



**PARTNERSHIP** *for*  
**HEALTH IT PATIENT SAFETY**  
*a national collaborative*



# Close the Loop in Your Organization

## A Step-by-Step Guide

Convened by

**ECRI** Institute

Funded in part by

**GORDON AND BETTY**  
**MOORE**  
FOUNDATION



**PARTNERSHIP** *for*  
HEALTH IT PATIENT SAFETY  
*a national collaborative*



# Close the Loop in Your Organization

A Step-by-Step Guide

Convened by

**ECRI**Institute

Funded in part by

GORDON AND BETTY  
**MOORE**  
FOUNDATION

## Acknowledgments

The ECRI Institute *Partnership for Health IT Patient Safety* thanks the organizations that participated in the Closing the Loop Implementation Workgroup. We also thank those who presented and shared with the workgroup valuable information and those who provided the expertise that assisted with the development of the work plans. The workgroup participants and contributors are listed below.

### Participants and Volunteers

**Erie Family Health Centers**

**Community Health Centers (CHCFL)**

**Jericho Road Community Health Center**

**Southcoast Health**

**Yakima Valley Farm Workers Clinics**

**Jennifer C. Fabre, DNP, APRN, ANP/FNP-C, CDE, CHIO**, Director of Quality and Risk Management, TECHE Action Board dba Teche Action Clinic

**Hardeep Singh, MD, MPH**, Chief, Health Policy, Quality and Informatics, Michael E. DeBakey VA Medical Center and VA Center of Innovation, Baylor College of Medicine

### ECRI Institute Internal *Partnership* Contributors

**Julia L. Barndt, MA**, Editor

**Sarah D. Creswell, MSN, RN, CPHQ**, Patient Safety Analyst III and Consultant

**Elizabeth Drozd, MS, MT(ASCP)SBB, CPPS**, Patient Safety Analyst

**Andrea Druga, MSPAS, PA-C**, Clinical Informaticist

**Robert Giannini, NHA, CHTS-IM/CP**, Patient Safety Analyst and Consultant

**Patricia Giuffrida, MSN, RN, CPHIMS**, Patient Safety Analyst and Health IT Liaison

**Patrice Polgar**, Copyeditor

**Lorraine Possanza, DPM, JD, MBE**, Program Director, *Partnership for Health IT Patient Safety*

**Patricia Stahura, MSN, RN**, Senior Analyst and Consultant

**Diana Winters**, Copyeditor

### Gordon and Betty Moore Foundation

We offer special thanks to the Gordon and Betty Moore Foundation for its generous support in building a sustainable private sector infrastructure for effective health IT patient safety practices.

## Introduction

A key component of many diagnostic errors is failure to “close the loop” on requested information. This failure to respond to new, actionable information about the patient in an appropriate and timely manner can impact patient care, resulting in missed or incorrect diagnoses, delays in care, or improper treatment. Closing the loop therefore is a priority in all care settings, whether acute, long term, or ambulatory.

An effective closed-loop process aims to improve patient safety and prevent harm by ensuring that all patient data and information that require action are communicated to the right individuals, at the right time, through the right mode of communication, allowing for review, action, acknowledgment, and documentation.

Diagnostic tests and referrals are requested daily in all healthcare settings, but ensuring a closed-loop process actually occurs can be a recurring challenge. This guide provides an opportunity to explore and implement strategies for meeting that challenge.

## Background

### About the *Partnership*

The *Partnership for Health IT Patient Safety* is a multi-stakeholder collaborative convened and operated by ECRI Institute and funded in part by the Gordon and Betty Moore Foundation. The collaborative is comprised of healthcare providers, health information technology (IT) vendors and developers, academic researchers, patient safety organizations, patient advocates, and professional societies. The *Partnership* has worked to identify health IT safety issues and to implement safe technology practices by bringing together multi-stakeholder subject matter experts, evaluating data, looking at evidence, and assimilating all of this information to identify safe practices. Once safe practices are identified, it is essential that stakeholders take ownership and identify ways to implement them.

### Safe Practice Recommendations for Closing the Loop

In 2017-2018, the *Partnership* developed three high-level safe practice recommendations for closing the loop on diagnostic testing. The safe practices include recommendations to improve communication, tracking, and linking and acknowledging of information:

1. Develop and apply IT solutions to communicate the right information (including data needed for interpretation) to the right people, at the right time, in the right format
2. Implement IT solutions to track key areas
3. Use health IT to link and acknowledge the review of information and documentation of the action taken

More information about the development of the recommendations and the rationale for the recommendations, as well as implementation strategies for the recommendations, can be found in the following sources:

- [Health IT Safe Practices for Closing the Loop: Mitigating Delayed, Missed, and Incorrect Diagnoses Related to Diagnostic Testing and Medication Changes Using Health IT](#)
- [Closing the Loop: Recommendations & Implementation Strategies](#)

The *Partnership* executed a closing the loop implementation project based on issues identified by volunteer participants. The lessons learned are captured here to facilitate broader implementation of the safe practice recommendations.

This guide provides a stepwise discussion and approach to implementing closing the loop strategies across various practice settings. Any interested organization can follow these processes to implement the safe practice recommendations.



## Goals

In a pilot program, the *Partnership* invited volunteers from seven ambulatory care sites to commit to implementing recommendations for closing the loop. The first step is setting goals and objectives. This guide is based on several organizations' experiences with implementing these safe practices.

The overarching goal for implementing the safe practices at these organizations was to improve results tracking for diagnostic results and referrals using the technologies at hand and to ultimately improve the timeliness and accuracy of diagnoses.

## Project Logic Map

To begin the project, a project logic map was created, representing each of the three aspects of the Closing the Loop Implementation Project (Figure 1). The project logic map served as a roadmap for the project and is a good starting point for others planning to undertake this activity. The map serves as a visual representation of the various components of the project, including the inputs needed to drive the project, the strategies and activities, outputs, and identified outcomes. The map can aid with initial problem solving and decision-making for various aspects of the project.

As illustrated in Figure 1, the four key phases of the project were as follows:

1. Identifying the needed inputs and all of the resources that will be needed to execute the project and achieve the project's goals and objectives.
2. Setting forth the strategies and activities the project team will need to complete to achieve improvement.
3. Identifying the outputs the project is expected to produce, the deliverables or results anticipated, and who will be affected by these outputs. Anticipated outputs may change as the project progresses.
4. Identifying the outcomes and payoffs the project anticipates producing—in particular, closing the loop on diagnostic testing results and referrals. Outcomes may be further categorized as short-, intermediate-, and long-term goals. It is important to consider what measures will be used to assess these goals both at the outset and throughout the improvement and postimprovement phases.

Specific goals included the following:

- Identifying improvements to processes for diagnostic test and referral results
- Evaluating current processes and uses of technology
- Identifying technology's role in improving ways to close the loop
- Implementing changes and monitoring their effectiveness

The process for implementing safe practices for closing the loop can be organized into three main parts as summarized below: organizing the project, identifying issues for structured focus, and taking steps to implement change. The following sections will highlight each of these areas and integrate the steps that need to be taken to facilitate each part of the project. Steps and activities in each of the parts of the project may be included in one or more areas of the logic map. The logic map is helpful in project planning, while the outlined parts will facilitate the implementation of the safe practices.

### **Part 1. Organizing the Project**

- Identify safe practices to be implemented
- Identify sites, departments, and participants
- Explain goals and objectives of the project
- Obtain commitment
- Gather background materials
- Establish meeting schedules

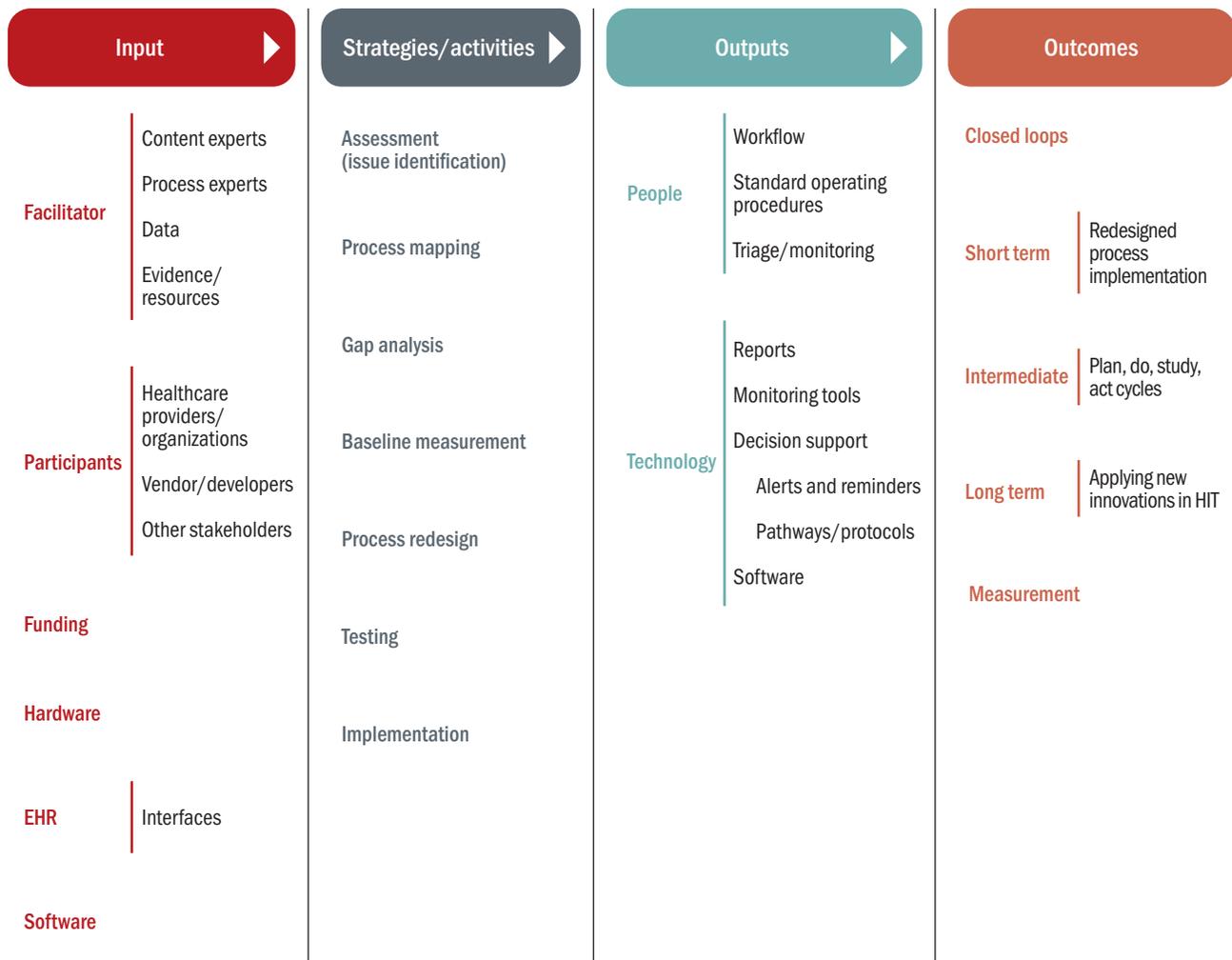
### **Part 2. Identifying Issues for Structured Focus**

- Assess current processes (e.g., ordering, executing, tracking, results)
- Identify gaps through process mapping and gap analysis
- Identify where improvements could be focused
- Identify where technology might assist
- Determine measures useful for monitoring

**Part 3. Taking Steps to Implement Change**

- Redesign and test processes
- Obtain buy-in for suggested changes as needed
- Educate and train staff
- Broadly implement changes
- Reevaluate
- Monitor the effectiveness of changes

**Figure 1. Implementation Project Logic Map for Closing the Loop**





## Part 1. Organizing the Project

### Identifying Project Resources

Once the desired project is identified, first determine the project needs and available resources, including the personnel who should participate. Identify all locations that may be affected by the project (single or multiple sites). Suggestions for other resources that will be needed are as follows:

- **Facilitator.** Identify someone who will drive the project to completion. During the pilot implementation project, an internal *Partnership* analyst served as the facilitator. However, the choice to fill the role of facilitator may vary depending on the organization and the focus area of the implementation project.
- **Content experts.** Identify individuals who are *familiar with* standards, processes, procedures, guidelines or guidance, tools, and (if applicable) regulations that are relevant to the process.
- **Process experts.** Identify individuals who are *experienced in* the practices related to the process under evaluation. It is important to include individuals who perform each step of the process.
- **Project team members.** The project team should include individuals who are interested in leading and executing the changes associated with their focused area of work.
- **Other participants.** Other participants may be involved for abbreviated periods. In the pilot project, the *Partnership* identified personnel who had experience in implementing similar processes, technology experts, researchers, and others to fill any knowledge gaps and encourage advancement. It is important to keep all those within the organization informed about the ongoing evaluation and improvement processes. Include physicians, nurses, nurse

practitioners, pharmacists, physician assistants, other clinical staff, leadership, IT staff, technical staff, laboratory and radiology technologists, office managers and other administrative staff, and any other relevant individuals in the support and execution of the project. Also include vendor and developer representatives, technology control networks, and consultants to provide input about the technology (hardware or software).

- **Other resources.** Gather the necessary resources to support and inform the project, including relevant policies and procedures, training materials that are currently used, and tools that are currently used. Also gather reports and the actionable information from those reports, such as the number of missed appointments or the number of open referrals (depending on the nature of the project). Also collect data that will inform baseline measures and mark areas for improvement. In the pilot project, information was obtained from the various sites including policies and procedures, including specifics about the procedures for clinical testing and referrals.
- **Other tools.** Other needed items may include other hardware or software or other relevant reports.

Finally, it is important to identify the costs associated with the project, including financial costs such as those associated with staffing as well as interruptions to daily activities. Costs estimated for the time to project completion, staff and staff time required, reporting, information gathering, discussions, and updates must be determined, tailored to the project and specific scope of improvement.

Once this information is gathered, establish regular meeting schedules for the project. Be sure that all individuals involved in the project are familiar with the goals and objectives.

## Part 2. Identifying Issues for Structured Focus

Next, identify the strategies and activities required to move the project forward. A number of techniques can be used to evaluate current processes, identify gaps, and examine where improvements may be most useful. These steps will require varied time and effort. Some may be accomplished rapidly; others may require additional staff or outside input and may entail reevaluation.

### Assessment: Evaluating Current Processes

Set forth the strategies and activities for the project, including consideration of the sociotechnical elements. Recall that the sociotechnical model includes the following elements: workflow and communication; organizational policies, procedures,

and culture; content; hardware and software; user interface; personnel; measurement and monitoring; and external rules and regulations.<sup>1</sup> Improving processes for diagnostic testing and referrals must include consideration of the relationship to each of these components. Singh has identified sociotechnical issues that must be addressed in closing the loop (Table 1). These concerns address both people and technology. On the “people” side, individuals performing the tasks are concerned with issues surrounding training and knowledge, clear processes, communication, and the usability of the technologies. On the “technology” side, considerations include usability, the software function and content, and how the technology fits within the workflow.

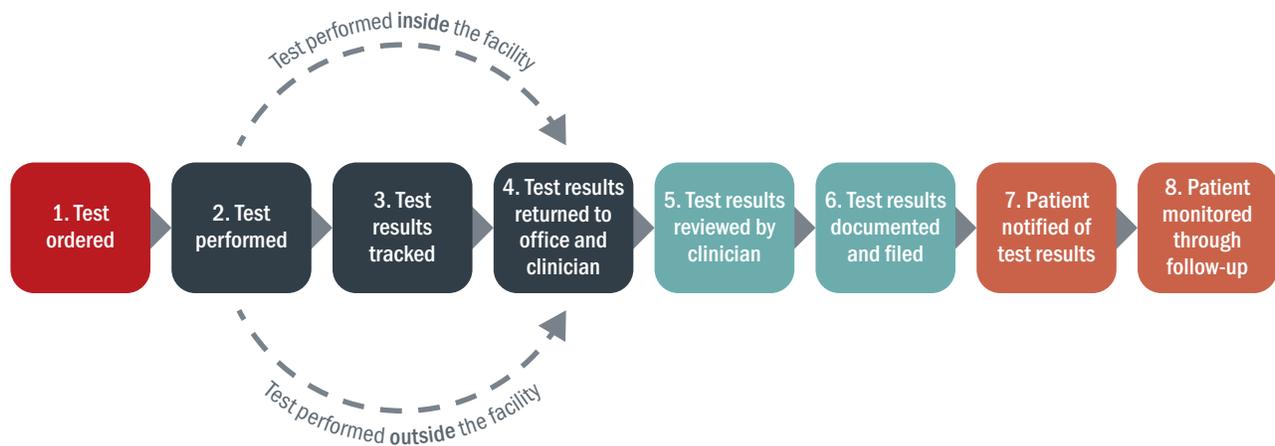
Examining the issues under consideration once they are identified will provide a precise focus. It is important to complete an initial phase of assessments and determine what (if any) modifications have already been made that help to clarify the identified issues.

## Process Mapping and Gap Analysis

In the pilot project for closing the loop, participants used the Agency for Healthcare Research and Quality’s (AHRQ) *Improving Your Office Testing Process*, a toolkit outlining the steps for a testing process (Figure 2).<sup>2</sup> These steps can also be applied generically to the referral process.

Process mapping or flow charting provides a visual representation of the steps in a process. Although sometimes considered a time-consuming step, process mapping is vital to success

**Figure 2. Example of an Office Testing Process**



Source: Eder M, Smith SG, Cappelman J, Elder N, Singh G. Improving your office testing process: a toolkit for rapid-cycle patient safety and quality improvement. Publication no. 13-0035. Rockville (MD): Agency for Healthcare Research and Quality; 2013 Aug.

**Table 1. Multiple Sociotechnical Issues to Consider in Closing the Loop**

Issue	Examples
Software	No functionality for saving, tracking, and retrieving alerts; alerts "disappear"
Content	Too many unnecessary alerts
Usability	Poor signal-to-noise ratio on screen
Workflow	"Surrogate feature" (to forward alerts when providers out of office) not used properly
Providers	Lack of knowledge/training
Organizational	Policies for follow-up ambiguous; informatics workforce

**Sources:**

Singh H, Spitzmueller C, Petersen NJ, Sawhney MK, Smith MW, Murphy DR, Espadas D, Laxmisan A, Sittig DF. Primary care practitioners’ views on test result management in EHR-enabled health systems: a national survey. *J Am Med Inform Assoc.* 2013 Jul-Aug;20(4):727-35. Also available: <https://dx.doi.org/10.1136/amiajnl-2012-001267>

Hysong SJ, Sawhney MK, Wilson L, Sittig DF, Esquivel A, Singh S, Singh H. Understanding the management of electronic test result notifications in the outpatient setting. *BMC Med Inform Decis Mak.* 2010 Jan-Feb;22. Also available: <https://dx.doi.org/10.1186/1472-6947-11-22>

Singh H, Spitzmueller C, Petersen NJ, Sawhney MK, Sittig DF. Information overload and missed test results in electronic health record-based settings. *JAMA Intern Med.* 2013;173(8):702-4. Also available: <https://dx.doi.org/10.1001/2013.jamainternmed.61>

Hysong SJ, Sawhney MK, Wilson L, Sittig DF, Espadas D, Davis T, Singh H. Provider management strategies of abnormal test result alerts: a cognitive task analysis. *J Am Med Inform Assoc.* 17(1):71-7. Also available: <https://dx.doi.org/10.1197/jamia.M3200>

Singh H, Thomas EJ, Mani S, Sittig D, Arora H, Espadas D, Khan MM, Petersen LA. Timely follow-up of abnormal diagnostic imaging test results in an outpatient setting: are electronic medical records achieving their potential?. *Arch Intern Med.* 2011 Apr 12;169(17):1578-86. Also available: <https://dx.doi.org/10.1001/archinternmed.2009.263>



**Table 2. Test Tracking Process-Tracking Gaps**

Testing Process	Tracking Gaps		
	Site #1	Site #2	Site #3
<b>1. Test ordered</b>			
Test done at point of service			
Test ordered outside the system	✓	✓	✓
Test ordered with the EHR system			
<b>2. Test performed</b>			
Test performed	✓	✓	✓
Test performed correctly	✓	✓	✓
<b>3. Test results tracked</b>			
EHR functionality available for tracking	✓	✓	
EHR functionality used for tracking	✓	✓	✓
Results received electronically	✓	✓	✓
Results received by fax	✓	✓	✓
Results associated with the wrong patient	✓	✓	✓
Criticality defined	✓	✓	✓
<b>4. Test results returned to office and clinician</b>			
One-way interface	✓		
Bidirectional interface	✓	✓	✓
Test results matched to order	✓	✓	✓
Paper results scanned in	✓	✓	✓
<b>5. Test results reviewed by clinician</b>			
Time frame in place for review and sign off			
Triage system in place for critical, abnormal, normal	✓	✓	✓
<b>6. Test results documented and filed</b>			
Automated filing	✓	✓	
Manual filing	✓	✓	
Error queue	✓	✓	
<b>7. Patient notified of test results</b>			
Standardized notification process for critical, abnormal, normal	✓	✓	✓
Portal available		✓	
Results sent to portal		✓	
Results called in to patient			
Results mailed to patient			
<b>8. Patient monitored through follow-up</b>			
Treatment plan documented			
Follow-up appointment scheduled		✓	✓

*Bold checkmarks indicate areas of commonality.*

because it provides a graphic understanding of the current process with input and agreement from the various team members, and it fosters a systems approach to analyze the current process. Important to the process are the brainstorming activities used to document the steps, whether on paper (e.g., using sticky notes so that steps can be rearranged as needed) or using electronic tools.

An example of how this process was applied in the *Partnership's* pilot project appears in Table 2 (which follows the steps identified in Figure 2). The steps of the process can be tracked across multiple participants or multiple sites for one organization. An assessment of potential gaps was included. A gap analysis compares the current process (“work as performed” or “what happens”) with the potential or desired improved process (“work as imagined” or “what should happen”). Using the process map, the current processes are compared with recommended practices or evidence-based practices or recommendations. The process map is used to identify any and all gaps in the processes, to document each gap, and clarify any missing information.

Differences may exist between sites or between organizations that may modify mitigation strategies.

Another example of a **gap analysis** is shown in Table 3.<sup>3</sup> This model accommodates assigning responsibility and establishing a timeline.

Finally, a model of steps taken in the referral or consultation request appears in Figure 3, found in the Institute for Healthcare Improvement’s *Closing the Loop: A Guide to Safer Ambulatory Referrals in the EHR Era*.<sup>4</sup> The same evaluative steps can be taken for this process.

## Identifying Where to Focus Improvements

When identifying gaps, it is important to address handoffs or transitions where breakdowns can occur (i.e., how is the information communicated back to the originator). Hysong et al. identified four areas where breakdowns commonly occur. This work focused on breaks in the referral process.<sup>5</sup>

Gaps in the referral process included the following:

1. Lack of clear policies and detailed instructions (e.g., how to address no-shows)
2. Lack of standard protocols for electronic referrals (e.g., how to handle information-only referrals)
3. Ambiguous roles and responsibilities for the primary care physician and the specialist (e.g., who should gather specific information for patient assessment)
4. Insufficient resources (e.g., staff to monitor referral process)

While identified from work on referrals, these gaps are applicable to other communication processes associated with closing the loop and should be considered when conducting a gap analysis.

Once the process steps have been identified, obtain clarifications of these processes as needed. This illuminates the process, makes certain that all participants are on the same page, and enables the identification of areas for additional focus.

**Table 3. Gap Analysis: Work as Performed and Work as Imagined**

Process (what happens [work as done])	What should happen (work as imagined)	Gap(s) identified	Corrective action	Responsible party	Due date
<b>1. Test ordered [insert process step]</b>					
a. [insert sub-process]					
b. [insert sub-process]					
<b>2. Test performed</b>					
a.					
b.					
<b>3. Test tracked in the EHR</b>					
a.					

In determining an action plan to address these gap-closing processes, assign an individual to lead the improvements and to make certain that each step is executed once the needs are clearly defined.

Others who may also need to be involved when defining a course of action include the following:

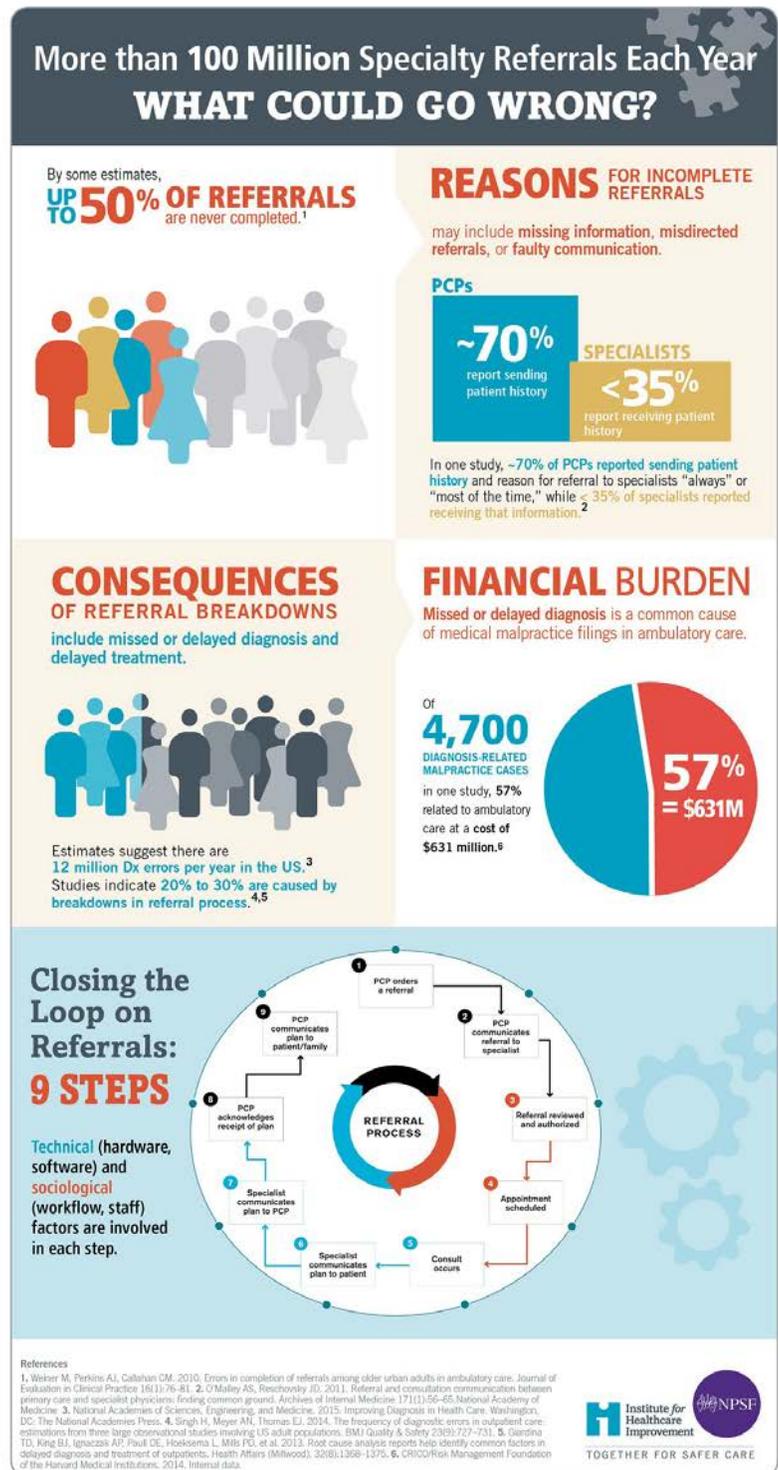
- Report writers:
  - to identify actionable reports
  - run and schedule reports
- EHR vendors:
  - to assess currently available functions and determine whether they are being fully utilized
  - identify reports or new features to to facilitate closing the loop
- Leadership:
  - to provide support
  - approve new policies
  - add staff or resources

## Baseline Measurement

Once these activities are completed, it is possible to gather baseline measurements to assess the current status and to gauge successes moving forward. It is important to determine what data is readily available for collection. Identify any challenges to data collection, including the effort that will be required to collect that information, what actions can occur based on the information gathered, and measures that are presently routinely gathered for other purposes. Vendors or other IT support may be necessary if reports require customization or if difficulties in data gathering are encountered.

It is important to monitor and track information over time to ensure that safety efforts that are initiated are improving processes that have been measured. Obtaining baseline information will help establish goals for improvement. Baseline measures could involve the number of open orders, consults, or referrals; the time required to complete an order, consult, or referral; the number of unmatched results (e.g., patient and result, result and ordering physician); or the amount of time an order, consult, or referral spends in a certain “status” (e.g., “in process”).

**Figure 3. The Nine Steps of the Closed-Loop EHR Referral Process**



Reprinted from www.IHI.org with permission of the Institute for Healthcare Improvement, ©2019. PCP, primary care physician. Available online: <http://www.ihl.org/resources/Pages/Publications/Closing-the-Loop-A-Guide-to-Safer-Ambulatory-Referrals.aspx>

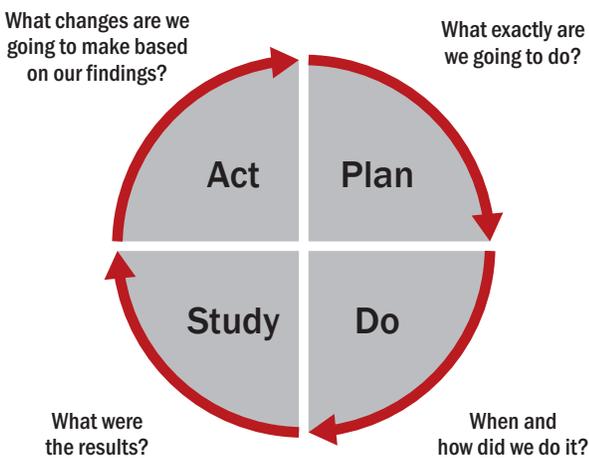
## Part 3. Taking Steps to Implement Change

### Process Redesign, Testing, and Implementation

Other activities that will occur during this stage include process redesign and testing of new processes or tasks, followed by evaluation and determination of needed modifications. Once satisfied, develop a plan for implementation of the identified changes.

Implement changes on a test scale using the “Plan, do, study, act” (PDSA) model (Figure 4).<sup>6</sup> Changes and proposed improvements require testing prior to broad-scale implementation. Identify and discuss the recommended scope of this testing and determine how success for the change will be demonstrated. For example, implementing a change at one site before implementing it at multiple sites may be ideal. Tools for testing implementations are also available (see “Resources”). Evaluating the testing results and if necessary making further revisions to the new process may be necessary prior to full implementation.

**Figure 4. Plan, Do, Study, Act**



**Source:** Centers for Medicare and Medicaid Services, PDSA cycle template. <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/QAPI/downloads/PDSACycledebedits.pdf>

It is important to review and discuss planned improvements with the team members. Obtaining leadership buy-in for improvements and keeping leadership informed on a regular basis is essential. Good communication at this stage will be crucial in presenting the anticipated changes, helps to train staff, and can be useful in documenting the new processes. Good communication will also facilitate the identification of any barriers to implementation and provide an opportunity to consider mitigation strategies. Leadership support is necessary to assist with addressing any difficult barriers or to allocate additional resources.

To implement the changes, multiple iterations of the PDSA cycle may be necessary.<sup>6</sup> Depending on the size of the organization, it may also be helpful to develop a written implementation and communication plan.

Continued monitoring of these processes will occur throughout the implementation, so that any changes can be noted and addressed. Addressing barriers and developing mitigation strategies may be required throughout the process. Fundamental to this process is understanding the depth of the issue under review, the potential benefits, and how the changes will impact the organization. It is essential to balance competing priorities, to involve the right mix of organizational stakeholders, to include technology experts and vendors in the process, and to ascertain the resources that will be required.

### Evaluating the Effectiveness of the Changes

The focused outputs and outcomes of the closing the loop implementation may vary by site. While the overarching goals of the safe practices are to use technology to facilitate closing the loop on diagnostic testing and referrals in order to mitigate delayed or missed diagnoses, shorter-term goals may also be identified. These goals may be related to the individuals involved in the work or to the technology used to execute the work. Anticipated outputs and outcomes in achieving the implementation of the safe practices may relate to people, technology, or both.



## People

Outputs affecting people that are driven by the improvement process may include the following:

- Workflow—new or improved workflows
- Standard operating procedures—new processes developed and implemented
- Monitoring—oversight of challenges and barriers and modifications as needed

## Technology

Project outputs driven by technology may include the following:

- Reports—creation of new reports or improvements to existing reports
- Monitoring tools—alerts or reminders
- Decision support enhancements
- Software changes or use

Using the safe practices to identify potential solutions for closing the loop, the workgroup members used a variety of tools available to them to execute short-, intermediate-, and long-term goals (see “Resources”). Answering the following questions was also instrumental in achieving the project goals:

- What is technology’s role?
- What can stakeholders do?
- How can this be accomplished?

For additional strategies, see “Appendix A”. These strategies take into account all of the stakeholders involved in the process of closing the loop, including the patient.

## Measuring and Summarizing the Outcomes

Discussing with team members what outcomes will be measured is important during the planning phase of the project. Monitor outcome measures regularly to identify positive or negative trends. Short-, intermediate-, and long-term outcomes may be identified for the project. Outcome measures should be documented prior to the project closure.

**Short-term outcomes.** Short-term outcomes may include obtaining support for one of the identified issues in closing the loop or working at following the identified process for scanning results into a patient record. Short-term outcomes can be immediate, but remember they should also be measurable.

**Intermediate outcomes.** Intermediate outcomes may require repeating the PDSA cycles until the desired outcome is achieved. An example here may be the development of an actionable report. It may not be initially clear how frequently a report should be run or whether staff can readily act on the information obtained from the report. Repeating the PDSA cycle may be helpful in refining this outcome.

**Long-term outcomes.** Long-term outcomes are the anticipated targets for each phase of the project. Long-term outcomes may include ultimately addressing several gaps, or redesigning processes.

Summarizing an implementation or an improvement process should involve ensuring that all of the desired actions have been completed, that all processes have been documented, that training has occurred, and that all stakeholders have been informed and are up to date on the changes. Communicating these actions serves as a check that the goals have been accomplished. Additionally, the summary provides the team with an opportunity to share the lessons learned with others and to recognize the team’s efforts and celebrate their successes.

## Conclusion

This guide provided a summary of the stepwise approach to implementing the three high-level closing the loop strategies across various healthcare practice settings. The project focused on the three safe practice recommendations for using technology to close the loop, as follows:

1. Develop and apply IT solutions to communicate the right information (including data needed for interpretation), to the right people, at the right time, in the right format
2. Implement IT solutions to track key areas
3. Use health IT to link and acknowledge the review of information and documentation of the action taken

Technology holds the promise of improving the process for closing the loop. In addition to applying technology-related recommendations, it is essential to address the “people” issues that are part of the sociotechnical environment in which these processes function. By considering all of the elements of this environment and focusing on those that are most applicable, safer, timely, and more accurate diagnostic decision-making can occur.

## References

1. Menon S, Smith MW, Sittig DF, Petersen NJ, Hysong SJ, Espadas D, Modi V, Singh H. How context affects electronic health record-based test result follow-up: a mixed-methods evaluation. *BMJ Open*. 2014 Nov 11;4(11):e005985. Also available: <http://dx.doi.org/10.1136/bmjopen-2014-005985>.
2. Eder M, Smith SG, Cappelman J, Hickner J, Elder N, Singh G. Improving your office testing process. Toolkit for rapid-cycle patient safety and quality improvement [AHRQ Publication No. 13-0035]. Rockville (MD): Agency for Healthcare Research and Quality; 2013 Aug. 44 p. Also available: <https://www.ahrq.gov/sites/default/files/publications/files/officetesting-toolkit.pdf>.
3. *Partnership for Health IT Patient Safety*. Health IT safe practices for closing the loop. Plymouth Meeting (PA): ECRI Institute; 2018. 60 p. Also available: [https://www.ecri.org/Resources/HIT/Closing\\_Loop/Closing\\_the\\_Loop\\_Toolkit.pdf](https://www.ecri.org/Resources/HIT/Closing_Loop/Closing_the_Loop_Toolkit.pdf).
4. Institute for Healthcare Improvement, National Patient Safety Foundation. Closing the loop: a guide to safer ambulatory referrals in the EHR era. Cambridge (MA): Institute for Healthcare Improvement; 2017. Also available: <http://www.ihf.org/resources/Pages/Publications/Closing-the-Loop-A-Guide-to-Safer-Ambulatory-Referrals.aspx>.
5. Hysong SJ, Esquivel A, Sittig DF, Paul LA, Espadas D, Singh S, Singh H. Towards successful coordination of electronic health record based-referrals: a qualitative analysis. *Implement Sci*. 2011 Jul 27;6:84. Also available: <http://dx.doi.org/10.1186/1748-5908-6-84>. PMID: 21794109.
6. Plan-Do-Study-Act (PDSA) cycle template. Baltimore (MD): Centers for Medicare & Medicaid Services (CMS); 3 p. Also available: <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/QAPI/downloads/PDSACycledebedits.pdf>.



## Resources

Communicating test results to providers and patients [VHA Directive 1088]. Washington (DC): Department of Veterans Affairs, Veterans Health Administration; 2015 Oct 7. 10 p. Also available: [https://www.va.gov/vhapublications/ViewPublication.asp?pub\\_ID=3148](https://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=3148).

Eder M, Smith SG, Cappelman J, Hickner J, Elder N, Singh G. Improving your office testing process. Toolkit for rapid-cycle patient safety and quality improvement [AHRQ Publication No. 13-0035]. Rockville (MD): Agency for Healthcare Research and Quality; 2013 Aug. 44 p. Also available: <https://www.ahrq.gov/sites/default/files/publications/files/office-testing-toolkit.pdf>.

HIMSS homepage. [internet]. Chicago (IL): HIMSS [accessed 2019 Nov 14]. Available: <http://www.himss.org/himss-patient-engagement-framework>.

Health Information Technology Research Center (HITRC), Iowa Foundation for Medical Care (IFMC), Health Information Technology Extension Center for Los Angeles County (HITEC LA). Workflow process mapping for Electronic Health Record (EHR) implementation [Version 1.0]. Washington (DC): National Learning Consortium (NLC); 2012 Jul 30. 9 p. Also available: <https://view.officeapps.live.com/op/view.aspx?src=https://www.thenationalcouncil.org/wp-content/uploads/2012/10/workflow-process-mapping-for-electronic-health-record-ehr-implementation-overview.doc>.

Institute for Healthcare Improvement. Quality improvement essentials toolkit. Boston (MA): Institute for Healthcare Improvement; 2017. 50 p. Also available: <http://www.ihl.org/resources/Pages/Tools/Quality-Improvement-Essentials-Toolkit.aspx>.

Jerzak J, Sinsky C. EHR in-basket restructuring for improved efficiency. Chicago (IL): American Medical Association (AMA); 2018. 16 p. Also available: <https://edhub.ama-assn.org/steps-forward/module/2702694#resource>.

Knox L, Brach C. Primary care practice facilitation curriculum (Module 10) [AHRQ Publication No. 15-0060-EF]. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ); 2015 Sep. 69 p. Also available: <https://pcmh.ahrq.gov/sites/default/files/attachments/pcpf-module-10-workflow-mapping.pdf>.

Partnership for Health IT Patient Safety. Health IT safe practices for closing the loop. Plymouth Meeting (PA): ECRI Institute; 2018. 60 p. Also available: [https://www.ecri.org/Resources/HIT/Closing\\_Loop/Closing\\_the\\_Loop\\_Toolkit.pdf](https://www.ecri.org/Resources/HIT/Closing_Loop/Closing_the_Loop_Toolkit.pdf).

SAFER guides. [internet]. Washington (DC): Office of the National Coordinator for Health Information Technology (ONC), U.S. Department of Health and Human Services [accessed 2018 Jan 23]. Available: <https://www.healthit.gov/topic/safety/safer-guides>.

Safety of personnel and security of laboratories involved in VA research [VHA Directive 1200.08]. Washington (DC): Department of Veterans Affairs, Veterans Health Administration; 2019 Apr 24. 29 p. Also available: [https://www.va.gov/VHAPUBLICATIONS/ViewPublication.asp?pub\\_ID=8307](https://www.va.gov/VHAPUBLICATIONS/ViewPublication.asp?pub_ID=8307).

Singh H. A compendium of best practices for improving test result follow-up. [internet]. 2019 [accessed 2019 Nov 06]. Available: DOI: 10.13140/RG.2.2.32796.33922.

Singh H, Vij MS. Eight recommendations for policies for communicating abnormal test results. *Jt Comm J Qual Patient Saf.* 2010 May;36(5):226-32. PMID: 20480756.

Singh H, Wilson L, Reis B, Sawhney MK, Espadas D, Sittig DF. Ten strategies to improve management of abnormal test result alerts in the electronic health record. *J Patient Saf.* 6(2):121-3. Also available: <https://dx.doi.org/10.1097/PTS.0b013e3181ddf652>.

Sittig DF, Singh H. Improving test result follow-up through electronic health records requires more than just an alert. *J Gen Intern Med.* 2011 Jul;27(10):1235-7. Also available: <https://dx.doi.org/10.1007/s11606-012-2161-y>.

Smith M, Murphy D, Laxmisan A, Sittig D, Reis B, Esquivel A, Singh H. Developing software to “track and catch” missed follow-up of abnormal test results in a complex sociotechnical environment. *Appl Clin Inform.* 2013;4(3):359-75. Also available: <https://dx.doi.org/10.4338/ACI-2013-04-RA-0019>.

Plan-Do-Study-Act (PDSA) cycle template. Baltimore (MD): Centers for Medicare & Medicaid Services (CMS); 3 p. Also available: <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/QAPI/downloads/PDSACycledebedits.pdf>.

## Appendix A. Closing the Loop Recommendations and Strategies

### Recommendations

**Communicate using health IT to close the loop: Develop and apply IT solutions to communicate the right information to the right people, at the right time, in the right format**

**Tracking loop closure using health IT: Implement IT solutions to track key areas**

**Link and acknowledge: Use health IT to link and acknowledge the review of information and documentation of the action taken**

When executing the safe practice recommendations, stakeholders must be cognizant not to complicate an already complex workflow. By executing these three recommendations, people and organizations across healthcare (including patients) can help ensure that providers have the most accurate and up-to-date information, which is necessary to provide the most effective and efficient care to patients, leading to an improvement in outcomes.

Additional information and tools are available in the full [report](#).

Communicate using health IT to close the loop: Develop and apply IT solutions to communicate the right information to the right people, at the right time, in the right format

**Rationale:** Effective and efficient communication between testing facilities, pharmacies, providers, and patients is necessary to prevent missed diagnostic opportunities that may lead to treatment failure. A closed loop will enhance care across disparate health systems.



### *What is technology's role?*

Health information technology can facilitate closing the loop through the clear communication, transmission, interpretation, and expression of information by designing, testing, deploying, and implementing health IT solutions to improve these communication pathways. IT has the potential to make closing the loop a seamless process, with all diagnostic results and medications communicated to the provider, to the pharmacy, and to the patient.

### *What can stakeholders do?*

Stakeholders should adopt clinical vocabulary standards; implement structured formats and findings; optimize existing EHR functionality so that it correlates the criticality of alerts with intrusiveness to reduce alert fatigue; and support result acknowledgment to enhance communication and improve transmission of diagnostic result information to providers and patients.

### *How can this be done?*

- Implement standard clinical vocabulary and definitions for reporting of diagnostic results and clinical findings (normal, abnormal, abnormal-noncritical, critical)
- Enter findings in a structured format (display latest results first, associate date of test with result)
- Agree upon and adopt universal display icons
- Implement multiple channels that allow secure transmission of results (direct messages, messages within the EHR, email notifications)
- Develop functionality to generate reminders with the ability to escalate and delegate
- Maintain and update provider directories and provider availability
- Enable systems to request and document delivery receipts for critical results
- Differentiate alerts by severity, intrusiveness, permission of automated responses using colored flags and tiers
- Provide ubiquitous off-site access for providers
- Use existing patient-facing communication technologies

**Table 1. How Various Stakeholders Communicate Using Health IT to Close the Loop**

Stakeholders	Requirements
EHR vendor/ developer	<ul style="list-style-type: none"> <li>■ Implement standards for documentation of diagnostic results and findings:               <ul style="list-style-type: none"> <li>– SNOMED CT and LOINC®</li> <li>– Universally recognizable icons</li> </ul> </li> <li>■ Optimize communication channels to meet provider needs based on:               <ul style="list-style-type: none"> <li>– Time</li> <li>– Current responsibilities</li> <li>– Delivery preference and message type</li> </ul> </li> <li>■ Enable alert tiering based on criticality</li> </ul>
Clinician	<ul style="list-style-type: none"> <li>■ Assist in developing standards for findings and documentation of those findings</li> <li>■ Adopt and use standards</li> </ul>
Healthcare organization	<ul style="list-style-type: none"> <li>■ Implement automatic triage to route results to the appropriate member of the team</li> <li>■ Adopt and enforce the use of standards for reporting diagnostic results and findings</li> <li>■ Give providers the option to customize their communication channel preference</li> <li>■ Ensure users have continuous, secure, ubiquitous access</li> </ul>
Government authorities	<ul style="list-style-type: none"> <li>■ Consider standards to enable:               <ul style="list-style-type: none"> <li>– Improved interoperability and information exchange</li> <li>– Usability and functionality</li> </ul> </li> </ul>

## Tracking loop closure using health IT: Implement IT solutions to track key areas

**Rationale:** Tracking diagnostic results and medication changes is a time-consuming, burdensome task, but necessary to ensure a closed loop. Identifying interruptions and potential failure points in the process is critical to finding and reacting to failures to close the loop.



### *What is technology's role?*

Technology can be used to accurately track and monitor diagnostic test results. It is important that these technologies can transmit information, provide opportunities for acknowledgement, and are capable of allowing documentation of these activities to ensure closed loops.

### *What can stakeholders do?*

Stakeholders can explore opportunities for tracking by determining where health IT can be used to correct deficiencies to improve tracking; assigning accountability for and ensure oversight of tracking; and implementing laboratory standards and bidirectional communication to improve tracking.

### *How can this be done?*

- Use existing EHR functionality to initiate tracking of issues related to closing the loop
- Apply EHR audits using redefined triggers to identify breaks in the process diagnostic-results management process
- Use applicable standards such as LOINC to automate accurate matching of result to ordered test to enable automated detection of loops closed
- Integrate interfaces to third-party systems to simplify the ordering and reporting of laboratory, radiology, pathology, and hospital diagnostic results, and returning results corresponding to the request
- Combine the monitoring of multiple interfaces into a single application

**Table 2. Tracking Loop Closure Using Health Information Technology**

Stakeholders	Requirements
EHR vendor/ developer	<ul style="list-style-type: none"> <li>■ Permit the integration of interfaces with third-party systems</li> <li>■ Deploy automated monitoring of interfaces for failure and performance degradation</li> <li>■ Use LOINC to automate accurate matching of results to test ordered</li> <li>■ Permit single application for monitoring interfaces</li> <li>■ Test interface-monitoring tools prior to deployment; include usability testing</li> </ul>
Clinician	<ul style="list-style-type: none"> <li>■ Review and revise existing organizational diagnostic results management:               <ul style="list-style-type: none"> <li>– Conduct gap analysis</li> <li>– Conduct workflow analysis</li> <li>– Update and publicize policies and contingency plans</li> </ul> </li> </ul>
Healthcare organization	<ul style="list-style-type: none"> <li>■ Implement all existing EHR test-tracking functionalities, including but not limited to:               <ul style="list-style-type: none"> <li>– Review of incomplete orders</li> <li>– Missing acknowledgements on critical results</li> <li>– Results not reviewed</li> <li>– Results not transmitted to patient or provider</li> <li>– Portal results not reviewed by patient</li> </ul> </li> <li>■ Implement LOINC standards for laboratory testing</li> <li>■ Permit the integration of interfaces with third-party systems</li> <li>■ Review and revise existing organization processes and procedures:               <ul style="list-style-type: none"> <li>– Conduct workflow analysis</li> <li>– Update and publicize policies and contingency plans</li> </ul> </li> <li>■ Implement audits of EHR data using redefined triggers to identify failure to close the loop</li> </ul>
Government authorities	<ul style="list-style-type: none"> <li>■ Advance the connectivity and interoperability of health IT</li> </ul>

Link and acknowledge: Use health IT to link and acknowledge the review of information and documentation of the action taken

**Rationale:** Using health IT to link and acknowledge the review of information and to document the action taken will safeguard against failure to close the loop.



Link and  
Acknowledge

### ***What is technology's role?***

It is important that health IT systems communicate, acknowledge, and document actions to allow for automatic confirmation of a closed loop.

### ***What can stakeholders do?***

Stakeholders can optimize health IT solutions to link and store an acknowledgement, to record the action taken, and to develop functionalities to communicate actions taken along with, or instead of, acknowledgements.

### ***How can this be done?***

- Improve interoperability through the integration of systems to connect information across the care continuum
- Develop functionality to communicate actions taken along with, or instead of, acknowledgements
- Allow documentation of the action taken in response to a notification

**Table 3. Link and Acknowledge Using Health IT**

Stakeholders	Requirements
EHR vendor/ developer	<ul style="list-style-type: none"> <li>■ Improve interoperability through the integration of systems</li> <li>■ Include the application programming interfaces (APIs) to allow laboratory and hospital systems to communicate</li> <li>■ Use Health Level Seven International (HL7®) and fast interoperability resources (FHIR) to aggregate and merge patient data from separate data sources</li> <li>■ Develop functionality to communicate actions taken along with or instead of acknowledgements</li> <li>■ Allow diagnostic result notification messages to be modifiable by the recipient to add the action performed to close the loop</li> <li>■ Provide functionality to document the action taken in response to a notification</li> </ul>
Clinician	<ul style="list-style-type: none"> <li>■ Document the action taken in response to a notification:               <ul style="list-style-type: none"> <li>– Ordered follow-up test</li> <li>– Notified the patient</li> <li>– Modified medication</li> </ul> </li> </ul>
Healthcare organization	<ul style="list-style-type: none"> <li>■ Implement the APIs</li> <li>■ Use HL7® and FHIR to aggregate and merge patient data from separate data sources</li> </ul>
Government authorities	<ul style="list-style-type: none"> <li>■ Consider standards to enable:               <ul style="list-style-type: none"> <li>– Improved interoperability and information exchange</li> <li>– Usability and functionality</li> </ul> </li> </ul>



**PARTNERSHIP** *for*  
**HEALTH IT PATIENT SAFETY**  
*a national collaborative*

Convened by

**ECRI** Institute

Funded in part by

**GORDON AND BETTY**  
**MOORE**  
FOUNDATION