Evaluation of the Impact of Electronic Reporting on the Completeness of Data

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OBJECTIVE

The objective of this surveillance evaluation is to assess the impact of automated electronic laboratory reporting of positive laboratory results for chronic hepatitis B and hepatitis C on the completeness of data in the San Francisco Department of Public Health's Chronic Viral Hepatitis Registry.

INTRODUCTION

Electronic laboratory reporting has been promoted for its potential to increase the volume of tests reported, as well as improve the timeliness and completeness of reports of notifiable infectious diseases to public health departments. Traditional methods of paper-based reporting rely on active participation of laboratory and clinical staff and are time consuming. For the purpose of this evaluation, paper-based reports are defined as those reports received by mail or fax. While electronic laboratory reporting offers many benefits to both laboratories and to public health departments, adoption has been slow both nationally and locally.

In 2005, the San Francisco Department of Public Health (SFDPH) received funding from the CDC to develop a population-based registry of persons living in San Francisco with chronic hepatitis B infection and/or past or present hepatitis C infection. In late 2005, standardized protocols were implemented for data entry into a longitudinal, person-based information system. All positive hepatitis B and C test results on chronic viral hepatitis cases who are known to either reside in San Francisco County or whose county of residence is unknown but who receive healthcare from a San Francisco medical provider are now entered into the Chronic Viral Hepatitis Registry.

In 2006, SFDPH received more than 6,500 positive hepatitis B and C paper-based reportsfrom laboratories. These laboratory reports were very basic and not infrequently were missing some key elements such as the name of the provider who ordered the test or contact information for the person being reported. Because of the large volume of hepatitis B and C reports and the key information that was missing from some of the paper reports, SFDPH recruited two large laboratories, Laboratory A and Laboratory B, to report their hepatitis test results by electronic file. A third large laboratory, Laboratory C, has been reporting very basic information by an electronic file since 2001. SFDPH worked with that laboratory to include ordering provider and to add several other types of tests for hepatitis B and hepatitis C to the electronic file, as well as to establish a mechanism to link laboratory data to more complete demographic data.

This evaluation seeks to compare the completeness of certain data elements reported with positive hepatitis B or C test results by reporting method (electronic reporting versus paper-based reporting). Because Hospital C did not begin reporting the name of the ordering provider until April 2008, this evaluation will appraise the completeness of data from May 1, 2008 through June 30, 2009. Elements to be evaluated include the name of the provider who ordered the test, the provider's contact information, the case's county of residence, the case's address, and the case's telephone number. These data elements were chosen because they are vital for defining a case and enabling SFDPH to conduct public health follow-up with patients and healthcare providers.

DESCRIPTION OF THE SURVEILLANCE SYSTEM

Mandated Reporting

Laboratorians, clinicians and other mandated reporters report positive results of tests for hepatitis B and hepatitis C to the SFDPH in compliance with Title 17, California Code of Regulations (CCR), Sections 2500 and 2505. In addition to reporting positive test results for hepatitis B and C, laboratories and providers are required to report patient identifiers, including: name, date of birth, gender, and Medical Record Number (MRN); patient contact information, including: address, city, state, and telephone number; and ordering provider name and contact information. The SFDPH stores the reported information in a secure electronic database that is person-based.

CDC Case Definitions

Laboratory criteria for diagnosis of Chronic HBV

CDC laboratory criteria for diagnosis are applied to test results to identify persons with probable and/or confirmed chronic hepatitis B. CDC defines a *probable* case of chronic hepatitis B as a person with one of the following: a single positive hepatitis B surface antigen (HBsAg), HBV DNA, or hepatitis B e antigen (HBeAg) with no IgM antibody to hepatitis B core antigen (IgM anti-HBc) test reported. A *confirmed* case of chronic hepatitis B is a person who has: 1) a single positive HBsAg, positive HBV DNA, or positive HBeAg test with a negative IgM anti-HBc; or 2) tests positive for hepatitis B surface antigen, HBV DNA, or hepatitis B e antigen twice at least six months apart.

Laboratory criteria for diagnosis of HCV infection, past or present

CDC laboratory criteria for diagnosis are applied to test results to identify persons with past or present hepatitis C infection. CDC defines a person with past or present infection with HCV as a person with: 1) anti-HCV positive (repeat reactive) by EIA, verified by an additional more specific assay (e.g. RIBA for anti-HCV or nucleic acid testing for HCV RNA); 2) HCV RIBA positive; 3) nucleic acid test for HCV RNA positive; 4) report of HCV genotype; 5) anti-HCV screening-test-positive with a signal to cut-off ratio predictive of a true positive as determined for the particular assay as determined and posted by CDC. Cases may be classified as either*:* 1) *Probable:* a case that is anti-HCV positive (repeat reactive) by EIA and has alanine aminotranferase (ALT or SGPT) values above the upper limit of normal, but the anti-HCV EIA result has not been verified by an additional more specific assay or the signal to cutoff ratio is unknown; or 2) *Confirmed*: a case that is laboratory confirmed and that does not meet the case definition for acute hepatitis C.

Data System

Data for the San Francisco Chronic Hepatitis Registry is stored in a secure electronic database, the Integrated Case Outbreak Management System (ICOMS), which is a locally developed and managed longitudinal, person-based data system.

Data Sources

SFDPH worked individually with each of three large laboratories to electronically report positive results of tests for hepatitis B and hepatitis C. Each of these laboratories reports to SFDPH in a slightly different manner. The laboratories report data using their own local coding. SFDPH staff initiate and monitor an automated file import program which translates the local hospital codes to coding used in ICOMS and, after SFDPH staff approval of the translation, imports the data. The three laboratories who report electronically are as follows:

1) Laboratory A which began comprehensive electronic reporting in October 2006;
2) Laboratory B which began comprehensive electronic reporting in January 2008;
3) Laboratory C which began comprehensive electronic reporting in May 2008.
   (NOTE: Laboratory C began electronic reporting of HBsAg and HCV Ab to SFDPH in July 2001. In response to SFDPH requests, Laboratory C enhanced their reports by adding the following to their electronic report: ordering provider identification number; HBV DNA test results; HCV RNA test results; a mechanism to link the laboratory reports to the clinical files to complete the case's county of residence, address and telephone number; and a mechanism to link the provider identification number to the provider files to complete the provider's name, telephone and fax numbers. These enhancements were completed by May 1, 2008.)

All other positive hepatitis reports from other reporting laboratories are received by SFDPH by fax or mail. Data are then manually entered into ICOMS. Once data is entered into ICOMS, it is then enhanced for a sample of cases by faxing the ordering provider for further information or by public health follow-up of the case by interview. If the most current reported county of residence, address and/or telephone number for the case differs from the previously reported contact information, it is then updated. During the evaluation period, approximately 40% of cases were followed-up by provider or by interview.

Data Confidentiality
SFDPH is authorized by law to collect information on cases of chronic hepatitis B and C for the purpose of controlling or preventing disease including: the reporting of disease, the conduct of public health surveillance, public health investigation and public health intervention. SFDPH employees have a legal and ethical responsibility to protect the confidentiality of this protected health information and to use that information only in the performance of their jobs. Data collected are kept strictly confidential.

EVALUATION METHODS

Evaluation Parameters
This evaluation will be based on reports of positive results that may define a chronic hepatitis B case (i.e., HBsAg, qualitative HBV DNA, quantitative HBV DNA, HBeAg) or a hepatitis C infection, past or present, (i.e., HCV Ab, HCV RNA, HCV genotype). This evaluation will assess the completeness of reports that were received from May 1, 2008 through June 30, 2009 for all persons who reside in San Francisco or whose county of residence is unknown.

Elements to be Evaluated
The data elements that are evaluated in this report are important for defining a case and enabling SFDPH to conduct public health follow-up with patients and healthcare providers.

Case's County of Residence, Address, and Telephone Number
County of residence is important for classifying whether the case is within the San Francisco County jurisdiction. Cases known to reside out of the jurisdiction of San Francisco County are excluded from the SFDPH Chronic Hepatitis Registry's population-based surveillance data. Receiving the case's current address allows SFDPH to send educational materials to the case, and having the case's current telephone number allows SFDPH to contact a sample of cases for further public health follow-up by interview. This evaluation will assess whether a person's county of residence, address and telephone number are more complete if the person was ever reported electronically from May 1, 2008 through June 30, 2009 versus persons reported only by paper-based reporting during that period. The evaluation of county of residence, address and telephone number will be person-based not report-based.

Ordering Provider Name and Contact Information
The SFDPH follows up on a sample of their cases by faxing the ordering provider for further information on the case. Receiving the provider's name, telephone and fax number facilitates contacting the provider. When a laboratory report is entered into ICOMS either electronically or by manual data entry, the provider who ordered the test is entered with the laboratory report. For this evaluation, the presence of ordering provider's name, telephone number and fax number will be compared by reporting method (electronic versus paper-based) and will be report-based.

RESULTS

From May 1, 2008 through June 30, 2009, SFDPH received 13,623 laboratory reports on 9,333 individuals not known to reside in another county; 7,367 (54%) of these laboratory reports were reported electronically.

Table 1. Percentage of cases with county of residence by method of reporting

	Reported by paper-based reporting N (%)	Reported by automatic electronic reporting N (%)	Total N (%)
County unknown	762 (16.8%)	906 (18.9%)	1,668 (17.9%)
County known to be San Francisco	3,765 (83.2%)	3,900 (81.1%)	7,665 (82.1%)
Total	4,527	4,806	9,333

Table 2. Percentage of cases with address by method of reporting

	Reported by paper-based reporting N (%)	Reported by automatic electronic reporting N (%)	Total N (%)
Address unknown	799 (17.7%)	951 (19.8%)	1,750 (18.8%)
Address known to be San Francisco	3,728 (82.4%)	3,855 (80.2%)	7,583 (81.2%)
Total	4,527	4,806	9,333

Table 3. Percentage of cases with telephone number by method of reporting

	Reported by paper-based reporting N (%)	Reported by automatic electronic reporting N (%)	Total N (%)
Telephone number unknown	555 (12.3%)	374 (7.8%)	929 (10.0%)
Telephone number known	3,972 (87.7%)	4,432 (92.2%)	8,404 (90.0%)
Total	4,527	4,806	9,333

Table 4. Percentage of reports with ordering provider's name by method of reporting

	Reported by paper-based reporting N (%)	Reported by automatic electronic reporting N (%)	Total N (%)
Ordering provider unknown	1,691 (27.0%)	518 (7.0%)	2,209 (16.2%)
Ordering provider known	4,565 (73.0%)	6,849 (93.0%)	11,414 (83.8%)
Total	6,256	7,367	13,623

Table 5. Percentage of reports with ordering provider's telephone number by method of reporting

	Reported by paper-based reporting N (%)	Reported by automatic electronic reporting N (%)	Total N (%)
Ordering provider's phone number unknown	1,700 (27.2%)	525 (7.1%)	2,225 (16.3%)
Ordering provider's phone number known	4,556 (72.8%)	6,842 (92.9%)	11,398 (83.7%)
Total	6,256	7,367	13,623

Table 6. Percentage of reports with ordering provider's fax number by method of reporting

	Reported by paper-based reporting N (%)	Reported by automatic electronic reporting N (%)	Total N (%)
Ordering provider's fax number unknown	1,703 (27.2%)	526 (7.1%)	2,229 (16.4%)
Ordering provider's fax number known	4,553 (72.8%)	6,841 (92.9%)	11,394 (83.6%)
Total	6,256	7,367	13,623

DISCUSSION

Comparison of the completeness of surveillance data for chronic hepatitis B and hepatitis C from May 1, 2008 through June 30, 2009 by reporting method shows that data for a number of key variables are more likely to be complete when reported electronically versus by paper-based reporting. Looking at Tables 4, 5 and 6, it is clear that SFDPH is more likely to receive the name of the provider who ordered the test, as well as the provider's fax and telephone number in electronic reports versus paper-based reports. If the provider's name is not on the report, a great deal of effort can be spent trying to identify him/her, often with little success. Time saved by receiving the ordering provider's name and contact information is significant.

Surprisingly, this evaluation also finds that SFDPH receives less complete contact information on persons reported electronically by laboratories compared to those who were reported by paper-based methods. This finding may be due to the populations served by some of the laboratories that participate in electronic reporting. For example, Laboratory C electronically reported 28.5% of persons reported in this period and of those, 47% had no contact information. Overall, of the persons reported electronically, Laboratory C reported 87% of the persons reported electronically with unknown address/county of residence information. Laboratory C serves a large proportion of San Francisco's homeless population, who might not have provided residence or telephone number. Also for paper-based reporting, a human has intervened to select reports to be faxed or mailed to SFDPH and may have looked up the patient contact information to complete the Confidential Morbidity Report.

Electronic reporting does require an investment of laboratory and public health staff resources. Much time is required to enlist laboratories to report electronically. Laboratory staff time is needed to assist in translating local laboratory codes to SFDPH data codes. Public health information technology staff resources must be devoted to setting up the electronic report. When electronic reporting is initiated, SFDPH staff must verify the reporting process by comparing paper-based reports to the electronic reports. Once electronic reporting is established, SFDPH staff must carefully examine the electronic files to ensure that the laboratories' coding of test types and/or test results has not changed and that provider and case information is correctly mapped into ICOMS.

However, these costs are offset by a number of advantages. In addition to more complete data for key variables, electronic reporting saves laboratory staff time that would be required to manually fax printed reports or manually complete Confidential Morbidity Report forms. It also saves public health staff time that would be required to manually enter thousands of reports into the registry data system, and reduces the likelihood of data entry errors.

Finally, establishing electronic reporting gives laboratories and the SFDPH an opportunity to improve communications. In setting up the electronic reporting, SFDPH reviewed laboratories' testing and reporting practices for the participating laboratories. Reporting mandates for laboratory reporting were clarified and laboratories improved their reports. Close attention to the import of electronic files has helped SFDPH identify when reporting or testing practices have changed and to work closely with reporting laboratories to identify problems in reporting.