Follow-up testing for hepatitis C virus infection: An analysis of Massachusetts surveillance data from 2007-2010

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Background

Hepatitis C virus (HCV) infection is a reportable condition in Massachusetts. Excluding duplicate patients and laboratory reports, the Massachusetts Department of Public Health (MDPH) received 68,024 reports on 34,005 individuals with laboratory evidence suggestive of HCV infection from 2007 to 2010, including results on a variety of different tests used to screen for HCV infection and identify past or current infection. The usual initial test for HCV infection is an enzyme-linked immunoassay (EIA), which detects anti-HCV antibodies. A quantitative value on an EIA, referred to as the "signal-to-cutoff ratio", indicates a level of antibody detected that is more likely due to HCV infection than to be a false positive result. The EIA can be supplemented with a RIBA (recombinant immunoblot assay) which is more specific in identifying HCV antibodies. The most accurate tests for identification of current HCV infection are nucleic acid tests (NAT), which detect HCV nucleic acid in the patient's blood sample. Ideally, a positive EIA will result in a follow-up NAT to confirm active infection. In order to estimate how many of the HCV cases reported to MDPH between 2007 and 2010 received a full series of appropriate laboratory tests, an analysis of surveillance data was conducted.

Objective

Determine the proportion of hepatitis C virus (HCV) antibody positive cases reported to MDPH that have had at least one HCV nucleic acid test (NAT) reported and analyze the demographics of cases that did not have this type of follow-up testing who were reported from 2007 through 2010.

Methods

Surveillance data for HCV cases were extracted from the Massachusetts disease surveillance system called MAVEN (Massachusetts Virtual Epidemiologic Network), a person-based reporting system, and analyzed using SAS version 9.2. Reports of hepatitis C infection are received via electronic laboratory reporting, faxed laboratory reports, and one-page optical character recognition forms (Teleforms®), all of which are entered into MAVEN. Laboratory tests, coded by LOINC (Logical Observation Identifiers Names and Codes®) were categorized based on test type and MDPH's disease classification protocol (Table 1). Negative test results are not always reported to the MDPH, but for the purposes of this analysis, all reported data were used.

Cases with an event date (earliest date among date of onset of symptoms, specimen collection date, test result date, or report date) between January 1, 2007 and December 31, 2010 were included. Cases reported at the end of 2010 were followed through January 27, 2012 for additional laboratory reporting. A time difference value was generated for time between reported antibody test to NAT or genotype test.

A multivariate logistic regression model was developed using SAS v9.2 in order to analyze demographic determinates of cases having any reported confirmatory HCV test. The model included age group, gender, race, and county. Ethnicity was excluded due to 21,749 (64%) cases missing information on ethnicity.

Results

Table 1. Reported laboratory results indicating HCV infection received by MDPH from 2007 through 2010 (n=68,024)

LOINC	Test description	N	Test
16128-1	Antibody	7595	Probable infection
13955-0	EIA	25311	Probable infection
13955-0	EIA (with significant signal-to-cutoff value)	5024	Supplementary test
5199-5	RIBA	4881	Supplementary test
34704-7	<50 iu/ml RNA	1342	NAT Confirmed
34703-9	<500 iu/ml RNA	17	NAT Confirmed
5012-0	RNA	16147	NAT Confirmed
32286-7	genotype	6110	NAT Confirmed
6422-0	rRNA	1597	NAT Confirmed

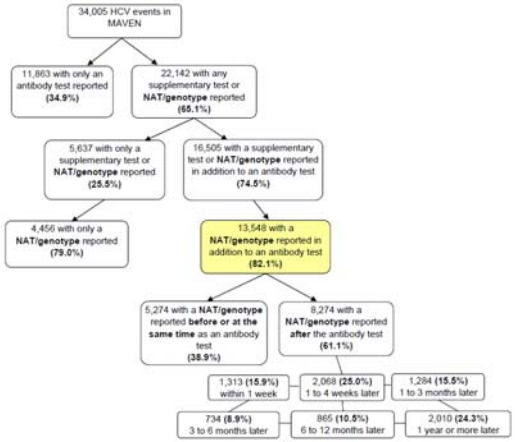
Data as of 1/27/12 and are subject to change
Source: MDPH Office of Integrated Surveillance and Informatics Services

Table 2. Demographic determinates of having a reported NAT or genotype confirmatory test for HCV in Massachusetts, 2007-2010

Age group (890 missing)	**Antibody test only**	**NAT or genotype**	**Odds ratio (Confidence interval)**
0-14	39 (34%)	76 (66%)	1.25 (0.64-2.45)
15-24	1421 (45%)	1714 (55%)	0.52 (0.47-0.59)
25-34	2654 (43%)	3463 (57%)	0.70 (0.63-0.77)
35-44	2257 (38%)	3611 (62%)	0.84 (0.76-0.94)
45-54	2704 (33%)	5538 (67%)	1
55-64	1431 (34%)	2772 (66%)	0.94 (0.83-1.05)
65+	623 (48%)	674 (52%)	0.46 (0.38-0.54)
Gender (2,425 missing)			
Female	3835 (37%)	6522 (63%)	1
Male	6034 (35%)	11051 (65%)	0.95 (0.89-1.03)
Race (13,043 missing)			
White	3878 (29%)	9407 (71%)	1
Black	472 (28%)	1192 (72%)	0.87 (0.77-0.99)
Asian	168 (34%)	330 (66%)	0.65 (0.53-0.80)
Other	497 (36%)	880 (64%)	0.75 (0.67-0.85)
Region (5,793 missing)			
1- West	1140 (32%)	2396 (68%)	0.80 (0.70-0.91)
2- Central	1015 (34%)	1993 (66%)	1.25 (1.06-1.47)
3- Northeast	1458 (33%)	2920 (67%)	1.02 (0.90-1.16)
4a- Boston Metrowest	384 (29%)	941 (71%)	1.23 (1.02-1.50)
4b- Boston Inner Suburbs	1082 (34%)	2122 (66%)	1.16 (1.02-1.33)
4c- Boston	1089 (34%)	2149 (66%)	1
5- Southeast	2368 (44%)	3017 (56%)	0.50 (0.46-0.56)

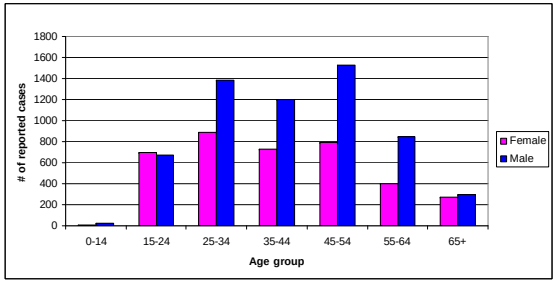
Data as of 1/27/12 and are subject to change
Source: MDPH Office of Integrated Surveillance and Informatics Services

Figure 1. Hepatitis C virus laboratory tests reported in MAVEN, 2007-2010



Data as of 1/27/12 and are subject to change
Source: MDPH Office of Integrated Surveillance and Informatics Services

Figure 2. Number of reported cases that never received follow-up testing after a positive HCV-antibody test by age group and gender, 2007-2010



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Source: MDPH Office of Integrated Surveillance and Informatics Services

Results

Laboratory data analysis

A total of 34,005 cases of HCV infection were reported to the MDPH from 2007 through 2010, 34.9% (n=11,863) of which had only an antibody test reported, while 65.1% (n= 22,142) had any supplementary test or a NAT (or genotype) reported **[Figure 1]**.

The chronological order of tests performed for HCV infection diagnosis for the 13,548 cases with a NAT or genotype confirmatory test in addition to an antibody test is presented in **Figure 2**.

Demographics Analysis

Age group (Wald Chi Square: p<0.0001), race (p<0.0001), and region of the state (p<0.0001), were found to be associated with having any reported NAT or genotype for HCV compared to having only an antibody test. Gender was not found to be a significant factor (p=0.19)

The percentage of reported cases (males and females) with only an antibody test result has essentially remained the same annually from 2007 to 2010, with a total of 35% of all cases never receiving follow-up confirmatory tests.

Conclusions

With over 68,000 laboratory reports received for over 34,000 patients from 2007 to 2010 at MDPH, hepatitis C virus is one of the most common reportable infections in Massachusetts. Analysis of the type and number of laboratory tests performed and reported by healthcare providers in the state showed that 35% of these cases never had a reported confirmatory test, indicating that these cases may not have received appropriate follow-up confirmatory testing for HCV infection. This could be due to a number of reasons, possibly including lack of appropriate medical follow-up, lack of concern among patients who test positive, and difficulty in accessing care.

Demographic analyses suggest that there are disparities in HCV diagnostic testing among populations across the state. HCV provider education is needed, with a focus on appropriate diagnosis. Services are available at several locations across the state, including counseling and testing sites, which refer patients to care, and at Hepatitis C Medical Management Program Sites, offering medical management services for individuals mono-infected with hepatitis C. However, more services and education about hepatitis C are needed in areas with high risk populations.

Limitations

- MDPH does not always receive negative confirmatory test results after positive HCV antibody tests.
- It is not feasible to analyze MDPH surveillance data for the type of reporting providers to further explore observations.
- Missing specimen dates were replaced with the event date, leaving several cases with the same date for their first antibody test and their first NAT or genotype test.