

Economic analysis of electronic case reporting

Final Report

Prepared for

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Executive Summary

This study is a prospective economic analysis of the electronic case reporting (eCR) shared service on the Public Health Community Platform (PHCP). The study reports on the net benefits that are expected to accrue to public health jurisdictions that use PHCP eCR to evaluate and route reportable condition case reports.

In order to assess and value benefits such as increased accuracy, timeliness, and completeness of reportable condition case reports, we compare estimates of average costs to public health jurisdictions associated with the current state of practice, enrolling in the PHCP eCR solution, or developing a standalone, localized eCR solution.

The PHCP eCR service will facilitate the automated generation and transmission of initial reportable condition case reports from electronic health record (EHR) systems at health care providers' locations to a decision support tool. The decision support tool will determine whether the case is reportable to local and state public health jurisdictions and notify the provider. If reportable, the case is forwarded to the appropriate jurisdiction. Future iterations of eCR may also include a Forms Manager, which would facilitate request for additional data by automatically serving up partially pre-populated forms for reporters to fill out.

ES.1 Potential benefits of electronic case reporting

Health care providers are the first line of defense in detecting conditions of public health concern and reporting them to the appropriate local and state authorities. However, no national standards or systems exist to facilitate the exchange of information between the two parties with respect to reportable conditions.

Many providers lack awareness of what and how they are required to report conditions. Furthermore, reporting is often manual, using a faxed or mailed form, which public health jurisdictions must manually enter into their disease surveillance systems. The combination of these factors result in underreporting of cases from providers, delays between diagnosis and public health's awareness of the case, and many opportunities for data error in the manual reporting process.

Implementation of PHCP eCR could

- provide decision support so that providers know exactly what they are required to report;
- reduce errors resulting from the manual nature of current case reporting;
- increase timeliness of case report submissions from providers;
- increase the amount of information the jurisdiction receives before having to contact the provider or patient;
- reduce the amount of resources expended on low-value efforts such as data cleaning and data entry, freeing up resources for more high-value efforts such as data analysis and case investigation; and
- offer a national standard that will streamline adoption, lower the burden on EHR vendors to create custom solutions for individual jurisdictions, and make data more usable for analysis at a national level

ES.2 Economic Analysis Results

The benefit-cost analysis, which focuses on costs and benefits accruing to public health jurisdictions, includes

- one-time costs associated with implementing electronic case reporting
- ongoing labor costs related to reportable condition case management
- ongoing costs associated with maintaining the technical infrastructure of electronic case reporting
- ongoing benefits associated with electronic case reporting, particularly greater labor efficiency

Individuals from 17 organizations contributed both qualitative and quantitative data to this analysis. Five state public health jurisdictions and four large local public health jurisdictions contributed quantitative data to the economic model.

Net economic benefits of PHCP eCR accruing to jurisdictions were estimated by comparing the costs of three scenarios:

1. **PHCP eCR Scenario:** participating in electronic case reporting utilizing shared services in a cloud-based solution
2. **Localized eCR Scenario:** developing localized jurisdiction-specific systems
3. **Status Quo Scenario:** not participating in any form of electronic case reporting

PHCP eCR is estimated to generate, on average, \$2.5 million in net benefits per participating public health jurisdiction over 15 years relative to the Status Quo Scenario, which is treated as the baseline for this analysis. Additionally, PHCP eCR is expected to create eight times the return on investment that a Localized eCR solution will offer.

Our analysis provides evidence to support the expectation that electronic case reporting will deliver substantial benefits to public health jurisdictions. Additionally, the results support the argument that a centralized, shared resource implementation of eCR represents a stronger value proposition than a localized eCR solution.

1 Introduction

This study is a prospective economic analysis of the electronic case reporting (eCR) service on the Public Health Community Platform (PHCP). The study reports on the net benefits that are expected to accrue to public health jurisdictions that use PHCP eCR to evaluate and route reportable condition case reports.

In order to assess and value benefits such as increased accuracy, timeliness, and completeness of reportable condition case reports, we compare estimates of average costs to public health jurisdictions associated with the current state of practice, enrolling in the PHCP eCR solution, or developing a standalone, localized eCR solution.

1.1 Overview of the PHCP and eCR

The PHCP is a multi-stakeholder development effort led by the Association of State and Territorial Health Officials (ASTHO). The goal of the PHCP is to “provide a forum for common information exchange and development of innovative and interoperable systems...to deliver generalized solutions to common public health informatics problems” (PCHP, 2016).

Electronic case reporting is the first solution to be hosted on the PHCP. The PHCP eCR service will facilitate the automated generation and transmission of initial reportable condition case reports from electronic health record (EHR) systems at health care providers’ locations to a decision support tool. The decision support tool will determine whether the case is reportable to local and state public health jurisdictions and notify the provider. If reportable, the case is forwarded to the appropriate jurisdiction. Future iterations of eCR may also include a Forms Manager, which would facilitate request for additional data by automatically serving up partially pre-populated forms for providers to fill out. Section 2.2 provides more a more detailed description of the eCR service.

1.2 Uses for electronic case reporting of reportable conditions

An important function of public health is to identify, track, and investigate the occurrence of reportable conditions, or health conditions that are considered to be of interest or concern to public health authorities. Reportable conditions, defined at the jurisdiction level, include communicable diseases, infections from bioterrorism agents, food borne diseases, conditions from environmental exposures, cancers, gunshot wounds, animal bites, and others.

Health care providers are the first line of defense in detecting reportable conditions and reporting them to the appropriate local and state authorities. However, no national standards or systems exist to facilitate the exchange of information between the two parties with respect to reportable conditions. Additionally, the only tools that exist in most jurisdictions to help providers know what is reportable and the process for reporting are static fact sheets. Lack of knowledge and/or inconsistent awareness about what is required of providers, combined with the lack of incentive to file timely reports, results in significant underreporting of reportable conditions from providers.

Once a report from a provider is delivered to public health, most jurisdictions must enter the data manually into the disease surveillance system. The manual nature of the process (at the provider’s office and public health) results in inaccuracies caused by illegible handwriting, transcription errors, and failure to complete all the required information.

The weaknesses of the current state of reportable condition case reporting complicate public health's ability to anticipate, respond to, and manage public health crises. Implementation of electronic case reporting could

- reduce errors resulting from the manual nature of current case reporting,
- increase timeliness of case report submissions from providers,
- increase the amount of information the jurisdiction receives before having to contact the provider or patient, and
- reduce the amount of resources expended on low-value efforts such as data cleaning and data entry, freeing up resources for more high-value efforts such as data analysis and case investigation.

1.3 Project Scope

ASTHO contracted with RTI International to conduct an economic analysis of PHCP eCR. The focus of our analysis was on the costs and benefits accruing to public health jurisdictions; quantifying potential costs and benefits for health care providers, patients, or others was not in scope.

RTI analyzed the net benefits of PHCP eCR accruing to jurisdictions by comparing the costs of three scenarios:

4. **PHCP eCR Scenario:** participating in electronic case reporting utilizing shared services in a cloud-based solution
5. **Localized eCR Scenario:** developing localized jurisdiction-specific systems
6. **Status Quo Scenario:** not participating in any form of electronic case reporting

RTI constructed this analysis by collecting the following types of data:

- Case report management workflows
- Labor costs associated with case reporting
- IT infrastructure costs associated with case reporting
- Estimates of changes in labor costs or labor efficiency associated with electronic case reporting
- Contextual considerations, including ELR adoption and the impact of Health Information Exchange

Data were collected through a survey of public health agencies, subject matter expert interviews, and online data collection from public sources. By understanding the costs of each scenario, we are able to compare them to understand the value of implementing eCR.

1.4 Report Overview

The remainder of this report is structured as follows:

- Section 2 provides background information about eCR including its current status, the expected benefits and costs of eCR, and a review of current literature.
- Section 3 offers a high-level overview of the anticipated costs and benefits of eCR.
- Section 4 describes the benefit-cost analysis approach taken to evaluate PHCP eCR and describes our data collection procedures.
- Section 5 presents the qualitative and quantitative results of the analysis.

- Section 6 concludes the analysis with summary findings and a discussion of the limitations of the study and unanswered questions regarding eCR.

2 Background

2.1 Legacy case reporting practices

States have the authority to decide how reportable conditions should be reported. Common methods of reporting include

- faxed forms,
- mailed forms,
- telephone reporting,
- teleform (fax-to-scan technology that incorporates optical character recognition), and
- web form.

Required reporting method may vary depending on the condition. For example, some jurisdictions may require faster reporting via telephone for conditions that are highly communicable or of particular concern (e.g., Zika, Ebola).

2.2 eCR components

The PHCP eCR service is composed of five overarching components:

1. locally mapped trigger codes embedded in EHRs at provider facilities,
2. initial case report generation (eICR),
3. APHL AIMS routing,
4. Decision Support Tool – Reportable Conditions Knowledge Management System (RCKMS), and
5. Forms Manager (supplemental information requests).

Figure 2-1 illustrates the flow of data through eCR. The following subsections will describe each step in the data flow.

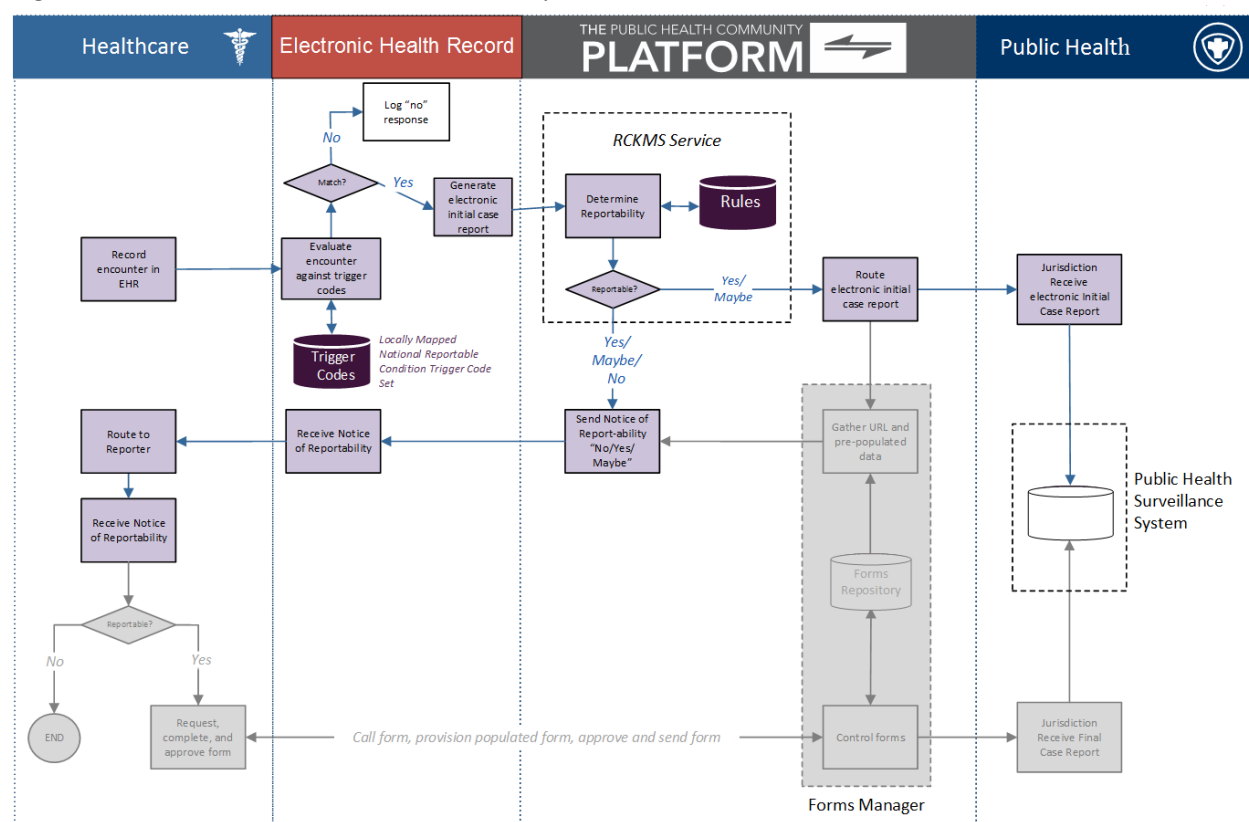
2.2.1 Locally mapped trigger codes

In order to obtain Meaningful Use Stage 3 (MU Stage 3) certification, EHR vendors are required to support locally mapped National Reportable Condition Trigger Codes (RCTC), which determine when an initial case report should be generated and sent through the eCR data flow. RCTCs will be capable of recognizing potential cases of all reportable conditions. Development of RCTCs is being led by the Council of State and Territorial Epidemiologists (CSTE).

2.2.2 Generation of initial case report (eICR)

When a diagnosis or other data entered into a provider's EHR matches a locally mapped RCTC, the EHR generates an Electronic Initial Case Report (eICR), which is an HL7 standard document that can be readily consumed by the Reportable Conditions Knowledge Management System. The eICR contains a standardized set of data fields, regardless of the condition triggering its transmission, which were drawn from Meaningful Use Stage 3 guidelines.

Figure 2-1. Initial eCR data flow from EHR to public health use case



2.2.3 APHL AIMS routing

Transmission of the eICR is facilitated by the APHL Informatics Messaging Service (AIMS), a secure cloud-based platform. APHL deployed AIMS in 2013 as an expansion of the services provided through the Route not Read (RnR) message transport hub that has been in production since 2009. AIMS provides messaging services for a variety of public health applications, including Electronic Laboratory Surveillance Messages (ELSM), state and regional Health Information Exchange (HIE) organizations, and the Public Health Interoperability Project (PHLIP) (APHL, 2013). AIMS is capable of receiving and sending information through a variety of trusted secure transport protocols.

2.2.4 Reportable Conditions Knowledge Management System (RCKMS)

When an eICR is received by AIMS, it is first routed through the Reportable Conditions Knowledge Management System (RCKMS), which is developed and maintained by CSTE. RCKMS is “an authoritative, real-time portal to enhance disease surveillance by providing comprehensive information to public health reporters about the ‘who, what, when, where, and how’ of reporting” (CSTE, 2016). RCKMS provides clinical decision support to determine if a case is reportable. When an eICR is determined to be reportable by RCKMS, AIMS routes the initial report to the appropriate public health jurisdiction and notifies the submitting provider of reportability.

2.2.5 Forms Manager (supplemental information requests)

The current pilot-stage implementation of eCR notifies the provider that a case is reportable and transmits the eCR to the appropriate public health jurisdiction. Depending on the condition, the jurisdiction may require supplemental information to determine next steps. A jurisdiction may contact a provider, or the provider may be required to submit additional paperwork.

In a future version of eCR, request for supplemental information may be automated. When RCKMS determines a case is reportable, a notice of reportability to the provider will be accompanied by a link to the appropriate form that the provider must complete to provide supplemental information to the public health jurisdiction. The form will be pre-populated with previously available information, and a completed form will be routed to the PHA and linked to the eCR.

2.3 PHCP eCR implementation

2.3.1 Phases of implementation

The following implementation phases are drawn from ASTHO's draft business case for PHCP eCR (ASTHO, 2015):

Phase I: Establish needed standards (HL7® CDA for initial case report, transaction protocols, and trigger code implementation). Prepare needed infrastructure to support case reporting (PHCP built on AIMS infrastructure). Prepare needed shared community applications (Reportable Conditions Knowledge Management System, forms manager. Prepare public health systems to integrate electronic case reports (including supplemental data).

Phase II: Provide initial implementation to growing number of early adopters. Continue to refine rules of decision support and supplemental forms. Apply data validity and quality controls.

Phase III: National onboarding as directed by public health authorities

2.3.2 PHCP eCR Implementation Timeline

The following implementation timeline is drawn from ASTHO's draft business case for PHCP eCR. (ASTHO, 2015)

Table 2-1. PHCP eCR Implementation Timeline

Milestones/Deliverables	Target Date	Status
Standards development	Q3-Q4 2015	Complete
Final MU Stage 3 Regulation	Q4 2015	Complete
Development of shared infrastructure	Q3 2015 – Q2 2016	Complete
Piloting of eCR using shared services	Q1 – Q2 2016	In Progress
Phase I complete	Q2 2016	In Progress
Phase II complete	Q1 2017	Pending
Phase III complete	Q1 2018	Pending

2.3.3 Stakeholders

Implementation of eCR is led by ASTHO, but involves multiple partners. Table 2-3 delineates the roles of each stakeholder in eCR implementation.

Table 2-2. PHCP eCR Stakeholders

Stakeholder	Role/Deliverables
Association of State and Territorial Health Officials (ASTHO)	Development and maintenance of the Public Health Community Platform (PHCP)
Association of Public Health Laboratories (APHL)	Development and maintenance of APHL Informatics Messaging Services (AIMS) platform
Council of State and Territorial Epidemiologists (CSTE)	Development and maintenance of Reportable Conditions Knowledge Management System (RCKMS) platform
Centers for Disease Control (CDC)	Funding provided to ASTHO, APHL, and CSTE for the development of eCR
Public health agencies/jurisdictions	Development of the capability to receive messages from the PHCP
Electronic health record vendors	Integration of locally mapped trigger codes to generate initial case reports
Health care providers	Providers must implement an eCR-compatible electronic health record

2.3.4 eCR Pilots

ASTHO is conducting two groups of pilots of the eCR service.

The initial pilot is testing the complete service of transporting an eICR from a provider EHR to the PHA. The two pilot groups are:

1. Utah Department of Health, Intermountain Healthcare, and Cerner (EHR developer)
2. Illinois Department of Public Health, Northshore Medical Group, and Epic (EHR developer)

The secondary pilot is testing the transfer and integration of an eICR from PHCP to the PHA. Jurisdictions participating at this stage are:

1. Idaho
2. Michigan
3. Tennessee
4. Virginia
5. Washington state
6. Houston, TX
7. Southern Nevada

3 Methods

The potential net economic benefits of electronic case reporting utilizing shared services were estimated by comparing the costs of three scenarios:

1. **PHCP eCR Scenario:** participating in electronic case reporting utilizing shared services in a cloud-based solution
2. **Localized eCR Scenario:** developing localized jurisdiction-specific systems
3. **Status Quo Scenario:** not participating in any form of electronic case reporting

This section documents our data collection and analysis procedures. Costs and benefits were only quantified for public health jurisdictions. Our discussion of qualitative findings in Section 4.1 discusses the implications of eCR more broadly and includes an assessment of probable benefits and costs for providers and EHR vendors.

3.1 PHCP eCR Scenario

Public health jurisdictions participating in PHCP eCR will utilize the shared service described in Section 2. In order to develop a cost profile of PHCP eCR, subject matter experts from a sample of jurisdictions were asked to estimate the cost of standing up PHCP eCR in their jurisdiction and the impact of eCR on their case report management workflow. RTI also worked with ASTHO, CSTE, and APHL to estimate the magnitude of the centralized costs associated with developing PHCP eCR.

3.2 Localized eCR Scenario

Localized eCR is an alternative that some public health jurisdictions are considering. This solution essentially mimics the functionality of PHCP eCR, but the individual jurisdiction bears the full burden of the development and maintenance of the decision support tool and data connections with providers. As part of this analysis, RTI interviewed jurisdictions that are currently pursuing or using some form of localized electronic case reporting. Additionally, subject matter interview experts were asked questions to help estimate the approximate level of effort required to implement an essentially identical version of electronic case reporting in a single jurisdiction.

3.3 Status Quo Scenario: Baseline legacy case reporting practices

The Status Quo scenario assesses the current state of practice and monetizes the tasks and investments involved in managing case reports that are submitted and processed under legacy reporting practices. This scenario will act as the baseline from which to measure incremental costs and benefits of the PHCP eCR solution as well as the Localized eCR scenario.

3.4 Expected impacts of PHCP eCR and Localized eCR

Table 3-1 presents a high-level overview of the expected economic costs and benefits of the two eCR scenarios. Section 4 contains a more detailed analysis of the two scenarios alongside quantitative results. Expected costs and benefits detailed below focus on those costs and benefits that are unique to implementing electronic case reporting. Baseline costs that will exist in any scenario will be quantified under the Status Quo scenario.

Table 3-1. Expected Impacts of PHCP eCR and Localized eCR

	Stakeholder	Short-term (One-time Costs and Benefits)	Long-term (Ongoing Costs and Benefits)
PHCP eCR	National Stakeholders	All development and initial onboarding costs are funded through cooperative agreements with the CDC. It is unclear at the time of this report whether CDC will provide funding support during the early stages of production when few jurisdictions are participating. CDC support would lower up-front costs, particularly to early adopter jurisdictions, which may incentivize more rapid adoption of eCR.	Over the long term, eCR will need to be maintained and expanded to include the Forms Manager feature set. RCKMS will need to be maintained as reportable conditions and trigger codes change over time. For some years after eCR enters production, new jurisdictions will need to be onboarded, and some technical support for providers attempting to onboard with AIMS/PHCP will be necessary. Where funding for ongoing development and maintenance of eCR and RCKMS will come from is unclear, though it is expected that something akin to a subscription model will raise the funds necessary from jurisdictions to maintain operations of necessary shared infrastructure. The CDC will benefit from receiving richer, more complete, and accurate surveillance data with which to analyze public health trends and spot crises with greater precision and speed.
	Public health jurisdiction	<i>Epidemiology/Case Investigation:</i> Some additional cost with respect to planning, implementation, and training related to eCR is expected. Input from epidemiologists will be required when creating jurisdiction-specific decision support tools on RCKMS. <i>Informatics:</i> eCR will require effort from Informatics staff to ensure messages from PHCP are being transmitted and consumed properly. Additionally, informatics staff will likely be involved in helping providers onboard with PHCP to generate and transmit eICRs. Level of effort for informatics will vary substantially depending on the size of the jurisdiction, the presence of a health information exchange, and the capabilities of the existing IT infrastructure going into eCR.	<i>Epidemiology/Case Investigation:</i> It is expected that eCR should save some time per case by providing more complete data, reducing some burden of seeking follow-up information. We expect these benefits to take the form of increased capacity rather than monetary savings. eCR will enable jurisdictions to do more with the same resources. <i>Informatics:</i> eCR will require some regular maintenance to maintain jurisdiction-specific decision support tools in RCKMS. Additionally, maintaining the connection between PHCP and the jurisdictions surveillance system will require some periodic maintenance when software updates are issued or features are added on either end.
	Health care providers	Providers will need to work with their EHR vendor and public health jurisdiction to ensure that they are onboarded with AIMS/PHCP and are able to successfully generate and transmit eICRs.	Over the long term, eCR should result in a higher level of reporting of reportable conditions from providers (though, depending on ELR adoption, this may not result in a substantial increase in new cases).

Localized eCR		Some training and behavior change may be required to ensure that patient care information is entered into the EHR in such a way that RCTCs can prompt the transmission of an eICR.	Use of eCR should reduce time spent by the provider on each case, particularly when the Forms Manager feature automates the collection of supplemental information.
	EHR Vendors	Most of the effort required from EHR vendors is front-loaded. In order to be certified under Meaningful Use Stage 3, EHR vendors will be required to develop support for RCTCs and transmission of standard documents like eICRs. Some level of effort will be required to help providers onboard with AIMS/PHCP in order to securely transmit messages to RCKMS.	Long-term impact is expected to be minimal. Maintenance of support for RCTCs, eICRs, and (eventually) the Forms Manager will be required.
	National stakeholders	Under a localized scenario, national stakeholders have little role, though it is likely that jurisdictions that choose to implement their own decision support tool would still use the RCTCs and eICR standard that will be supported by all MU Stage 3 certified EHRs. Thus, in a passive way, they will contribute resources to jurisdictions that chose this route.	
	Public health jurisdiction	Jurisdictions would likely choose to utilize the RCTCs and eICR message format that will be supported by EHRs. Jurisdictions would be responsible for: 1. Developing decision support logic to replace the functionality offered by RCKMS 2. Managing individual connections with health care providers to match functionality of connecting to PHCP/AIMS These two tasks would require substantial epidemiology, informatics, and software development expertise.	Over the long-term, the responsibility for maintaining the decision support tool and secure connections to the provider would fall to the jurisdiction. We anticipate this would require more staffing resources than under the PHCP eCR scenario. An additional long-term consideration for potential localized jurisdictions is their dependence on RCTCs and eICR messages. Depending on how ongoing development of these standards is structured from a governance and oversight perspective, a jurisdiction that is not opted into PHCP eCR may have limited input on the direction of these standards.
	Health care providers	Short-term impacts should be similar to that of the PHCP eCR scenario, though providers will not transmit messages through PHCP/AIMS	Long-term impacts should be similar to that of the PHCP eCR scenario, though providers will not transmit messages through PHCP/AIMS
	EHR Vendors	The role of EHR vendors in a localized scenario is expected to be essentially identical to the PHCP eCR scenario because we assume that PHAs will choose to use the national standards that EHR vendors are supporting for MU Stage 3 certification. However, the level of effort required from EHR vendors may increase because providers will be connecting directly to individual jurisdictions through a variety of connection methods. In some cases, large providers that span multiple jurisdictions will need to manage multiple connections. Under PHCP eCR, providers need only connect directly to PHCP, regardless of jurisdiction or size.	

3.5 Benefit-Cost Analysis Approach

Our economic model is populated with data from eCR pilot participants, public health jurisdictions that are developing localized eCR solutions, subject matter experts, relevant literature, and publicly available data.

3.5.1 Time series of net ongoing benefits

All costs and benefits are placed in a time series and projected over 5, 10, and 15 years. PHCP eCR is expected to enter full production in 2018. Thus, we begin to estimate on-going costs and benefits related to case report management in 2018. Some one-time costs related to development, setup, and onboarding are quantified in 2016 and 2017 depending on the scenario.

3.5.2 Data Collection

The primary source of data for the economic analysis of PHCP eCR is interviews with subject matter experts. Reviews of secondary material such as project implementation reports, cooperative agreement budgets, and publicly available data provided supplemental information to support the analysis.

In brief, our data collection approach included¹

- preliminary “scoping” interviews and conversations with a small number of subject matter experts and ASTHO to validate known lines of inquiry and identify unanticipated ones;
- revision of discussion guides and surveys to reflect insights acquired from scoping interviews;
- telephone interviews with a diverse group of public health jurisdictions, both at the state and local level, including some that are pursuing some form of localized eCR;
- telephone interviews with subject matter experts from health care providers, EHR vendors, and national stakeholder groups, including ASTHO, CSTE, APHL, and CDC; and
- use of interview transcripts from interviews conducted on behalf of ASTHO by Porter Novelli.

3.5.3 Interview procedures

Interviewees included informatics team leads, technical directors, public health nurses, epidemiologists, and subject-matter experts. Wherever possible, contact information and background were provided by ASTHO. RTI prioritized targeting jurisdictions and other candidates for interview based on their engagement with issues related to case reporting reform.

Individuals were contacted and asked to participate in the study. Although it is likely a jurisdiction’s participation in the analysis could be ascertained because the pool of interview candidates is small, care has been taken to aggregate responses to avoid disclosure of any data or comments attributable to any one entity.

Individuals who were solicited for participation received an introductory communication from ASTHO, a project abstract describing the study, and a copy of the discussion guide and survey. If a participant agreed to an interview, notes were taken in the survey document and saved. Alternatively, participants could choose to fill out the survey independently and submit it via email. Follow-up questions were answered by email or phone.

¹ This protocol, the project abstract, and the draft discussion guides and surveys were submitted to RTI’s Institutional Review Board (IRB) for a determination as to whether it constitutes Human Subjects Research, as established by the Department of Health Human Services, and the project received a non-research determination.

Table 3-2 describes the breakdown of interviewees and subject matter experts that contributed qualitative and quantitative data to this study. For the purposes of estimating net benefits of electronic case reporting, data populating the model was contributed by five state public health jurisdictions and four large local public health jurisdictions. Other participants from public health jurisdictions contributed qualitative information but declined to provide data for the economic model.

Table 3-2. Description of Study Participants

Stakeholder group	Organizations invited	Individuals invited	Organizations that participated	Individuals that participated	Organization response rate
State and territorial public health jurisdictions	12	22	7	16	69%
Large local public health jurisdictions	6	7	5	6	86%
National stakeholders (not including ASTHO)	3	7	3	7	100%
Pilot health care providers	2	2	1	1	50%
EHR Vendors	2	2	1	1	50%
TOTAL	25	40	17	31	68%

3.6 Structure of the economic model

Our eCR economic model has two high-level cost categories:

1. Baseline Costs
2. Alternative Scenario Costs

The **Baseline Costs** section of the model establishes average costs under the Status Quo scenario. Costs are divided into five task categories:

1. Data Management
2. Case Analysis/Follow-up
3. Data Analysis
4. IT Support of Case Management Systems
5. IT Infrastructure Costs (this is the only non-labor cost)

Costs for each task category were determined for each participating public health jurisdiction based on survey and interview responses about the number of FTEs they have and approximately what percent of their time is devoted to each category. Using fully loaded wage rates from ASTHO and the BLS, we estimate annual costs associated with case management for each category. IT Infrastructure Costs are also collected during the survey as a simple annual dollar cost.

Annual average costs are projected out to 2032 with some adjustments based on assumptions detailed below. The resulting stream of costs are presented in constant 2016 dollars as well as discounted to net present value (2016 US Dollars) using real discount rates of 3% and 7%.

The **Alternative Costs** are divided into four sections:

1. eCR Labor Costs
2. Localized eCR Setup, Onboarding, and Ongoing Maintenance Costs
3. PHCP eCR Jurisdiction Setup and Onboarding Costs
4. PHCP eCR Centralized Costs

eCR Labor Costs contain the same task categories as the Baseline Costs. Using survey and interview responses, we calculate labor savings with electronic case reporting fully implemented relative to the Baseline Costs. Savings are calculated using estimates of how much time (%) employees would save on the cost categories in the model. Alternately, interviewees could estimate how many new hires could be deferred due to efficiency and productivity gains that are attributable to eCR.

For the purposes of this analysis, we assume that eCR Labor Costs (and resulting benefits relative to the Status Quo) will be the same whether the eCR scenario is PHCP eCR or Localized eCR.

Localized eCR Setup, Onboarding, and Ongoing Maintenance Costs are estimates of the one-time and ongoing costs that are unique to implementing a localized, jurisdiction-level PHA.

PHCP eCR Jurisdiction Setup and Onboarding Costs are estimates of the one-time and ongoing costs accruing directly to a jurisdiction that are unique to adopting the PHCP eCR solution.

PHCP eCR Centralized Costs are estimates of the one-time and ongoing costs that accrue to ASTHO, APHL, and CSTE for the development and ongoing maintenance of PHCP eCR. Centralized costs are estimated based on feedback and data from ASTHO, APHL, and CSTE. The ongoing costs related to operations and maintenance of PHCP eCR are assumed to be distributed amongst participating jurisdictions, while the cost of initially developing PHCP eCR is separately funded through cooperative agreements with the CDC.

3.6.1 Monetization of labor time

Data was collected from participants in the form of percentages of a full-time employee's time commitment, based on a standard work year of 2080 hours. Fully loaded wage rates were sourced from the *ASTHO Profile of State Public Health: Volume 3* (ASTHO, 2014) and the Bureau of Labor Statistics (BLS, 2016) in order to monetize person effort (Table 3-3).

3.6.2 Projecting costs by year

Each of the cost categories listed above are estimated on an annual basis. In order to model costs over the full timeline of our analysis, these annual calculations are placed on a timeline and scaled appropriately according to the model assumptions detailed below.

PHCP eCR is scheduled to enter production in Q1 2018. However, development, integration, and onboarding costs will take place before 2018. Additionally, all estimates are reported in 2016 dollars. Thus, 2016 is the base year for our calculations. All future costs and benefits will be discounted back to 2016 dollars and presented in net present value form.

Table 3-3. Job titles used in quantifying reportable conditions case management workflow costs

Job title	Wage Data Source	Annual Wage	Cost of Employment Multiplier	Adjusted Annual Wage	Adjusted Hourly Wage
Clerical staff	ASTHO	\$47,386	40%	\$66,340	\$31.89
Public health nurse	ASTHO	\$61,038	41%	\$86,063	\$41.38
Public health manager	ASTHO	\$89,565	39%	\$124,495	\$59.85
Epidemiologist I (Generalist)	ASTHO	\$49,941	41%	\$70,417	\$33.85
Epidemiologist II	ASTHO	\$62,427	41%	\$88,021	\$42.32
Epidemiologist III (Specialist)	ASTHO	\$74,912	41%	\$105,626	\$50.78
Epidemiologist IV (Supervisor)	ASTHO	\$86,232	41%	\$121,587	\$58.46
Nurse practitioner	ASTHO	\$70,031	35%	\$94,542	\$45.45
Public health informatics specialist	ASTHO	\$63,899	40%	\$89,458	\$43.01
Public health information specialist	ASTHO	\$63,430	38%	\$87,533	\$42.08
Chief medical officer	ASTHO	\$163,315	39%	\$227,008	\$109.14
Chief information officer	ASTHO	\$91,010	40%	\$127,413	\$61.26
State epidemiologist	ASTHO	\$113,568	41%	\$160,131	\$76.99
Information Technologist	BLS	\$82,200	48%	\$121,656	\$58.49
Sr. Information Technologist	BLS	\$124,090	48%	\$183,653	\$88.29
Computer Network Support Specialists	BLS	\$62,250	48%	\$92,130	\$44.29
Network & Computer Sys. Admin.	BLS	\$82,200	48%	\$121,656	\$58.49
Database Administrators	BLS	\$84,250	48%	\$124,690	\$59.95
Software Developers, Applications	BLS	\$102,160	48%	\$151,197	\$72.69
Software Developers, Systems Software	BLS	\$108,760	48%	\$160,965	\$77.39

Sources: ASTHO Profile of State Public Health, Volume Three; Occupational Employment and Wages, Bureau of Labor Statistics, May 2015.

3.6.3 Model Assumptions

The economic model makes five major assumptions that impact costs and benefits:

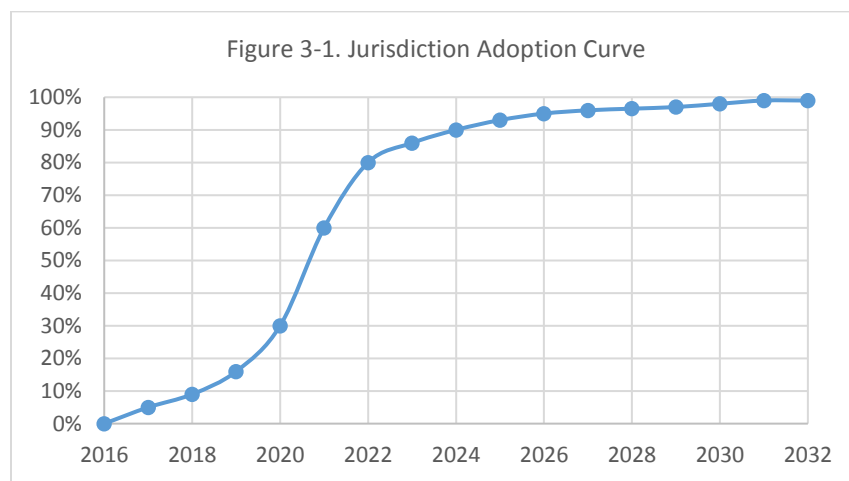
1. Jurisdiction adoption curve
2. Provider adoption curve
3. RCKMS coverage
4. Reporting volume impact
5. Timing of implementation of stage 2 of eCR

Jurisdiction Adoption curve

We estimate a curve (Figure 3-1) to model the pace of adoption of PHCP eCR among public health jurisdiction. The curve is based on the assumption that a small number of jurisdictions will be ready to begin using the eCR service when it enters production in 2018. Once early adopters have started using eCR, it is expected that the pace of adoption will accelerate, before tapering off as some jurisdictions lag behind.

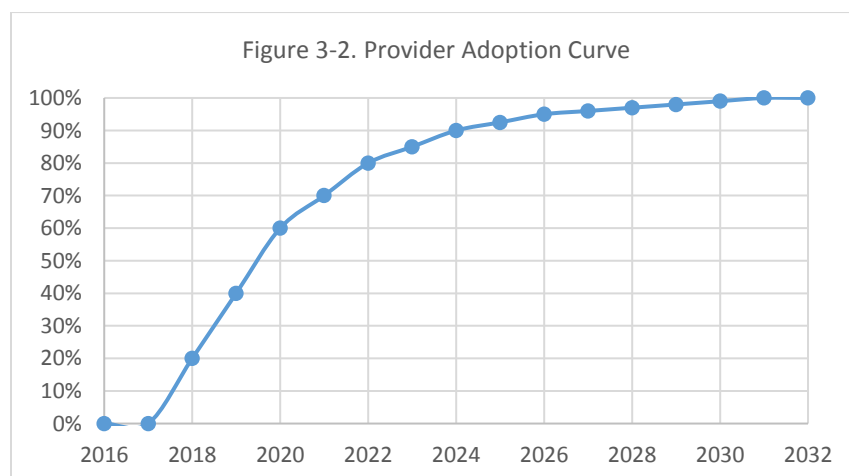
This curve is based on a conservative estimate. Meaningful Use Stage 3, which comes into effect starting in 2018, requires jurisdictions to declare their readiness to accept electronic case reports by July 2017. This deadline could create more pressure on jurisdictions to be ready and thus accelerate the rate of adoption. Additionally, the CDC could opt to support centralized costs of PHCP eCR or directly to jurisdictions through grant funding. In both cases, CDC support would lower the up-front cost of implementation and encourage a faster rate of adoption.

The Jurisdiction Adoption Curve assumption impacts Centralized Costs in two ways. The number of jurisdictions adopting PHCP eCR in a given year will determine the level of effort required on the part of national stakeholders (e.g., ASTHO, CSTE, APHL, PHCP) to onboard those jurisdictions. Additionally, as more jurisdictions are participating in PHCP eCR, the centralized costs are shared among more jurisdictions. Thus, over time, higher adoption should result in lower costs per jurisdiction to support the PHCP eCR service.



Provider Adoption curve

In addition to jurisdiction adoption curve, we estimate a provider adoption curve (Figure 3-2) based on subject matter expert feedback, which models the pace at which providers begin to use eCR in both the localized and PHCP eCR scenarios. This curve is applied to scale the calculated net benefits of eCR, which start small and grow over time as more providers begin to submit cases using eCR.



RCKMS coverage

Similar to the rate of provider participation, the rate at which trigger code sets are integrated into RCKMS for all reportable conditions will impact the ability of eCR to deliver benefits to PHAs.

Currently there only 5 conditions (out of 100+) have been mapped with trigger codes for eCR: salmonella; gonorrhea; chlamydia; pertussis; and Zika. Based on feedback from CSTE, it is expected that all conditions will be covered by the time PHCP eCR enters production (Q1 2018). However, given the constantly evolving nature of public health and conditions of concern, we expect RCKMS to be a “living document,” always changing in small ways to respond to changes in practice. The model, therefore, currently reflects an assumption that 98% of conditions will have trigger codes.

Reporting volume impact

In theory, electronic case reporting should increase the number of unique cases being reported to jurisdictions because the automation and decision support features will increase awareness of what needs to be reported by the provider and in some cases will automatically report all the data that is needed to open a case investigation.

In reality, the impact of eCR on the number of cases identified is more nuanced. Jurisdictions that have achieved a high level of electronic laboratory reporting (ELR) activity may already be capturing most of the cases that were missed by providers prior to ELR being implemented. The exceptions to this rule are the conditions that are often or always diagnosed without a lab result. While eCR will increase the volume of messaging from the provider, we are assuming that most of these will be merged with an ELR, resulting in more data but relatively few new cases.

As a result of these considerations, we estimate only a small increase (5%) in the number of new cases created as a result of eCR being implemented.

Rollout of Forms Manager feature of PHCP eCR

As is described in Section 2.2.5, the Forms Manager feature of PHCP eCR will automate the collection of supplemental information that the jurisdiction needs to complete a case investigation. Forms Manager will substantially reduce the effort required on the part of the epidemiologist or case investigator and the provider when supplemental information is required. 4.1.10 explores the nuances of the value of Forms Manager in more detail.

Surveys and interviews collected participants’ estimates of the impact of eCR under the assumption that the Forms Manager is in place. We make an assumption that Forms Manager will not be available until 2020 at the earliest. Thus, prior to 2020, the calculated benefits of eCR are scaled down by 50% to reflect the expectation that the full value proposition of eCR for many reportable conditions depends on the availability of the Forms Manager to automate supplemental information requests.

4 Results and Discussion

This section presents analysis results, which are separated into qualitative interview and survey findings and benefit-cost analysis results. The results of the analysis show that PHCP eCR is an investment that will yield positive net benefits over 5, 10, and 15 years. Furthermore, PHCP eCR is a more efficient solution to providing electronic case reporting than a Localized eCR solution, offering eight times more net value over a 15 year period than Localized eCR.

4.1 Stakeholder perspectives on the impact of eCR

As described in Table 3-2, data was collected from 31 individuals from state public health jurisdictions, large local public health jurisdictions, national stakeholder groups, health care providers, and EHR vendors. Experts' perspectives were synthesized thematically into

- reportable condition case reporting workflow
- originating sources of new reportable condition cases
- costs of legacy reporting and management practices
- impact of electronic case reporting on case management workflow
- impact of electronic laboratory reporting on eCR benefits and costs
- timeliness of reporting
- data quality and consistency
- technical considerations
- impact of eCR on demand for informatics expertise
- impact of Forms Manager on the value of eCR
- comparison of PHCP eCR and localized eCR
- impact of eCR on other stakeholders

4.1.1 Reportable condition case reporting workflow

In order to standardize data collection as much as possible, the survey instrument characterized the case reporting workflow using 17 tasks derived from a statewide study of reportable condition case reporting (Pina et al., 2009). The tasks were categorized into three task categories: Data management, Case Analysis and Follow-up, and Data Analysis.² Table 4-1 presents participants' assessment of the frequency of each task.

² While some participants suggested some additional tasks that were specific to their jurisdiction, they all agreed that these tasks were fairly representative of case management workflow.

Table 4-1. Validation of Reportable Condition Case Management Workflow

Category/Task	Frequency of task			
	This is a daily activity	This is a weekly activity	This is a monthly activity	We rarely do this activity
Data management				
Create new electronic records	90%	0%	0%	10%
Identify a case in the electronic record	90%	0%	0%	10%
Maintain/update electronic records	100%	0%	0%	0%
Maintain paper records	50%	20%	0%	30%
Harmonize paper records with electronic records	70%	10%	0%	20%
Data cleaning	80%	0%	10%	10%
Deduplication	80%	10%	10%	0%
Case analysis and follow-up				
Assign a case to a staff member	100%	0%	0%	0%
Assess case status	100%	0%	0%	0%
Use the electronic record during patient contact & data collection	100%	0%	0%	0%
On-the-fly analysis of disease or trend	40%	60%	0%	0%
Review comments to determine potential causes of disease	85%	5%	0%	10%
Fill our State Reporting Forms (local PHAs only)	100%	0%	0%	0%
Data Analysis				
Create queries	30%	60%	10%	0%
Re-use a pre-made query/report	80%	20%	0%	0%
Edit a pre-made query/report	50%	40%	0%	10%
Export data for analysis with a statistical program	56%	33%	0%	11%
Create new data repositories for disease specific investigation	0%	33%	0%	67%

4.1.2 Originating sources of new reportable condition cases

Participants reported their jurisdiction's methods of receiving reports from providers. Methods of submission include

- Email
- Web form
- Fax
- Mail
- Phone
- Electronic laboratory reporting (ELR)
- Teleform – a method in which a fax is scanned and turned into machine-readable text using optical character recognition (OCR)
- Localized electronic case reporting (ESPNNet)

Fax is the dominant method of reporting under the current state of practice, followed by ELR and web form. Five of the nine participating jurisdictions receive between 45% and 83% of their reporting via fax. Three jurisdictions reported receiving reports of new cases via ELR over 70% of the time, while one jurisdiction relies on web forms filled out by providers 50% of the time.

4.1.3 Costs of legacy reporting and management practices

As we highlight elsewhere in this section, the costs and benefits of PHCP eCR will depend heavily on a jurisdiction's starting point. The nature of legacy case reporting and management practices varies widely across jurisdictions. Some jurisdictions have well-developed informatics infrastructure that will ease the transition to eCR, while others are still struggling to implement ELR and are heavily reliant on more traditional forms of report submission, such as fax.

Table 4-2. Impact of eCR on case management workflow

Category/Task	Impact of electronic case reporting			
	eCR would make this step take longer	eCR would have no impact	eCR would save <u>some</u> time	eCR would save <u>a lot</u> of time
Data management				
Create new electronic records	10%	20%	50%	20%
Identify a case in the electronic record	10%	30%	30%	30%
Maintain/update electronic records	0%	20%	70%	10%
Maintain paper records	0%	65%	25%	10%
Harmonize paper records with electronic records	15%	55%	10%	20%
Data cleaning	50%	20%	30%	0%
Deduplication	60%	20%	20%	0%
Case analysis and follow-up				
Assign a case to a staff member	0%	44%	44%	11%
Assess case status	0%	33%	44%	22%
Use the electronic record during patient contact & data collection	0%	13%	75%	13%
On-the-fly analysis of disease or trend	0%	50%	50%	0%
Review comments to determine potential causes of disease	25%	13%	63%	0%
Fill our State Reporting Forms (local PHAs only)	0%	17%	67%	17%
Data Analysis				
Create queries	25%	50%	25%	0%
Re-use a pre-made query/report	25%	50%	25%	0%
Edit a pre-made query/report	25%	50%	25%	0%
Export data for analysis with a statistical program	25%	50%	25%	0%
Create new data repositories for disease specific investigation	25%	50%	25%	0%

4.1.4 Impact of electronic case reporting on case management workflow

When assessing the impact of eCR on case management, participants were asked to re-examine the tasks outlined in Table 4-1 and identify where eCR would result in increased efficiency or lead to an increased commitment of resources. Table 4-2 presents the results of this section of the survey.

A majority of survey participants, ranging from 55% to 88%, said that eCR would save at least some time for all Case Analysis and Follow-up tasks. Half of respondents said eCR would not impact Data Analysis tasks, while 25% said Data Analysis would be more time-consuming under eCR. Data Cleaning and Deduplication were the identified by participants as being most negatively impacted by eCR with 50% and 60% (respectively) saying that eCR would make these steps take longer.

4.1.5 Impact of electronic laboratory reporting on eCR benefits and costs

A key insight that was affirmed by most study participants is the importance of the relationship between eCR and ELR. ELR is the digital transmission of laboratory test results from labs to public health. While this is distinct from submitting case reports that are generated by health care providers, ELR and eCR serve some of the same purposes. In states where most laboratory reports are submitted via ELR, most new cases of a reportable condition originate from an ELR rather than from a provider-submitted report. In some cases, this is because ELRs simply reach the jurisdiction before manually generated provider case reports. In some jurisdictions, when a reportable condition is diagnosed with a lab test, providers are not required to submit reports.

ELR also delivers benefits similar to eCR where reportable condition case management is concerned, including increased timeliness in reporting and increased reporting of cases that may have been missed by the provider. Overhage, et al (2008) found that, compared to traditional paper-based reporting from a provider, ELR identified 4.4 times as many cases and identified cases 7.9 days earlier, on average.

In general, states with a higher level of ELR adoption are expected to realize fewer benefits that are attributable to eCR because ELR is already delivering those benefits. At the same time, ELR and eCR are not substitutes. For example, ELR often does not contain data that would be important to a reportable condition case investigation, such as pregnancy status or the name of the reporting physician.

In one respect, eCR is dependent on a jurisdiction's progress on ELR because federal funding through the CDC's Epidemiology and Laboratory Capacity cooperative agreements places a high priority on achieving substantial levels of ELR adoption before significant funding will be made available for eCR. Thus, jurisdictions who are lagging behind with respect to ELR will likely delay implementation of eCR.

However, even while focusing on ELR and delaying implementation of eCR, jurisdictions are making progress towards readiness to embrace eCR. One participant divided the technical process of both ELR and eCR into three categories: message receipt, message transformation, and message integration. By the time a jurisdiction has achieved high levels of ELR adoption, they will have addressed these three components with ELR and will be able to reuse much of the same technical infrastructure and staff to stand up eCR.

With respect to duplicate data, one challenge jurisdictions will have to cope with is deduplication of overlapping data fields. When the eCR and ELR messages agree, this should be fairly straightforward to handle in the jurisdiction's integration engine. However, when the two deliver even slightly different data, manual intervention will be required to decide which source contains more correct or more complete data. For the purposes of this economic analysis, we assumed that the average integration engine of a jurisdiction participating in PHCP eCR will have fairly robust deduplication capabilities.

4.1.6 Volume and timeliness of reporting

Pilot implementations of PHCP eCR are still too early in development to report actual data on the impact of eCR on the volume and timeliness of reporting. As noted in the discussion of the economic model's reporting volume assumption (Section 3.6.3), eCR will increase the volume and timeliness of data coming from providers, but may not necessarily result in an increase in new, previously missed reportable condition cases. Thus, while eCR will increase the richness and accuracy of the data available automatically to public health, it is unclear how much incremental progress can be made in terms of underreporting and timeliness of reporting.

4.1.7 Data quality and consistency

The quality and accuracy of data is expected to increase under eCR, while reducing the time required to transcribe handwritten reports and correct errors made by the provider or by the data entry specialist at public health. While some data may be redundant with ELR data, eCR messages will contain some critical data that an ELR message will not. For example, pregnancy status is rarely included in ELR messages, but is critically important for prioritizing investigations.

4.1.8 Technical considerations

The set-up and implementation costs associated with eCR (PHCP or localized) are significantly affected by the technical factors outlined below.

Health information exchange (HIE)

Health information exchanges offer existing secure data transfer infrastructure within a jurisdiction that allows for sharing of patient data between providers, and between providers and public health. While HIEs vary in terms of their capabilities and coverage of providers, they have the potential to significantly lower the cost of onboarding providers to eCR. If an HIE is broadly available across a jurisdiction and can act as an aggregator of eCR messaging, providers would not need to create a secure connection with APHL AIMS to send eCRs to RCKMS. Within a Localized eCR solution, the potential gains are more substantial as the burden of managing secure data connections falls entirely on the jurisdiction, rather than APHL AIMS.

Surveillance systems and integration engines

A jurisdiction's choice of disease surveillance system and integration system also has cost implications for eCR implementation. For example, two jurisdictions participating in the study use open-source software, which they can modify at will to integrate new features. Open source software requires more robust expertise on staff, but eliminates the licensing costs of an off-the-shelf surveillance system, and allows them to be more flexible and proactive in implementing new innovations, such as eCR.

Some types of paid surveillance systems are more prepared than others. One study participant indicated that a NEDSS-based system will require less modification than a MaVEN-based system in order to begin consuming eCR messages.

Deduplication is one capability that participants cited as an important feature of an integration engine. Given that eCR and ELR will be sending a substantial amount of overlapping data, the ability of the integration engine to intelligently deduplicate overlapping data points will be critical to not overwhelming investigators with the burden of manually reconciling duplicate data.

4.1.9 Impact of eCR on demand for informatics expertise

One category of cost that is not fully captured in the case management workflow but is central to the development and implementation of eCR informatics staff. As case reporting transitions to increasingly rely on electronic transmission and consumption of messages, skilled informaticians will be in high demand to manage trigger codes, integration engines, and other technical infrastructure. Additionally, it is likely that informatics staff will assist providers in their jurisdictions with the onboarding process.

Two participants in this study cited the shortage of qualified informaticians as a challenge for the coming years as public health continues to increase health information technology investments. Participants also discussed that the increased need for informatics expertise will result in cost increases for public health that will at least partially erode any savings gained from the implementation of eCR.

4.1.10 Impact of Forms Manager on the value of eCR

As noted previously in Section 2.2.5, the Forms Manager is a feature of PHCP eCR that will provide pre-populated web forms to providers for the purposes of collecting supplemental information once a case is determined to be reportable by RCKMS. Survey and interview participants from public health jurisdictions were asked to estimate the impact of eCR on their workflow assuming the presence of the Forms Manager feature of eCR.

When asked about the Forms Manager feature, all participants agreed that this would add value to PHCP eCR. However, the magnitude of contribution will vary depending on the complexity of the case. For very simple and common cases, the data contained in an eICR may be sufficient and an investigator may not need additional information from a provider. Some cases require additional information, but from the patient rather than the provider, such as cases where very detailed travel history or sexual partner history is required. Cases of moderate complexity that require information from the provider above and beyond an eICR will be where the Forms Manager adds substantial value by automating the data collection process.

Still, the Forms Manager will not be an exact replacement for a conversation with a provider's office or with a patient in complicated cases. Several participants noted that the level nuance and detail that can be gained from a skilled investigator asking the right questions in a conversation exceeds what will be feasible with a web form.

4.1.11 Comparison of PHCP eCR and Localized eCR

Three jurisdictions were interviewed in order to estimate the cost of implementing a localized eCR. When asked to compare PHCP eCR and Localized eCR, one interviewee said that it is safe to assume that a jurisdiction implementing localized eCR would still opt to use the trigger code sets and eICR message format that all MU Stage 3 compliant EHR vendors must support. In that scenario, the jurisdiction is left with developing their own decision support tool to replace RCKMS and managing their own data connections to providers.

While the need for decision support to mimic the functionality of PHCP eCR is clear, the implications of managing data connections is more nuanced. In states with a robust HIE, some of this infrastructure may already be in place. Without an HIE, the task of managing individual data connections to every provider in a given jurisdiction is substantial, particularly in larger jurisdictions where providers may number in the thousands. The secure messaging from AIMS thus provides a substantial value to jurisdictions participating in PHCP eCR.

One interviewee also noted that jurisdictions that choose to “go it alone” will likely forfeit some federal funding support for implementing PHCP eCR. The loss of funding will require the engagement of other funders, such as the state government, which may require the time of an executive of the jurisdiction, such as the Chief Medical Information Officer (CMIO).

4.1.12 Impact on other stakeholders

This scope of this study focused specifically on the impact of eCR on public health jurisdictions, but eCR is a multi-stakeholder effort, including national public health authorities, health care providers, and EHR vendors. Thus, one cannot fully be considered without examining the impact of eCR on the entire ecosystem.

Health care providers

Health care providers will benefit from eCR because the decision support tools will remove uncertainty about what should be reported. Additionally, the automation transmission of eCRs and supplemental information requests through the Forms Manager will save time.

While it is too early to make reliable estimates of time savings for providers, one jurisdiction conducted a pilot of a messaging service similar to eCR with a clinical partner. The pilot study found that their clinical partner would save 120 hours per year across nine small clinics by automating case reporting for chlamydia and gonorrhea alone.

Providers will face some costs as well. Time will be required to test and onboard with eCR, and it is not yet known whether EHR vendors will charge additional fees to support this feature. One interviewee from a large hospital system noted that the technical aspects of implementing eCR will be straightforward, but creating the documentation, providing support, and arranging the appropriate legal contracts will require more effort on the part of the provider.

Some behavior change will be required on the part of providers as well. Because eCR depends entirely on trigger codes embedded in EHRs, clinicians will need to ensure that diagnoses and symptoms are being recorded in patient records in such a way that can trigger an eCR. Interviews collected by Porter Novelli with providers indicated that this may be a challenge for providers, many of whom greatly prefer to notate patient interactions using unstructured prose rather than data fields and drop-down menus of preset values. A key capability to consider for future development in partnership with EHR vendors is text analysis of unstructured prose.

EHR vendors

Interviews with EHR vendors, collected both by RTI and Porter Novelli, indicate that standardization is the single most important component of eCR to EHR vendors. Encouraging the continued development of national standards in reportable condition case reporting represents significant value to EHR vendors that are trying to serve clients in jurisdictions across the country.

With respect to supporting eCR, specific estimates of level of effort were not available when interviews were conducted. However, participating EHR vendors indicated that, from a software development perspective, eCR is a fairly straightforward feature to implement. One interviewee divided the process into six steps: design, development, quality assurance, setup, support, and documentation.

According to one interviewee, the most significant concerns of EHR vendors with regard to eCR are regulatory burden and opportunity cost. The interviewee expressed that, with limited resources,

addressing the multiple regulatory mandates that are in place is challenging, requiring vendors to invest more in compliance and make tradeoffs with respect to other development goals.

4.3 Benefit-Cost Analysis

The benefit-cost analysis includes

- one-time costs associated with implementing electronic case reporting
- ongoing labor costs related to reportable condition case management
- ongoing costs associated with maintaining the technical infrastructure of electronic case reporting
- ongoing benefits associated with electronic case reporting, particularly greater labor efficiency

Results are presented over time frames of 5, 10, and 15 years of operation in constant 2016 dollars. Note that some costs that accrue in 2016 and 2017 are included to reflect the impact of one-time setup costs. See Appendix C for full time series data presented in constant 2016 dollars and net present value using discount rates of 3% and 7%.

4.3.1 Average cost of reportable condition case management

Data collected with our survey instrument (see Appendix A) forms the basis for estimating the ongoing labor costs associated with reportable condition case management.

Ongoing labor costs for both eCR scenarios (PHCP and local) are assumed to be the same. Labor costs include the staff that manage reportable condition cases day-to-day, such as clerical staff, data entry specialists, epidemiologists, public health nurses, surveillance investigators, and baseline informatics support.

Table 4-3. Average annual cost of reportable condition case management per jurisdiction (Constant 2016\$)

Task Category	Status Quo (\$ millions)	eCR (\$ millions)	Percent Change under eCR
Data management	\$0.84	\$0.8	-4.55%
Case Analysis and Follow-Up	\$1.18	\$1.13	-4.46%
Data Analysis	\$0.44	\$0.47	5.08%

Labor costs were quantified according to the three task categories: Data Management; Case Analysis and Follow-up; and Data Analysis. Under eCR, costs associated with Data Management and Case Analysis and Follow-up tasks decreased by approximately 4.5%, while Data Analysis showed an increase in costs of 5.1% (Table 4-3).³ Over a 15 year period, the average cost of case management per jurisdiction drops from \$45.5 million to \$40.7 million (Table 4-4).

³ These percent changes account for a 5% increase in reporting, which offsets some of the efficiency gains under eCR. Without an increase in reporting, Data Management and Case Analysis categories show a 9% drop in costs, and Data Analysis shows a small increase of less than 0.1%.

Table 4-4. Average reportable condition case management costs per jurisdiction (Constant 2016\$)

Year	Baseline (Status Quo)	eCR (PHCP or local)
5 year estimated cost (2018-2022)	\$15.2	\$13.6
10 year estimated cost (2018-2027)	\$30.3	\$27.1
15 year estimated cost (2018-2032)	\$45.5	\$40.7

4.3.2 Average development, onboarding, and ongoing maintenance costs for eCR

To evaluate the difference in costs between PHCP eCR and Localized eCR, we quantify the costs related to development of the service, onboarding of jurisdictions and providers, and ongoing maintenance of the service that accrue to public health jurisdictions in both scenarios. These costs are presented in Table 4-5.

In the **PHCP eCR** category, **Jurisdiction-specific Costs** cover costs that accrue at the local level.

Centralized Costs cover development, onboarding, and ongoing maintenance costs that initially accrue at the national level and are distributed to participating jurisdictions.

In the **Localized eCR** category, all of these costs are borne directly by the jurisdiction. Note that when presenting totals for 5, 10, and 15 year timeframes, we include any setup costs that took place before the first full year of production, which is expected to be 2018.

Over 15 years, we estimate that a jurisdiction participating in PHCP eCR will spend an average of \$1.2 million on development, onboarding, and ongoing maintenance. The bulk of this cost occurs early in the timeline because of the upfront investments required to adopt PHCP eCR. Localized jurisdiction costs are almost three times higher, totaling an estimated \$3.4 million over 15 years.

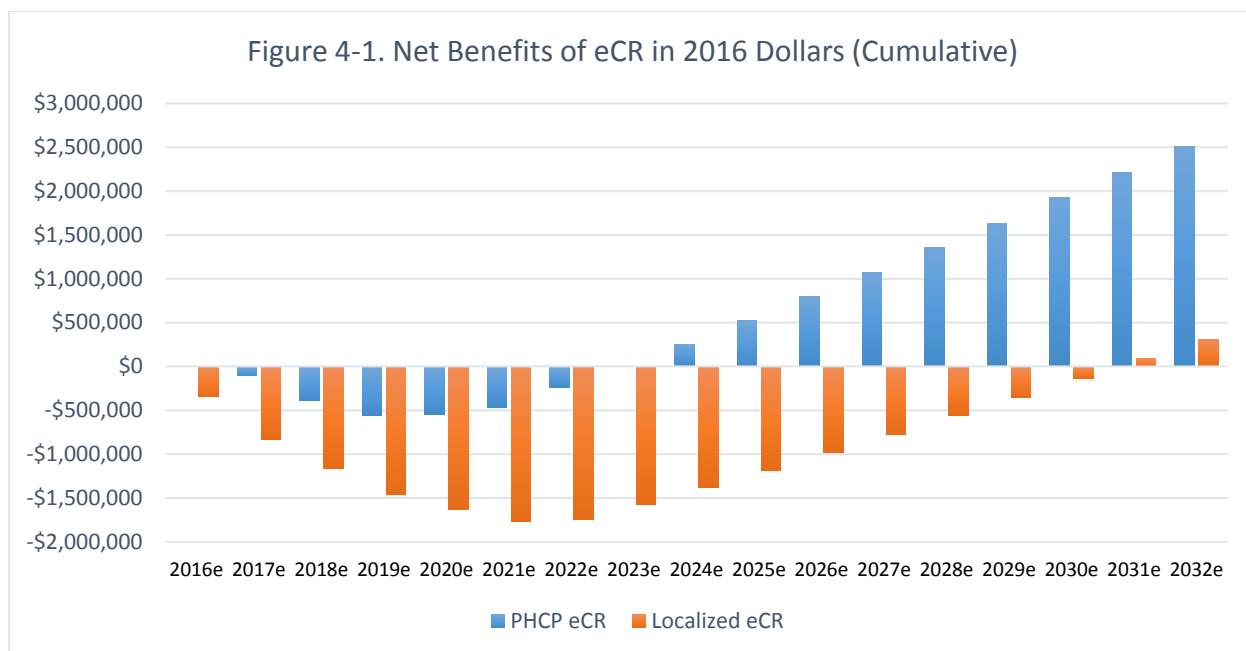
Table 4-5. Average Development, Onboarding, and Ongoing Maintenance Costs Per Jurisdiction (2016\$ millions)

Year	PHCP eCR			Localized eCR
	Jurisdiction-specific Costs	Centralized Costs	Total	
Setup + 5 yr. est. cost (2018-2022)	\$0.5	\$0.5	\$1.0	\$2.5
Setup + 10 yr. est. cost (2018-2027)	\$0.5	\$0.6	\$1.1	\$2.9
Setup + 15 yr. est. cost (2018-2032)	\$0.5	\$0.7	\$1.2	\$3.4

See Appendix B for a detailed breakdown of costs

4.3.3 Total Estimated Costs by Scenario and Net Benefits per Jurisdiction

Net benefits of PHCP eCR and Localized eCR are estimated by comparing the cost of each scenario to the Status Quo. We also estimate the net benefits of PHCP eCR relative to Localized eCR. These results, along with estimated total costs for each scenario, are presented in Table 4-6. When presenting net benefits over 5, 10, and 15 year timeframes, we include any setup costs that took place before the first full year of production, which is expected to be 2018. Figure 4-1 presents cumulative net benefits of both eCR scenarios relative to the Baseline in constant 2016 dollars.



Under PHCP eCR, we estimate cumulative net benefits are negative until 2024, when cumulative savings begin to outweigh the up-front costs associated with adoption of PHCP eCR. Under a Localized eCR, we estimate that cumulative net benefits will be negative until 2031 (Figure 4-1).

Over a 15 year period, we estimate net benefits of \$2.5 million for PHCP eCR and \$0.3 million for Localized eCR (Table 4-6). PHCP eCR will deliver 8 times more value over 15 years than Localized eCR, offering a much more efficient path to implementing eCR than a localized solution.

Table 4-6. Estimated Average Total Costs and Net Benefits per Jurisdiction (2016\$ millions)⁴

	Total Costs			Estimated Net Benefits		
	Baseline (Status Quo)	PHCP eCR	Localized eCR	PHCP eCR relative to Baseline	Localized eCR relative to Baseline	Localized eCR relative to PHCP eCR
Setup + 5 yr. est. NB (2018-2022)	\$15.2	\$14.5	\$15.2	-\$0.2	-\$1.7	-\$1.5
Setup + 10 yr. est. NB (2018-2027)	\$30.3	\$28.1	\$29.3	\$1.1	-\$0.8	-\$1.8
Setup + 15 yr. est. NB (2018-2032)	\$45.5	\$41.8	\$43.3	\$2.5	\$0.3	-\$2.2

4.3.4 Net Benefits in the Absence of Forms Manager

The qualitative results of the study concluded that the Forms Manager feature of PHCP eCR is central to achieving the full value proposition of PHCP eCR. To estimate the impact on net benefits in a scenario

⁴ Some assumptions, including impact of Forms Manager and Provider Adoption Rate, are applied when the calculations of net benefits occurs (i.e. after estimated total costs are calculated); thus net benefits values in this table will not equal the difference in total costs values in this table.

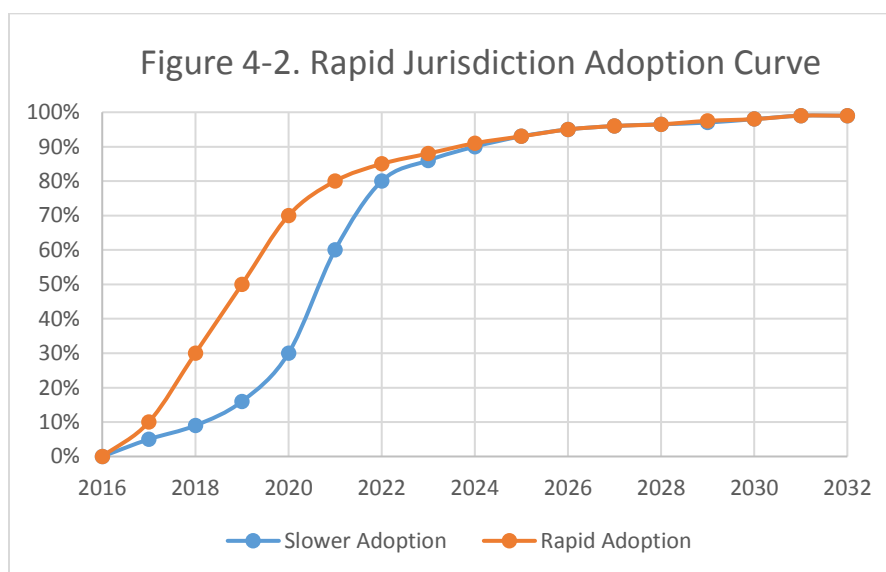
where the Forms Manager is never developed, we removed the assumption that Forms Manager will come online in 2020. In the absence of the Forms Manager, we estimate that net benefits over 15 years will drop by over 70% (Table 4-7).

Table 4-7. Comparing Net Benefits of PHCP eCR With and Without Forms Manager (2016\$ millions)

Year	Forms Manager Online in 2020	No Forms Manager
Setup + 5 yr. est. NB (2018-2022)	-\$0.3	-\$0.6
Setup + 10 yr. est. NB (2018-2027)	\$1.1	\$0.03
Setup + 15 yr. est. NB (2018-2032)	\$2.5	\$0.7

4.3 Net Benefits under alternative adoption and funding scenarios

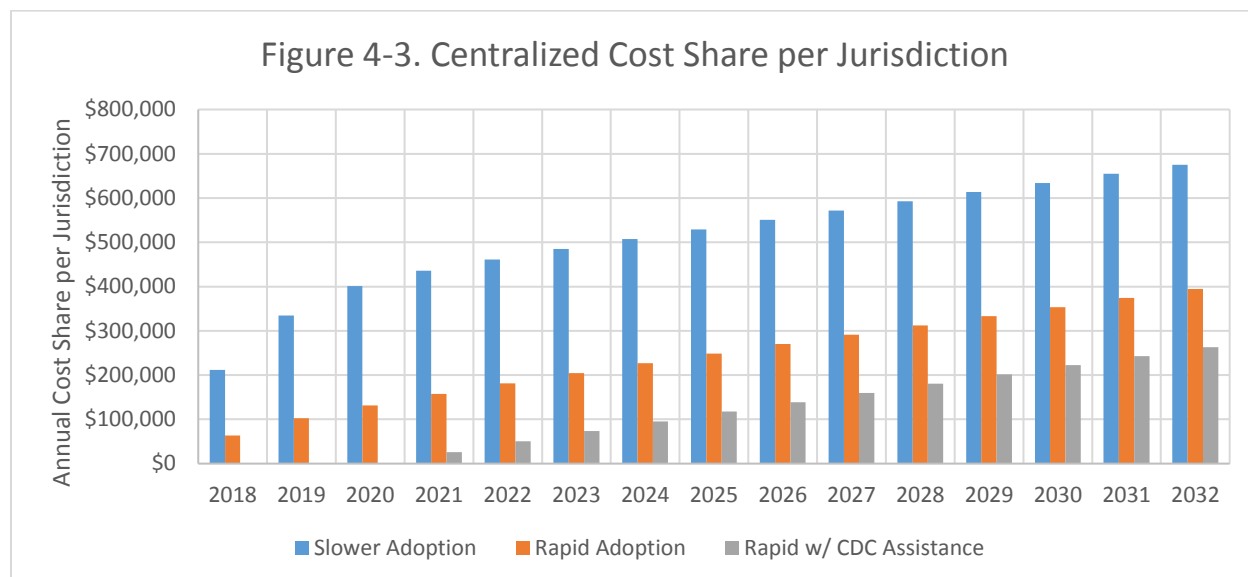
Figure 3-1 presents the Jurisdiction Adoption Curve, which impacts how many jurisdictions share the burden of supporting the centralized infrastructure of PHCP eCR. Under the current assumption, we assume that participating jurisdictions will shoulder the full cost of centralized infrastructure and we assume a conservative rate of adoption in the first years of production. In this scenario, a small number of early adopter jurisdictions would pay over \$212,000 in the first year and \$122,500 in the second year of production in order to support PHCP eCR.



This section illustrates two alternative scenarios and their impact on the net benefits accruing to public health jurisdictions. The first scenario is a more rapid rate of adoption, which is illustrated in Figure 4-2. The second scenario is one in which rapid adoption takes place, and the CDC opts to provide funding for the centralized infrastructure of PHCP eCR for three years.

Figure 4-3 presents the cumulative centralized costs per jurisdiction. Under the current assumption, early adopter jurisdictions will pay \$675,000 over 15 years to participate PHCP eCR. If adoption proceeds more rapidly, the cumulative contribution drops substantially to just under \$400,000. In a scenario where the CDC supports centralized infrastructure for 3 years after PHCP eCR enters production, jurisdiction contributions drop to \$263,000 over 15 years, and do not begin until 2021.

In these alternative scenarios, the bulk of the savings occur in the early years of PHCP eCR production, which could act to reduce a significant barrier to adoption of high upfront costs.



Net benefits increase following a decrease in Centralized Costs per jurisdiction. More rapid adoption modeled in the alternative scenario will increase net benefits of PHCP eCR from \$2.5 million to 2.78 million over 15 years, and CDC support would increase net benefits further to \$2.91 million. Importantly, the timing of the savings means that net benefits are no longer negative after 5 years (Table 4-8). By imposing fewer costs early in the timeline, jurisdictions may find the upfront investment more manageable.

Table 4-8. Net Benefits Under Alternative Adoption and Funding Scenarios (2016\$ millions)

Year	Slower Adoption (Original)	Rapid Adoption (Alternative)	Rapid Adoption + CDC Support
Setup + 5 yr. est. NB (2018-2022)	-\$0.25	\$0.03	\$0.17
Setup + 10 yr. est. NB (2018-2027)	\$1.07	\$1.35	\$1.48
Setup + 15 yr. est. NB (2018-2032)	\$2.50	\$2.78	\$2.91

4.4 Contextualizing quantitative results

In Section 3.6, we detail the structure of the economic model, including assumptions that are factored into our estimates. However, the prospective nature of this analysis, combined with the many variables that impact public health and public health jurisdictions, make it challenging to factor in all assumptions that may impact the costs and benefits of implementing eCR without data on each jurisdiction. This section details caveats that should be kept in mind when readers attempt to apply the results of this analysis to their specific situation.

4.4.1 Focus on Building Capacity

While this analysis presents a dollar valuation of the net benefits of implementing PHCP eCR, all study participants from public health jurisdictions agreed that the benefits of PHCP eCR will accrue in the form of increased capacity, rather than money in the coffers of the jurisdiction. The increased efficiencies

delivered by eCR will enable jurisdictions to redirect resources from low-value tasks, such as data entry, to high value tasks, such as data analysis and case investigation. The ability to do more with the same resources will create the value presented in Section 5.3.

4.4.2 Impact of HIE

As mentioned previously, HIEs have the potential to lower the cost of implementing PHCP eCR in a jurisdiction. This is difficult to include in model estimates because HIE capabilities vary widely and are not well documented.

4.4.3 Impact of ELR

ELR adoption rates vary from 5% to 100% across jurisdictions, making it difficult to model an average jurisdiction. We expect that high ELR adoption will make eCR cheaper to implement, and poor ELR adoption may prevent jurisdictions from obtaining funds to implement eCR.

4.4.4 Population, Demographics, and Climate

Over time, an increase in population served may cause an increase in costs of reportable condition case management. However, the extent of additional burden on public health is unclear and not uniform across the country. The populations served by some jurisdictions are growing while others are shrinking.

Similar to population, the disease burden of jurisdictions and what is considered reportable varies widely change is not uniform across jurisdictions. Over the long term, for example, climate change will trigger shifts in the ranges of disease vectors (e.g. mosquitoes).

4.4.5 Disparities in funding across jurisdictions

Per capita state and federal funding of public health varies widely across jurisdictions (see Appendix D). While substantial funding is available from CDC to pursue health IT projects, the long-term availability of this funding is uncertain and it cannot be assumed that other sources of funding (e.g. state budgets) will prioritize investments in health IT.

5 Conclusion

Our economic analysis of PHCP eCR relative to the status quo and Localized eCR leads us to conclude that PHCP eCR will be cost saving over 5, 10, and 15 year timeframes for the average public health jurisdiction. Furthermore, we are also able to conclude that PHCP eCR represents a less costly implementation of electronic case reporting than localized, jurisdiction-level solutions. The cost of developing and maintaining decision support capabilities in each jurisdiction results in much higher costs relative to sharing the cost of developing one centralized infrastructure. Over the course of 15 years, PHCP eCR delivers eight times more value in benefits than Localized eCR.

While this study was scoped to focus specifically on costs and benefits accruing to public health, health care providers will also derive benefits through decreased cost of reporting. Over the long term, the largest benefits will be to society. With more accurate, timely, and complete data on conditions of concern across the nation, public health authorities will have the ability to respond more quickly and strategically to outbreaks, inform the public of developing health risks in their area, and ultimately reduce the prevalence and economic cost of reportable conditions.

5.1 Summary results

Our analysis provides evidence to support the expectation of the public health community that developing and implementing PHCP eCR represents a net economic benefit of \$2.5 million over 15 years for the average public health jurisdictions (Table 5-1). Furthermore, PHCP eCR offers a much more efficient path to eCR than a localized eCR solution.

Table 5-1. Summary Results (2016\$ millions)

	Total Costs			Estimated Net Benefits		
	Baseline (Status Quo)	PHCP eCR	Localized eCR	PHCP eCR relative to Baseline	Localized eCR relative to Baseline	Localized eCR relative to PHCP eCR
Setup + 5 yr. est. NB (2018-2022)	\$15.2	\$14.5	\$15.2	-\$0.2	-\$1.7	-\$1.5
Setup + 10 yr. est. NB (2018-2027)	\$30.3	\$28.1	\$29.3	\$1.1	-\$0.8	-\$1.8
Setup + 15 yr. est. NB (2018-2032)	\$45.5	\$41.8	\$43.3	\$2.5	\$0.3	-\$2.2

Our analysis is significantly impacted by several assumptions:

- the availability of the Forms Manager feature;
- the rate of adoption among jurisdictions.
- and the assumption that the CDC will not continue to support the centralized costs of PHCP eCR and will not provide direct support to jurisdictions for implementation;

A delay in the rollout of the Forms Manager will reduce net benefits substantially; if the feature is never implemented, net benefits reduce from \$2.5 million to \$0.7 million over the 15 year timeframe (Table 4-7).

A more rapid rate of adoption would impact net benefits by distributing centralized costs amongst a greater number of participating jurisdictions earlier in the production stage of PHCP eCR. We estimate

an alternative, more rapid adoption curve (Figure 4-2) that would increase net benefits from \$2.5 million to \$2.78 million over 15 years. Adoption may be more rapid than our conservative estimate due to Meaningful Use deadlines or funding decisions made by CDC.

A decision from the CDC to support PHCP eCR in the early years of production would substantially reduce the up-front and ongoing costs to jurisdictions, which would encourage more rapid adoption. We estimate that CDC support plus an increased rate of adoption could increase average net benefits from \$2.5 million to \$2.9 million over 15 years (Figure 4-3 and Table 4-8). An additional funding scenario—one in which the CDC provides implementation funding directly to jurisdictions through grant funding similar to the Epidemiology and Laboratory Capacity (ELC) Cooperative Agreement program—is not modeled in this report, but would have a similar effect of lowering up-front costs to jurisdictions.

5.2 Remaining Questions

Given that PHCP eCR is still early in its development and testing phases, many questions remain that will impact the success of PHCP eCR, including

- *Who will pay for the centralized costs of developing and maintaining PHCP eCR?* We assume for this analysis that costs are distributed to participating jurisdictions, but some stakeholders have discussed engaging providers to help cover some costs as well.
- *Will the federal government support the centralized costs of PHCP eCR once it is in production?* Without any support from the federal government, we estimate that early adopters of PHCP eCR will pay around \$185,000 in 2018 to support the centralized costs of operation and maintenance. While this number drops quickly assuming relatively rapid adoption, such a high cost in the beginning may deter jurisdictions from participating.
- *When will the Forms Manager be implemented?* While the results of this study have shown that the Forms Manager is not critical for every case, it still delivers substantial benefits, and is necessary to realize the full value proposition of PHCP eCR.

5.3 Limitations

This analysis has some notable limitations. Our analysis

- relied on self-reported estimates of the impacts of eCR on labor costs, mostly collected from subject matter experts that are advocates of a national cloud-based eCR service, which could introduce some bias.
- relied on a small sample size to make average estimates that should be applied carefully and conservatively to specific jurisdictions.
- is prospective, and public health is a rapidly changing field that is shaped by emerging threats and challenges that are impossible to anticipate

In many respects, this is a preliminary analysis. As pilot testing progresses for PHCP eCR, more accurate data on the impact of eCR on case management workflows can be gathered in order to validate the estimates of this study and further refine the results.

These assumptions are notable and should be considered when communicating and framing our results. However, they are not so significant that we believe our conclusions are false or that our average results are suspect.

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Appendix A: Survey Instrument for Data Collection

Electronic Case Reporting (eCR) Cost-Benefit Analysis

Survey for Public Health Agencies

About this study

The Association for State and Territorial Health Officials (ASTHO) has contracted with RTI International to conduct an economic analysis of its cloud-based, shared electronic case reporting (eCR) service hosted on the Public Health Community Platform.

This survey is designed to gather information about the current workflows and processes involved in managing reportable condition case reports at your public health agency. Establishing a comprehensive baseline picture of the current state of practice helps us to make estimates of the ways in which electronic case reporting will impact the current state of practice in public health case management.

If you have any questions regarding this study, please contact:

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Economist
kcs@rti.org
(919) 541-5874

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Project Director and Economist
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(919) 541-8841

About ASTHO eCR

ASTHO's eCR service is designed to provide automated generation of initial reportable condition case reports using trigger codes embedded in health care providers' electronic health records (EHR). Automatically generated reports are prepopulated using data from the EHR and filtered through a cloud-based decision matrix to determine if the flagged condition is reportable. If a condition is determined to be reportable, the initial case report is forwarded to the appropriate public health jurisdiction and a notice of reportability is sent to the provider. Future versions of the service may also automate requests for supplemental information from the provider using standardized forms that are pre-populated with available data.

Participant Information

If more than one person participates in filling out this survey, please fill out all names and contact information. Or, you may opt to designate one person a point of contact.

Name	
Title	
Division	

Company/Organization	
Telephone	
Email	

About your public health agency (PHA)

1. Please describe your work at this PHA (e.g., background, role, tenure). If more than one person is participating in this survey, please give some background on each participant.

--

2. What is or has been your role in managing reportable condition case reports?

--

Reportable condition reporting workflow

This section is intended to help us build the “life story” of a reportable condition case report from beginning to end, including the volume of cases reported to your agency, what tasks must be performed with each case, who performs those tasks, and how long they take on average.

- The table below describes steps taken to process a reportable condition report based on one study of an entire state’s local health department workforce. Please use the table to help us construct a framework of the kinds of tasks that occupy your time in case management.

Category/Task	Frequency of task		
	This is a daily activity	This is a weekly activity	We rarely do this activity
Data management			
Create new electronic records for an incoming case report	☐	☐	☐
Identify a case in the electronic record	☐	☐	☐
Maintain/update electronic records	☐	☐	☐
Maintain paper records	☐	☐	☐
Harmonize paper records with electronic records	☐	☐	☐
Data cleaning	☐	☐	☐
Deduplication	☐	☐	☐
OTHER:	☐	☐	☐
Case analysis and follow-up (i.e. analyzing the circumstances and facts of an individual case)			
Assign a case to a staff member	☐	☐	☐
Assess case status	☐	☐	☐
Use the electronic record during patient contact & data collection	☐	☐	☐
On-the-fly analysis of disease or trend	☐	☐	☐
Review comments to determine potential causes of disease	☐	☐	☐
Fill our State Reporting Forms (local PHAs only)	☐	☐	☐
OTHER:	☐	☐	☐
Data Analysis (i.e. analyzing trends over multiple reports, not a single case)			
Create queries	☐	☐	☐
Re-use a pre-made query/report	☐	☐	☐
Edit a pre-made query/report	☐	☐	☐
Export data for analysis with a statistical program	☐	☐	☐
Create new data repositories for disease specific investigation	☐	☐	☐
OTHER:	☐	☐	☐

4. Which job titles are responsible for carrying out the tasks outlined in Question 3? Use the table below to break down how their time is spent across the different tasks.

Example: The example line below will be interpreted to mean that 2 epidemiologists spend 8 hours on data management, 16 hours on case analysis and follow-up, and 6 hours on data analysis each week, totaling 75% of their working time, or 60 hours of labor.

Job Title	# of FTEs in this position	What percentage of your staff's time is spent on each category of case management tasks?		
		Data management	Case Analysis and Follow-up	Data analysis
<i>Example: Epidemiologist</i>	<i>2.0</i>	<i>20%</i>	<i>40%</i>	<i>15%</i>

5. Do you have a summary of cases submitted by month and condition for the last 1-2 years that you would be willing to provide?

☐ Yes

☐ No

☐ Other _____

If you answered YES, please attach the relevant files (or links to publicly available files) to the same email you send to submit your survey. Thank you!

6. How are case reports submitted to your department?

Submission Method	Approximately what percent of reports are submitted using this method?	Approximately what percent of reports submitted using this method are handwritten?	Approximately what percent of reports using this method require manual entry into your case management database
Emailed form			
Electronic web entry form			
Faxed form			
Mailed form			
Other: _____			
Other: _____			

IT support of case management

7. Which job titles are involved in supporting case management staff or case management resources (e.g., server space, software) from an IT perspective? This may include staff from the IT department as well as other departments (case management, epidemiology, etc.)

Job Title	# of FTEs in this position	Approximately what percentage of their time is dedicated to supporting case management systems?

8. Estimate your annual budgeted non-labor costs for supporting case management systems. This may include hardware, cloud storage, or software-related costs.

--

Impact of electronic case reporting on your workflow

This section is intended to gauge your impression of how electronic case reporting might impact the workflow that you described in the first part of the survey. As a refresher, ASTHO's eCR service is designed to provide automated generation of initial reportable condition case reports using trigger codes embedded in health care providers' electronic health records (EHR). Automatically generated reports are prepopulated using data from the EHR and filtered through a cloud-based decision matrix to determine if the flagged condition is reportable. If a condition is determined to be reportable, the initial case report is forwarded to the appropriate public health jurisdiction and a notice of reportability is sent to the provider. Future versions of the service may also automate requests for supplemental information from the provider using standardized forms that are pre-populated with available data.

9. Is your public health agency currently working towards implementing an electronic case reporting service?
- ☐ Yes – we are working towards participating in ASTHO's eCR
 - ☐ Yes – we are developing our own localized electronic case reporting capabilities
 - ☐ No – but we are exploring our options for electronic case reporting
 - ☐ No – we have no current plans to implement electronic case reporting

10. If you answered YES to the previous question, would you be willing to participate in phone interview about your PHA's efforts to implement electronic case reporting?

☐ Yes

☐ No

11. Using the table below and the description of electronic case reporting above, please indicate what you expect the impact of electronic case reporting would be on your workflow.

Category/Task	Impact of electronic case reporting			
	eCR would make this step take longer	eCR would have no impact	eCR would save <u>some</u> time	eCR would save a <u>lot</u> of time
Data management				
Create new electronic records	☐	☐	☐	☐
Identify a case in the electronic record	☐	☐	☐	☐
Maintain/update electronic records	☐	☐	☐	☐
Maintain paper records	☐	☐	☐	☐
Harmonize paper records with electronic records	☐	☐	☐	☐
Data cleaning	☐	☐	☐	☐
Deduplication	☐	☐	☐	☐
OTHER:	☐	☐	☐	☐
Case analysis and follow-up (i.e. analyzing the circumstances and facts of an individual case)				
Assign a case to a staff member	☐	☐	☐	☐
Assess case status	☐	☐	☐	☐
Use the electronic record during patient contact & data collection	☐	☐	☐	☐
On-the-fly analysis of disease or trend	☐	☐	☐	☐
Review comments to determine potential causes of disease	☐	☐	☐	☐
Fill our State Reporting Forms (local PHAs only)	☐	☐	☐	☐
OTHER:	☐	☐	☐	☐
Data Analysis (i.e. analyzing trends over multiple reports, not a single case)				
Create queries	☐	☐	☐	☐
Re-use a pre-made query/report	☐	☐	☐	☐
Edit a pre-made query/report	☐	☐	☐	☐
Export data for analysis with a statistical program	☐	☐	☐	☐
Create new data repositories for disease specific investigation	☐	☐	☐	☐
OTHER:	☐	☐	☐	☐

12. Populate this table with the job titles you filled into the table in Question 4. Approximately how much will electronic case reporting impact your workflow for each job title and category of tasks?

Example: In question 5, we calculated that 2 epidemiologists devoted 8 hours a week each on data management tasks. Using the information below, we calculate that a 10% savings in data management workload will save 0.8 hours per epidemiologist per week.

Job Title	# of FTEs in this position	Approximately how would electronic case reporting impact each category of case management tasks?		
		Data management	Case Analysis and Follow-up	Data analysis
EXAMPLE: Epidemiologist	2.0	-10%	-20%	0%

Concluding questions

13. Do you have any additional comments you would like to share?

14. If we have follow-up questions, are you willing to be contacted for an email or phone interview follow-up?

- ☐ Yes – either email or phone
☐ Yes – by phone
☐ Yes – by email
☐ No

Survey continues next page (just one more question!) →

15. Do you have any contacts at other states or large municipal health agencies that you think would be willing to contribute to this study?

☐ Yes—and I would be willing to act as a connection to this person on behalf of ASTHO/RTI

Name	
Title	
Public Health Jurisdiction	
Telephone	
Email	

Note: *If you choose to share your colleague's contact information here, we will still follow up with you before initiating any contact. Thank you for using your network to assist in this important study.*

☐ No, I do not have any contacts I can share

YOU HAVE REACHED THE END OF THE SURVEY
Thank you for your valuable contribution to this study.

Please return your completed survey and any supporting data you are able to share as an email attachment to Kyle Clark-Sutton at kcs@rti.org.

Appendix B: Cost Estimates Breakdown

B.1. PHCP eCR – Jurisdiction Setup, Onboarding, and Ongoing Maintenance Costs

This average estimate was drawn from interviews of three subject matter experts, one of which is implementing eCR as a pilot participant. Tasks associated with these costs include

- establishing and validating the appropriate trigger codes for the jurisdiction
- testing the transmission of eICR from a pilot provider to the jurisdiction
- testing the ability of the jurisdiction’s integration engine to consume eICR messages
- assisting providers with the task of preparing to use PHCP eCR
- ongoing maintenance associated with keeping trigger codes updated
- eventually, building supplemental information request forms using Forms Manager

We make an assumption that, after an initial period of significant effort related to setup and onboarding, ongoing maintenance tasks can eventually be absorbed into the daily workflow costs once most or all providers in the jurisdiction are participating.

Estimates of how long this initial period should be ranged from 3.5 to 5 years. We divide these costs into 2 categories: **Technical Development** and **Onboarding Support & Maintenance**

B-1. Jurisdiction-specific Setup, Onboarding, and Ongoing Maintenance Cost Estimates

Job Role	FTE	% time of each FTE	Wage Rate (fully loaded)	Cost Category	Length	Total Cost
Developer	2	35%	\$121,656	Technical Development	6 months	~\$42,580
Informatician	3	35%	\$89,458	Technical Development	6 months	~\$40,256
Informatician	1.25	100%	\$89,458	Onboarding Support & Maintenance	4 years	~\$447,290
Total					5 years	~\$530,000

One contributor to this estimate said they would have a separate budget for marketing and communications. To arrive at an average of the estimates we collected, we assume that informaticians will be operating as informal communications professionals by managing the onboarding process, including informing, educating, and coordinating with providers. Given the prospective nature of this study, these numbers are necessarily broad estimates, lacking specificity and detail, and should be interpreted as such.

B.2. PHCP eCR – Centralized Costs

In order to estimate centralized costs associated with the ongoing maintenance of the eCR service on PHCP, we collected estimates of costs from ASTHO, APHL, and CSTE. Table B-2 represents the detailed description of costs that make up Centralized Costs. The **Per Jurisdiction** column estimates the cost share per jurisdiction participating in PHCP eCR. Per Jurisdiction estimated costs are estimated based on the Jurisdiction Adoption Curve (see Section 3.6.3)

Table B-2. Centralized Costs Breakdown

Year	Marketing and Comm.	Technical Development	Onboarding	Onboarding (variable costs)	RCKMS Development	Governance and Management	Support	Legal	Cloud services	TOTAL	Per Jurisdiction
2013	\$0	\$0	\$0	\$0	\$0	\$462,259	\$0	\$0	\$4,500	\$466,759	\$0
2014	\$0	\$154,000	\$0	\$0	\$327,400	\$712,259	\$0	\$0	\$4,500	\$1,198,159	\$0
2015	\$0	\$509,000	\$0	\$0	\$827,400	\$603,500	\$0	\$5,000	\$0	\$1,944,900	\$0
2016	\$40,000	\$175,000	\$50,000	\$0	\$1,627,400	\$828,500	\$0	\$5,000	\$0	\$2,725,900	\$0
2017	\$0	\$350,000	\$100,000	\$8,703	\$2,216,100	\$435,000	\$0	\$0	\$78,300	\$3,188,103	\$0
2018	\$45,150	\$160,965	\$100,000	\$6,962	\$156,000	\$175,450	\$314,782	\$10,000	\$118,300	\$1,087,609	\$212,009
2019	\$45,150	\$160,965	\$100,000	\$12,184	\$156,000	\$175,450	\$314,782	\$10,000	\$142,300	\$1,116,830	\$122,459
2020	\$45,150	\$160,965	\$100,000	\$24,367	\$156,000	\$175,450	\$314,782	\$10,000	\$148,300	\$1,135,014	\$66,375
2021	\$45,150	\$160,965	\$100,000	\$52,215	\$156,000	\$175,450	\$314,782	\$10,000	\$172,600	\$1,187,162	\$34,712
2022	\$45,150	\$160,965	\$100,000	\$34,810	\$156,000	\$175,450	\$314,782	\$10,000	\$178,600	\$1,175,757	\$25,784
2023	\$45,150	\$160,965	\$100,000	\$10,443	\$156,000	\$175,450	\$314,782	\$10,000	\$181,900	\$1,154,690	\$23,555
2024	\$45,150	\$160,965	\$100,000	\$6,962	\$156,000	\$175,450	\$314,782	\$10,000	\$184,900	\$1,154,209	\$22,499
2025	\$45,150	\$160,965	\$100,000	\$5,222	\$156,000	\$175,450	\$314,782	\$10,000	\$188,200	\$1,155,768	\$21,803
2026	\$45,150	\$160,965	\$100,000	\$3,481	\$156,000	\$175,450	\$314,782	\$10,000	\$191,200	\$1,157,028	\$21,367
2027	\$45,150	\$160,965	\$100,000	\$1,741	\$156,000	\$175,450	\$314,782	\$10,000	\$191,200	\$1,155,287	\$21,113
2028	\$45,150	\$160,965	\$100,000	\$870	\$156,000	\$175,450	\$314,782	\$10,000	\$191,200	\$1,154,417	\$20,987
2029	\$45,150	\$160,965	\$100,000	\$870	\$156,000	\$175,450	\$314,782	\$10,000	\$191,200	\$1,154,417	\$20,879
2030	\$45,150	\$160,965	\$100,000	\$1,741	\$156,000	\$175,450	\$314,782	\$10,000	\$191,200	\$1,155,287	\$20,682
2031	\$45,150	\$160,965	\$100,000	\$1,741	\$156,000	\$175,450	\$314,782	\$10,000	\$191,200	\$1,155,287	\$20,473
2032	\$45,150	\$160,965	\$100,000	\$0	\$156,000	\$175,450	\$314,782	\$10,000	\$191,200	\$1,153,547	\$20,442
Startup Costs (2013-2017)	\$40,000	\$1,188,000	\$150,000	\$8,703	\$4,998,300	\$3,041,517	\$0	\$10,000	\$87,300	\$9,523,820	\$0
5 year cost (2017-2021)	\$180,600	\$993,860	\$500,000	\$104,430	\$2,840,100	\$1,136,800	\$1,259,126	\$40,000	\$659,800	\$7,714,716	\$435,556
10 year cost (2017-2026)	\$406,350	\$1,798,685	\$1,000,000	\$165,348	\$3,620,100	\$2,014,050	\$2,833,034	\$90,000	\$1,584,600	\$13,512,167	\$550,565
15 year cost (2017-2031)	\$632,100	\$2,603,510	\$1,500,000	\$172,310	\$4,400,100	\$2,891,300	\$4,406,942	\$140,000	\$2,540,600	\$19,286,862	\$654,699

B.3. Localized eCR – Development, Onboarding, and Ongoing Maintenance Costs Breakdown

Based on input from subject matter estimates, we developed estimates of the level of effort required for an individual jurisdiction to develop their own eCR service. Cost estimates were divided into three stages: **Development**, **Onboarding**, and **Long-term Costs**. Table B-3 presents the staffing estimates; Table B-4 delineates the timing of the stages; and Table B-5 presents a time series of costs based on staffing estimates and the timing of stages.

Table B-3. Staff roles associated with Localized eCR Setup, Onboarding, and Ongoing Maintenance Costs

Staff Roles	Stage	# of FTEs	Salary	Annual Cost
Software Developer	Development	2	\$160,965	\$321,930
Informatician	Development	3	\$89,458	\$268,374
Sr. Epidemiologist	Development	0.5	\$121,587	\$60,794
Epidemiologist	Development	0.5	\$88,021	\$44,011
Chief Medical Information Officer	Development	0.01	\$227,008	\$2,270
Informatician	Onboarding	3	\$89,458	\$268,374
Epidemiologist	Long-term	0.25	\$88,021	\$22,005
Software Developer	Long-term	0.15	\$160,965	\$24,145
Informatician	Long-term	0.5	\$89,458	\$44,729

Table B-4. Stages of Localized eCR Development, Onboarding, and Ongoing Maintenance Costs

Stage	Timeframe
Development	mid-2016 to end of 2017
Onboarding	mid-2017 to mid-2022
Long-term	2018 onward

Table B-5. Time Series of Localized eCR Setup, Onboarding, and Ongoing Maintenance Costs

Year	Average Estimates
2015	\$0
2016	\$348,689
2017	\$482,876
2018	\$359,253
2019	\$359,253
2020	\$359,253
2021	\$359,253
2022	\$225,066
2023	\$90,879
2024	\$90,879
2025	\$90,879
2026	\$90,879
2027	\$90,879
2028	\$90,879
2029	\$90,879
2030	\$90,879
2031	\$90,879
2032	\$90,879

Appendix C: Time Series Results

C.1. Time Series Results in Constant 2016 Dollars

Introduce numbers here, noting that inflation is not included b/c we're using inflation-adjusted discount rates.

Table C-1. Time Series of average reportable condition case management labor costs per jurisdiction (Constant 2016\$)

Year	Baseline (Status Quo)	eCR (PHCP or local)
2018e	\$3,030,981	\$2,713,678
2019e	\$3,030,981	\$2,713,678
2020e	\$3,030,981	\$2,713,678
2021e	\$3,030,981	\$2,713,678
2022e	\$3,030,981	\$2,713,678
2023e	\$3,030,981	\$2,713,678
2024e	\$3,030,981	\$2,713,678
2025e	\$3,030,981	\$2,713,678
2026e	\$3,030,981	\$2,713,678
2027e	\$3,030,981	\$2,713,678
2028e	\$3,030,981	\$2,713,678
2029e	\$3,030,981	\$2,713,678
2030e	\$3,030,981	\$2,713,678
2031e	\$3,030,981	\$2,713,678
2032e	\$3,030,981	\$2,713,678
5 year estimated cost (2018-2022)	\$15,154,903	\$13,568,390
10 year estimated cost (2018-2027)	\$30,309,805	\$27,136,779
15 year estimated cost (2018-2032)	\$45,464,708	\$40,705,169

Table C-2. Average Development, Onboarding, and Ongoing Maintenance Costs Per Jurisdiction (Constant 2016\$)

Year	PHCP eCR			Localized eCR
	Jurisdiction-specific Costs	Centralized Costs	Total	
2016e	\$0	\$0	\$0	\$348,689
2017e	\$106,000	\$0	\$106,000	\$482,876
2018e	\$106,000	\$212,009	\$318,009	\$359,253
2019e	\$106,000	\$122,459	\$228,459	\$359,253
2020e	\$106,000	\$66,375	\$172,375	\$359,253
2021e	\$106,000	\$34,712	\$140,712	\$359,253
2022e	\$0	\$25,784	\$25,784	\$225,066
2023e	\$0	\$23,555	\$23,555	\$90,879
2024e	\$0	\$22,499	\$22,499	\$90,879
2025e	\$0	\$21,803	\$21,803	\$90,879
2026e	\$0	\$21,367	\$21,367	\$90,879
2027e	\$0	\$21,113	\$21,113	\$90,879
2028e	\$0	\$20,987	\$20,987	\$90,879
2029e	\$0	\$20,879	\$20,879	\$90,879
2030e	\$0	\$20,682	\$20,682	\$90,879
2031e	\$0	\$20,473	\$20,473	\$90,879
2032e	\$0	\$20,442	\$20,442	\$90,879

Setup + 5 yr. est. cost (2018-2022)	\$530,000	\$461,340	\$991,340	\$2,493,643
Setup + 10 yr. est. cost (2018-2027)	\$530,000	\$571,678	\$1,101,678	\$2,948,038
Setup + 15 yr. est. cost (2018-2032)	\$530,000	\$675,141	\$1,205,141	\$3,402,433

Table C-3. Estimated Average Total Costs and Net Benefits per Jurisdiction (Constant 2016\$)⁵

	Total Costs			Estimated Net Benefits		
	Baseline (Status Quo)	PHCP eCR	Localized eCR	PHCP eCR relative to Baseline	Localized eCR relative to Baseline	Localized eCR relative to PHCP eCR
2016e	\$0	\$0	\$348,689	\$0	-\$348,689	-\$348,689
2017e	\$0	\$106,000	\$482,876	-\$106,000	-\$482,876	-\$376,876
2018e	\$3,030,981	\$3,031,687	\$3,072,931	-\$286,914	-\$328,157	-\$41,244
2019e	\$3,030,981	\$2,942,137	\$3,072,931	-\$166,268	-\$297,062	-\$130,794
2020e	\$3,030,981	\$2,886,053	\$3,072,931	\$14,199	-\$172,679	-\$186,878
2021e	\$3,030,981	\$2,854,390	\$3,072,931	\$76,957	-\$141,583	-\$218,541
2022e	\$3,030,981	\$2,739,462	\$2,938,744	\$222,981	\$23,699	-\$199,282
2023e	\$3,030,981	\$2,737,233	\$2,804,557	\$240,758	\$173,434	-\$67,324
2024e	\$3,030,981	\$2,736,177	\$2,804,557	\$257,362	\$188,982	-\$68,380
2025e	\$3,030,981	\$2,735,481	\$2,804,557	\$265,832	\$196,756	-\$69,076
2026e	\$3,030,981	\$2,735,045	\$2,804,557	\$274,042	\$204,530	-\$69,512
2027e	\$3,030,981	\$2,734,791	\$2,804,557	\$277,406	\$207,639	-\$69,766
2028e	\$3,030,981	\$2,734,665	\$2,804,557	\$280,640	\$210,749	-\$69,892
2029e	\$3,030,981	\$2,734,557	\$2,804,557	\$283,858	\$213,858	-\$70,000
2030e	\$3,030,981	\$2,734,360	\$2,804,557	\$287,165	\$216,968	-\$70,197
2031e	\$3,030,981	\$2,734,151	\$2,804,557	\$290,484	\$220,078	-\$70,406
2032e	\$3,030,981	\$2,734,120	\$2,804,557	\$290,514	\$220,078	-\$70,437
Setup + 5 yr. est. NB (2018-2022)	\$15,154,903	\$14,453,730	\$15,230,468	-\$245,045	-\$1,747,347	-\$1,502,303
Setup + 10 yr. est. NB (2018-2027)	\$30,309,805	\$28,132,457	\$29,253,252	\$1,070,354	-\$776,007	-\$1,846,360
Setup + 15 yr. est. NB (2018-2032)	\$45,464,708	\$41,804,310	\$43,276,037	\$2,503,015	\$305,724	-\$2,197,292

⁵ Some assumptions, including impact of Forms Manager and Provider Adoption Rate, are applied when the calculations of net benefits occurs (i.e. after estimated total costs are calculated); thus net benefits values in this table will not equal the difference in total costs values in this table.

C.2. Time Series Results in Net Present Value and Discount Rate of 3%

Table C-4. Time Series of average reportable condition case management labor costs per jurisdiction (NPV, Discount Rate = 3%)

Year	Baseline (Status Quo)	eCR (PHCP or local)
2018e	\$2,856,990	\$2,557,902
2019e	\$2,773,777	\$2,483,400
2020e	\$2,692,987	\$2,411,068
2021e	\$2,614,550	\$2,340,842
2022e	\$2,538,398	\$2,272,663
2023e	\$2,464,465	\$2,206,468
2024e	\$2,392,684	\$2,142,202
2025e	\$2,322,994	\$2,079,808
2026e	\$2,255,334	\$2,019,231
2027e	\$2,189,645	\$1,960,419
2028e	\$2,125,869	\$1,903,319
2029e	\$2,063,950	\$1,847,883
2030e	\$2,003,835	\$1,794,061
2031e	\$1,945,471	\$1,741,807
2032e	\$1,888,807	\$1,691,074
5 year estimated cost (2018-2022)	\$13,476,702	\$12,065,874
10 year estimated cost (2018-2027)	\$25,101,824	\$22,474,003
15 year estimated cost (2018-2032)	\$35,129,756	\$31,452,146

Table C-5. Average Development, Onboarding, and Ongoing Maintenance Costs Per Jurisdiction (NPV, Discount Rate = 3%)

Year	PHCP eCR			Localized eCR
	Jurisdiction-specific Costs	Centralized Costs	Total	
2016e	\$0	\$0	\$0	\$348,689
2017e	\$102,913	\$0	\$102,913	\$468,812
2018e	\$99,915	\$199,839	\$299,754	\$338,630
2019e	\$97,005	\$112,068	\$209,073	\$328,767
2020e	\$94,180	\$58,973	\$153,153	\$319,192
2021e	\$91,437	\$29,943	\$121,380	\$309,895
2022e	\$0	\$21,594	\$21,594	\$188,489
2023e	\$0	\$19,153	\$19,153	\$73,893
2024e	\$0	\$17,761	\$17,761	\$71,741
2025e	\$0	\$16,710	\$16,710	\$69,651
2026e	\$0	\$15,899	\$15,899	\$67,623
2027e	\$0	\$15,252	\$15,252	\$65,653
2028e	\$0	\$14,720	\$14,720	\$63,741
2029e	\$0	\$14,218	\$14,218	\$61,884
2030e	\$0	\$13,673	\$13,673	\$60,082
2031e	\$0	\$13,141	\$13,141	\$58,332
2032e	\$0	\$12,739	\$12,739	\$56,633
Setup + 5 yr. est. cost (2018-2022)	\$485,449	\$422,417	\$907,866	\$2,302,474
Setup + 10 yr. est. cost (2018-2027)	\$485,449	\$507,193	\$992,642	\$2,651,034
Setup + 15 yr. est. cost (2018-2032)	\$485,449	\$575,683	\$1,061,132	\$2,951,706

Table C-6. Estimated Average Total Costs and Net Benefits per Jurisdiction (NPV, Discount Rate = 3%)

	Total Costs			Estimated Net Benefits		
	Baseline (Status Quo)	PHCP eCR	Localized eCR	PHCP eCR relative to Baseline	Localized eCR relative to Baseline	Localized eCR relative to PHCP eCR
2016e	\$0	\$0	\$348,689	\$0	-\$348,689	-\$348,689
2017e	\$0	\$102,913	\$468,812	-\$102,913	-\$468,812	-\$365,899
2018e	\$2,856,990	\$2,857,656	\$2,896,532	-\$270,444	-\$309,320	-\$38,876
2019e	\$2,773,777	\$2,692,472	\$2,812,167	-\$152,159	-\$271,854	-\$119,695
2020e	\$2,692,987	\$2,564,221	\$2,730,259	\$12,616	-\$153,423	-\$166,039
2021e	\$2,614,550	\$2,462,222	\$2,650,737	\$66,384	-\$122,131	-\$188,515
2022e	\$2,538,398	\$2,294,256	\$2,461,152	\$186,743	\$19,848	-\$166,895
2023e	\$2,464,465	\$2,225,621	\$2,280,361	\$195,758	\$141,018	-\$54,740
2024e	\$2,392,684	\$2,159,963	\$2,213,943	\$203,164	\$149,184	-\$53,980
2025e	\$2,322,994	\$2,096,518	\$2,149,459	\$203,738	\$150,797	-\$52,941
2026e	\$2,255,334	\$2,035,130	\$2,086,854	\$203,913	\$152,189	-\$51,723
2027e	\$2,189,645	\$1,975,671	\$2,026,072	\$200,404	\$150,003	-\$50,401
2028e	\$2,125,869	\$1,918,039	\$1,967,060	\$196,835	\$147,815	-\$49,020
2029e	\$2,063,950	\$1,862,100	\$1,909,767	\$193,294	\$145,627	-\$47,666
2030e	\$2,003,835	\$1,807,734	\$1,854,143	\$189,850	\$143,441	-\$46,409
2031e	\$1,945,471	\$1,754,947	\$1,800,138	\$186,450	\$141,259	-\$45,191
2032e	\$1,888,807	\$1,703,813	\$1,747,707	\$181,039	\$137,145	-\$43,894
Setup + 5 yr. est. NB (2018-2022)	\$13,476,702	\$12,870,828	\$13,550,847	-\$259,773	-\$1,654,381	-\$1,394,608
Setup + 10 yr. est. NB (2018-2027)	\$25,101,824	\$23,363,732	\$24,307,537	\$747,203	-\$911,189	-\$1,658,393
Setup + 15 yr. est. NB (2018-2032)	\$35,129,756	\$32,410,366	\$33,586,351	\$1,694,672	-\$195,901	-\$1,890,573

C.3. Time Series Results in Net Present Value and Discount Rate of 7%

Table C-7. Time Series of average reportable condition case management labor costs per jurisdiction (NPV, Discount Rate = 7%)

Year	Baseline (Status Quo)	eCR (PHCP or local)
2018e	\$2,647,376	\$2,370,231
2019e	\$2,474,183	\$2,215,170
2020e	\$2,312,321	\$2,070,252
2021e	\$2,161,047	\$1,934,815
2022e	\$2,019,670	\$1,808,238
2023e	\$1,887,542	\$1,689,942
2024e	\$1,764,058	\$1,579,385
2025e	\$1,648,653	\$1,476,061
2026e	\$1,540,797	\$1,379,496
2027e	\$1,439,997	\$1,289,249
2028e	\$1,345,792	\$1,204,905
2029e	\$1,257,749	\$1,126,080
2030e	\$1,175,466	\$1,052,411
2031e	\$1,098,567	\$983,562
2032e	\$1,026,698	\$919,217
5 year estimated cost (2018-2022)	\$11,614,597	\$10,398,706
10 year estimated cost (2018-2027)	\$19,895,644	\$17,812,839
15 year estimated cost (2018-2032)	\$25,799,916	\$23,099,014

Table C-8. Average Development, Onboarding, and Ongoing Maintenance Costs Per Jurisdiction (NPV, Discount Rate = 7%)

Year	PHCP eCR			Localized eCR
	Jurisdiction-specific Costs	Centralized Costs	Total	
2016e	\$ --	\$ --	\$ --	\$348,689
2017e	\$99,065	\$ --	\$99,065	\$451,286
2018e	\$92,585	\$185,177	\$277,762	\$313,785
2019e	\$86,528	\$99,963	\$186,491	\$293,257
2020e	\$80,867	\$50,637	\$131,504	\$274,072
2021e	\$75,577	\$24,749	\$100,326	\$256,142
2022e	\$ --	\$17,181	\$17,181	\$149,971
2023e	\$ --	\$14,669	\$14,669	\$56,595
2024e	\$ --	\$13,095	\$13,095	\$52,892
2025e	\$ --	\$11,859	\$11,859	\$49,432
2026e	\$ --	\$10,862	\$10,862	\$46,198
2027e	\$ --	\$10,030	\$10,030	\$43,176
2028e	\$ --	\$9,319	\$9,319	\$40,351
2029e	\$ --	\$8,664	\$8,664	\$37,712
2030e	\$ --	\$8,021	\$8,021	\$35,244
2031e	\$ --	\$7,420	\$7,420	\$32,939
2032e	\$ --	\$6,924	\$6,924	\$30,784
Setup + 5 yr. est. cost (2018-2022)	\$434,621	\$377,708	\$812,329	\$2,087,204
Setup + 10 yr. est. cost (2018-2027)	\$434,621	\$438,224	\$872,845	\$2,335,497
Setup + 15 yr. est. cost (2018-2032)	\$434,621	\$478,572	\$913,193	\$2,512,527

Table C-9. Estimated Average Total Costs and Net Benefits per Jurisdiction (NPV, Discount Rate = 7%)

	Total Costs			Estimated Net Benefits		
	Baseline (Status Quo)	PHCP eCR	Localized eCR	PHCP eCR relative to Baseline	Localized eCR relative to Baseline	Localized eCR relative to PHCP eCR
2016e	\$0	\$0	\$348,689	\$0	-\$348,689	-\$348,689
2017e	\$0	\$99,065	\$451,286	-\$99,065	-\$451,286	-\$352,221
2018e	\$2,647,376	\$2,647,993	\$2,684,017	-\$250,602	-\$286,625	-\$36,024
2019e	\$2,474,183	\$2,401,660	\$2,508,427	-\$135,724	-\$242,491	-\$106,767
2020e	\$2,312,321	\$2,201,756	\$2,344,324	\$10,832	-\$131,736	-\$142,568
2021e	\$2,161,047	\$2,035,141	\$2,190,957	\$54,869	-\$100,947	-\$155,816
2022e	\$2,019,670	\$1,825,419	\$1,958,209	\$148,582	\$15,792	-\$132,790
2023e	\$1,887,542	\$1,704,611	\$1,746,537	\$149,932	\$108,006	-\$41,926
2024e	\$1,764,058	\$1,592,480	\$1,632,278	\$149,787	\$109,989	-\$39,798
2025e	\$1,648,653	\$1,487,920	\$1,525,493	\$144,595	\$107,022	-\$37,573
2026e	\$1,540,797	\$1,390,358	\$1,425,695	\$139,309	\$103,973	-\$35,336
2027e	\$1,439,997	\$1,299,279	\$1,332,425	\$131,793	\$98,648	-\$33,145
2028e	\$1,345,792	\$1,214,224	\$1,245,257	\$124,608	\$93,575	-\$31,033
2029e	\$1,257,749	\$1,134,744	\$1,163,791	\$117,791	\$88,744	-\$29,047
2030e	\$1,175,466	\$1,060,432	\$1,087,656	\$111,368	\$84,144	-\$27,224
2031e	\$1,098,567	\$990,982	\$1,016,500	\$105,285	\$79,766	-\$25,518
2032e	\$1,026,698	\$926,141	\$950,000	\$98,407	\$74,548	-\$23,859
Setup + 5 yr. est. NB (2018-2022)	\$11,614,597	\$11,111,970	\$11,685,935	-\$271,108	-\$1,545,982	-\$1,274,875
Setup + 10 yr. est. NB (2018-2027)	\$19,895,644	\$18,586,619	\$19,348,362	\$444,308	-\$1,018,345	-\$1,462,653
Setup + 15 yr. est. NB (2018-2032)	\$25,799,916	\$23,913,142	\$24,811,566	\$1,001,766	-\$597,568	-\$1,599,334

Appendix D: Jurisdiction-Level Data

Table D-2 presents a list of potential adopters of eCR, including the 50 U.S. states, the District of Columbia, Puerto Rico, and 5 large local public health jurisdictions. This list is limited to the jurisdictions that report ELR data to the CDC, but other large city or county public health departments may also be attractive targets for adoption.

In order to understand what characterizes and distinguishes public health jurisdictions, we collected a variety of data on each jurisdiction. Table D-1 describes each variable and its source.

Table D-1. Sources of Jurisdiction-level Data

Variable	Description	Source
Population	Population	U.S. Census Bureau, 2014 Population Estimates
MMWR	Volume of confirmed cases in 2013 of national notifiable conditions as reported in the CDC Morbidity and Mortality Weekly Report	CDC Morbidity and Mortality Weekly Report, 2014
HIE Score	A simple score developed based on the availability of directed and query-based exchanges in a given jurisdiction.	HealthIT.gov Program Measures Dashboard: State HIE Implementation Status
ELR Penetration	The percentage of laboratory reports that are submitted to state public health using electronic laboratory reporting	Centers for Disease Control ELC Cooperative Agreement Program
CDC spending per capita	Spending per capita allocated to the state jurisdiction from the CDC	Trust for America's Health <i>Investing in America's Health 2016</i>
State spending per capita	Spending per capita allocated to the state jurisdiction from the state budget	Trust for America's Health <i>Investing in America's Health 2016</i>
ASTHO governance classification	ASTHO characterizes each state public health jurisdiction based on the distribution of authority and funding sources between the state and local levels.	<i>ASTHO Profile of State Public Health, Volume 3</i>

Table D-2. Jurisdiction-level Data

State/Territory	Population	MMWR	HIE Score	ELR Penetration	CDC spending	State spending	ASTHO Governance Classification
Alabama	4,858,979	42,520	4	91%	\$21.81	\$59.20	Largely Centralized
Alaska	738,432	7,798	4	76%	\$53.06	\$126.50	Mixed
Arizona	6,828,065	50,047	4	62%	\$20.66	\$9.00	Decentralized
Arkansas	2,978,204	24,149	4	88%	\$26.20	\$49.00	Centralized
California	39,144,818	241,743	2	60%	\$19.39	\$56.20	Decentralized
Chicago, IL	469,428	--	--	96%	--	--	--
Colorado	5,456,574	28,589	4	76%	\$21.02	\$48.70	Decentralized

Connecticut	3,590,886	21,390	2	72%	\$21.43	\$31.00	Decentralized
Delaware	945,934	7,852	4	75%	\$34.87	\$44.30	Centralized
District of Columbia	658,893	10,458	4	68%	\$159.51	\$139.60	Centralized
Florida	20,271,272	126,570	4	61%	\$18.38	\$20.20	Shared
Georgia	10,214,860	77,968	4	94%	\$25.93	\$19.00	Shared
Hawaii	1,431,603	8,452	4	89%	\$26.98	\$158.30	Centralized
Idaho	1,654,930	6,701	2	95%	\$24.81	\$94.70	Decentralized
Illinois	12,859,995	91,653	2	84%	\$20.27	\$25.30	Decentralized
Indiana	6,619,680	40,355	4	91%	\$15.99	\$12.40	Decentralized
Iowa	3,123,899	16,634	4	87%	\$21.82	\$38.90	Decentralized
Kansas	2,911,641	15,787	4	83%	\$19.86	\$12.40	Decentralized
Kentucky	4,425,092	24,651	2	37%	\$20.46	\$33.50	Shared
Los Angeles, CA	1,258,000	--	--	60%	--	--	--
Louisiana	4,670,724	44,712	4	96%	\$26.46	\$19.90	Largely Centralized
Maine	1,329,328	6,467	2.5	72%	\$27.70	\$21.70	Mixed
Maryland	6,006,401	40,209	4	89%	\$32.18	\$39.80	Largely Shared
Massachusetts	6,794,422	39,103	3	95%	\$22.30	\$49.80	Decentralized
Michigan	9,922,576	63,474	3	95%	\$18.48	\$24.20	Decentralized
Minnesota	5,489,594	31,622	4	42%	\$21.40	\$14.60	Decentralized
Mississippi	2,992,333	25,283	4	17%	\$25.76	\$12.00	Centralized
Missouri	6,083,672	40,261	4	23%	\$17.33	\$5.90	Decentralized
Montana	1,032,949	5,451	4	64%	\$33.39	\$22.20	Decentralized
Nebraska	1,896,190	10,634	4	95%	\$27.71	\$43.30	Decentralized
Nevada	2,890,845	17,041	2	87%	\$22.11	\$4.10	Largely Decentralized
New Hampshire	1,330,608	6,094	2	45%	\$27.04	\$15.80	Largely Centralized
New Jersey	8,958,013	46,303	1	95%	\$16.65	\$26.90	Decentralized
New Mexico	2,085,109	16,500	2.5	82%	\$31.75	\$47.60	Centralized
New York	19,795,791	144,195	3	100%	\$25.40	\$94.90	Decentralized
New York City	1,579,000	85,918	4	99%			
North Carolina	10,042,802	70,295	4	71%	\$18.81	\$14.30	Decentralized
North Dakota	756,927	4,244	3	73%	\$29.13	\$97.80	Decentralized
Ohio	11,613,423	80,280	2	77%	\$16.68	\$13.80	Decentralized
Oklahoma	3,911,338	27,097	4	68%	\$22.79	\$39.30	Mixed
Oregon	4,028,977	19,101	2	87%	\$22.43	\$26.60	Decentralized
Pennsylvania	12,802,503	81,283	3	76%	\$16.76	\$14.40	Mixed
Philadelphia, PA	1,912,000	--	0	74%	--	--	--
Puerto Rico	3,474,182	18,844	4	5%			
Rhode Island	1,056,298	6,867	4	10%	\$39.22	\$53.20	Centralized

South Carolina	4,896,146	37,415	4	88%	\$22.45	\$20.80	Centralized
South Dakota	858,469	6,016	4	74%	\$33.29	\$35.60	Largely Centralized
Tennessee	6,600,299	44,584	3	65%	\$20.01	\$45.60	Mixed
Texas	27,469,114	195,665	3	79%	\$19.94	\$28.00	Largely Decentralized
Utah	2,995,919	11,598	4	65%	\$23.67	\$31.60	Decentralized
Vermont	626,042	3,599	3	34%	\$40.47	\$45.00	Centralized
Virginia	8,382,993	48,126	4	89%	\$16.93	\$36.50	Largely Centralized
Washington	7,170,351	33,923	3	9%	\$20.17	\$38.20	Decentralized
West Virginia	1,844,128	7,709	4	59%	\$24.87	\$220.80	Decentralized
Wisconsin	5,771,337	36,194	4	82%	\$16.40	\$15.10	Decentralized
Wyoming	586,107	2,582	4	74%	\$31.91	\$56.60	Mixed