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During a nosocomial hepatitis C outbreak, emergency public clinics employed the OraQuick HCV rapid antibody test on site, and all results were verified by a standard enzyme immunoassay (EIA). Of 1,157 persons, 1,149 (99.3%) exhibited concordant results between the two tests (16 positive, 1,133 negative). The sensitivity, specificity, positive predictive value, and negative predictive value were 94.1%, 99.5%, 72.7%, and 99.9%, respectively. OraQuick performed well as a screening test during an outbreak investigation and could be integrated into future hepatitis C virus (HCV) outbreak testing algorithms.

Clinical signs and symptoms of hepatitis C virus (HCV) infection are generally nonspecific, and many patients with acute or chronic infection are asymptomatic. As a result, laboratory testing for evidence of HCV infection is required for diagnosis. Because of its high sensitivity, ease of automation, and relatively low cost, enzyme immunoassay (EIA) for the detection of the IgG class of antibodies to HCV (IgG anti-HCV) is the most commonly used approach to HCV infection screening. Generally, EIA requires a subsequent patient encounter to provide results. This delay can lead to patient anxiety or loss to follow-up.

Recently, rapid HCV antibody tests have been developed and their performance has been evaluated (1, 2). The OraQuick HCV rapid antibody test (OraQuick), manufactured by OraSure Technologies, Inc., is the first to gain approval by the Food and Drug Administration (FDA) (3) and a Clinical Laboratory Improvement Amendments (CLIA) waiver (4) for qualitative detection of HCV antibodies in finger stick or venipuncture whole blood. OraQuick is a single-use lateral-flow indirect immunoassay intended for use in symptomatic or high-risk asymptomatic patients. Results can be obtained at the point of care in 20 to 40 min. In earlier evaluations of symptomatic or high-risk asymptomatic patients, OraQuick demonstrated high sensitivity (97.8 to 100%) and specificity (99.5 to 100%) (1, 5, 6). Few studies have evaluated the performance of the test in a low-risk population. One (7) conducted by OraSure Technologies and collaborators examined 450 low-risk subjects and demonstrated high sensitivity (100%) and specificity (100%) of OraQuick with both finger stick blood and venous whole blood. No performance data for OraQuick have been reported for screening a large population of patients at mixed risk for HCV infection, such as during an outbreak investigation.

On 25 May 2012, the New Hampshire Division of Public Health Services (NH DPHS) confirmed an HCV outbreak at a local hospital cardiac catheterization laboratory (CCL) (8). Epidemiologic and laboratory data strongly suggested that their source was an infected health care worker (HCW) who was diverting narcotics (8). The NH DPHS recommended HCV testing for all patients who received care in all at-risk settings during the period of this HCW's employment at the local hospital. Due to the large number of patients indicated for testing, and intense community concern, NH DPHS organized eight emergency public health clinics for HCV testing in two stages: OraQuick on site, followed by EIA and any necessary supplemental testing performed at the New Hampshire Public Health Laboratories (NH PHL).

NH DPHS notified all patients who were indicated for HCV testing of the eight scheduled public clinics through direct phone calls and letters as well as the local media. At the clinics, two serum separator tubes (SSTs) and one lavender (anticoagulant) tube from each eligible patient were obtained. The lavender tube was for the OraQuick HCV rapid test at the public health clinics, and the two SSTs were for EIA and supplemental testing at the NH PHL. Patients were counseled and offered their OraQuick test result on site by trained counselors. Patients who elected not to receive their result on site were called and/or mailed their results.

Laboratorians from the NH PHL and Laboratory Response Network facilities were trained on the OraQuick HCV rapid antibody test and proficiency tested by OraSure Technologies, Inc., technical representatives. Testing was performed on venipuncture whole blood in accordance with the manufacturer's instructions (9). Any specimen that tested positive or invalid was retested on site by a second tester who was blinded to the original result and was unaware that the test was a repeat test. Once confirmed, a result was finalized and provided to the patient. All specimens with positive or invalid OraQuick test results were also repeat tested at the NH PHL.

Serum specimens were transported from the clinic settings to the NH PHL within 6 h of collection using coolers with cold packs. Upon receipt, the SSTs were centrifuged and tested for anti-HCV antibodies by use of the Ortho HCV version 3.0 EIA (Ortho Clinical Diagnostics, Rochester, NY) (10) with the ETI-Max 3000 automated EIA analyzer (DiaSorin). The remaining serum specimens were frozen at −70°C

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TABLE 1 Summary of test results of OraQuick anti-HCV rapid test in comparison with Ortho HCV version 3.0 EIA

OraQuick result	No. of patients with indicated EIA result		
	Positive	Negative	Total
Positive	16	6	22
Negative	1	1,133	1,134
Invalid	0	1	1
Total	17	1,140	1,157

TABLE 2 Summary of test results for patients with discordant results between OraQuick and EIA[a]

Specimen identification no.	OraQuick	EIA (SCR)	CIA (SCR)	HCV RNA
1	Positive	Negative (0.007)	Negative (0.02)	Negative
2	Positive	Negative (0.31)	Positive (1.18)	Negative
3	Positive	Negative (0.016)	Negative (0.02)	Negative
4	Positive	Negative (0.013)	Negative (0.02)	Negative
5	Positive	Negative (0.043)	Negative (0.43)	Negative
6	Positive	Negative (0.011)	Negative (0.01)	Negative
7	Negative	Positive (5.123)	Positive (12.9)	Negative

[a] SCR, signal-to-cutoff ratio. Specimens were considered as reactive for antibody to HCV if the SCR was ≥1.0 in both EIA and chemiluminescence immunoassay (CIA). The HCV RNA test was performed using the Cobas Amplicor HCV test, v2.0.

and used for supplemental testing, if necessary. Final results were obtained within 48 h of specimen collection.

Specimens which yielded discordant results between OraQuick and EIA were frozen at −70°C and sent to the laboratory at the Division of Viral Hepatitis of the Centers for Disease Control and Prevention (CDC) to be tested for anti-HCV using the Ortho Vitros immunodiagnostics anti-HCV chemiluminescence immunoassay (CIA) (Ortho Clinical Diagnostics, Rochester, NY). The CIA was performed according to the manufacturer's instructions (11). Specimens which tested positive by either OraQuick or EIA were tested for HCV RNA by use of the Cobas Amplicor HCV test, v2.0 (Roche Molecular Diagnostics, Almere, Netherlands) (12).

Of 1,157 patients presenting to the eight public clinics, 714 (61.7%) were female and 443 (38.3%) were male. Their median age was 53 years (range, 15 to 95 years). After OraQuick testing, 22 (1.9%) were found to be positive, 1 (0.1%) had an invalid result, and 1,134 (98.0%) were negative (Table 1). Repeat OraQuick testing on specimens yielding positive or invalid results was 100% reproducible both on site and at the NH PHL.

Six of the 22 specimens (27%) which were positive by OraQuick were negative by EIA. One specimen with an invalid OraQuick result tested negative by EIA. One of the 1,134 specimens (0.1%) which tested negative by OraQuick tested positive by EIA. Excluding the invalid result, the sensitivity and specificity of OraQuick compared with EIA were 94.4% and 99.4%, respectively. The negative predictive value (NPV) and positive predictive value (PPV) of OraQuick were 99.9% and 72.7%, respectively.

The seven specimens with discordant results underwent CIA testing at the CDC (Table 2). Of the six that were OraQuick positive and EIA negative, five tested negative and one tested positive by CIA, suggesting five false-positive results by OraQuick and one false-negative result by EIA when agreement of two tests out of three (OraQuick, EIA, and CIA) was used as the determinant result. Of note, the specimen that tested positive by CIA (specimen 2) gave a CIA signal-to-cutoff ratio of 1.18, just above the cutoff of 1.00. Discordant specimen 7, which tested negative by OraQuick and positive by EIA, was positive by CIA, suggesting one false-negative result by OraQuick. All seven specimens tested negative for HCV RNA by reverse transcription (RT)-PCR.

This is the first report of the OraQuick HCV rapid antibody test for the detection of HCV antibodies in a large population with potential exposure to nosocomial HCV infection. Compared with EIA, we confirm that the OraQuick assay demonstrated high specificity (99.5%), which is similar to the findings of other reports (1, 5, 6). OraQuick also displayed a high NPV (99.9%), which is a critical characteristic for a screening test, especially in the setting of mass testing related to an outbreak, because it is critical to provide the patient reassurance regarding the absence of disease with a high degree of confidence. The sensitivity (94.1%) in our study was slightly lower than previously reported (97.8% to 100%) (1, 2), likely an artifact of a relatively small sample size. We consider the modest PPV (72%) to not be a significant limitation for OraQuick as a screening test, because all positive results should be confirmed by additional testing.

Nosocomial HCV outbreaks have been increasingly identified as a source of HCV transmission and usually require screening of large populations. Between 2008 and 2012, 16 hepatitis C outbreaks were reported in the United States and more than 90,000 at-risk persons were advised to undergo HCV screening (13). Screening of large populations is challenging, and the use of a rapid test can greatly aid testing efforts.

We demonstrate that OraQuick can be used in an outbreak setting to allow rapid screening of a large number of patients. This can identify HCV-infected patients who may be informed of their status and offered counseling to prevent further spread of the virus. In addition, timely identification or exclusion of HCV infection reduces anxiety and frustration among those potentially exposed.

In this study, CIA results were consistent with the EIA results for all but one specimen. The single patient whose specimen tested positive by OraQuick, negative by EIA, and positive by CIA may be explained by early infection/seroconversion or may be a biological false positive due to an unidentified interfering substance. Testing the patient at a later date would be useful to resolve the testing discrepancy in this single patient.

In a previous study (1), false results with OraQuick ranging from 0.65% to 1.31% were reported and the association between gender and false results was determined. In the current report, we found six specimens (0.52%) displaying false results and five of them were from females. This is consistent with the finding in the previous study that gender was associated with false rapid anti-HCV results of OraQuick testing. It is unclear why a higher occurrence of false rapid anti-HCV results is observed in females, and more studies are needed.

In this public health response, OraQuick was performed in nontraditional emergency public health clinics set up in nonmedical community settings (e.g., local school gymnasiums and cafeterias). The settings exhibited different ambient conditions, such as non-air-conditioned space in the summer and less-than-ideal lighting for reading the results. In spite of these limitations, there was only one invalid result, and repeat testing under controlled

conditions at the NH PHL documented perfect reproducibility. One limitation to our discordant analysis is that the recombinant immunoblot assay (RIBA) became unavailable in March 2012. RIBA had previously been considered a confirmatory test for positive IgG anti-HCV EIA or CIA test results. We were unable to confirm the anti-HCV results for those specimens with discrepant results between OraQuick and the EIA due to the manufacturer's discontinuation of RIBA.

Recently, the CDC has recommended widespread screening of "baby boomers" (persons born during 1945 and 1965) without prior determination of HCV risk because of the high prevalence of HCV infection and related disease (14). To help health care providers and public health professionals implement this recommendation, the CDC proposed a laboratory testing algorithm for identifying current HCV infection (15). This testing algorithm includes OraQuick as a screening test.

Our findings demonstrate that OraQuick is a robust and reliable field tool to detect HCV infection in the setting of mass testing. Supplemental testing using an RT-PCR assay and/or immunoassays should be performed on any specimen exhibiting a positive result.

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