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Automating Case Reporting of Chlamydia and Gonorrhea to Public Health Authorities in Oregon Clinics

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Abstract

Background: Optimizing sexually transmitted disease (STD) reporting to state public health authorities is important to reduce incidence and manage outbreaks of STDs. Electronic laboratory reporting (ELR) is the standard through which local clinics report STDs to state public health authority. Electronic case reporting (eCR) is an alternative approach which automates transmission of case reports to public health jurisdictions using electronic health record (EHR) data.

Methods: Working with 3 community health centers in Oregon between February 3, 2020 and May 15, 2020, we piloted an automated eCR approach for gonorrhea (GC) and chlamydia (CT) from these clinics to the Oregon Health Authority. We compared the eCR approach to the existing ELR approach to determine completeness of case reporting for GC/CT.

Results: A total of 365 eCRs from 206 unique patients were generated. Among 154 instances where the case detection logic was satisfied for CT, 37% (54 instances) were based on the presence of a diagnosis and 63% (97 instances) were based on laboratory data. Among 232 instances where logic was satisfied for GC, 44% (102 instances) reflected a diagnosis and 56% (130 instances) reflected laboratory results. Data completeness was uniformly equal or higher for eCRs versus ELRs.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Conclusions: The eCR approach was successful in identifying CT and GC cases and provided a more complete set of information to assist public health authorities when compared with ELRs. Electronic case reporting has the potential to automate and relieve staff burden on an important reporting requirement for clinical providers.

Background

In Oregon, rates of sexually transmitted diseases (STDs) have substantially increased.[1] Between 2009 and 2018, the rate of reported gonorrhea (GC) increased nearly fivefold from 29 to 140 cases per 100,000 population and the rate of reported chlamydia (CT) increased 1.5-fold from 300 to 455 cases per 100,000 population. It is important for public health surveillance to provide timely, complete, and actionable data as evidence to make decisions on interventions for reversing these trends.[2] Electronic laboratory reporting (ELR) has been shown to improve the timeliness and accuracy of case confirmation and reporting when compared with traditional manual mechanisms (eg, paper and Web-based forms).[3–5] Since March 2010, ELR for CT and GC to state and local public health authorities has been legally mandated for most commercial, public health, and hospital laboratories in Oregon by the state.[6] However, ELRs are limited to the information available on laboratory test results and have typically incomplete demographics (patient race, sex, ethnicity, etc.) and treatment information, although they do typically confirm the presence of an infection.[7–9] This information is important from an epidemiological perspective, as it informs prevention and control strategies. Demographics, diagnosis, and treatment information is typically available in the electronic health record (EHR) where patient encounters are recorded and managed.[10,11]

Progress in Standards-Based Automated Case Reports

The Council of State and Territorial Epidemiologists (CSTE) standardizes and maintains the case definition and recommends reporting criteria of notifiable conditions as position statements.[12] The CSTE maintains position statements for both CT and GC.[13,14] Based on these position statements, an earlier study developed the EHR-based case detection algorithm for CT and GC comprised of value sets using industry standard technologies (eg, *International Classification of Diseases, Tenth Revision, Clinical Modifications*, Logical Observation Identifiers Names and Codes, and Systematized Nomenclature of Medicine–Clinical Terms).[15] These trigger codes were based on 3 scenarios: (1) diagnosis, (2) laboratory result (named organism), or (3) a combination of laboratory test performed and result indicating presence of infection.[16] Electronic case reporting (eCR) refers to an approach where an EHR or other inter-mediary system, such as a health information exchange automatically detects reportable conditions and sends a case report to a public health surveillance system, based on 1 of the 3 triggers mentioned above.[17] Because eCR uses a consensus set of trigger events and a standardized format (described above), EHR vendors can incorporate automated case reporting into medical record systems consistently across the nation, minimizing development time and simplifying disease reporting for providers.[15] The eCR also may improve the completeness of patient contact, clinical, and epidemiologic information, providing a richer set of information for public health authorities to inform case investigations. The extensive information available in an eCR, powered by the broad set of patient data available within the EHR, prompted us to consider a new process for easing the work and burden required to transmit STD case information to local public health authorities. We believe this approach holds promise for upgrading the breadth of information available in STD case reporting, as well as limiting clinical burden.

Objective

Prior work has described the implementation of eCRs in comparison to manual case reporting.[15] There has yet to be a systematic comparison of the information obtained from the 2 types of automated case reports, ELRs and eCRs. The goal of this project was to implement and increase the uptake of the standards-based eCR for CT and GC with the intention of reducing the burden of manual reporting. In addition to building an evidence base for eCR, we extend the work of Mishra et al by comparing the information obtained from CT and GC case reports from both eCRs and ELRs, including the number of reported cases in 3 Oregon clinics and the proportion of CSTE-identified key variables populated in each type of report.[13–15]

MATERIALS AND METHODS

The Western Institutional Review Board defined this project as quality improvement and not involving research. The project period was for 15 weeks, beginning February 3, 2020, and ending May 15, 2020. The implementing partners (OCHIN and Oregon Health Authority [OHA]) elected to continue exchanging eCRs as a mechanism of regular case reporting method beyond the project period.

EHRs System Platform, Clinical Sites, and Public Health Departments

To build the evidence base for eCR with the potential of scaling up the implementation to additional sites, a shared platform was needed that hosted a centralized EHR implemented across multiple local health jurisdictions. OCHIN Inc., is a non-profit community-based health center-controlled network with over 766 clinics including community health centers (CHCs) and public health agencies across 19 states serving over 4.6 million patients that shared a single epic EHR with other CHCs.[18,19] Oregon Health Authority—the State of Oregon Public Health Agency—served as the public health implementing partner, using its integrated public health surveillance system—Oregon Public Health Epidemiology User System (Orpheus)—to ingest both ELRs and eCRs.[20] Oregon Health Authority is the state public health agency for Oregon. The OCHIN team recruited 3 clinics using the OCHIN Epic EHR within Oregon with a demonstrated high volume of CT and GC cases. To diversify the clinical settings, a total of 3 clinics were recruited, which included: 1 STD clinic in the Portland metro area (largest metropolitan area in Oregon), 1 primary care clinic in the Portland metro area, and 1 clinic operated by a local health department outside of the Portland metro area. This was intended to be representative of the different types of clinical settings (and types of clinical facilities) that provide the majority of STD services and to ensure that this architecture could be tested and generalized to these diverse settings. The state of Oregon mandates that health care providers and clinical laboratories report all cases of CT and GC to the local health department within 1 working day.[21,22]

Implementation of eCR Architecture and Ingestion by Public Health Surveillance System

Although the reference eCR-sexually transmitted infection implementation was previously defined,[16] some degree of customization was required to accommodate existing clinical and public health workflows, available code terminologies, and data parsing capabilities. OCHIN Epic© leveraged 2 of the 3 case detection scenarios which had equivalent concepts for scenario 1 (encounter diagnoses) and 3 (a combination of laboratory test performed and result indicating presence of infection) but not for scenario 2 (name of pathogen identified). Once the case detection logic was met within the EHR, the encounter was summarized according to a predefined data format known as the eCR maintained by the standards development organization health level 7 (Fig. 1). These eCRs were then transmitted via secure file transfer protocol to the Oregon Health Authority once every 5 hours to be consistent with jurisdictional case reporting practices, laws, and rules.[21,22] The eCRs were ingested, parsed and merged into Orpheus[20]—the agency's existing downstream surveillance system—using OHA's Rhapsody integration engine. Local health department staff reviewed eCR data, in a manner similar to existing ELR processes. If the eCR did not meet the case definition, it was ignored, and a reason indicated. If the case definition was met, a new case profile was created if one did not already exist—or it was linked to case profile for an existing record.

Quantitative Data Collection and Analysis Methods

OCHIN identified eCRs triggered by the EHR from the 3 clinics and parsed the eCR into a database to easily run queries and retrieve evaluation metrics. At OHA, cases reported and matched ELRs from the 3 clinical sites were extracted from the surveillance system. As individual providers may see patients across multiple clinic sites, records from nonparticipant clinics were excluded. Cases were also excluded from analysis if they did not meet the CDC confirmed or probable case definition for CTor GC, or if the patient was not an Oregon resident. To compare the data completeness between ELRs and eCRs, a simple random sample of 20 cases were extracted from all cases with an eCR linked with an ELR. This sampling strategy was chosen to limit the reporting burden upon the OHA, which was required to extract and process the necessary ELR data, during the height of the SARS-CoV-2 pandemic, during which extensive OHA resources were diverted toward the pandemic response. We believe this sampling approach still allows us to describe differences in data availability between the eCR and ELR. We compared the data elements of eCRs with the mandated ELRs ingested by OHA's surveillance system to evaluate the completeness, timeliness, and accuracy of the case reports. We used SAS version 9.4 (Cary, NC) for all analyses.

RESULTS

eCR Throughput and Case Detection Metrics

In 2018, before the implementation of the automated STD reporting project, most CT (84%) and GC (81%) cases reported to OHA throughout Oregon originated via ELR data feeds. During the 15-week project period in 2020, 33,041 encounters were logged in the EHR of the participating clinics, representing 8658 unique patients seeking medical care for reasons not limited to STDs. A total of 365 eCRs reflecting 206 unique patients were generated during the project period. All 365 eCRs were determined to be valid case reports and ingested by the public health surveillance system, of which 328 met the CDC case definition and OHA's reporting criteria. Of the 37 eCRs that did not meet these criteria, 14 patients were excluded for not being Oregon residents, 2 reflected COVID-19 results and not STDs, 19 had no positive laboratory results associated with the case, 1 patient was already reported as a case, and 1 patient was a telemedicine visit with orders for CT tests with no results. After case determination and manual review by local health department staff, there were 196 unique CT and GC cases reported via this eCR mechanism, representing 184 unique patients. More than 1 case detection logic may be satisfied to trigger 1 eCR. Among the 154 instances where the case detection logic was satisfied for CT, 37% (54 instances) were based on the presence of a diagnosis or problem list code (scenario 1) and 63% (97 instances) were based on laboratory result data (scenario 3) (Fig. 2). Among the 232 instances where the case detection logic was satisfied for GC, 44% (102 instances) reflected a diagnosis or problem list entry, and 56% (130 instances) reflected laboratory result data (Fig. 2).

eCR Data Completeness

A total of 206 cases of CT and GC were detected via 365 eCRs. Some cases generated subsequent eCRs because they met the trigger criteria again. Table 1 summarizes data completeness, comparing eCRs to ELRs. Data elements describing the provider and facility revealed that the date of the report and facility phone number were present in every eCR. For a given individual, provider name was included on 65% of all eCRs, whereas this information was complete on 44% of all eCRs generated. Patient identifiers and demographics, such as name, sex, and address were present on all eCRs and race and ethnicity were consistently reported on the majority of the eCRs (>80%). Information related to the clinical visit such as date/time was complete on all the eCRs. Clinical information was also present on most eCRs. Diagnoses were reported on all eCRs, whereas reason for visit was complete (>95%) on nearly all eCRs. Laboratory results were reported on only half (56%) of the eCRs during the first visit but were present on the majority (80%) of eCRs that were subsequently triggered with 71% of all eCRs reporting it. Symptoms were consistently reported on almost all eCRs (~75%), and medications were reported on half of the all the initial, subsequent, and total eCRs.

Comparison Between eCRs and Electronic Laboratory Reports

A total of 131 cases of CTwere reported to OHA from the participating clinics during the project period across all reporting modalities. Seventy-two percent (n = 94) of the cases were reported by at least 1 eCR, 89% (n = 117) were reported by ELR, whereas 6% (n = 8) of cases were reported via mechanisms (eg, electronic provider morbidity report) other than ELR and eCR. Of note, eCR alone reported an additional 6 cases that were not reported by ELRs or other mechanisms. Similarly, 117 cases of GC were reported to OHA. 88% (n = 103) of cases were reported by at least 1 eCR, 81% (n = 95) were reported by ELR, whereas 6% (n = 7) cases were reported via mechanisms (eg, electronic provider morbidity report) other than ELR and eCR. Here too, eCR alone reported an additional 15 cases that were not reported by ELRs or other mechanisms. The median time for receipt of eCRs by scenario 1 (diagnoses, problems) was 5 days, by scenario 3 (laboratory results) was 17 days, and by ELRs was 3 days.

In addition cases reported via eCR contained more data elements and had a higher rate of completeness (Table 2). Both eCRs and ELRs have similar demographic and contact information data elements that can be reported; however, eCRs consistently were more complete than ELRs (eg, provider phone: eCR, 100%; ELR, 10%; race: eCR, 70%; ELR, 25%; ethnicity: eCR, 70%; ELR, 20%, etc.). Electronic case reportings also reported pregnancy status, symptoms (list), diagnosis, medications administered (list), immunization status, and travel history, which are not available in ELRs.

DISCUSSION

We implemented a novel case reporting approach to automate and enhance the data available to public health authorities for STDs in Oregon. This approach successfully identified cases of GC and CT by meeting the case definition criteria in the EHR, created a case report message in the health level 7 eCR standard with standardized data elements, and ingested by the health department's surveillance system. We found that this automated eCR approach was generally robust in identifying case reports for CT and GC infections and provided a richer set of demographics and treatment data than did the ELR approach. In general, the eCR approach was well received by partners at the participating clinics. A key feature of eCRs is the lack of additional burden on clinic staff. Although ELRs must be entered into the OHA's Orpheus reporting system by a staff member, eCRs are automatically generated upon a trigger condition being satisfied and require no input from clinical staff. For providers and clinical staff working at CHCs, this is an important benefit to eCRs. Further, eCRs included a richer set of data, including demographics and treatment information, in comparison to the ELR. Another attractive property to the eCR is that multiple eCRs can be generated when new information, such as a new treatment regimen, is added to the EHR; with no further intervention required by provider staff. This ability to extract actionable data, especially related to clinical encounters from the EHR, has long been a goal sought after by public health partners.

This work was instrumental in testing an approach that is being developed for automating the transmission of all required reportable diseases to state public health authorities throughout the OCHIN network. Of note, this approach can be generalized to other EHR systems utilizing the Epic platform, as the code used for the automated algorithm can be, with minor modifications, used across other Epic systems. The logic is also transferable to other EHR systems as well, although likely requiring further development time.

We did experience some limitations to our intervention. Of greatest note is that the project period overlapped the declaration of the SARS-CoV-2 virus as a pandemic, which had substantial impacts upon HIV and sexually transmitted infection testing in Oregon. In Oregon, a stay at home executive order was implemented on March 23, 2020.[23] The participating clinics also reported clinic closures, and limited appointments to urgent visits and symptomatic screenings only. Compared with before, the Oregon stay at home order, testing for GC/CT decreased 58% and diagnoses of GC and CT decreased 23% and 34%, respectively, during the project period.[24] This reduction in patient volume and screening rates likely led to lower overall case numbers than might have been anticipated outside of a pandemic. The eCR approach seemed to work particularly well for GC cases but did not identify as many CT cases as did ELR. Further exploration as to potential enhancements to the eCR algorithm for the identification of CT cases is warranted. We have also found that ELRs and eCRs detect cases independently that the other missed. We note some potential explanations for this: one, ELRs may not be linked to a case if there is an existing ELR or eCR, as this process is not automated and completed by a human and thus subject to human error, which may explain higher numbers of GC cases not classified by ELR. For CT cases, where there were more cases potentially missed by the eCR process, it is possible we are missing a code from our algorithm, or that providers in some instances may not be updating diagnosis or testing results codes after a presumptive diagnosis code, in which case our automated algorithm would not capture the case. This is a topic for further investigation and presents an opportunity for enhancing ELRs with additional data as demonstrated by Mishra et al.[25] Further, our automated approach, although it does serve the primary function of notifying public health authorities about cases, did not include measures of negative tests that would serve to construct denominators, in the eCRs submitted to OHA. This could potentially be addressed in a future implementation including the automated transmission of negative, as well as positive, GC/CT tests, which would permit the calculation of risks and provide further information to decision makers at public health authorities. We also did not measure the cost and extent of manual work that would be expended for manual reporting of these case reports (had they been manually reported) and saved by the automated case reporting through eCR.

In our prior work done with a clinical facility (without any public health agency), we outlined the architecture and trigger logic for eCRs for CT and GC.[15] In this study, we recruited a public health agency and multiple clinical facilities within that jurisdiction and found that the eCR approach was successful in identifying CT and GC cases and provided a more extensive set of information to assist public health authorities. Electronic case reporting has the potential to relieve staff burden on an important reporting requirement for clinical providers while at the same time enhancing the quality and depth of information available to public health partners.

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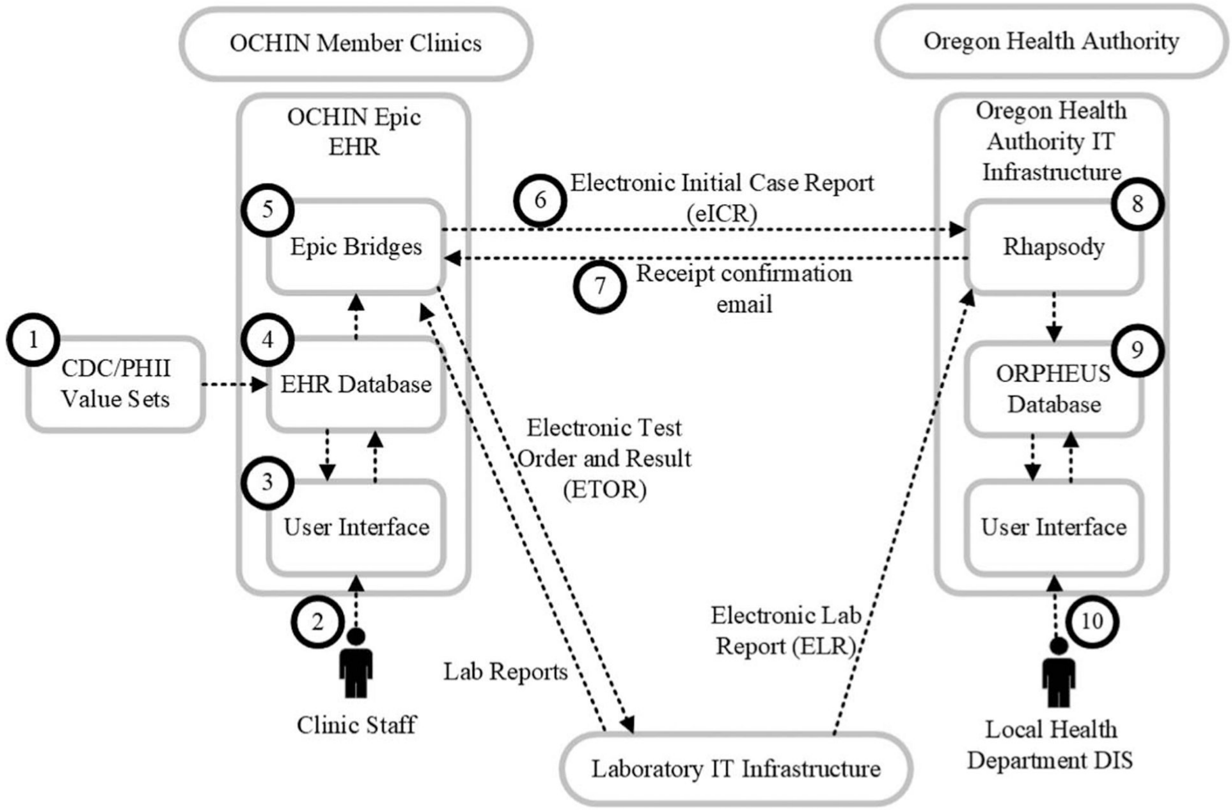

Figure 1.
eCR detection, generation, and ingestion workflow and roles of organizations and personnel.

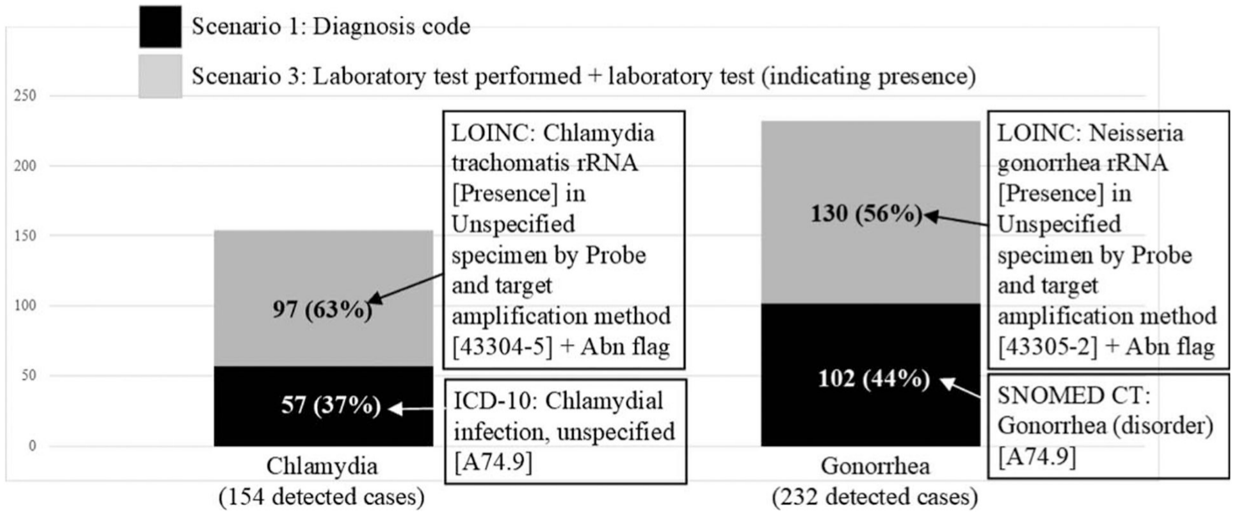

Figure 2.
Frequency of case-detection logic triggered by each scenario for both CT and GC.

TABLE 1.

Completeness of Data Reported in eCRs and ELRs From the Participating Clinics

Data Element Name	% Complete (Non-Null Value), eCR	% Complete (Non-Null Value ELR
Date of the report	100%	100%
Provider phone	100%	10%
Patient name	100%	100%
Patient phone	95%	75%
Patient sex	100%	100%
Race	70%	25%
Ethnicity	70%	20%
Patient address	95%	95%
Pregnancy status	0%	*Not available
Reason for visit (reason for study)	100%	25%
Symptoms (list)	30%	*Not available
Laboratory result	100%	100%
Diagnosis	90%	*Not available
Medications administered (list)	55%	*Not available
Immunization status	55%	*Not available
Travel history	0%	*Not available

*These data elements were not available to be reported in the ELR message.

TABLE 2.

Comparison of Cases GC and CT Cases Reported by eCR and ELR

		Reported by ELR						
		CT				**GC**		
		Yes	**No**	**Total**		**Yes**	**No**	**Total**
Reported by eCR	Yes	88	6	94	Yes	88	15	103
	No	29	8*	37	No	7	7*	14
	Total	117	14	131	Total	95	22	117

*Cases reported neither by ELR nor by eCR were independently reported by providers.