, and data collection strategies on your evaluation, and made any needed adjustments to the measures you selected in Section 4, “Prioritizing Candidate Evaluation Measures” or to the methods to be used, you should have a final set of evaluation measures. You are then ready to begin drafting your evaluation plan. For each measure, document important information such as what evaluation goal each measure will address, how you will collect the data, and how you will analyze each of the final measures. Have your proposed methodology reviewed by the research methodological experts. For example, if your evaluation will include a quantitative study, you may want to have a statistician review your plan, as this may save you time later in your evaluation. In addition, you may want to test your proposed methods. For example, if you will use survey methods as part of your evaluation, you may want to conduct a small pilot test to ensure that the survey instrument you have developed is easily understood and can be used in accordance with your plan.

In developing your plan, you can use the following template (Table 4-3) to help you outline the details. Although this table has columns for four measures, your evaluation design might involve a smaller or larger number of measures.



TABLE 4-3. EVALUATION PLAN DETAILS

Document for Each Measure	Final Evaluation Measures			
	Measure 1	Measure 2	Measure 3	Measure 4
Briefly describe the HIE project.				
Describe the HIE intervention and the intended impact.				
What questions do you want to ask to evaluate this impact (either positive or negative)?				
What will you measure to answer these questions?				
How will you collect the needed data?				
How will you design your study? For a quantitative study, you might consider what comparison group you will use. For a qualitative study, you might consider whether you will make observations or interview users.				
Analysis: • For quantitative methods: What types of statistical analysis will you perform on your data? • For qualitative methods: What analysis will you conduct using qualitative data?				
Sample size: • For quantitative methods: Estimate the number of observations needed to demonstrate that the measure has changed statistically. • For qualitative methods: Estimate the appropriate sample size needed to reach conclusions regarding this measure.				
How would the answers to these questions inform future decisionmaking about the HIE project and/or HIE system implementations?				
What is the planned timeframe for evaluating this measure?				
Responsibilities: • Who will take the lead for the evaluation for this measure? • Who will be responsible for data collection? • Who will lead data analysis? • Who will present the findings? • Who will draft a summary of the findings?				



TABLE 4-3. EVALUATION PLAN DETAILS (CONTINUED)

Document for Each Measure	Final Evaluation Measures			
	Measure 1	Measure 2	Measure 3	Measure 4
Estimate the cost for evaluating the measures. Take into consideration planning, meetings, travel, analysis, consultation time with a methodologist (e.g., statistician, qualitative researcher, survey methods expert), and time to prepare a final report or summary on your findings, if necessary.				

Completing Your Draft Evaluation Plan

This subsection provides a sample evaluation plan outline.

Based on your work to this point, you have everything you need to complete a draft evaluation plan for your HIE project. You are now ready to write your evaluation plan following the suggested outline below, with a quantitative and qualitative measure example. In addition to evaluation approaches, your plan should have some discussion of budget considerations that show you have considered costs and available staffing resources.

Outline for Evaluation Plan

1. Short Description of the HIE Project
2. Goals and Objectives of the HIE Project
3. Questions To Be Answered by the Evaluation Effort
4. First Measure To Be Evaluated – Quantitative
 - a. Overview—General Considerations
 - b. Timeframe
 - c. Study Design/Comparison Group
 - d. Data Collection Plan (Including Power/Sample Size Calculation for Quantitative Measures)
 - e. Analysis Plan
5. Second Measure To Be Evaluated—Qualitative
 - a. Overview—General Considerations
 - b. Timeframe
 - c. Study Design
 - d. Data Collection Plan
 - e. Analysis Plan
6. Subsequent Measures To Be Evaluated in Same Format
7. Budget Considerations
8. Conclusion



Checking Your Evaluation Budget

This subsection describes budgetary considerations, including—

- Ensuring that the evaluation can be completed within budget
- Determining potential ways to reduce costs

Prior to finalizing your evaluation plan, you should review the costs associated with implementing it as currently drafted. Your evaluation team needs to ensure that your planned evaluation can be conducted within your evaluation budget. Your review should focus on measures that could put your budget at risk due to the complexity and costs associated with the study design, data collection, and/or data analysis activities. By conducting this review, you should determine if there are ways to reduce the costs of including these measures in your evaluation plan. Below are some suggestions on how to review your budget prior to finalizing your evaluation plan.

Review or Revise Your Quadrant Analysis

If it is clear that your budget is insufficient to conduct all evaluation activities for your planned measures, have your team reassess the importance and feasibility of these measures and develop a second quadrant analysis table (see Section 4, “Prioritizing Candidate Evaluation Measures” for original discussion). Criteria that could guide your reassessment are whether the proposed study design for a given measure is too expensive, as this may impact your team’s estimation as to whether it is feasible to evaluate as planned. Alternatively, the evaluation approach for a given measure may be expensive, but the measure is critical to understanding the impact of your HIE project, which might cause you to exclude several of the less important measures from the evaluation plan.

Approaches for Reducing Budget Requirements

One approach you can use to maintain some measures that your team considers important in your evaluation plan is to change the study design that will be used to evaluate your HIE project’s impact on that measure. For example, instead of obtaining rigorous quantitative measures to evaluate “efficiency” by comparing “time on task” before and after implementation, you could instead conduct a survey of system users to obtain their feedback regarding how the HIE system has impacted efficiency in conducting their work.

Finalizing Your Evaluation Plan

This subsection describes how to finalize the evaluation plan and share it with all key stakeholders.

At this point, you have reviewed the evaluation budget and completed the draft evaluation plan. Depending on the costs associated with implementing your study design, data collection, and data analyses activities, you may have revised the evaluation plan to accommodate your available evaluation budget. Before you finalize your evaluation plan and budget, you should review the evaluation again to ensure that it conveys the steps, insights, recommendations,



and measures that are important to the evaluation team, the HIE project, and the stakeholders. Update your evaluation plan to balance your needs and constraints. If appropriate, you may want to have your usability expert review the plan to ensure usability for the implementation team. You may also need to satisfy any formal review processes imposed by your HIE project, member organizations, and stakeholders, such as an oversight committee. Once you have completed all of these steps and finalized your evaluation plan, distribute the plan widely to ensure that you have informed all of the stakeholders and can maximize buy-in. By following the steps outlined in this guide, balancing your needs and constraints, and connecting with your stakeholders, you will have a strong foundation for a successful evaluation.





Section 5: Creating Your Dissemination Plan

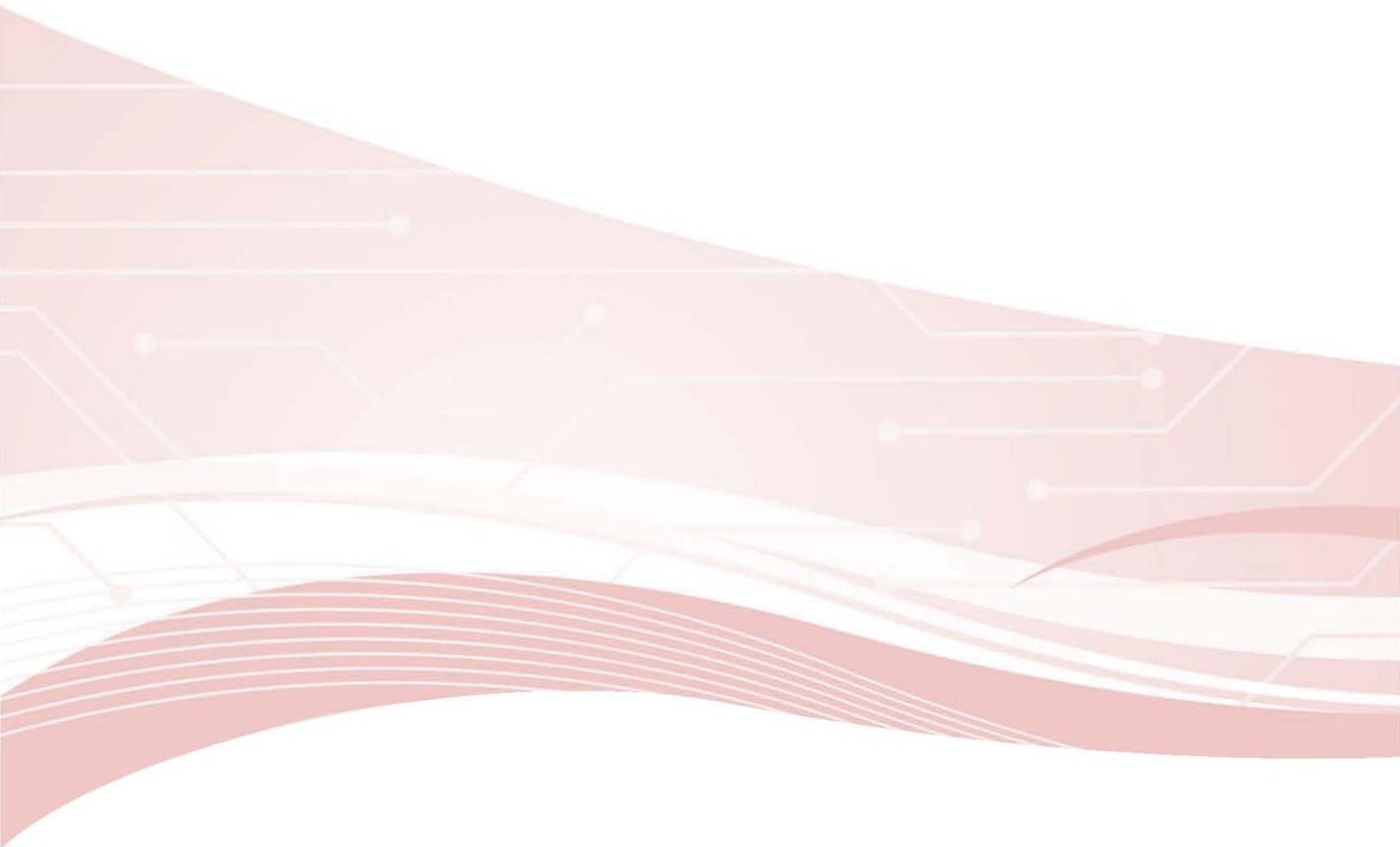
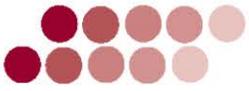
Disseminating your evaluation findings will ensure that your evaluation has “real world” impact and that other HIE projects can benefit from your experiences and lessons. By incorporating dissemination strategies early in the planning stages of the evaluation, you can achieve the most effective dissemination. No single approach or strategy will achieve all of your dissemination goals; you will likely use multiple methods and tools in the dissemination plan.

In creating your dissemination plan, you should consider the following key questions:

- **Goal:** What are the goals and objectives of your dissemination effort? What impact do you hope to have?
- **Evaluation findings and products:** What will be disseminated?
- **Audience and end users:** Which stakeholder organizations will apply your findings in actual practice? Who is affected most by the evaluation? Who would be interested in learning about the study findings? Is this of interest to a broader community?
- **Communication:** How can you effectively convey the evaluation outcomes?
- **Medium:** What is the most effective way to reach each audience? What resources does each group typically access?
- **Execution:** When should each aspect of your dissemination plan occur (i.e., at which points during the evaluation and afterwards)? Who will be responsible for dissemination activities? Who are the dissemination partners—individuals, organizations, or networks through whom you can reach end users?



In planning for dissemination, it is critical that you start by following the steps outlined in Section 2 to identify your HIE project’s stakeholders, along with their goals and objectives. Dissemination starts with awareness, as stakeholders learn about the motivation, goals, needs, measures, and plan for the evaluation. Your dissemination plan should then tailor communication strategies, materials, and the medium to the priority areas of interest for your audience and end users. For example, researchers might prefer formal peer-reviewed publications, while clinicians may prefer presentations that highlight clinical benefits and improved patient outcomes, and administrators are more likely to focus on financial impact and return on investment. A strong dissemination plan would account for these preferences, address each stakeholder’s pain points, and ultimately answer each stakeholder’s question, “Is this HIE project a success for me?”





Section 6: Examples of Evaluation Measures

Section 6 includes tables that list sample measures you might use to evaluate your HIE project. Each table includes possible measures, suggested data sources for each measure, practical notes, considerations, and, when available, links to suggested resources. The tables are not exhaustive, but rather highlight measures that have been commonly used to evaluate HIE projects. You should not try to incorporate all or a large number of measures into your evaluation; it is likely that only a small subset of the measures is directly applicable and relevant to your project. Your evaluation team should carefully consider whether a measure is important and applicable to your HIE project, based in part on having an understanding of the resources required to develop the study design and collect and analyze the data for the measures. For example, some data sources may be difficult to access or costly, and patient data may require informed consent. Based on the information provided, do your best to determine whether the value of a given measure outweighs the corresponding cost to your project's resources.



Section 6 is divided into three subsections:

1. “Measures to evaluate the process of creating an HIE organization” provides a set of mostly process measures to evaluate progress in planning and implementing an HIE system.
2. “Measures for specific types of data exchange” provides details about specific measures, based on the kind of data that are being exchanged among the health care providers participating in the HIE project.
3. “Measures for clinical outcome and clinical process evaluation” provides suggested outcome, impact, and financial measures to use in analyzing the process and quality of clinical care.

Measures To Evaluate the Process of Creating an HIE Organization

The tables in this subsection provide examples of measures that are based on the *structure* and *function* of an HIE organization. Most of these measures are “Yes/No” measures, and can be ascertained from strategic planning, operations planning, legal, technical, and other documents (e.g., meeting minutes, Gantt charts, and organizational charts). The tables list measures in the following categories:

- Table 6-1. Measures of the infrastructure development effort;
- Table 6-2. Measures of process.



TABLE 6-1. MEASURES OF THE INFRASTRUCTURE DEVELOPMENT EFFORT

Measure	Data Source(s)	Practical Notes	Considerations
<ul style="list-style-type: none"> • Has a strategic plan been developed for the HIE organization? 	<ul style="list-style-type: none"> • The governing board for the HIE organization may have an executive or management team responsible for planning. In the absence of a governing board, the HIE organization executives will assign planning responsibilities. 	<p>A strategic plan is a document that describes the mission, vision, and goals of the HIE organization.</p>	<p>The strategic plan is a persistent document that drives the development and direction of the HIE organization.</p>
<ul style="list-style-type: none"> • Have the appropriate stakeholders been identified (i.e., the institutions and individuals who will participate or be impacted by the evaluation)? 	<ul style="list-style-type: none"> • Strategic or business plan documents • Minutes from governance meetings • Memorandums of understanding • Business agreements • Standards of participation 	<p>An HIE organization's stakeholders typically include both institutions and individuals. Institutions may include laboratories, pharmacies, hospitals, clinics, long-term care facilities, radiology offices, and payers. Individuals may include providers, pharmacists, allied health care workers, and patients.</p>	<p>It is important to include patients as stakeholders</p>
<ul style="list-style-type: none"> • Has the legal climate for data sharing been ascertained? • Is there a document establishing the legal entity (e.g., articles of incorporation or State legislation)? • Have data-sharing agreements been executed among the partners? • Have State privacy laws been mapped to the HIE project? 	<ul style="list-style-type: none"> • Strategic plan • Operations plan • Stakeholders • Data-sharing agreements 	<p>Many factors impact stakeholders' willingness and ability to share data.</p>	<p>Be aware of issues arising when the data are to be shared across State boundaries, as the legal environment may be different from State to State.</p>



TABLE 6-1. MEASURES OF THE INFRASTRUCTURE DEVELOPMENT EFFORT (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations
<ul style="list-style-type: none"> • Has a technical plan for data sharing been developed? • Has there been an assessment of all systems that are to become part of the exchange? • Will each site have an HIE-provided server? 	<ul style="list-style-type: none"> • Strategic plan • Technical architecture documents 	A technical plan typically specifies the architecture, the hardware and software to be used, and the required technical standards to be implemented.	The technical plan will likely change as the HIE project and system evolve.
<ul style="list-style-type: none"> • Has an implementation team been identified? • What resources have been assigned by each participating organization? 	<ul style="list-style-type: none"> • Committee meeting minutes • Planning documents • Operations plan 	An implementation committee is typically responsible for overseeing the implementation effort, organizational processes, and costs.	
<ul style="list-style-type: none"> • Has an HIE project plan been developed? 	<ul style="list-style-type: none"> • HIE project plan • Gantt charts • Strategic plan • Operations plan 	A project plan is necessary to allocate tasks to individuals and teams that will be responsible for conducting them, monitoring task completion and the project schedule, and monitoring project costs.	The project plan may be revised, and it should be updated over time as the HIE project evolves.
<ul style="list-style-type: none"> • What specific data elements are to be shared, and why? • Have standards for data exchange been identified? • Is there a testing plan to validate data being sent? 	<ul style="list-style-type: none"> • Strategic plan • Operations plan 	Selection of data to be exchanged will help determine the necessary technical components of the HIE system and the type of data-sharing agreements that will be needed.	Be aware that different partner organizations may define these data elements differently.
<ul style="list-style-type: none"> • Have sources of data elements been identified? 	<ul style="list-style-type: none"> • Minutes from technical architecture discussions • Strategic plan • Operations plan 	The source of the data elements could include EHR systems and other databases and systems (e.g., registration system, billing system, pharmacy system).	Sources for needed data elements will vary across organizations, and the data may need to be reorganized or relabeled so it can be easily understood across institutions.

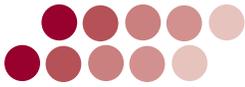


TABLE 6-1. MEASURES OF THE INFRASTRUCTURE DEVELOPMENT EFFORT (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations
<ul style="list-style-type: none"> • Is there a procedure in place to obtain patient consent to share their data? to opt-out of sharing their data? • Does that consent include any use of de-identified data for research purposes? • Who is responsible for obtaining consent? • Has the HIE project operationally defined any data that will have special protection, such as behavioral health, Federal alcohol and drug treatment, adolescent reproductive health, or other sensitive data? • Has the technical implementation team been educated about these definitions? 	<ul style="list-style-type: none"> • Operations plan • Legal documents • State law • Patient consent forms • Trust Principles/ Framework 	<p>HIE organizations may use different consent models. For example, some may use an “opt-in” model, in which patients are explicitly asked for consent to participate in the HIE system. In those cases, some institutions may prefer to ask patients for a single agreement to share all pertinent patient data, while others may prefer to request patient consent to share each data element to be shared. Other HIE organizations may use an “opt-out” consent model, in which patient data will be shared unless they decline participation.</p>	<p>State law may stipulate consent provisions. The Health Insurance Portability and Accountability Act (HIPAA) has special requirements for consent in a research context. Be sure to consult with an institutional review board regarding your evaluation plan design.</p>



TABLE 6-1. MEASURES OF THE INFRASTRUCTURE DEVELOPMENT EFFORT (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations
<ul style="list-style-type: none"> • Are security and privacy policies in place for all HIE partners? 	<ul style="list-style-type: none"> • Risk assessment process • Internal reviews and monitoring, including reactive and preventive controls • User authentication and access controls • Competence of personnel; privacy and security training • Physical and environmental security • Personal health information collection and use limits • Notice of data practices • Personal health information integrity and correction processes • Third-party transfer restrictions 	<p>Before determining which legal and information-sharing agreements should be applicable to those they contract with, an HIE project should consider their current internal policies and practices for maintaining the privacy and security of personal health information.</p>	
<ul style="list-style-type: none"> • Have governance structures been established? • Have meetings of the governance group been held? 	<ul style="list-style-type: none"> • Operations plan • Articles of incorporation • State legislation establishing an HIE organization • Business principles 		
<ul style="list-style-type: none"> • Is an evaluation planned as a part of the HIE project? 	<ul style="list-style-type: none"> • Operations plan 	<p>Evaluation is necessary to assess the impact of the HIE project.</p>	<p>The evaluation may evolve as the HIE organization and system develop.</p>



TABLE 6-2. MEASURES OF PROCESS

Measure	Data Source(s)	Practical Notes	Considerations
<ul style="list-style-type: none"> • Are participating organizations ready to share the specific data elements? 	<ul style="list-style-type: none"> • Committee meeting minutes and other documents • Signed data-sharing agreements 	It is important to understand whether stakeholders understand what data elements will be shared, how these data elements are represented in their databases, and whether they have plans in place to share data electronically.	It is important to understand each stakeholder's knowledge regarding these specific data elements.
<ul style="list-style-type: none"> • Do stakeholders know their roles and responsibilities on the HIE project? 	<ul style="list-style-type: none"> • Governance diagrams • Charter documents • Legal documents 	Stakeholders' understanding of their roles is important, as roles and responsibilities are instrumental for building trust and settling disputes.	
<ul style="list-style-type: none"> • Has the technical architecture been finalized? 	<ul style="list-style-type: none"> • Meeting minutes and documents 	A technical architecture typically specifies the data-sharing model, the standards and interfaces to be used between systems, the patient matching scheme, the data aggregation scheme, and security.	
<ul style="list-style-type: none"> • Is the implementation progressing according to the project timeline? 	<ul style="list-style-type: none"> • Project plan • Implementation plan 		
<ul style="list-style-type: none"> • Is the implementation proceeding within budget? 	<ul style="list-style-type: none"> • Budget • Implementation plan • Actual costs • Project plan 	It is important to monitor implementation costs for each deliverable. The organization may need to shift or reallocate efforts if costs are higher than anticipated.	Cost-related data may be difficult to obtain and analyze for large-scale projects.



Measures for Specific Types of Data Exchange

The tables in this subsection provide examples of measures based on five types of data exchange. Each table provides measures regarding the value of one particular type of data exchange. Some measures are “exchange capability questions,” which are simple “Yes/No” questions as to whether the exchange has achieved certain capabilities. These capability questions do not require every participating organization to have achieved the functionalities, but it is necessary to demonstrate that the exchange organization and technical infrastructure can support the functionalities. The tables list measures in the following categories:

- Table 6-3. Data exchange between providers and laboratories
- Table 6-4. Data exchange between providers and pharmacies
- Table 6-5. Data exchange between providers
- Table 6-6. Data exchange between providers and radiology centers
- Table 6-7. Data exchange between providers and public health departments



TABLE 6-3. DATA EXCHANGE BETWEEN PROVIDERS AND LABORATORIES

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Was electronic ordering of laboratory tests between outpatient providers and laboratories achieved? 	<ul style="list-style-type: none"> Implementation team 	<p>Exchange requires an interface between the ambulatory EHR system and the laboratory data system. This is an exchange capability question as to whether this has been demonstrated anywhere within the exchange.</p>	<p>Is this a standards-based bidirectional interface?</p>	
<ul style="list-style-type: none"> Are providers using data exchange capability with laboratories? 	<ul style="list-style-type: none"> Usage statistics from system's audit logs (e.g., order logs, result view logs, system log-on tracking) 	<p>You could measure this in several ways. One would be to divide the number of providers using the system (numerator) by the number of total providers (denominator). A second approach might measure how often individual providers are accessing the system, with access hit rates as the numerator and the number of individual providers as the denominator. A third approach might be to get an overall average rate by dividing the number of access hits by the total number of providers. Providers might be defined as nurses and/or physicians. Tracking this information over time and presenting it visually would give stakeholders an understanding of adoption trends for your project. You could also track the number of paper transactions still being used (i.e., clinical staff putting laboratory results into records).</p>	<p>Finding baseline provider rates might be difficult. For example, what is your sample of physicians who could be using the system? You could consider getting this information from local medical societies or boards of medicine.</p>	<p>See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 133, for a detailed definition and evaluation method for this measure.³⁵ This resource is freely available.</p>



TABLE 6-3. DATA EXCHANGE BETWEEN PROVIDERS AND LABORATORIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • What percentage of laboratory orders is sent electronically? 	<ul style="list-style-type: none"> • Usage statistics from system's audit logs 	The denominator is all orders (electronic and paper). The numerator is electronic orders only. This can be done on both the laboratory and provider side.	This measure can be costly if it requires counting paper orders.	See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 136 for a detailed definition and evaluation method for this measure. ³⁵
<ul style="list-style-type: none"> • Was there a reduction in calls to providers to clarify an order? • How much of a reduction? 	<ul style="list-style-type: none"> • Call logs 	This measure requires tracking call volume before and after the intervention.	Calls may not be for order clarification but to report other issues (e.g., improper specimen collection, unavailability of test, or new test version).	See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 64 for a detailed definition and evaluation method for this measure. ³⁵
<ul style="list-style-type: none"> • What was the reduction in costs to send orders to laboratory? 	<ul style="list-style-type: none"> • Pre- and post-implementation review of financial logs, time and motion studies, and workflow analysis in a sample of various settings 	First, estimate what these costs are per order (labor costs to prepare forms, costs to send forms) and then multiply by the number of orders sent out. Using time and motion studies compare paper and electronic methods on how much time individuals spend searching for results, writing orders, and transcribing; multiply time by mean staff hourly wage.	Make sure to track orders electronically. The cost of an "electronic transfer" is not zero; it includes the cost of developing and maintaining the infrastructure to send the information electronically.	See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴



TABLE 6-3. DATA EXCHANGE BETWEEN PROVIDERS AND LABORATORIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Impact on duplicate laboratory tests 	<ul style="list-style-type: none"> Pre- and post-implementation review of claims data 	<p>If you are rolling out your project in stages, you could use those organizations or providers who have not gone live yet as your control group, thereby avoiding the need for a retrospective medical record review. You may also be able to use billing data to help focus the search for redundant tests.</p>	<p>Need to define “duplicate” for each type of test. For example, the definition of duplicate would differ by type of blood test, and would differ based on whether the initial test were normal vs. abnormal. This measure might be costly if you have to do a medical record review.</p>	
<ul style="list-style-type: none"> Was electronic exchange of laboratory results between outpatient providers and laboratories achieved? 	<ul style="list-style-type: none"> Implementation team 	<p>This exchange requires an interface between the ambulatory EHR system and the laboratory data system. The measure is whether exchange capability is in place.</p>	<p>Is this a standards-based bidirectional interface?</p>	
<ul style="list-style-type: none"> Impact on the number of calls to the laboratory for results 	<ul style="list-style-type: none"> Laboratory call logs 	<p>A reduction in the number of calls to the laboratory for results suggests that providers can find results in a timelier fashion.</p>	<p>Measurements need to be adjusted for the volume of tests conducted by each of the participating laboratories. Also, changes in market share by laboratories need to be considered.</p>	



TABLE 6-3. DATA EXCHANGE BETWEEN PROVIDERS AND LABORATORIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Decrease in time to report critical results by the laboratory 	<ul style="list-style-type: none"> Call logs pre- and post-implementation 	<p>This is a great measure to consider, given the Joint Commission’s interest in this topic.</p>	<p>If call log information is not already being collected, it will be hard to collect.</p>	<p>See Canada Health Infoway’s Benefits Evaluation Indicators Technical Report, p. 57, for a detailed definition and evaluation method for this measure.³⁵</p>
<ul style="list-style-type: none"> Costs saved for sending and receiving results 	<ul style="list-style-type: none"> Financial logs 	<p>Estimate the costs associated with receiving a single result (labor to open mail, sort, distribute to clinicians, and post on patient medical record) and multiply by the number of laboratory results received.</p>	<p>If users are still printing out electronic results to put in paper medical records, this cost must be considered as well.</p>	
<ul style="list-style-type: none"> Impact on the satisfaction of clinicians 	<ul style="list-style-type: none"> Surveys or focus groups examining the perception of usability, the ease of learning to use the system, and efficiency as a result of the data exchange 	<p>You might consider sampling both your users as well as clinicians who could be involved in the project but who have chosen not to participate. Going to State- or region-wide provider databases from local medical societies or boards of registrations may be ways to determine your target survey group. Consider questions such as asking clinicians how often they were able to find the result they were looking for in a timely manner. You could compare responses before and after implementation. It may be helpful to conduct satisfaction surveys multiple times at different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>		



TABLE 6-3. DATA EXCHANGE BETWEEN PROVIDERS AND LABORATORIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Satisfaction of laboratory personnel 	<ul style="list-style-type: none"> Survey or focus groups 	<p>Your survey could sample the laboratory technicians, or the administrative personnel, including those who are responsible for taking phone calls. The survey would need to be designed to be distributed to all involved laboratories. It could be helpful to conduct the survey multiple times at different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>	<p>Be careful to survey only the personnel affected by data exchange, which may be invisible to some staff. That is, they may not know to whom the data are being sent or who is accessing it. For example, if a laboratory result is viewed by a provider outside the laboratory's traditional service base, the laboratory technician may not know that, and thus may not be aware of the data exchange.</p>	<p>Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>
<ul style="list-style-type: none"> How much data were able to be exchanged? 	<ul style="list-style-type: none"> Implementation team Data exchange logs Number of messages sent or received 	<p>Look at the number of discrete elements that were exchanged.</p>	<p>Note that just because a message was sent properly, it does not mean that it was received and processed properly. For example, if an abnormal result is placed in an exception queue, it might stay in that state for months before the "correct" individual has access to those results.</p>	



TABLE 6-4. DATA EXCHANGE BETWEEN PROVIDERS AND PHARMACIES

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Is e-prescribing available in your HIE region? • What percentage of prescribers use EHR technology to e-prescribe? • What percentage of prescribers use a standalone system for e-prescribing? 		<p>This could be accomplished through an e-prescribing system (i.e., via RxHub or SureScripts) or through an existing HIE system. This measures whether this type of exchange capability is available through the HIE system.</p>	<p>Is this a standards-based bidirectional interface? What does the pharmacy communicate to the provider? Is that communication done using electronic exchange of information?</p>	



TABLE 6-4. DATA EXCHANGE BETWEEN PROVIDERS AND PHARMACIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Are providers using data exchange capability with pharmacies? • How many new prescriptions vs. renewals were ordered electronically? • How are providers performing on meaningful use measure 4, which (for stage 1) requires 40 percent of all prescriptions to be sent electronically? 	<ul style="list-style-type: none"> • Usage statistics from system's audit logs • Implementation team • Regional extension centers, which track the number of providers who have reached milestone 3, (attesting to meaningful use) 	<p>Electronic information collection is possible in several ways. First, you could look at the number of electronic prescriptions received as the numerator and the total number of prescriptions received (both electronic and printed) as the denominator. A second approach would be to divide the number of physicians submitting prescriptions electronically (numerator) by the total number of users of the system (denominator). A third approach would be to divide the number of physicians submitting prescriptions electronically (numerator) by the total number of physicians in the service area (denominator). In addition to providers who have reached milestone 3, providers who have reached milestone 2 have implemented an EHR system and may have operationalized e-prescribing. Any authorized testing and certification bodies (ATCB)-certified complete EHR system must be able to e-prescribe. Some States have found that initial orders for prescriptions are being ordered electronically, while renewals are not ordered electronically.</p>		



TABLE 6-4. DATA EXCHANGE BETWEEN PROVIDERS AND PHARMACIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • How much data were able to be exchanged? • What type of data were exchanged (formulary, eligibility, medication history), and by whom? • How many electronic drug orders were transmitted as a percentage of total drugs ordered? 	<ul style="list-style-type: none"> • Usage statistics from system's audit logs for e-prescribing orders 	Use the number of e-prescribing orders sent as the numerator and the total number of prescriptions filled (both electronic and printed) as the denominator. The total number of prescriptions may need to be estimated by surveying a sample of provider practices, or by reviewing e-prescribing system audit logs.	Be sure that the messages were correctly received and processed on the receiving end. Evaluators may need to contact the pharmacy to verify the numerator.	
<ul style="list-style-type: none"> • Impact on calls to pharmacies 	<ul style="list-style-type: none"> • Provider call logs with protected health information removed 	The logs should also capture the nature of the call.	This is primary data collection from the provider office.	
<ul style="list-style-type: none"> • Impact on calls to providers to clarify a prescription 	<ul style="list-style-type: none"> • Pharmacy call logs with protected health information removed 	Make sure the pharmacy call log has the requisite level of detail to capture the nature of the call.	This is primary data collection.	See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 54, for a detailed definition and evaluation method for this measure. ³⁵
<ul style="list-style-type: none"> • Impact on costs due to improved formulary compliance or use of generic drugs 	<ul style="list-style-type: none"> • IT team • Medical record reviews • Health plan utilization review databases 	If the new system has decision support, the system may have the data to show how often a switch is made from a nonformulary choice to a formulary alternative. Evaluating formulary patterns may be more feasible if you focus on a single drug class or narrow down to a subset of patients.	It could be difficult to find the pre-implementation compliance rate. The measure may be costly if medical record reviews are required.	



TABLE 6-4. DATA EXCHANGE BETWEEN PROVIDERS AND PHARMACIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Impact on costs by switching to generics 	<ul style="list-style-type: none"> • Health plan utilization review databases • IT team • Medical record reviews 	<p>If the new system has decision support, the system may have the data to show how often a switch is made from a brand name choice to a generic alternative. Evaluating brand to generic patterns may be more feasible if you focus on a single drug class or narrow down to a subset of patients.</p>	<p>Measuring costs impact may be costly if medical record reviews are required, or if the EHR system cannot report it.</p>	
<ul style="list-style-type: none"> • Impact on adverse drug events 	<ul style="list-style-type: none"> • Medical record reviews 	<p>You will need to have longitudinal data in order to measure this. You could do active surveillance and build prompts into the system for clinicians to report adverse drug events under certain circumstances (e.g., when discontinuing a drug).</p>	<p>This can be very difficult to define and measure. The teams must come together to decide what constitutes an adverse drug event and how it will be measured. Adverse drug events are relatively rare and it takes many medical record reviews to be confident about the results.</p>	<p>See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 43 for a detailed definition and evaluation method for this measure.³⁵</p>



TABLE 6-4. DATA EXCHANGE BETWEEN PROVIDERS AND PHARMACIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Clinician satisfaction 	<ul style="list-style-type: none"> • Surveys • Focus groups 	<p>You might consider sampling both your users as well as clinicians who could be involved in the project but who have chosen not to participate. Going to State- or region-wide provider databases from local medical societies or boards of registrations may be ways to determine your target survey group. It may be helpful to conduct the satisfaction survey multiple times during different stages of project to monitor trends and potential unintended consequences (positive and negative).</p>	<p>Costs may be prohibitive for conducting a survey.</p>	<p>See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 121 for a detailed definition and evaluation method for this measure.³⁵ Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>
<ul style="list-style-type: none"> • Pharmacist satisfaction 	<ul style="list-style-type: none"> • Surveys • Focus groups 	<p>Your survey could sample the pharmacists, the technicians, or the administrative personnel, including those who are responsible for taking phone calls. The survey would need to be designed to be distributed to all involved pharmacies. It may be helpful to conduct the satisfaction survey multiple times during different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>		<p>Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>



TABLE 6-4. DATA EXCHANGE BETWEEN PROVIDERS AND PHARMACIES (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none">• Patient satisfaction	<ul style="list-style-type: none">• Surveys• Focus groups	One approach is to give patients a survey along with the prescription.		Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site. ³²



TABLE 6-5. DATA EXCHANGE BETWEEN PROVIDERS

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • What percentage of participating practices were able to demonstrate meaningful use measure 14 (exchange of key clinical information)? • What percentage of practices used the HIE system to demonstrate exchange of key clinical information? • What percentage used Direct (secure messaging protocol)? • Did providers use other means to achieve electronic exchange of information? 	<ul style="list-style-type: none"> • Implementation team • Data exchange logs • Regional extension centers, which track the number of providers who have reached milestone 3, (attesting to meaningful use) 	<p>In addition to providers who have reached milestone 3, providers who have reached milestone 2 have implemented an EHR system and may have operationalized electronic exchange</p>	<p>Is this a standards-based bidirectional exchange?</p>	



TABLE 6-5. DATA EXCHANGE BETWEEN PROVIDERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Are providers using HIE data exchange capability with other providers? 	<ul style="list-style-type: none"> • Usage statistics from system's audit logs • Surveys • Implementation team • Number of providers accessing data in or through HIE, and average number of records accessed per month per provider 	<p>If the exchange is sending only administrative data, this clearinghouse function is not considered clinical exchange. It is important to consider how you define providers exchanging information with other providers. Would you define it as e-mail communication, or does it need to be something more, such as the ability to send referrals electronically, or the ability to electronically send a patient's medical record for a referral?</p>	<p>Hospital discharge summaries are sometimes made available through the exchange.</p>	
<ul style="list-style-type: none"> • How much data were able to be exchanged? 	<ul style="list-style-type: none"> • Implementation team 	<p>Message count might be used</p>		
<ul style="list-style-type: none"> • How much of the total health data was exchanged electronically vs. using other methods (e.g., fax, mail, and courier)? 	<ul style="list-style-type: none"> • Implementation team • Logs 		<p>It will be difficult to determine the amount of data being exchanged by nonelectronic methods means.</p>	



TABLE 6-5. DATA EXCHANGE BETWEEN PROVIDERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Impact on costs of medical record pulls 	<ul style="list-style-type: none"> Logs Time and motion studies Medical record reviews 	<p>Estimate the labor cost of a medical record pull and multiply by the number of referrals in a given time period. You could also review a sample of medical records to determine the percentage of consultant notes that are captured electronically for a sample of patients.</p> <p>To do a time and motion study, track the user time and then extrapolate the staff costs.</p>	<p>This assumes that the requisite data for a referral or other request is being exchanged electronically. In many cases, data such as notes are not available electronically because they are handwritten. In this case, a medical record pull may be required.</p> <p>Try to capture WHY the medical record was pulled, and then use that data to determine the actual impact of the HIE system on medical record pulls.</p>	<p>See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available.³⁴</p>
<ul style="list-style-type: none"> Impact on costs of providing duplicate paper medical records in response to medical record requests from other providers 	<ul style="list-style-type: none"> Logs Time and motion studies 	<p>Estimate the cost of duplicating a medical record (finding and copying the medical record, preparing for mailing, and mailing charges) and multiply by the number of medical records duplicated.</p>		<p>See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available.³⁴</p>
<ul style="list-style-type: none"> Impact on inter-provider calls requesting results 	<ul style="list-style-type: none"> Logs Time and motion studies 	<p>Logs of such calls recorded during time and motion studies would be one way to track this.</p>	<p>This involves primary data collection.</p> <p>If this type of information has not been tracked, this will be difficult to measure.</p>	<p>See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available.³⁴</p>



TABLE 6-5. DATA EXCHANGE BETWEEN PROVIDERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Impact on costs for referral letters (time to write and to send) 	<ul style="list-style-type: none"> Logs 	<p>Estimate the labor cost (to review medical record, dictate referral letter, transcribe letter, mail letter) and multiply by the number of referrals.</p>	<p>This involves primary data collection.</p> <p>This assumes that referrals were not done electronically prior to implementation of the HIE system.</p>	
<ul style="list-style-type: none"> Satisfaction of providers 	<ul style="list-style-type: none"> Survey Focus groups 	<p>You might consider sampling both your users as well as clinicians who could be involved in the project but who have chosen not to participate. Going to State- or region-wide provider databases from local medical societies or boards of registrations may be ways to determine your target survey group. It may be helpful to conduct the satisfaction survey multiple times during different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>	<p>Cost may be prohibitive.</p>	<p>Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>



TABLE 6-6. DATA EXCHANGE BETWEEN PROVIDERS AND RADIOLOGY CENTERS

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Was electronic ordering of radiology tests between providers and radiology centers achieved? • How many independent or hospital radiology centers are participating in the HIE system? 	<ul style="list-style-type: none"> • Implementation team • Provider surveys 	<p>This assumes that the providers are using an EHR system.</p>	<p>Is broadband access available throughout the HIE system's region? This can impact the size of files that can be sent to and from providers. Radiology reports may be available if images are not.</p>	
<ul style="list-style-type: none"> • Was electronic exchange of radiology results between providers and radiology centers achieved? 	<ul style="list-style-type: none"> • Implementation team • Provider surveys 	<p>You need to know if the providers are using an EHR system or are using some other results display application.</p>		
<ul style="list-style-type: none"> • How much data was able to be exchanged? 	<ul style="list-style-type: none"> • Implementation team • Data exchange logs (for orders and results) 	<p>Look at the number of discrete messages that were exchanged and the number of images that were exchanged.</p>		



TABLE 6-6. DATA EXCHANGE BETWEEN PROVIDERS AND RADIOLOGY CENTERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Are providers using data exchange capability with radiology centers (i.e., what is the usage rate of the new system)? 	<ul style="list-style-type: none"> • Usage statistics from system's audit logs 	<p>You could measure this in several ways. One would be to divide the number of providers using the system (numerator) by the number of total providers (denominator). A second approach might measure how often individual providers are accessing the system, with access hit rates as the numerator and the number of individual providers as the denominator. A third approach might be to get an overall average rate by dividing the number of access hits by the total number of providers. Providers might be defined as nurses and/or physicians. Tracking this information over time and presenting it visually would give stakeholders an understanding of adoption trends for your project.</p>	<p>Finding baseline provider rates might be difficult (i.e., what is your pool of physicians who could be using the system)? You could consider getting this information from local medical societies or boards of medicine.</p>	
<ul style="list-style-type: none"> • Impact on duplicate radiology tests 	<ul style="list-style-type: none"> • Pre- and post-implementation medical record review 	<p>If you are rolling out your project in stages, you could consider using providers, units, or organizations that have not gone live yet as your control group. This would allow you to collect your data without needing a retrospective medical record review.</p>	<p>You have to define what is meant by a duplicate test. Sometimes a repeat radiology test in a short timeframe is the standard of care and is not duplication. Another approach would be to measure test frequencies pre- and post-implementation.</p>	



TABLE 6-6. DATA EXCHANGE BETWEEN PROVIDERS AND RADIOLOGY CENTERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Impact on costs to send orders (provider) 	<ul style="list-style-type: none"> • Pre- and post-implementation check of logs • Time and motion studies • Workflow analysis 	Estimate the labor costs for preparing and mailing forms, and then multiply by the number of orders.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴
<ul style="list-style-type: none"> • Impact on costs to receive orders (radiology) 	<ul style="list-style-type: none"> • Pre- and post-implementation check of logs • Time and motion studies • Workflow analysis 	Estimate the costs for opening and processing forms, and then multiply by the number of orders.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴
<ul style="list-style-type: none"> • Impact on results requests from providers 	<ul style="list-style-type: none"> • Phone logs • Workflow analysis 	A reduction in the number of calls to the radiology center for results suggests that providers can find results in a timelier fashion.	These measurements need to be adjusted for the volume of exams done by each center, so the data can be compared in a meaningful manner.	
<ul style="list-style-type: none"> • Impact on calls to providers to clarify an order 	<ul style="list-style-type: none"> • Phone logs • Workflow analysis 	This assumes that providers are using some electronic method to order a test, typically through an order entry system.	Many times providers may not use an appropriate indication for a test, and the call to the provider may occur anyway.	
<ul style="list-style-type: none"> • Impact on time to report critical results 	<ul style="list-style-type: none"> • Call logs • Pre- and post-implementation • Workflow analysis 			See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 25, for a detailed definition and evaluation method for this measure. ³⁵



TABLE 6-6. DATA EXCHANGE BETWEEN PROVIDERS AND RADIOLOGY CENTERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Satisfaction of radiology personnel 	<ul style="list-style-type: none"> • Survey • Interviews • Focus group 	<p>Your survey could sample radiologists, radiology technicians, and/or administrative personnel, including those who are responsible for taking phone calls. The survey would need to be designed to be distributed to all involved radiology centers. It may be helpful to conduct a satisfaction survey multiple times during different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>		<p>Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>



TABLE 6-6. DATA EXCHANGE BETWEEN PROVIDERS AND RADIOLOGY CENTERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Satisfaction of clinicians 	<ul style="list-style-type: none"> Survey Interviews Focus group 	<p>You might consider sampling both your users as well as clinicians who could be involved in the project, but who have chosen not to participate. Going to State- or region-wide provider databases from local medical societies or boards of registration may be ways to determine your target survey group. It may be helpful to conduct satisfaction surveys multiple times during different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>		<p>Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>
Picture Archiving and Communications Systems (PACS)				
<ul style="list-style-type: none"> Impact on film costs 	<ul style="list-style-type: none"> Finance tracking (e.g., balance sheet, or receipts), pre- and post-implementation 		<p>In some places, a backup may still be done on film, while in others the backup may be done electronically.</p>	
<ul style="list-style-type: none"> Impact on chemical costs 	<ul style="list-style-type: none"> Finance tracking (e.g., balance sheet, or receipts), pre- and post-implementation 	<p>This is the cost of the chemical to process the films.</p>		
<ul style="list-style-type: none"> Impact on file room costs 	<ul style="list-style-type: none"> Labor costs, pre- and post-implementation Overtime costs, pre- and post-implementation 	<p>These are the costs to maintain a file room and personnel to manage the films (pulling and filing).</p>	<p>This would be replaced by the cost of maintaining the same image data electronically.</p>	



TABLE 6-6. DATA EXCHANGE BETWEEN PROVIDERS AND RADIOLOGY CENTERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Impact on duplication of films for referrals 	<ul style="list-style-type: none"> Duplication logs 	This includes the cost of the films, the chemicals, the personnel costs and time, and the charge to use the processing facilities.	This would be replaced by the cost of duplicating the same image data electronically.	
<ul style="list-style-type: none"> Impact on costs to receive films for review (provider) 	<ul style="list-style-type: none"> Pre- and post-implementation checking of logs 	Determine the labor costs to open films, distribute to provider, collect films from provider, package for radiology, and return to radiology; then multiply this cost by number of films received.	May not track films received.	
<ul style="list-style-type: none"> Impact on costs to send films (radiology) 	<ul style="list-style-type: none"> Pre- and post-implementation financial and workflow logs Time and motion studies Workflow analysis 	Determine the labor costs to receive requests, copy film, package film, and mail film; then multiply this cost by number of requests received.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴
<ul style="list-style-type: none"> Impact on costs to re-file films received after having sent films out 	<ul style="list-style-type: none"> Pre- and post-implementation check of financial and workflow logs Time and motion studies Workflow analysis 	Determine labor costs to receive returned film and re-file, then multiply this cost by number received.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴
Scheduling/Workflow				
<ul style="list-style-type: none"> Impact on imaging studies performed due to more efficient scheduling 	<ul style="list-style-type: none"> Pre- and post-review of schedules 	Online ordering and scheduling leads to increased efficiencies and an increase in the number of tests that can be done. Tests can be more easily grouped by type, and fewer errors are made in resource scheduling.		



TABLE 6-6. DATA EXCHANGE BETWEEN PROVIDERS AND RADIOLOGY CENTERS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Impact on time to schedule appointments 	<ul style="list-style-type: none"> Time and motion studies 	This can be measured on both the provider side and the receiving side of scheduling.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴
<ul style="list-style-type: none"> Impact on lost films 	<ul style="list-style-type: none"> Logs 	The post-implementation loss rate should be close to zero.	This measure assumes that films are being archived.	
<ul style="list-style-type: none"> Impact on canceled exams due to better preparation (online instructions available to scheduler) and avoidance of contraindications (e.g., iodine allergy known at time of scheduling) 	<ul style="list-style-type: none"> Pre- and post-review of schedules 	Cancellations may still occur even with an HIE system, as some of the information needed for exams may not be available through the ordering process.	Groups may not have this information in their schedules depending on whether or not they are tracking cancellation reasons.	



TABLE 6-7. DATA EXCHANGE BETWEEN PROVIDERS AND PUBLIC HEALTH DEPARTMENTS

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Was electronic exchange of public health information between providers and public health departments achieved? Are local or State public health partners in the exchange? 	<ul style="list-style-type: none"> Implementation team Data exchange logs for reportable health conditions 	<p>Evaluators may want to consider bidirectional data flow (to public health for reportable conditions, and from public health for treatment guidelines).</p> <p>This is an exchange capability measure.</p>	<p>Is there an immunization registry for your area? Evaluators may need to take into consideration that, in many States, this information transfer happens by other means already. Therefore, evaluators need to determine how much of the information flow is occurring due to the new HIE system.</p>	
<ul style="list-style-type: none"> How much data were able to be exchanged? Have participation levels in the immunization system increased? 	<ul style="list-style-type: none"> Implementation team Data exchange logs State or regional public health offices 	<p>Look at the number of discrete messages that were exchanged.</p>	<p>Evaluators may need to take into consideration that, in many States, this information transfer happens by other means already. Therefore, evaluators need to determine how much of the information flow is occurring due to the new HIE system.</p>	
<ul style="list-style-type: none"> Impact on costs to prepare reports 	<ul style="list-style-type: none"> Reports prepared Time and motion studies 	<p>Estimate labor costs to find information and prepare a report, then multiply by the number of reports prepared.</p>		<p>See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available.³⁴</p>



TABLE 6-7. DATA EXCHANGE BETWEEN PROVIDERS AND PUBLIC HEALTH DEPARTMENTS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Impact on costs to send paper reports 	<ul style="list-style-type: none"> Reports prepared Time and motion studies 	This is the cost to send reports by fax or mail, multiplied by the number of reports prepared.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴
<ul style="list-style-type: none"> Impact on costs to receive reports (public health) 	<ul style="list-style-type: none"> Logs Time and motion studies 	Estimate the costs to receive and open a report, then multiply by the volume received.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴
<ul style="list-style-type: none"> Impact on costs to process paper reports 	<ul style="list-style-type: none"> Logs Time and motion studies 	Estimate the costs to process a report, and then multiply by the volume received. This includes the cost of transcribing the data into the health department's electronic registry system.		See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available. ³⁴



TABLE 6-7. DATA EXCHANGE BETWEEN PROVIDERS AND PUBLIC HEALTH DEPARTMENTS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Impact on reportable diseases reported 	<ul style="list-style-type: none"> Logs 	<p>Reportable conditions vary by State. Few States are capable of electronically receiving electronic reports on reportable conditions. HIE systems may use diagnosis or procedure codes, or medications, to identify cases that would otherwise go unreported. A pre-post study can demonstrate a change in the number of mandatorily reported diseases.</p>	<p>In many cases, this is a direct laboratory to public health report and does not involve providers. You have to be careful, as the codes may be incorrect.</p>	
<ul style="list-style-type: none"> Impact on time to report events 	<ul style="list-style-type: none"> Logs Report review 	<p>This study is based on a pre- and post-implementation sample, where the time interval from the date of the event to the time it is logged into the public health database is tracked.</p> <p>The reporting interval is defined as the report generation time minus the event detection time.</p> <p>The time measure can be the time from providers or laboratories to the public health department.</p>		



TABLE 6-7. DATA EXCHANGE BETWEEN PROVIDERS AND PUBLIC HEALTH DEPARTMENTS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Impact on time to detection of an adverse event or outbreak 	<ul style="list-style-type: none"> • Logs • Report review 	<p>Pre- and post-implementation review of reports of adverse events or outbreaks can help determine if there has been an improvement in the early detection of these events.</p> <p>The detection interval is defined as the time of detection minus the time of the event.</p>		
<ul style="list-style-type: none"> • Satisfaction of clinicians 	<ul style="list-style-type: none"> • Survey • Focus groups 	<p>You might consider sampling both your users as well as clinicians who could be involved in the project but who have chosen not to participate. Going to State- or region-wide provider databases from local medical societies or board of registrations may be ways to determine your target survey group. It may be helpful to conduct satisfaction surveys multiple times during different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>	<p>This involves primary data collection.</p>	<p>Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>



TABLE 6-7. DATA EXCHANGE BETWEEN PROVIDERS AND PUBLIC HEALTH DEPARTMENTS (CONTINUED)

Measure	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Public health personnel satisfaction 	<ul style="list-style-type: none"> Survey Focus groups 	<p>Your survey could sample clinicians, public health practitioners, or administrative personnel, including those who are responsible for collating paper reports. The survey would need to be designed to be distributed to all involved public health departments. It may be helpful to conduct satisfaction surveys multiple times during different stages of the project to monitor trends and potential unintended consequences (positive and negative).</p>	<p>This involves primary data collection</p>	<p>Consider using or amending an existing satisfaction survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>



Measures for Clinical Outcome and Clinical Process Evaluation

The tables in this subsection provide examples of measures for the four types of outcomes: process outcomes, intermediate outcomes (e.g., provider adoption and attitudes, patient knowledge and attitudes, impact on workflow), clinical outcomes, and financial outcomes. The tables list measures in the following categories:

- Table 6-8. Clinical outcomes measures
- Table 6-9. Clinical process measures
- Table 6-10. Provider adoption and attitudes measures
- Table 6-11. Patient knowledge and attitudes measures
- Table 6-12. Workflow impact measures
- Table 6-13. Financial impact measures



TABLE 6-8. CLINICAL OUTCOMES MEASURES

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Preventable adverse drug events 	<ul style="list-style-type: none"> Patient safety Quality of care 	<ul style="list-style-type: none"> Medical record review Prescription review Direct observations Patient phone interviews Instrumentation of study database to the EHR system 	<p>HIE between providers and pharmacies can reduce, to a limited extent, the frequency of preventable adverse drug events by better communication of prescriptions, current medication lists, allergies, and patient diagnosis.</p>		<p>See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 43, for detailed definition and evaluation method for this measure.³⁵</p>
<ul style="list-style-type: none"> Readmission rates after discharge 	<ul style="list-style-type: none"> Patient safety Effectiveness Efficiency Patient centeredness 	<ul style="list-style-type: none"> Medical records Billing data Emergency department visit histories Discharge summaries Medical record review Data repository: administrative Check on data being collected by facility's quality assurance team 	<p>HIE can reduce, to a limited extent, readmission rates by enabling better transitions of care between inpatient, primary, long-term and post-acute care (LTPAC) and other types of care.</p>	<p>You need to define the time period for readmission. For many organizations, this standard is 7 days and/or 30 days (used by CMS) after inpatient discharge.</p>	<p>See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 85, for detailed definition and evaluation method for this measure.³⁵</p>



TABLE 6-8. CLINICAL OUTCOMES MEASURES (CONTINUED)

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Inpatient admission rates/ emergency department visits for populations with chronic diseases 	<ul style="list-style-type: none"> Patient safety Effectiveness Efficiency Patient centeredness 	<ul style="list-style-type: none"> Medical records Billing data Patient registries Emergency department visit data Medical record review Data repository: administrative Check on data being collected by your facility's quality assurance team 	<p>HIE can reduce, to a limited extent, health care utilization for chronic diseases by better communication of the patient's care regimen among primary care providers, specialists, and emergency departments.</p>		<p>See Canada Health Infoway's Benefits Evaluation Indicators Technical Report, p. 88, for detailed definition and evaluation method for this measure.³⁵</p>



TABLE 6-9. CLINICAL PROCESS MEASURES

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Documentation of key clinical data elements • Does the HIE system aggregate clinical data use a master patient index (MPI)? • Do the aggregated data produce an accurate and complete clinical picture? • Is there a central data repository? How are data de-duplicated? 	<ul style="list-style-type: none"> • Patient safety • Quality of care 	<ul style="list-style-type: none"> • EHR data • For paper records, medical record reviews probably needed 		<p>You may need to look in different places to get this, for example, paper medical records vs. EHRs. Some practices may enter orders online but handwrite a note in the paper medical record.</p>	
<ul style="list-style-type: none"> • Accuracy and completeness of the medication reconciliation process 	<ul style="list-style-type: none"> • Patient safety • Patient centeredness 	<ul style="list-style-type: none"> • EHR data • EHR medication list • Pharmacy medication list • Personal health record (PHR) medication list • Patient recall 	<p>This involves comparison of medication lists obtained from different data sources.</p>		



TABLE 6-9. CLINICAL PROCESS MEASURES (CONTINUED)

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Percent of patients, discharged from an inpatient facility to home or other site of care for whom a transition record was transmitted to the facility, primary physician or other health care provider designated for followup care within 24 hours of discharge 	<ul style="list-style-type: none"> Patient Safety Quality of Care 	<ul style="list-style-type: none"> Audit logs 	<p>HIE is increasingly used to support care transitions and coordination.</p>		
<ul style="list-style-type: none"> Transfers from LTPAC to emergency departments 	<ul style="list-style-type: none"> Patient safety Effectiveness Efficiency Patient centeredness 	<ul style="list-style-type: none"> Medical records Billing data Emergency department visit data Medical record review Data repository: administrative Check on data being collected by your facility's quality assurance team 	<p>HIE can reduce transfers to Emergency Departments for persons receiving LTPAC with better communication of the patient's health status, medications, and other key information with primary care providers, specialists, and other providers.</p>		



TABLE 6-10. PROVIDER ADOPTION AND ATTITUDES MEASURES

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Use of help desk 	N/A	<ul style="list-style-type: none"> • Central HIE organization help desk logs • Help desk logs at provider organizations 	You will need to ensure that help desks at provider organizations can (1) tag HIE issues, and (2) produce abstract reports of HIE issues.	This measure may be confounded by the quality of up-front training, continued support, or usability of the application. The measure also may be confounded by the training level of the user. The novice user will require more support, while someone with more experience with technology may solve many problems without seeking help.	
<ul style="list-style-type: none"> • Time to resolution of reported problems 	N/A	<ul style="list-style-type: none"> • Help desk logs 		This measure may be confounded by the nature of the reported problems. You need to adjust for reported problem types and the time it takes to solve them. Some can be fixed quickly, while others are system-wide issues that may take years to resolve.	



TABLE 6-11. PATIENT KNOWLEDGE AND ATTITUDES MEASURES

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Patient attitudes 	<ul style="list-style-type: none"> • Patient centeredness 	<ul style="list-style-type: none"> • Patient surveys • Patient interviews • Focus groups and other qualitative methodologies 		<p>It is important to do iterative cognitive testing and piloting of surveys developed internally. Methodologies leading to good survey response rates may be expensive. Online surveys might lower the cost, but may bias the results because patients who complete a survey online may be different from those who are unable or uncomfortable doing so. You may be able to add customized questions to standard surveys, such as the Consumer Assessment of Healthcare Providers and Systems (CAHPS).³⁶</p>	<p>Consider using an existing survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>



TABLE 6-11. PATIENT KNOWLEDGE AND ATTITUDES MEASURES (CONTINUED)

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Patient satisfaction 	<ul style="list-style-type: none"> • Patient centeredness 	<ul style="list-style-type: none"> • External surveys • Internally developed survey 		<p>It is important to do iterative cognitive testing and piloting of surveys developed internally. Methodologies leading to good survey response rates may be expensive. Online surveys might lower the cost, but may bias the results because patients who complete a survey online may be different from those who are unable or uncomfortable doing so. You may be able to add customized questions to standard surveys such as CAHPS.³⁶</p>	<p>Consider using an existing survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>
<ul style="list-style-type: none"> • Patient use of secure messaging 	<ul style="list-style-type: none"> • Patient centeredness 	<ul style="list-style-type: none"> • Patient surveys • Focus groups • Logs of EHRs, PHRs, patient portals, and HIE systems 	<p>You need to understand how messages are communicated to providers (e.g., via an EHR or PHR).</p>		<p>Consider using an existing survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>



TABLE 6-11. PATIENT KNOWLEDGE AND ATTITUDES MEASURES (CONTINUED)

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> • Patient utilization of the HIE patient portal 	<ul style="list-style-type: none"> • Patient centeredness 	<ul style="list-style-type: none"> • Portal and PHR logs • Focus groups • Surveys 	<p>It would be helpful to identify what “functions” of the PHR are being utilized. It is necessary to consider differences between true PHR functions and those that are just “patient portals.”</p>	<p>Looking at raw numbers may not give the type of information you are interested in. Collecting data on numbers of new users vs. recurring users may be more informative.</p>	<p>Consider using an existing survey. Review existing surveys using the Health IT Survey Compendium on the AHRQ Health IT Web site.³²</p>
<ul style="list-style-type: none"> • Patient utilization of HIE patient portal 	<ul style="list-style-type: none"> • Patient centeredness 		<ul style="list-style-type: none"> • HIE patient portal logs • Focus groups • Surveys 		
<ul style="list-style-type: none"> • Patient adherence to medication regimens 	<ul style="list-style-type: none"> • Patient centeredness 	<ul style="list-style-type: none"> • Pharmacy and billing logs (number of medications prescribed and number of medications dispensed or refilled) • Focus groups • Surveys 		<p>Just because a medication is documented does not mean it has been taken, or taken correctly. Patients often take their medications in ways not prescribed by their providers. Therefore, if you are looking for effects of “proper” medication reconciliation on quality and safety outcomes, make sure that you question whether medications are being taken properly.</p>	



TABLE 6-12. WORKFLOW IMPACT MEASURES

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Percentage of orders or prescriptions that require a pharmacy callback 	<ul style="list-style-type: none"> Efficiency 	<ul style="list-style-type: none"> Pharmacy logs 		<p>Observers need to understand the difference between a “callback episode” and a single callback. A callback episode is when there is some back-and-forth vetting and multiple callbacks occur.</p>	<p>See Canada Health Infoway’s Benefits Evaluation Indicators Technical Report, p. 54, for a detailed definition and evaluation method for this measure.³⁵</p>
<ul style="list-style-type: none"> Patient throughput 	<ul style="list-style-type: none"> Efficiency 	<ul style="list-style-type: none"> Billing and administrative data 	<p>This measure examines patient volume in a hospital or practice as an indicator of how the HIE system helps save time in collecting relevant clinical, administrative, and financial information.</p>	<p>Concurrent interventions may have an effect.</p>	<p>See Canada Health Infoway’s Benefits Evaluation Indicators Technical Report, p. 92, for a detailed definition and evaluation method for this measure.³⁵</p>
<ul style="list-style-type: none"> Impact on patient wait time in emergency department 	<ul style="list-style-type: none"> Efficiency Patient centeredness 	<ul style="list-style-type: none"> Emergency department administrative data 	<p>This may already be captured in many emergency departments; therefore, you may be able to measure with minimal effort.</p>	<p>This may be confounded by many other factors (e.g., patient volume or demand)</p>	<p>See Canada Health Infoway’s Benefits Evaluation Indicators Technical Report, p. 92, for a detailed definition and evaluation method for this measure.³⁵</p>



TABLE 6-12. WORKFLOW IMPACT MEASURES (CONTINUED)

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none"> Prescribing patterns for preferred or formulary medications 	<ul style="list-style-type: none"> Efficiency 	<ul style="list-style-type: none"> E-prescribing Computerized provider order entry (CPOE) logs 	<p>This requires a case-control study at the patient level, based on exchange of formulary information. This measure will be confounded by differences in the formularies that payers use.</p>		
<ul style="list-style-type: none"> Use cases around HIE, impact on workflow 	<ul style="list-style-type: none"> Efficiency 	<ul style="list-style-type: none"> Interviews Surveys Time motion studies 	<p>Many use cases are designed to facilitate workflows such as referrals for services, approving care plans, and notifying providers when a patient is hospitalized or discharged. These measures can assess how the HIE is impacting workflow and time spent in coordinating care</p>	<p>A pre-post design can help to compare the workflow before and after the HIE. Or you may ask the staff to describe the impact that the HIE has had on workflow for a given use case.</p>	<p>See AHRQ's Time and Motion Studies Database for a detailed definition of this measure and additional resources. This resource is freely available.³⁴</p>
<ul style="list-style-type: none"> Percentage of claims denied 	<ul style="list-style-type: none"> Efficiency (from providers' perspective) 	<ul style="list-style-type: none"> Billing data 	<p>This is measured pre- and post-implementation of HIE. The pre-HIE group may need to be separated into paper-based vs. other electronic claims submission methods.</p>		



TABLE 6-13. FINANCIAL IMPACT MEASURES

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
Utilization: <ul style="list-style-type: none"> • Prescribing patterns for cost-effective drugs • Duplicate testing • Radiology utilization 	<ul style="list-style-type: none"> • Efficiency 	<ul style="list-style-type: none"> • Billing and administrative data 	You need to define what is meant by a duplicate test. In many cases, repeat testing is necessary and the standard of care.	This measure may not be easy to capture, especially if clinical information is on paper. Cost data are often very difficult to analyze properly; you may need expert analysis for proper interpretation.	See Canada Health Infoway's Benefits Evaluation Indicators Technical Report for a detailed definition and evaluation method for this measure (laboratory testing, p. 68; radiology, p. 32.) ³⁵
Staffing costs: <ul style="list-style-type: none"> • Nursing • Pharmacy • Physician 	<ul style="list-style-type: none"> • Efficiency 	<ul style="list-style-type: none"> • Billing and administrative data 	You need to relate these specifically to your HIE implementation.	Many concurrent initiatives might confound this measure. The measure is not very elastic.	
Staffing costs: <ul style="list-style-type: none"> • Training for physicians • Application support • Management of medical knowledge (rules, order sets) • Subject matter experts 	<ul style="list-style-type: none"> • Efficiency 	<ul style="list-style-type: none"> • Training logs • Information system administrative data 	This measure involves expressing staffing costs in terms of full-time equivalents. Any HIE implementation incurs additional staffing costs that would not be incurred if there was no HIE system in place.	Staffing measures may be influenced by the quality of the vendor or the tools provided by the vendor. They also may be influenced by the resources at your disposal and your funding for the implementation process.	



TABLE 6-13. FINANCIAL IMPACT MEASURES (CONTINUED)

Measure	Quality Domain(s)	Data Source(s)	Practical Notes	Considerations	Resources
<ul style="list-style-type: none">• Risk reduction, based on Centers for Medicare & Medicaid Services fines for readmissions	<ul style="list-style-type: none">• Patient safety• Efficiency	<ul style="list-style-type: none">• Billing and administrative data		It is very hard to define what is meant by “readmission.” For example, in many cases a readmission may be the result of the natural history of a disease and not because of the health IT system.	

NOTE: Some measures in other categories may overlap with the ones included in this table (e.g., effect on length of hospital stay in Table 6-11).





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Appendix A: Workbook

Please note that a standalone PDF version of this appendix that can be edited electronically is available at the Agency for Healthcare Research and Quality's National Resource Center Web site (<http://healthit.ahrq.gov/hieevaluationguideworkbook.pdf>). Readers are encouraged to download a copy of that version of the workbook and use it to take notes as they review the guide.

Detailed information on each of the following topics can be found within the guide at the corresponding section number and title.

Selecting Your Evaluation Team

Consider including team members with core expertise in the areas of technical implementation, health care operations, clinical care, research methodology, project management, and health care consumer (patient) perspective to assist in achieving a successful HIE project evaluation.

Describing Your HIE Project

Provide a description of your HIE project that you are evaluating. This may come directly from the HIE strategic plan, project plan, proposal, or similar documents outlining the vision, mission, goals, and objectives of the HIE project.



Identifying Your HIE Project Stakeholders

Identify the stakeholders involved including all of the organizations accessing the HIE as well as funding sources, patients, and any other groups interested in and impacted by the HIE.

Articulating Your HIE Project Goals and Objectives

Articulate the goals and objectives of your HIE project. Also consider which of the HIE project goals support the value and mission of the stakeholder organizations.

Assessing the Value of HIE

It is critical to demonstrate to stakeholders that your HIE project provides value, especially by offering financial and clinical benefits. Consider the project's positive effects, such as increased revenues, decreased costs, and improvements in patient safety and quality of care.



Defining Evaluation Goals and Objectives

Document your evaluation goals, then operationalize what you want to accomplish by defining your evaluation objectives (measurable steps and deadlines).

Identifying Potential Evaluation Measures

Select a set of evaluation measures that you may use in assessing your HIE project. These measures will be prioritized later in the process.

Designing the Evaluation Study

Design the evaluation that you will use to collect and analyze data in order to produce each measure. Consult Section 4, “Designing the Evaluation Study” in the guide for a discussion of types of evaluations and research designs, as well as evaluation planning resources that describe approaches and methods.



Identifying Data Sources

Identify potential data sources for your measures, and investigate what technology would be used by these sources in order to generate the associated measures.

Prioritizing Candidate Evaluation Measures

Evaluate each potential measure that you identified in Section 4, “Identifying Potential Evaluation Measures” to narrow down to a set of candidate measures before you assess their feasibility and relative cost.

Next rank each measure in the order of importance to your stakeholders.

1. Very Important:

2. Moderately Important:

3. Not Important:



You should also determine which measures are feasible for you to evaluate.

Feasible:
Feasible With Moderate Effort:
Not Feasible:

Based on the ratings you have assigned to your measures, use the following quadrant analysis table to group your measures by importance and feasibility.

QUADRANT ANALYSIS TABLE

		Feasibility Scale		
		1-Feasible	2-Feasible With Moderate Effort	3-Not Feasible
Importance Scale	1-Very Important			
	2-Moderately Important			
	3-Not Important			

Using the results of the quadrant analysis table, create a short list of primary measures to evaluate.

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Considering the Impact of Data Collection Strategies on Relative Cost and Feasibility

Refine your data collection strategy by considering commonly used study designs (prospective and retrospective) and data collection methods (both qualitative and quantitative), and their relative cost implications.

Developing Your Evaluation Plan Based on Selected Measures

Document how you will evaluate each of the final measures you identified, and have your proposed methodology reviewed by methodological experts. In developing your plan, you can use the following template to help you outline the details.

Document for each measure	Final evaluation measures			
	Measure 1	Measure 1	Measure 3	Measure 4
Briefly describe the HIE project.				
Describe the HIE intervention and the intended impact.				
What questions do you want to ask to evaluate this impact? These will likely reflect the expected impact (either positive or negative) of your intervention.				
What will you measure to answer these questions?				
How will you collect the required data?				
How will you design your study? For a quantitative study, you might consider what comparison group you will use. For a qualitative study, you might consider whether you will make observations or interview users.				
Analysis:				
• For quantitative methods: What types of statistical analysis will you perform on your data?				
• For qualitative methods: What analysis will you conduct using qualitative data?				
Sample size:				



Document for each measure	Final evaluation measures			
	Measure 1	Measure 1	Measure 3	Measure 4
<ul style="list-style-type: none"> For quantitative methods: Estimate the number of observations needed to demonstrate that the measure has changed statistically. 				
<ul style="list-style-type: none"> For qualitative methods: Determine the appropriate sample size needed to reach conclusions regarding the measure. 				
How would the answers to these questions inform future decisionmaking about the HIE project and/or HIE system implementations?				
What is the planned timeframe for evaluating the measure?				
Responsibilities:				
<ul style="list-style-type: none"> Who will take the lead for the evaluation for the measure? 				
<ul style="list-style-type: none"> Who will be responsible for the data collection? 				
<ul style="list-style-type: none"> Who will lead the data analysis? 				
<ul style="list-style-type: none"> Who will present the findings? 				
<ul style="list-style-type: none"> Who will draft a summary of the findings? 				
Estimate the cost for evaluating each measure. Take into consideration planning, meetings, travel, analysis, consultation time with a methodologist (e.g., statistician, qualitative researcher, survey methods expert), and time to prepare a final report or a summary of your findings, if necessary.				

Completing Your Draft Evaluation Plan

Based on your work to this point, you have everything you need to draft an evaluation plan for your HIE project. In addition to evaluation approaches, your plan should have some discussion regarding budget considerations that shows you have taken costs and available staffing resources into consideration.



Checking Your Evaluation Budget

Prior to finalizing your evaluation plan, you should review the costs associated with implementing it as currently drafted. By conducting this review, you should determine if there are ways to reduce the costs of by including or excluding some of the selected measures in your evaluation plan.

Finalizing Your Evaluation Plan

After you have reviewed your evaluation budget and the costs associated with implementing your study design, data collection, and data analyses activities, you may need to revise the evaluation plan to accommodate your available evaluation budget. Define any changes that you plan to incorporate into your plan.



Appendix B: Sample Literature Search Strategy

You can easily conduct a search of academic, peer-reviewed articles, as well as nonacademic sources, using freely available tools such as PubMed, Google Scholar, and Advanced Google Search.

To represent HIE, you could include the following concepts:

- Health Information Network(s)
- Health Information Exchange(s)
- Health Information Organization(s)
- Nationwide Health Information Network (NwHIN)
- Regional Health Information Organizations (RHIO)
- eHealth Exchange

For PubMed, you could use the following search string to represent HIE:

“health information organization*” OR “health information exchange*” OR RHIO

The HIE search string uses PubMed’s wildcard search capability and the OR function to include relevant concepts in a single search. Please note that PubMed does not recognize or allow the use of “NwHIN” in its search string (it is automatically replaced with Nahin, the last name of some authors.)

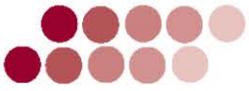
You should combine the HIE search string with PubMed search strings describing your evaluation goals and objectives.

Once you have the search results, you should start by reviewing each title and abstract for relevance, and then retrieve the full text for articles that are of interest to your evaluation team.

For Google searches, you could use the following search string to represent HIE:

“Health Information” (|organization|exchange|NwHIN|RHIO|eHealth Exchange)

You should also construct a Google search string for your evaluation goals and objectives, then combine that with the HIE search string. A good search strategy should yield highly relevant articles within the top 10 results. You may want to review the top 100 results obtained using Advanced Google Search, Google Blog Search, and Google Scholar Search.



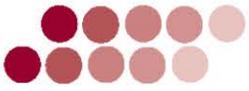


Appendix C: Tips for Facilitating Brainstorming

Brainstorming is a group collaboration designed to generate ideas. When brainstorming, it is important to create an open and receptive environment for group discussion. Not everyone is familiar or comfortable with brainstorming, so consider holding a brief “warm-up” session so all attendees feel welcome and at ease. Once the group has been introduced and is settled, you should discuss the rules of the brainstorming session:

- Define clearly the problem you want solved, and lay out any criteria to be met.
- Appoint someone to record the ideas that come from the session. These should be noted in a format that everyone can see and refer to. You may want to record the ideas on flip charts, whiteboards, or computers with data projectors.
- Discuss everything that could be measured with your team, without regard to feasibility, to get as many ideas as possible.
- Withhold and postpone your judgment of ideas.
- Encourage and remain open to all ideas and suggestions.
- If the conversation comes to a stop, use that as an opportunity to review the discussion up to that point.
- Consider taking a short break.
- Build on ideas put forward by others.
- Emphasize that every person and every idea has equal worth.
- Be mindful that the brainstorming session may not last as long as originally planned, and try not to force the conversation to continue past a natural breaking point.
- Close the session by thanking the attendees for their participation and checking to make sure they have nothing else to add.

It is a good idea to collate the ideas and distribute them promptly to the group.





Appendix D: The Importance of Sample Size

To conduct an effective and efficient study, it is important to calculate an appropriate sample size. Sample size determines resource requirements and the relevance of findings. If a sample is too large or too small, the results may be expensive or ambiguous. Sample size is only one element that researchers must consider in designing studies. Other factors that affect the quality of a study include definition of research questions, identification of measures, and selection of procedures for data collection.

Sample size calculations should be done by trained statisticians, as the calculations depend on several variables. How much confidence a researcher will have in study results depends in part on how much variability there is in the expected measure. A larger sample size requires greater resources, so the value of having a larger sample size must be balanced against requirements for funding and other resources.

To illustrate the importance of calculating sample size, consider this fictional example:

Before implementation of an e-prescribing system in an outpatient practice, the office manager believed they were making a large number of prescription errors, maybe as high as one in every four prescriptions, or 25 percent. Experience from other e-prescribing sites suggests that after implementation of the e-prescribing system, the rate would drop to 2.5 errors per 100 prescriptions. If you select 100 prescriptions at random for review both before and after implementation of e-prescribing, you might observe the following:

	Before	After
Number of Errors in 100 Sampled Prescriptions	27	3
Observed Error Rate	27%	3%

Given the large difference in both the percentage and the number of errors, you could be fairly confident that you were measuring some “real” effect, even though you measured only a small sample of prescriptions. On the other hand, if you observe the following data...

	Before	After
Number of Errors in 100 Sampled Prescriptions	5	3
Observed Error Rate	5%	3%

It would be inappropriate to conclude that the e-prescribing system had reduced prescribing errors. Statistics show that repeated samples of 100 would reveal slightly different rates. Since the number of observed events (prescription errors) is so small both before and after implementing the e-prescribing system, the errors may have shown up in the sampled prescriptions by chance. Random events might even result in one or two fewer errors before implementation, giving the impression that the system was causing errors rather than preventing them.



However, to illustrate the power of sample size, consider if you could afford to examine 100,000 prescriptions before and after implementation of the e-prescribing system. Even if the underlying probabilities did not change, you might observe:

	Before	After
Number of Errors in 100,000 Sampled Prescriptions	4,932	2,592
Observed Error Rate	4.9%	2.6%

Based on these data, would you feel more confident that the reduction in errors is real and not due to random chance? Most people would say “yes.” Even if, by chance, the observed data are a few errors off from the “true” error rate, the overall rate would still not change in a significant way, and you still would conclude that the prescribing error rate was very different after implementation of e-prescribing.

For this example, the actual number of observations required to determine if there was a change in the number of errors with statistical certainty (i.e., the minimal sample size) falls somewhere between 100 and 100,000. To determine the exact number required, you need to conduct a “sample size calculation.” A full discussion of sample size calculations is beyond the scope of this guide. Due to the need for expert advice to complete this work, it is preferable to consult with a statistician. The purpose of this discussion is to convey a rudimentary understanding of the importance of sample size in research design.

It is important to determine sample size before you embark on certain types of evaluation study designs such as pre-post designs. Doing so will help your team determine whether the required sample size is feasible within your evaluation budget and resources. If you find the required sample size is too large, you may need to reprioritize the measures you will include in your evaluation plan.



Appendix E: Glossary

Computerized Provider Order Entry (CPOE). An application that allows health care providers to use information technology to directly enter medical orders electronically in inpatient and ambulatory settings, replacing the more traditional order methods (paper, verbal, telephone, and/or fax). CPOE systems can allow providers to electronically enter medication orders as well as laboratory, admission, radiology, referral, and procedure orders. Strictly defined, it is the process by which providers directly enter medical orders into an application.¹

Data Mining. Analysis of information in a database using tools that search for trends or anomalies, without knowledge of the data's meaning. Mining a clinical database may produce new insights regarding outcomes, alternate treatments, or effects of treatment on different races and genders.²

Electronic Prescribing (e-prescribing). The use of computing devices to enter, modify, review, and communicate drug prescriptions. E-prescribing allows providers to electronically transmit a new prescription or renewal authorization to a community or mail-order pharmacy. E-prescribing delivers eligibility, formulary, and medication history data and provides additional clinical decision support.³

Electronic Health Record (EHR). An electronic record of health-related information about an individual that conforms to nationally recognized interoperability standards, and that can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization.⁴

Electronic Medical Record (EMR). An electronic record of health-related information about an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within a single health care organization.⁴

Health Information Exchange (HIE). The electronic movement of health-related information among organizations according to nationally recognized standards.⁴

Health Information Organization. An organization that oversees and governs the exchange of health-related information among organizations according to nationally recognized standards.⁴

Health Insurance Portability and Accountability Act of 1996 (HIPAA). A law that protects the privacy of individually identifiable health information and sets national standards for the security of electronic protected health information.⁵

Master Patient Index (MPI). An index of patients maintained by individual providers and organizations that treat patients. The MPI contains the patient identifiers and the patient's personal and demographic information. The MPI maintained by an organization is unique to that organization, and serves as a directory of patients for ready reference, verification, and identification of the patient and patient information.⁶



Nationwide Health Information Network (NwHIN). The portfolio of nationally recognized services, standards and policies that enable secure health information exchange over the Internet. NwHIN is also used as an umbrella term to describe the result of standards harmonization and pilot testing activities led by the Office of the National Coordinator for Health Information Technology, U.S. Department of Health and Human Services.⁷

Personal Health Record (PHR). An electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards, and that can be drawn from multiple sources while being managed, shared, and controlled by the individual.⁴

Regional Health Information Organization (RHIO). An organization that brings together health care stakeholders within a defined geographic area and governs health information exchange among them for the purpose of improving health and health care in that community.⁴

Standards. Standards enable interoperability by encoding health information using a common, generally agreed-upon “language” that multiple systems can read. There are two main concepts to consider about standards: syntax and semantics. Syntax refers to the grammar rules for a defined “language” so the electronic messages being exchanged can be properly deconstructed when received. Semantics ensures that message components are coded so that their meaning can be interpreted or understood (e.g., which lab tests were performed and what their values are) when the message is deconstructed.⁸

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Appendix F: Resources

Resources on Assessing HIE Value

Throughout this guide, selected resources offer additional information on the topics discussed. Many are freely available online, while others require purchase and are available in various formats. The location and availability of each resource is noted accordingly, and the information was verified as of December 2013. The following resources expand upon the topic of assessing the value of HIE:

- Bailey JE, Wan JY, Mabry LM, et al. Does health information exchange reduce unnecessary neuroimaging and improve quality of headache care in the emergency department? *J Gen Intern Med* 2013 Feb;28(2):176-83. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3614141/?report=classic>

This study shows that HIE use was associated with a reduction of unnecessary diagnostic neuroimaging in the emergency department. Through an analysis of patient visits to a Memphis-area emergency department connected to a regional HIE, the authors demonstrate an associated decrease in diagnostic imaging and an increase in evidence-based guideline adherence during the emergency evaluation. The study was unable to associate HIE use with a decrease in the overall costs of care. The article is available for a fee at the Web site noted above.

- Dixon BE, Zafar A, Overhage JM. A Framework for evaluating the costs, effort, and value of nationwide health information exchange. *J Am Med Inform Assoc* 2010;17(3):295-301. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2995720/?report=classic>

Through a review of the literature and the knowledge gained from nationwide health information network (NHIN) technology and policy development, the authors offer a framework that can help HIE organizations consider available measures to evaluate data exchange between an HIE network and the NHIN. The authors conclude that the proposed evaluation framework may enable HIE organizations and the NHIN to demonstrate value. This resource is freely available at the Web site noted above.

- Frisse ME, Johnson KB, Nian H, et al. The financial impact of health information exchange on emergency department care. *J Am Med Inform Assoc* 2012 May-Jun;19(3):328-33. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3341788/>

This landmark study estimates the financial impact of HIE on emergency department care and related costs for hospital admissions from the emergency department and laboratory tests. Through an analysis of clinical and administrative documents obtained from 16 major health care provider organizations in the Memphis area, the authors demonstrate considerable annual financial savings due to HIE use. This resource is freely available at the Web site noted above.



- Hansagi H, Olsson M, Hussain A, Öhlén G. Is information sharing between the emergency department and primary care useful to the care of frequent emergency department users? *Eur J Emerg Med* 2008;15(1):34. <http://meta.wkhealth.com/pt/pt-core/template-journal/lwwgateway/media/landingpage.htm?issn=0969-9546&volume=15&issue=1&page=34>.

This study describes how primary care physicians and emergency departments assessed the usefulness of HIE. Though the information was considered useful, no decrease in emergency department utilization was found. This article is available for a fee at the Web site noted above.

- Joshi J. Clinical value-add for health information exchange (HIE). *Int J Med Inform* 2011;6(1). <http://www.ispub.com/journal/the-internet-journal-of-medical-informatics/volume-6-number-1/clinical-value-add-for-health-information-exchange-hie.html>.

This article describes the clinical impact of HIE—positive and negative—to help ascertain how true value can be attained. Utilizing an advanced literature review, the author populated two tables with information on the positive and negative aspects of HIE. The result is an excellent resource for a broad overview of the benefits, negative aspects, and notable uncertainties of HIE. This resource is freely available at the Web site noted above.

- Kern LM, Wilcox A, Shapiro J, et al. Which components of health information technology will drive financial value? *Am J Manag Care* 2012 Aug;18(8):438-45. <http://www.ajmc.com/publications/issue/2012/2012-8-vol18-n8/which-components-of-health-information-technology-will-drive-financial-value/1>.

Seeking to measure the financial value of electronic health records and HIE, the investigators developed a framework for rating the financial effects of HIE. The study identified 27 high-scoring HIE functionalities that have a measurable positive financial effect. This article is freely available at the Web site noted above.

- Various authors. Focus on health information technology, electronic health records, and their financial impact. *J Am Med Inform Assoc* 2012;19:328-412. <http://jamia.bmj.com/content/19/3.toc>.

This special issue of JAMIA may provide guidance in studying the financial benefits of health IT, including HIE projects. The articles cover topics such as the financial impact of HIE on emergency department care, HIE technology workflow factors and patterns of use, and the cost-effectiveness of a shared computerized decision support system. This resource is freely available at the Web site noted above.

- Vest JR. Health information exchange and healthcare utilization. *J Med Syst* 2009 Jun;33(3):223-31. <http://rd.springer.com/article/10.1007%2Fs10916-008-9183-3>.

The author sought to identify associations between HIE utilization and a reduction of emergency room visits and inpatient hospitalizations for ambulatory care-sensitive conditions among medically indigent adults. Higher levels of HIE utilization were



significantly associated with an increase in instances of all encounter types, but HIE utilization did not transform care in the ways that the author sought to demonstrate. This article is available for a fee at the Web site noted above.

Legal and Policy Resources

The following resources provide more information on research oversight, IRB review, and related legal and policy issues:

- Office for the Protection of Research Subjects, Office of the Provost, University of Southern California. Is your project human subjects research? http://www.usc.edu/admin/oprs/private/docs/oprs/NHSR_3_6_06_WEB.pdf.

This booklet provides guidance to investigators who may be uncertain if their study meets the definitions of human subjects research stated in Federal regulations, offers an explanation of the definitions, and provides examples of studies that commonly do or do not qualify as human subjects research. It includes a useful resources section. The booklet is freely available at the Web site above.

- Office for Human Research Protections (OHRP), U.S. Department of Health and Human Services. <http://www.hhs.gov/ohrp/index.html>.

The OHRP site provides clarification and guidance for HHS-sponsored research. It provides advice on ethical and regulatory issues in biomedical and social-behavioral research, for example, and guidance on exempt and expedited review determinations and continuing review. It also has decision trees and checklists. This resource collection is freely available at the Web site above.

Online Evaluation Resources

The following resources help support program evaluation planning and describe different evaluation approaches and methods:

- Bamberger M, Rugh J, Mabry L. American Evaluation Association. Real World Evaluation. <http://comm.eval.org/Resources/ViewDocument/?DocumentKey=c4ffe767-22ad-435a-82b2-699608e44b8b>. Accessed June 12, 2014.

This online publication from the American Evaluation Association focuses on the practical or “real world” issues that can arise at each stage of the design and implementation of a typical evaluation. Readers will learn to identify and address common evaluation constraints related to funding, time, availability of data, and clients’ preconceptions, while maintaining the highest level of methodological rigor. This resource can help in selecting an evaluation design that best addresses the needs of clients and stakeholders. This resource is freely available at the Web site noted above.



- Centers for Disease Control and Prevention. CDC's Evaluation Efforts. <http://www.cdc.gov/eval/index.htm>. Accessed June 12, 2014.

The CDC believes that program evaluation is an essential organizational practice in public health, and that when programs conduct strong, practical evaluations, the findings are better positioned to inform their management and improve program effectiveness. This Web site provides information on the CDC's evaluation standards and expectations, as well as a set of steps and standards for practical evaluation by programs and partners. This resource is freely available at the Web site above.

- Program Development and Evaluation—University of Wisconsin—Extension. Evaluation. <http://www.uwex.edu/ces/pdande/evaluation/index.html>.

The University of Wisconsin-Extension Cooperative Extension has made available online two of the key resources that form their organizational evaluation framework. The first is a guide designed to help the reader plan a program evaluation and adapt it to their own needs and situation. The second resource is an online course that provides a holistic approach to planning and evaluating education and outreach programs. The course also discusses logic models and how they apply to program evaluation. Also available on this Web site are many links to evaluation resources and standards across organizations. This resource is freely available at the Web site above.

- Trochim WMK. Research Methods Knowledge Base. Introduction to Evaluation. <http://www.socialresearchmethods.net/kb/intreval.php>.

The Research Methods Knowledge Base is a great introductory discussion of evaluation. Readers will learn the definitions and goals of evaluation, as well as the different evaluation strategies. This site also provides useful information on the types of evaluation, and the situations in which each is most effective. This resource is freely available at the Web site above.

- W.K. Kellogg Foundation Evaluation Handbook. Battle Creek, MI. <http://www.wkkf.org/resource-directory/resource/2010/w-k-kellogg-foundation-evaluation-handbook>.

This online handbook from the W.K. Kellogg Foundation discusses the role that evaluation should play at the project level. It provides a framework for thinking about evaluation, and outlines a plan for designing and conducting evaluations, either independently or with the support of an external evaluator or consultant. The action steps are organized into three main sections: (1) Planning: Preparing for an Evaluation; (2) Implementation: Designing and Conducting an Evaluation; and (3) Utilization: Communicating Findings and Utilizing Results. This resource is freely available at the Web site above.



Other Evaluation Resources

The following resources provide more information on evaluating HIE projects:

- Johnson KB, Gadd C. Playing smallball: Approaches to evaluating pilot health information exchange systems. *J Biomed Inform* 2007;40(6 Suppl):S21-6. <http://www.sciencedirect.com/science/article/pii/S1532046407000822>.

The authors of this article suggest that, because of their use of newly evolving technology, HIE projects need to be evaluated beginning with an assessment of the processes and functional usability of the HIE system. Next, the stability of the HIE system and its environment must be considered. Only after these two areas have been evaluated is it appropriate to consider evaluating outcome measures. This resource is freely available at the Web site above.

- Marchibroda JM. Health information exchange policy and evaluation. *J Biomed Inform* 2007;40(6 Suppl):S11-6. <http://www.sciencedirect.com/science/article/pii/S1532046407001013>.

Marchibroda offers a series of critical evaluation questions for HIE projects. These questions broadly address the topics of quality improvement, safety, efficiency, value to stakeholders, sustainability, and barriers to HIE projects. This resource is freely available at the Web site above.

- Shapiro JS. Evaluating public health uses of health information exchange. *J Biomed Inform* 2007;40(6 Suppl):S46-9. <http://www.sciencedirect.com/science/article/pii/S1532046407000810>.

This article describes use cases for evaluating public health uses of HIE systems. The author describes use cases for laboratory reporting, mandated diagnoses, investigating reportable diseases, analyzing laboratory results that do not have mandatory reporting, antibiotic-resistant organism surveillance, and population health quality monitoring. This resource is freely available at the Web site above.

Additional Resources

The following resources provide strategies for using **qualitative methods in HIE project evaluations**:

- Ash JS, Guappone KP. Qualitative evaluation of health information exchange efforts. *J Biomed Inform* 2007;40(6 Suppl):S33-9. <http://www.sciencedirect.com/science/article/pii/S1532046407000846>.

This article reviews methods that can be used to collect qualitative data to evaluate HIE projects (e.g., interview, observation, and focus groups). The article also discusses the following critical elements for evaluation: design, development of the research questions, and description of the context and evaluation strategies. This resource is freely available at the Web site above.



- Ash JS, Smith AC, Stavri PZ. Interpretive or qualitative methods: subjectivist traditions responsive to users. In: Friedman CP, Wyatt JC, editors. Evaluation methods in medical informatics. 2nd edition. New York, NY: Springer-Verlag; 2005. p. 267-300.

This book chapter is intended to provide a “how to” guide for biomedical informatics evaluation research. Full access to this book chapter requires purchase.

- Berg BL. Qualitative Research Methods for the Social Sciences (6th Edition). Boston, MA: Pearson; 2007.

This book provides an overview of qualitative research design and methods. It also provides information on interviewing, focus group interviewing, ethnographic field research, action research, unobtrusive measures in research, historiography and oral traditions, and case studies. Full access to this book requires purchase.

The following resources address aspects of **survey design**:

- Agency for Healthcare Research and Quality. Health IT Survey Compendium. <http://healthit.ahrq.gov/health-it-tools-and-resources/health-it-survey-compedium>.

This is a centralized and regularly updated collection of health IT surveys. The collection includes publicly available surveys, and is not a comprehensive set of survey instruments and tools available in the health IT community. Many of the surveys were developed by AHRQ grantees. Others were found via searches on PubMed, BioMed Central, and the Internet. The user can search for publicly available surveys by survey type, technology, care setting, and respondent type. The surveys can then be used as is, or can be modified to suit a user’s needs. This resource is freely available at the Web site above.

- UCLA Center for Health Policy Research. California Health Interview Survey. <http://healthpolicy.ucla.edu/chis/design/Pages/overview.aspx>.

The California Health Interview Survey (CHIS) is the nation’s largest State health survey. Conducted every 2 years on a wide range of health topics, CHIS data provide detailed information regarding the health and health care needs of California’s large and diverse population. The CHIS Web site allows you to download and review detailed methodological reports, questionnaires, sample design descriptions, survey topics, and the data quality strategies used in conducting CHIS. This resource is freely available at the Web site above.

- Doyle JK. Introduction to survey methodology and design. In: Woods DW, editor. Handbook for IQP Advisors and Students. Worcester, MA: Interdisciplinary & Global Studies Division—Worcester Polytechnic Institute; 2009. p. 84-109. <http://www.wpi.edu/Images/CMS/IGS/IQP-Handbook-one-file.pdf>.

This chapter discusses the basic principles of scientific survey design and methodology. Readers are introduced to these basic principles and advised where to go to learn more. This resource is freely available at the Web site above.



- Hinkin TR. A brief tutorial on the development of measures for use in survey questionnaires. *Org Res Meth* 1998;1:104-21. [http://www.iacmr.org/v2/Conferences/WS2011/Submission_XM/Participant/Readings/Lecture4A_Larry/Hinkin%20\(1998\)%20A%20Brief%20on%20the%20Development%20of%20Measures%20for%20Use%20in%20Survey%20Questionnaires.pdf](http://www.iacmr.org/v2/Conferences/WS2011/Submission_XM/Participant/Readings/Lecture4A_Larry/Hinkin%20(1998)%20A%20Brief%20on%20the%20Development%20of%20Measures%20for%20Use%20in%20Survey%20Questionnaires.pdf).

This article provides a conceptual framework and a guide for the development of scales with established psychometric principles for use in survey research. The article is directed toward readers who may have limited knowledge or methodological expertise in the scale development process, but who are somewhat familiar with statistical concepts and survey methodology. The article discusses which analysis methods should be used for a particular study, potential problems that may arise with the use of surveys, recommendations for reporting results, and ways to make survey development more effective. This resource is freely available at the Web site above.

The following resources address the use of **focus groups**:

- Robert Wood Johnson Foundation. Focus Groups. <http://www.qualres.org/HomeFocus-3647.html>

This Web site provides introductory information for learning about focus groups. It describes the general design principles and characteristics of focus groups. The Web site also provides information on when it is appropriate to use a focus group, how to record focus group data, and how a focus group can benefit a research study. This resource is freely available at the Web site above.

- Dawson S, Manderson L, Tallo VL. A manual for the use of focus groups. Boston, MA: International nutrition foundation for developing countries; 1993. <http://libdoc.who.int/publications/1993/0963552228.pdf>.

This online manual is intended for social science and medical researchers who intend to use focus groups to obtain information quickly regarding a topic. The manual discusses the benefits of the focus group methodology and techniques that can be used to help ensure valid results. The manual also provides a series of step-by-step instructions for conducting focus groups. This resource is freely available at the Web site above.

- Grudens-Schuck N, Allen BL, Larson K. Focus Group Fundamentals. 2004;PM 1969b:1-6. <http://www.extension.iastate.edu/publications/pm1969b.pdf>.

This article describes focus group methodology to generate valid information important to the advancement of programs, such as HIE projects. The article describes the fundamental aspects of focus groups by distinguishing them from surveys and other commonly used research methods. This resource is freely available at the Web site above.

- Kitzinger J. Qualitative research. Introducing focus groups. *BMJ* 1995;311(7000):299-302. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2550365/pdf/bmj00603-0031.pdf>.



- This article suggests that focus groups are particularly suited to the study of attitudes and experiences, and to the examination of how knowledge and ideas develop and operate within a cultural context. The article provides an introduction to focus group methodology and provides guidance on group composition, conducting the discussion, and analyzing the results. The article also discusses factors to consider when designing or evaluating a focus group study. This resource is freely available at the Web site above.

The following resources provide more information on **manual medical record review**:

- Allison JJ, Wall TC, Spettell CM, et al. The art and science of chart review. *Jt Comm J Qual Improv* 2000;26(3):115-36. <http://www.ingentaconnect.com/content/jcaho/jcjqqs/2000/00000026/00000003/art00001>

Based on prior research, Allison et al. concluded that many investigators overlook the intricacies involved in obtaining high-quality data. The article concludes that medical record review is a difficult process, and is hard to standardize across projects. Many factors may compromise data quality, such as imprecisely worded research questions, vague specification of variables, poorly designed abstraction tools, inappropriate interpretation by abstractors, and poor or missing recording of data in the medical record. For projects that require ongoing abstraction of large numbers of clinical records, data quality may be observed with control charts and the principles of statistical process control. This resource is available for purchase at the Web site above.

- Cassidy LD, Marsh GM, Holleran MK, et al. Methodology to improve data quality from chart review in the managed care setting. *Am J Manag Care* 2002;8(9):787-93. <http://www.ajmc.com/publications/issue/2002/2002-09-vol8-n9/Sep02-134p787-793>.

When medical record review data are collected by multiple reviewers, the potential for variability always exists. This may also result from difficulties with data abstraction tools. To determine the extent of agreement between multiple reviewers, the authors present their method consisting of statistical analyses, the identification of areas for improving data collection procedures, and a description of the processes they implemented to improve data reliability. Results indicate that inter-rater reliability (IRR) studies that use appropriate statistical sample size techniques and analysis methods are likely to ensure the reliability of data collected through medical record review. Standardized methods of data collection and evaluation of IRR results increased confidence in data collection and statistical analyses, and in reaching conclusions and deriving relevant recommendations. This resource is available with a free registration at the Web site above.

- Gearing RE, Mian IA, Barber J, et al. A methodology for conducting retrospective chart review research in child and adolescent psychiatry. *J Can Acad Child Adolesc Psychiatry* 2006;15(3):126-34. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2277255>.

Despite the volume of data available in historical medical records, retrospective research that incorporates medical record review is not often used in child and adolescent psychiatry. In this article, Gearing et al. describe a scientific approach to medical record review research methodology in the field of psychiatry. This article also contains



step-by-step guidelines for extracting data effectively and systematically from historical records. The authors conclude that despite notable limitations to retrospective medical record review research, including incomplete or missing documentation, the methodology continues to offer numerous advantages. This resource is freely available at the Web site above.

- Murff HJ, Forster AJ, Peterson JF, et al. Electronically screening discharge summaries for adverse medical events. *J Am Med Inform Assoc* 2003;10:339-50. <http://171.67.114.118/content/10/4/339.full.pdf+html>.

In this article, Murff et al. hypothesized that discharge summaries would contain important information related to adverse events (AEs). They then created an electronic screening method that searched discharge summaries to detect AEs. Prior to this study, medical records often underwent a two-part review process. Records were first reviewed manually for the presence of one or more predefined screening criteria. If a medical record contained one of these criteria, it then went through physician review to make the final assessment regarding AE occurrence. This manual prescreening approach often leads to inclusion of more medical records than appropriate, so the authors sought to develop a tool that would automate the process. The article concluded that electronic screening of discharge summaries for adverse events is possible but has poor specificity. However, computerized clinical narrative screening methods potentially could offer researchers the ability to routinely detect adverse events. This resource is freely available at the Web site above.

The following resources discuss **data mining**:

- Moore A. Auton Lab—Carnegie Mellon University’s School of Computer Science. Statistical Data Mining Tutorials. <http://www.autonlab.org/tutorials>.

This Web site includes “a set of tutorials on many aspects of statistical data mining, including the foundations of probability, the foundations of statistical data analysis, and most of the classic machine learning and data mining algorithms. These include classification algorithms such as decision trees, neural nets, Bayesian classifiers, Support Vector Machines and case-based (aka non-parametric) learning.” Created in 2006, the Web site has summary information on statistical and mathematical models and theories. This resource is freely available at the Web site above.

- Palace B. Anderson Graduate School of Management at UCLA. Data Mining. <http://www.anderson.ucla.edu/faculty/jason.frand/teacher/technologies/palace/index.htm>.

This online report describes what data mining is, what it can be used for, and how it works. The report also describes how organizations have used data mining in the past and the technical infrastructure that is required to enable data mining. The author also introduces social, business, and technological issues raised by this methodology. This resource is freely available at the Web site above.



The following resources provide information on **time and motion studies**:

- Agency for Healthcare Research and Quality. Time and Motion Studies Database. <http://health-it-tools-and-resources/time-and-motion-studies-database>.

Researchers at Partners HealthCare created a tool to help others capture time and motion study data. The tool—a Microsoft Access database—allows observers to record time and motion data, and store the data for analysis. In addition, the tool includes a user guide and a published journal article that provides a case example of how the tool can be used to evaluate the effectiveness of health IT. The database can help you measure the impact of technology on clinical workflow. This resource is freely available at the Web site above.

- Caughey MR, Chang BL. Computerized data collection: Example of a time-motion study. *West J Nurs Res* 1998;20(2):251-6. <http://wjn.sagepub.com/content/20/2/251>. <http://www.sagepub.com/journalsPermissions.nav?path=/journals/08980101/v20n02/200202251>

The authors describe their experience with using a computerized system to conduct a time and motion study as part of a study that included skilled nursing facilities and subacute units. The data collection methods were designed for future use in a case-mix reimbursement system study. The authors provide suggestions for future applications of this work in nursing research. This resource is available with a paid subscription at the Web site above.

- Finkler SA, Knickman JR, Hendrickson G, et al. A comparison of work-sampling and time-and-motion techniques for studies in health services research. *Health Serv Res* 1993;28(5):577-97. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1069965/pdf/hsresearch00062-0055.pdf>.

This article describes the use of work-sampling and time-and-motion studies by industrial engineers. This resource is freely available at the Web site above.

The following resources address these **kinds of studies**:

- Concato J, Shah N, Horwitz RI. Randomized, controlled trials, observational studies, and the hierarchy of research designs. *N Engl J Med* 2000;342(25):1887-92. <http://www.nejm.org/doi/full/10.1056/NEJM200006223422507#t=articleTop>.

This article compares the validity and outcomes of randomized controlled trials and observational studies. The authors used published meta-analyses to identify randomized clinical trials and observational studies that examined the same clinical topics. They then compared the results of the original studies according to the type of study design. The authors conclude that the results of well-designed observational studies (with either a cohort or a case-control design) do not systematically overestimate the magnitude of the effects of treatment, compared with the results of randomized controlled trials on the same topic. This resource is freely available at the Web site above.



- Green SB, Raley PL. What to Look for in a Randomized Controlled Trial. *Sci Ed* 2000;23(5):157. <http://www.councilscienceeditors.org/files/scienceeditor/v23n5p157.pdf>.

This article summarizes a presentation by Sylvan B. Green that addressed the comparative advantages of randomized controlled trials and observational studies. The article also advises the reader regarding the elements of a well-designed trial, and suggests that data from multiple well-designed randomized control trials may be combined in a meta-analysis to increase statistical power and yield more precise outcomes. This resource is freely available at the Web site above.

- Sibbald B, Roland M. Understanding controlled trials. Why are randomized controlled trials important? *BMJ* 1998;316(7126):201. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2665449/pdf/9468688.pdf>.

This article provides an introduction to conducting randomized controlled trials, including the features of such trials and how they compare with other study designs. The article concludes with a discussion of the limitations of randomized controlled trials. This resource is freely available at the Web site above.

The following resources discuss such **study designs**:

- Barlow WE, Ichikawa L, Rosner D, et al. Analysis of case-cohort designs. *J Clin Epidemiol* 1999;52(12):1165-72. http://www.tc.umn.edu/~alonso/Barlow_JCE_1999.pdf.

This article discusses the use of case cohort designs in clinical research. According to the authors, despite the efficiency of case cohort methodology, these designs are not often used because of perceived analytic complexity. This article compares case cohort methodology to a nested case-control design and assesses the efficiency of both approaches. This resource is freely available at the Web site above.

- Ernster VL. Nested case-control studies. *Prev Med* 1994;23(5):587-90. <https://ephpublic.aecom.yu.edu/sites/SViswanathan/Shared%20Documents/Week2/Ernster%20-%20Nested%20Case-control%20study.pdf>.

This article describes nested case-control design and its benefits. This resource is freely available at the Web site above.

- Meirik O. World Health Organization. Cohort and Case-Control Studies. http://www.gfmer.ch/Books/Reproductive_health/Cohort_and_case_control_studies.html.

This Web site includes overviews of the use of cohort and case-control studies in epidemiological research. This resource is freely available at the Web site above.

- Schenker M. Dept. of Public Health Sciences—UC Davis. Case-Control Studies. <http://www.ucdmc.ucdavis.edu/ome/mcrtp/docs/Case%20Control%20Studies.ppt>.



This PowerPoint presentation describes uses of case-control studies and epidemiological studies that use this study design. This resource is freely available at the Web site above.

The following resources offer guidance on the development of a **dissemination plan**:

- Dissemination Planning Tool: Exhibit A: Volume 4. Programs, Tools, and Products. December 2006. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.ahrq.gov/professionals/quality-patient-safety/patient-safety-resources/resources/advances-in-patient-safety/vol4/planningtool.html>.

This tool was designed to assist patient safety researchers in developing a plan for disseminating research findings and products to potential users in the health care system, and in facilitating the translation of research into practice. The tool can help researchers evaluate their research and develop appropriate dissemination plans for findings that are determined to have “real-world” impact.

- Beyond Scientific Publication: Strategies for Disseminating Research Findings. Yale Center for Clinical Investigation. http://www.yale.edu/bioethics/contribute_documents/CARE_Dissemination_Strategies_FINAL_eversion.pdf.

This resource for developing a research findings dissemination plan includes writing guidelines; strategies for dissemination and a checklist; and sample dissemination documents such as a dissemination planning form and a press release.

