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Research and Applications

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An economic evaluation of the expansion of electronic case reporting in an academic healthcare setting

Joel Hartsell, PhD, MPH[1,2,*], Fernando A. Wilson, PhD[1,3,4], Kimberley Shoaf, DrPH[5], Angela Dunn, MD[6], Matthew H. Samore, MD[7,8], Catherine Janes Staes, PhD, MPH[9,10]

[1]Department of Population Health Sciences, University of Utah, Salt Lake City, UT 84112, United States, [2]Department of Public Health Informatics, Epi-Vant, Salt Lake City, UT 84092, United States, [3]Department of Economics, University of Utah, Salt Lake City, UT 84112, United States, [4]Matheson Center for Health Care Studies, University of Utah Health, Salt Lake City, UT 84112, United States, [5]Division of Public Health, University of Utah, Salt Lake City, UT 84112, United States, [6]Salt Lake County Health Department, Salt Lake City, UT 84112, United States, [7]Department of Internal Medicine, University of Utah, Salt Lake City, UT, United States, [8]Veteran Affairs, Salt Lake City, UT, United States, [9]College of Nursing, University of Utah, Salt Lake City, UT 84112, United States, [10]Department of Biomedical Informatics, Spencer Fox Eccles School of Medicine, University of Utah, Salt Lake City, UT 84108, United States

*Corresponding author: Joel Hartsell, MPH, Department of Population Health Sciences, University of Utah, 201 Presidents' Cir, Salt Lake City, UT 84112 (joelhartsell@epi-vant.com)

Abstract

Objectives: Determine the economic cost or benefit of expanding electronic case reporting (eCR) for 29 reportable conditions beyond the initial eCR implementation for COVID-19 at an academic health center.

Materials and methods: The return on investment (ROI) framework was used to quantify the economic impact of the expansion of eCR from the perspective of an academic health system over a 5-year time horizon. Sensitivity analyses were performed to assess key factors such as personnel cost, inflation, and number of expanded conditions.

Results: The total implementation costs for the implementation year were estimated to be $5031.46. The 5-year ROI for the expansion of eCR for the 29 conditions is expected to be 142% (net present value of savings: $7166). Based on the annual ROI, estimates suggest that the savings from the expansion of eCR will cover implementation costs in approximately 4.8 years. All sensitivity analyses yielded a strong ROI for the expansion of eCR.

Discussion and conclusion: Our findings suggest a strong ROI for the expansion of eCR at UHealth, with the most significant cost savings observed implementing eCR for all reportable conditions. An early effort to ensure data quality is recommended to expedite the transition from parallel reporting to production to improve the ROI for healthcare organizations. This study demonstrates a positive ROI for the expansion of eCR to additional reportable conditions beyond COVID-19 in an academic health setting, such as UHealth. While this evaluation focuses on the 5-year time horizon, the potential benefit could extend further.

Lay Summary

This study aimed to assess the economic impact of expanding electronic case reporting (eCR) for 29 reportable conditions beyond the initial eCR implementation for COVID-19 at an academic health center. The costs and benefits were calculated over a 5-year period using the return on investment (ROI) framework. The total implementation costs were estimated to be $5031.46, with the 5-year ROI for the eCR expansion estimated to be 142% (net present value of savings: $7166). The findings indicate a strong ROI for the expansion of eCR, with potential savings covering implementation costs in approximately 4.8 years. The study recommends early efforts to implement eCR for all reportable conditions while ensuring data quality could yield the most significant cost savings for the respective healthcare organizations.

Key words: healthcare economics; electronic case reporting; public health surveillance; health information technologies.

Background

Healthcare organizations (HCOs) often face competing financial pressures to ensure quality care while reducing costs.[1,2] This can be a challenge when considering the range of policies and unfunded requirements imposed on HCOs, such as public health reporting of selected conditions for public health surveillance. Many HCOs still depend on legacy reporting processes to fulfill this mandate. This legacy process for public health reporting may involve abstracting relevant information from patient records, completing case report forms, and manually sending the case reports to public health.[3,4] Due to a range of infrastructure at HCOs, this may also take the form of sharing clinical encounter information with public health agencies (PHAs) through a portal to enable personnel to abstract relevant information. Despite the variability between HCO infrastructure and processes, it often requires significant resources to fulfill the reporting mandate, particularly for high-incidence conditions that require more frequent reporting, such as chlamydia or COVID-19.

Electronic health records (EHRs) capture data associated with patient healthcare visits, including most of the data needed for public health case reporting. The use of EHRs has

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increased dramatically since the enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009.[5,6] As of 2021, over 85% of general acute care hospitals had adopted a certified EHR.[7] Given the robustness of data and the prevalence of adoption, attempts to use clinical data derived from the EHR for public health purposes have been undertaken. Initial attempts focused solely on reportable events detected using laboratory results.[8–10] A national infrastructure and standards have been established to support automated case reporting on a broader scale.[11]

Standards-based eCR is a process that leverages laboratory-, diagnosis-, and problem-based triggers within the EHR to initiate automatic reporting of relevant reportable conditions to public health authorities.[12] As reporting criteria vary by public health jurisdiction, nationally curated value sets, called the reportable condition trigger codes (RCTC), were developed to enable broad adoption by HCOs without requiring jurisdiction-to-jurisdiction implementation variation.[12] After triggering occurs, an electronic initial case report (eICR) is created in a standard format and then sent to a centralized infrastructure called the Association of Public Health Laboratories Informatics Messaging System (AIMS), which manages the validation and routing of reports.[12] A centralized knowledgebase, called the Reportable Condition Knowledge Management System (RCKMS), manages jurisdiction-specific reporting requirements allowing case reports to flow to the appropriate PHAs when required by authorities.[13,14]

Due to the magnitude of cases of COVID-19 throughout the pandemic, many HCO and EHR vendors implemented a solution to enable eCR to handle case reporting of COVID-19 infections diagnosed within their facilities.[15] As of March 2023, more than 23 000 healthcare facilities have enabled eCR for at least 1 reportable condition[16]; however, only around 10% of HCOs have enabled eCR for all reportable conditions.

While funding is rarely available for HCOs to implement or expand eCR, Medicare Promoting Interoperability and the Merit-Based Incentive Payment System and Quality Payment Programs require active engagement with eCR.[17] Active engagement can take many forms and is often defined by the respective PHA. Failure to engage in this program could incur a downward payment adjustment of approximately $4.5 million for the University of Utah Healthcare (UHealth), an academic health system in Salt Lake City, Utah. Despite the requirement for active engagement, HCOs have often been reluctant to allocate personnel and resources to expand and streamline eCR within their organization, suggesting the importance of an evaluation of the economic benefit of the expansion of eCR.

UHealth adopted eCR for COVID-19 in June 2020. In 2021, they began expanding their eCR capacity to an additional 29 reportable conditions. The objective of this study is to determine the return on investment (ROI) of expanding eCR for these reportable conditions beyond COVID-19 at an academic health center. In addition, we undertook sensitivity analyses to examine the robustness of our ROI estimates. This evaluation will focus solely on the financial impact from the healthcare perspective, as the benefit of eCR is widely accepted among public health practitioners and agencies.

Methods

Setting

This evaluation was conducted between July 2022 and January 2023 at the University of Utah Hospitals and Clinics (UHealth), a major academic health setting in the Intermountain West. The health system includes 5 hospitals staffed by more than 1400 physicians and more than 5000 other healthcare professionals and serves patients from several states.[18] UHealth reported approximately 98 500 case reports to public health authorities in 2022, including COVID-19 (Collingwood, A, unpublished).

The Epic EHR system has been implemented in the in- and out-patient settings at UHealth since 2014. Information coordinators at UHealth leverage an infection prevention module, Bugsy, within Epic to view a curated list of cases reportable to public health. This module was implemented to handle the case identification step for laboratory-based reportable diseases. Within this module, an infection preventionist can select and share relevant patient medical record information with epidemiologists from local PHAs. Information shared includes demographics, laboratory results, treatment, and relevant clinical notes.

In 2020, UHealth implemented the infrastructure to support eCR and started reporting COVID-19 cases in the production system. This entailed establishing the RCTC for select conditions within the Epic utility to enable the identification and generation of an eICR. In 2022, UHealth started collaborating with Utah's state PHA, Utah Health and Human Services (UHHS), to expand the number of conditions reported using eCR from only COVID-19 to an additional 29 conditions (Figure 1). At the time of this evaluation, UHealth was onboarding the expanded conditions, which meant cases were being dually reported through both the legacy and eCR workflows.

Data collection

Case reporting resources and workflows

Time-driven activity-based costing was performed to capture costs associated with the legacy and eCR workflows to report conditions mandated by public health authorities.[19] A data collection tool was piloted from December 5 to 16, 2022 to capture the time one infection preventionists spent reporting cases to public health. The captured reporting process was divided into time to perform the following steps: case identification, report curation, transmission, and public health follow-up.

After the initial pilot, investigators met with the information preventionist to refine the data collection tool based on identified workflows. A second round of data collection was performed from January 16 to 27, 2023. The information coordinator was asked to capture the time it took to curate and report a maximum of 20 cases in each workflow described above. Additionally, the information coordinator was asked to capture the time it took to review a pre-curated list of patients with positive laboratory results for influenza to identify hospitalized cases, as only influenza-associated hospitalizations are reportable in Utah. This step was not captured for the remaining conditions in the standard or expanded workflows, as the Bugsy module within Epic automatically curates a list of patients with positive laboratory results associated with reportable conditions. As UHealth was reporting using both the legacy and eCR workflows, investigators could not determine if follow-up activities were associated with the legacy or eCR workflows for the 29 conditions of interest. For this reason, time spent on public health follow-up was excluded from this analysis.

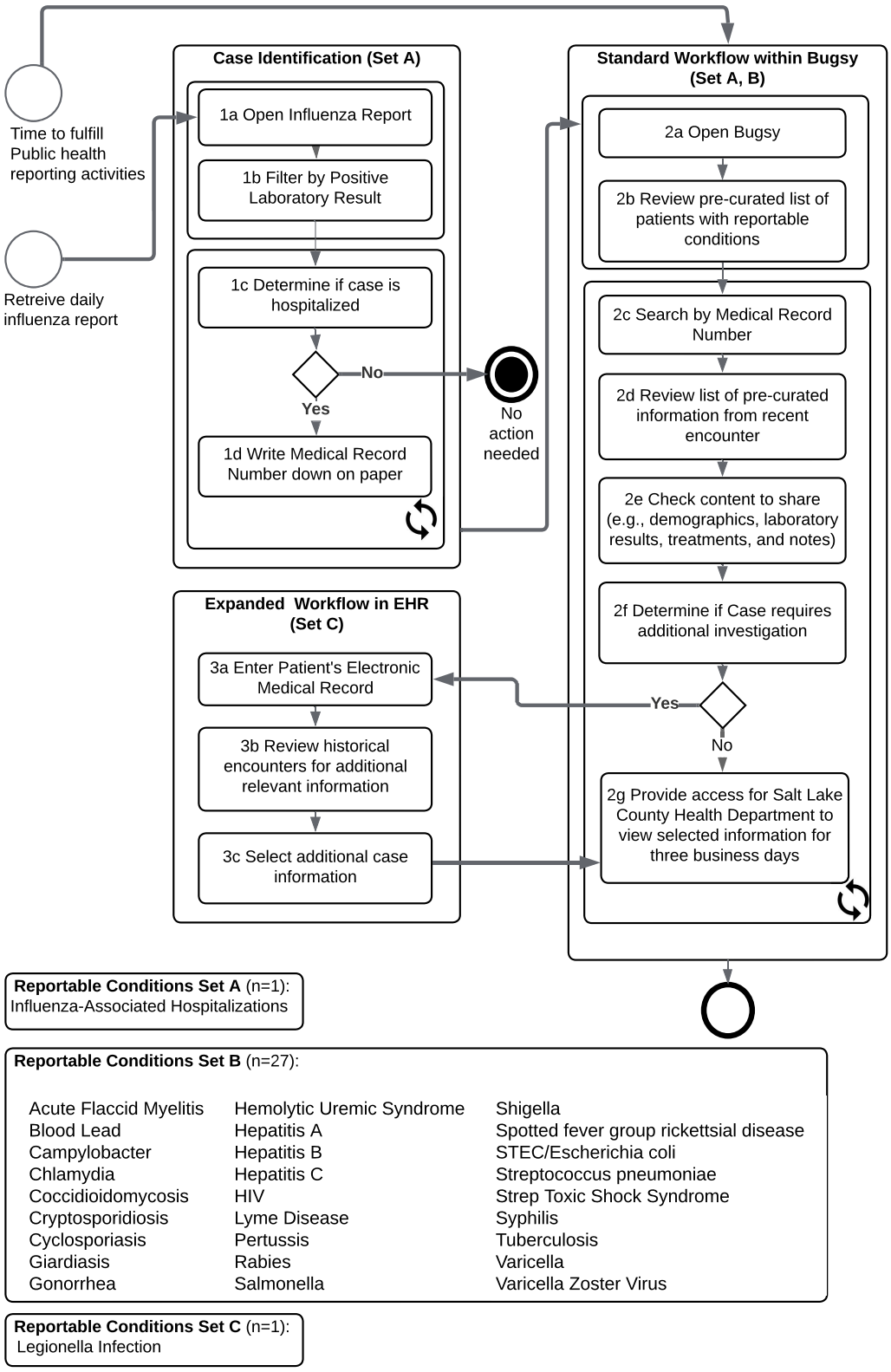

Figure 1. Current exemplar workflows for the legacy case reporting processes.

Implementation and maintenance costs

Baseline costs for the legacy reporting process were solely personnel driven and captured through coordination with the information coordinator. Costs were binned into case identification and report curation categories.

Investigators worked with Application System Analysts at UHealth to capture time costs associated with the expansion and maintenance of eCR throughout the initial 6-month evaluation timeframe. Costs were binned into implementation and maintenance categories.

Maintenance costs were estimated based on the time required for troubleshooting, and retriggering failed messages during the 6-month implementation period. Additionally, maintenance costs included the estimated time required to implement bi-annual updates to the RCTC within the health systems EHR environment.

Systems and license costs associated with the legacy and eCR reporting workflows for the expanded conditions did not require maintenance or license costs; therefore, these were excluded from the analysis.

Cases per year

Total cases per year per condition reported from all UHealth facilities from 2018 through 2022 were exported from the electronic disease surveillance system managed by UHHS. The total annual counts per workflow were used as the expected base implementation state. The 5-year average annual growth in reportable cases was used to estimate the expected number of cases throughout a prospective 5-year time horizon.

Salary

Salary ranges were captured from Transparent Utah[20] for all employees involved in implementing or maintaining evaluated activities. The 5-year historical wage growth was averaged for each employee to estimate the expected growth for each role. Median salaries were captured for each role involved for sensitivity analyses.

Primary analysis

Cost estimates were aggregated for the legacy reporting process and the expanded implementation of eCR for each workflow. The activity rate was calculated for each workflow in the legacy reporting process by averaging the time to fulfill each step and multiplying by the observed reportable cases from UHealth in 2022. Then the total category-specific cost was estimated by multiplying the average cost per workflow by the activity rate. The total cost of the legacy and post-expansion workflows was calculated using each category's estimate.

Investigators leveraged the ROI framework to quantify the economic impact for the expansion of eCR beyond COVID-19 from the perspective of UHealth over a 5-year time horizon. Historic wage increases per employee (Application system analyst: 5.2% and Information Coordinator 3.8%) and an average increase in reportable cases (7%) was applied annually throughout the evaluated time horizon as observed from 2018 to 2022. To estimate the value of future savings in today's value, we calculated the net present value (NPV) over the 5-year time horizon.[21] The NPV is calculated by taking the current value of the expected total cost minus the current value of initial cost.[21,22] A nominal discount rate of 4% was used as an estimate for the opportunity cost of money based on the yield for a 10-year US treasury note.[23]

Using the estimates and associated discount rate described above, the annual and cumulative expansion of 5-year ROI and the NPV of the net savings were calculated. The ROI is estimated by taking the ratio of the net savings of the given time frame, 1-year and 5-year time horizons, by the total cost of the implementation phase. This analysis excluded the initial implementation costs for eCR for COVID-19 because our focus was to estimate the ROI for the continued expansion for additional reportable conditions.

Sensitivity analyses

Sensitivity analyses were performed, adjusting critical assumptions of the base analysis to evaluate the impact on the ROI and NPV of the savings for the expansion of eCR across the 5-year time horizon. Sensitivity analyses included adjustments for inflation, resource salary, expansion to all reportable conditions, and eCR expansion for a HCO in a jurisdiction with a higher volume of reportable conditions.

Given the current economic variability and elevated inflation, investigators evaluated the impact on the estimated savings following adjustments to the base discount rate. Investigators evaluated the impact of a 50% variation in the 4% discount rate used in the base analysis. The discount rates applied in this analysis were 2% and 6%.

A senior information coordinator conducted the legacy reporting in the evaluated implementation, and a System Application Analyst IV implemented the eCR solution for UHealth. However, maintenance activities for eCR were performed by a System Application Analyst III. As the salaries for each role participating in the various workflows were above the median pay range and all of the costs associated with both reporting processes are personnel driven, the 5-year ROI and associated NPV of the savings were re-evaluated using the median salary for each role involved at UHealth.

The primary analysis estimated the ROI for the expansion to 29 additional conditions beyond COVID-19; however, other reportable conditions still follow the legacy reporting processes. As the effort to implement and maintain eCR within Epic is not impacted by the number of conditions implemented, we estimated the ROI assuming UHealth implemented eCR for 74 reportable conditions in Utah. This analysis excluded COVID-19 as it was already implemented at the time of evaluation. As no data were collected on the time it took to report the remaining 44 reportable conditions beyond the 29 conditions in the base analysis, we used a conservative approach and assumed all remaining conditions were handled using the standard reporting workflow.

Ethics review

The University of Utah Institutional Review Board determined this evaluation did not meet the criteria for human subject research (IRB_00158185).

Results

Workflows and associated costs

Legacy reporting

The legacy reporting process for the 29 conditions evaluated consisted of 2 overarching reporting workflows and 1 sub-workflow. The 2 overarching workflows included a standard workflow and an expanded workflow. The sub-workflow had an initial case identification step but then followed the standard workflow.

The standard reporting workflow was used to report 28 of the evaluated conditions. In this workflow, cases are identified within the Bugsy module that provides a list of patients with positive laboratory results for a given condition. Within this module, the information coordinator can access a pre-curated selection of relevant demographic, laboratory results, and treatment information to be shared with public health. After selecting relevant information needed for public health reporting, the information is made available to

epidemiologists at the Salt Lake County Health Department through an electronic portal for 3 business days. Public health practitioners use this access to manually extract and enter relevant information into their surveillance system. On average, it took 59.3 s per case for the information coordinator to report relevant clinical information through the standard workflow, equating to 68.6 h per year to fulfill the initial public health reporting requirements.

Reporting of influenza-associated hospitalization follows the standard workflow but requires an additional case identification step. This step requires the information coordinator to review a pre-curated list of all influenza results to identify patients with positive influenza laboratory results that were hospitalized. After identifying hospitalized patients, the information coordinator searches each patient's medical record number within Bugsy and follows the standard workflow described above. This case identification step associated with this sub-workflow took approximately 9 min per week. After adjusting for seasonality by applying this sub-workflow to week within influenza season, this process accounts for approximately 5.1 h per year.

The expanded workflow was only used for one of the evaluated conditions, legionella infection (disorder). This workflow required a more detailed review of the patient's current and historical clinical records for encounters to capture all relevant information required for public health reporting. In particular, this required the information coordinator to review information outside the pre-curated information for public health reporting described in the standard workflow. Given the low prevalence of legionella infections, only 1 case in the expanded workflow was reported during the evaluation period, which took approximately 420 s. Based on the expected number of legionella cases per year, this would equate to approximately 2.8 h per year to fulfill the reporting requirement following the expanded workflow.

Figure 1 provides a visualization of each workflow and the conditions captured in each.

eCR expansion

To support the expansion of eCR to include the 29 evaluated conditions, all relevant costs were tied to the workforce and were divided into coordination activities, system implementation, and maintenance.

Approximately 6 h were spent in coordination meetings with a range of participants from the Infection Prevention, Information Technology Services, and Quality and Reporting Departments within UHealth. Each meeting was estimated to cost $578.24.

Application System Analysts spent approximately 4 h implementing the expanded trigger codes through the Epic utility. Due to technical challenges with UHealth's Health Information Service Provider, approximately 19.5 h were spent during the 6-month implementation effort evaluating and retriggering failed messages, with an expected maintenance effort of 13 h per year (15 min per week). Investigators assumed biannual updates to the trigger codes (4 h per update), 13 h spent for ongoing technical support and coordination, and approximately 13 h per year spent retriggering errored messages.

As shown in Table 1, the total implementation costs and troubleshooting for the implementation year were estimated to be $5031.46.

Primary analysis

Assuming observed average wage increases of involved personnel, continued increases in the incidence of reportable conditions, and inflation continues on its current trajectory, the 5-year ROI for the expansion of eCR for the 29 conditions is expected to be 142% (NPV: $7166) (Table 2). Based on the annual ROI, our estimates suggest the savings from the expansion of eCR will cover the costs of the implementation costs in approximately 4.8 years.

Sensitivity analyses

Due to current economic variability, we evaluated the impact of adjusting the discount rate (4%) for an increase and decrease of 50% throughout the 5-year time horizon. Applying a 2% and 6% discount rate to the base analysis described above yielded a 5-year ROI of 134% and 154%, respectively (Table 3).

While the eCR expansion effort at UHealth was implemented by a more senior Application System Analyst (IV), an Application System Analyst III maintained ongoing maintenance and troubleshooting activities. Additionally, the Information Coordinator responsible for the legacy reporting process had a salary 19% higher than the median salary for similar roles at UHealth. Expected wage increases per year of the Information Coordinator and Application System Analysts were maintained at 3.8% and 5.2%, respectively. This yielded a 5-year ROI of 89% and a net savings (NPV) of $4493.90 (Table 3).

As the process to update the triggers and prospective maintenance activities are similar regardless of the number of conditions implemented, investigators estimated the 5-year ROI assuming triggers were implemented for the full spectrum of reportable conditions in Utah, assuming all conditions fall within the standard workflow. While COVID-19 makes up the majority of the reporting burden for UHealth (94,147 cases in 2022), it was in production for eCR prior to this evaluation and therefore excluded from this analysis (Collingwood, A, unpublished). The 5-year ROI for implementing eCR for all reportable conditions, excluding COVID-19, was 157% (net savings: $7905.36), a 10.5% increase in ROI over the 5-year time horizon (Table 3).

The cost breakdown for each sensitivity analysis can be found in Tables S1-S4.

Discussion

This analysis revealed a strong ROI for the expansion of eCR to 29 additional conditions beyond COVID-19 for UHealth. While the strength of the ROI may vary based on adjustments to a number of factors, including the discount rate, salary ranges, and expected number of cases, net savings were always present over the 5-year time horizon.

Our findings suggest the most significant cost savings are observed when implementing eCR for all reportable conditions, as implementation and maintenance costs are relatively similar regardless of the number of conditions implemented. These findings are corroborated by the evaluation performed by Whipple et al., which identified significant time savings and value of eCR for sexually transmitted infections for a network of family planning centers in Utah.[4]

For the sake of this analysis, investigators assumed the same number of cases would be identified and reported through the legacy reporting processes as through eCR.

Table 1. Implementation and 5-year maintenance costs by reporting processes.

	Parameter	Implementation phase Cost	Year 1 Cost	Year 2 Cost	Year 3 Cost	Year 4 Cost	Year 5 Cost	Total cost
Legacy process	**Case identification**							
	Influenza workflow	$178.76	$198.54	$220.51	$244.91	$272.01	$302.11	$1238.07
	Report curation							
	Standard workflow	$2404.43	$2670.50	$2966.02	$3294.24	$3658.78	$4063.66	$16 653.22
	Expanded workflow	$98.14	$109.00	$121.06	$134.46	$149.34	$165.86	$679.72
	Total	$2681.33	$2978.04	$3307.59	$3673.61	$4080.13	$4531.64	$18 571.01
	Total Cost (NPV)		$2863.50	$3058.05	$3265.82	$3487.71	$3724.68	$16 399.77
eCR process	**System implementation**							
	eRSD implementation	$265.88	–	–	–	–	–	–
	Coordination emails/meetings	$3469.41	–	–	–	–	–	–
	System maintenance							
	Updates to RCTC	–	$441.61	$464.57	$488.73	$514.14	$540.88	$2449.92
	Retriggering errors	$432.06	$717.61	$754.92	$794.18	$835.48	$878.92	$3981.11
	Ongoing TS/coord	$864.11	$717.61	$754.92	$794.18	$835.48	$878.92	$3981.11
	Total	$5031.46	$1876.82	$1974.42	$2077.09	$2185.10	$2298.72	$10 412.14
	Total cost (NPV)	–	$1804.64	$1825.46	$1846.52	$1867.83	$1889.38	$9233.83

This analysis assumes continuation of historic wage increases for the Application System Analysts (III and IV) of 5.2% and Information Coordinator of 3.8%. An average increase in reportable cases of 7% was applied annually. A nominal discount rate of 4% was applied to calculate the NPV of costs.

Table 2. Annual and 5-year horizon ROI and NPV for the expansion of eCR to 29 additional conditions.

	Year 1	Year 2	Year 3	Year 4	Year 5	5-year total
Return on investment	21%	24%	28%	32%	36%	142%
Net savings (NPV)	$1058.86	$1232.59	$1419.30	$1619.88	$1835.29	$7165.94

This analysis assumes continuation of historic wage increases for the Application System Analysts (III and IV) of 5.2% and Information Coordinator of 3.8%, an average increase in reportable cases of 7% was applied annually, and a nominal discount rate of 4% to calculate the NPV savings.

Table 3. Annual and 5-year horizon NPV and ROI for all sensitivity analyses.

	Year 1	Year 2	Year 3	Year 4	Year 5	5-year total
Discount rate (2%)[1]						
Net savings (NPV)	$1079.63	$1281.40	$1504.44	$1750.72	$2023.33	$7639.51
ROI	21%	25%	30%	35%	40%	152%
Discount rate (6%)[2]						
Net savings (NPV)	$1038.88	$1186.52	$1340.47	$1501.04	$1669.31	$6736.23
ROI	21%	24%	27%	30%	33%	134%
Salary adjustment[3]						
Net savings (NPV)	$592.17	$734.19	$887.03	$1051.45	$1229.06	$4493.90
ROI	12%	15%	18%	21%	24%	89%
All reportable conditions[4]						
Net savings (NPV)	$1211.77	$1395.89	$1593.70	$1806.13	$1897.86	$7905.36
ROI	24%	28%	32%	36%	40%	157%

1 and 2 describe the impact assuming an adjustment in the discount rate due to economic variability, 2% and 6% respectively; 3 describes the impact of median salaries for an information coordinator and use of Application System Analyst IV for implementation and Application System Analyst III for maintenance activities; 4 describe the impact assuming eCR was implemented for all reportable infections diseases.

However, eCR will likely identify additional cases that would not be captured using the legacy process that focuses on predominately laboratory-based identification.[4,24] Additionally, the legacy reporting process only provides case information to Salt Lake County Health Department, which may lead to more follow-up inquiries from PHAs concerning patients that reside outside the county or state. As eCR is a national approach, both the jurisdiction of residence and UHealth facility location will receive the case reports.[11] While not captured in this analysis, we expect the effort required to respond to PHA requests for additional information to be reduced. This is likely to increase further the ROI for the HCO expanding eCR. Similarly, this analysis required several assumptions surrounding the expected number of cases throughout the 5-year time horizon. While these trends are likely to vary year to year, the estimates used were derived from historical trends and projected population growth by 2030.[25]

HCOs are often required to maintain the legacy and eCR reporting feeds, or parallel reporting, throughout onboarding to enable adequate quality assurance by PHAs. To expedite the onboarding process with public health and maximize the ROI for the implementing organization, HCOs should ensure all data outlined in the Public Health Data Needs Workbook are appropriately mapped within their EHR.[12] Failure to address all quality assurance needs is likely to extend the

parallel reporting timeframe and negatively impact the implementation costs and, therefore, the ROI for eCR expansion.

While this study focused on the economic impact of implementing eCR for primarily reportable infectious diseases from the UHealth perspective, eCR can provide additional benefits for the surveillance of non-infectious diseases, such as opioid overdose. Additionally, eCR has the potential to benefit others beyond the HCO perspective through the streamlined reporting process, including PHAs and patients. Future evaluations should be performed to estimate the ROI for all reportable conditions and evaluate the societal benefit.

There are several limitations to this study. UHealth has case identification and reporting workflows enabled for laboratory-based conditions through the Epic module, Bugsy, for the legacy reporting process. Other HCOs, like the one described by Whipple et al., may not have this capability, which can significantly increase the ROI due to the additional effort to fulfill the public health reporting mandate.[4] Further studies should be conducted to evaluate the ROI for HCOs with varying levels of infrastructure. Additionally, our evaluation assumes an HCO has already implemented the infrastructure for eCR for COVID-19 using native functionality available with Epic. However, not all EHRs have this capability; further evaluation is needed to assess the ROI for EHR vendors leveraging the eCR Now FHIR app for trigger code management and eICR generation.

Conclusion

This study demonstrates a positive ROI for the expansion of eCR to additional reportable conditions beyond COVID-19 in an academic health setting, such as UHealth. The findings are relevant for settings using the Epic EHR, which includes functionality to support several tasks associated with public health case reporting. While this evaluation focuses on the 5-year time horizon, the potential benefit could extend further. Future studies are needed to assess the ROI to support eCR at other HCOs with varying infrastructure.

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Author contributions

Study conception and design: J.H., F.W., C.S.; data collection: J.H.; analysis and interpretation of results: J.H., F.W., C.S.; draft manuscript preparation: J.H., F.W., C.S., A.D., K. S., M.S.

Supplementary material

Supplementary material is available at *JAMIA Open* online.

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Conflicts of interest

JH serves as a consultant for the Association of Public Health Laboratories' Electronic Case Reporting Team.

Data availability

The data underlying this manuscript will be shared on request to the corresponding author.

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