

Self-Collected Nasal Swabs for Respiratory Virus Surveillance

Michael L. Jackson, Matthew Nguyen, Beth Kirlin, and Lawrence Madziwa

Group Health Research Institute, Seattle, Washington

We tested whether 135 patients reporting acute respiratory illness (ARI) could self-collect nasal swab specimens and ship them for laboratory testing. Most subjects (78.2%) collected and shipped their specimens without errors; 10.5% excluded ≥ 1 packing components; 12.9% made ≥ 1 packing errors. Self-swabbing at home is feasible for confirming ARI etiology.

Keywords. detection; human; influenza; public health surveillance.

Community-based studies of respiratory viruses can identify transmission patterns, estimate disease incidence, and estimate vaccine effectiveness [1–3]. In typical community studies, study staff collect oropharyngeal or nasopharyngeal swab specimens from subjects with acute respiratory illness (ARI); these specimens are tested for respiratory pathogens to determine disease etiology [3–5]. This approach requires either that study staff visit households whenever an ARI is reported (which is costly), or that ill subjects come to a study clinic to be tested (which is burdensome).

With the advent of molecular diagnostic methods, it is possible for study subjects to self-collect nasal swabs at home and ship the specimens to a designated laboratory for testing [6, 7]. Nasal swabs are nearly as sensitive as nasopharyngeal aspirates or swabs for detecting respiratory viruses in patients with ARI [8–10]. Self- or parent-collected nasal swabs also have comparable sensitivity to swabs collected by medical staff [11, 12]. Self-collection requires subjects to correctly collect, package, and ship the specimens to the laboratory in a timely manner. Little

is known about whether subjects are able to correctly complete these tasks. We tested the feasibility of self-collected nasal swabs, focusing on the timeliness of specimen collection and shipping and on the correct packaging of the specimens.

METHODS

Study Population and Setting

This study was conducted among members of Group Health, a managed care organization in Washington State. Group Health operates a telephone consulting nurse service (CNS) to give medical advice to members. Consulting nurse service calls are assigned a specific call protocol based on the chief complaint, such as “ankle injury” or “shortness of breath.” The consulting nurse collects symptom and exposure information from the patient and provides recommendations ranging from self-care at home to seeking immediate care. During periods of influenza circulation, all ARI calls are triaged to a “flu-like symptoms” protocol.

We identified all CNS calls triaged to the flu-like symptoms protocol between January 1, 2015 and March 31, 2015. Every Monday through Saturday, the study programmer identified all relevant calls for adult Group Health members (age ≥ 18 years) made the previous day (previous 2 days for Mondays). Calls were excluded as ineligible if the call data indicated that the illness was not acute. We initially defined acute illness as ≤ 3 days’ duration. However, on January 14, 2015, we changed the definition to ≤ 7 days’ duration due to the large number of callers reporting illness of 4–7 days’ duration. Study staff attempted to contact each potentially eligible patient by phone to verify eligibility; consenting patients were enrolled into the study. Patients were excluded if they did not have a cough or if they had used antivirals for the current illness.

Specimen Collection

On the day of study enrollment, we shipped a study packet to each participant via FedEx Priority Overnight. Each packet contained swab kits, consisting of the following: (1) a tube of remel MicroTest M4RT viral transport media; (2) a sterile package of polyester-tipped swabs (MacroPur Swab P); (3) absorbent pad, specimen transport bag, shipping manifest, and bubble wrap; and (4) prepaid US Postal Service shipping box addressed to the study laboratory (Marshfield Clinic Research Laboratory, Marshfield, WI). The packet also contained written instructions for collecting, packaging, and shipping the swab specimen; a link to an internet video demonstrating the process was included. Participants were instructed to collect the nasal swab the day they received the packet. After collecting the swab and placing it in

Received 3 August 2015; accepted 6 October 2015.

Presented in part: First International Meeting on Respiratory Pathogens, Singapore, September 2–4, 2015.

Correspondence: Michael L. Jackson, PhD, MPH, Group Health Research Institute, 1730 Minor Ave, Suite 1600, Seattle, WA 98101-1448 (jackson.ml@ghc.org).

Open Forum Infectious Diseases

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DOI: 10.1093/ofid/ofv152

the transport media, they were instructed to write the date on the specimen tube and on the shipping manifest. The manifest included questions on whether the subjects watched the video and whether it was helpful.

Laboratory Methods

Upon specimen receipt by the laboratory, laboratory staff recorded receipt of packages and whether any of the components were missing or packaged incorrectly. The nasal swab in M4RT was vortexed for 15 seconds. The sample was divided into aliquots containing a minimum of 500 µL and stored at -70°C until time of testing, up to 5 months. Nucleic acid was extracted from the sample using Roche MagNA Pure LC 2.0 system, and the samples were tested using a multiplex respiratory virus panel (eSensor Respiratory Viral Panel; GenMark Diagnostics, Inc., Carlsbad, CA). This multiplex panel tested for the following: respiratory syncytial virus (RSV) A and B; human rhinovirus; human metapneumovirus; parainfluenza viruses 1–4; influenza A(H1N1), A(H3N2), and B; coronaviruses OC43, NL63, HKU1, and 229E; and adenoviruses B and E.

We compared the prevalence of respiratory virus detection in our specimens with the prevalence in clinical specimens from the same time period and geographic area. Clinical specimen data were obtained from the University of Washington Clinical Virology Laboratory, which provides respiratory virus assays for the University of Washington Medical Center.

Analysis

We calculated the percentage of enrolled subjects who returned the kits, the prevalence of various packing errors, and the mean lag from enrollment to specimen collection and from specimen collection to arrival at the laboratory. We compared the prevalence of errors between those who watched the video with those who did not, using a χ^2 test.

RESULTS

During the study period, there were 3983 CNS calls from adults reporting an influenza-like illness; 3051 (76.6%) were known to be ineligible based on reported symptom duration. Of the remaining 932 calls, our study team was unable to contact 310 (33.3%) of the callers. We were able to enroll 135 (21.7%) of the 622 patients we contacted; 322 (51.8%) refused to participate, 76 (12.2%) were ineligible due to symptom duration, 30 (4.8%) were ineligible due to not reporting a cough, 58 (9.3%) were ineligible for having used antiviral medication, and 1 (0.1%) was ineligible due to not being a Group Health member.

Of the 135 subjects, 124 (91.8%) returned their completed swab kits to the study laboratory, and 1 additional subject returned an unused swab kit (Table 1). Most subjects (78.2%) collected, packaged, and shipped their kits without errors. However, 13 (10.5%) of the subjects were missing 1 or more of the

Table 1. Frequency of Completed Mailing of Self-Swab Kits, and Errors Among Returned Kits

Packing/Shipping Tasks	Number	%
Kits returned (n = 135 subjects)		
Did not return kit	10	7.4%
Returned an unused kit	1	0.7%
Returned a completed kit	124	91.9%
Error rates in completed kits (n = 124)		
No errors	97	78.2%
Any missing component	13	10.5%
Missing manifest	1	0.8%
Missing absorbent pad	10	8.1%
Missing bubble wrap	5	4.0%
Any packing errors ^a	16	12.9%
Manifest	13	10.6%
Absorbent pad	2	1.8%
Bubble wrap	0	0.0%
Bag not sealed	1	0.8%
Any date errors	11	8.9%
No date on swab tube	7	5.6%
No date on manifest ^a	3	2.4%
Date mismatch ^a	2	1.8%

^aRestricted to specimens in which the component was not missing.

packing components. An additional 16 (12.9%) specimen kits had 1 or more packing errors among the included components. For example, the absorbent pad was not correctly put in the bag containing the tube of media in 2 of the 114 kits (1.8%) that included the pad. None of the errors made the specimens unfit for testing. The 37 subjects who reported watching the video did not have fewer errors (21.6%) than the 82 subjects who reported not watching the video (19.5%) ($P = .79$).

In general, study subjects collected and shipped their specimens in a timely manner. The median time from enrollment to specimen collection was 1 day (range, 1–13 days), and 83% of subjects collected the specimen within 2 days of enrollment. However, 7 subjects (6%) waited more than 5 days to collect the swab. The median time from swab collection until receipt by the laboratory was 4 days (range, 2–8 days); 51% were received more than 3 days after collection.

We detected 1 or more respiratory viruses in 44.4% of the specimen samples. When we restricted our analysis to the 93 specimens collected within 7 days of illness onset, 1 or more respiratory viruses were detected in 52.7%. For comparison, 55.5% of clinical specimens from the University of Washington clinical virology laboratory during the study time period tested positive.

DISCUSSION

Most study participants self-collected nasal swab specimens in a timely manner and correctly packaged and shipped the specimens

to the study laboratory. Among specimens collected within 7 days of illness onset, the prevalence of virus detection was comparable to clinical specimens from the same time period. All but 1 swab were received within 7 days of collection, which appears to be acceptable for virus detection by reverse transcription-polymerase chain reaction [7]. These results support the use of self-collected nasal swabs in community-based respiratory virus studies.

In this study, subjects with ARI were enrolled by phone, with no opportunity for in-person training in the study procedures. We found that a nonnegligible fraction of our study subjects made 1 or more errors in packaging and shipping the specimens. We hypothesized that watching the video would reduce the rate of errors relative to using only the written instructions; however, this was not the case in our study. Researchers relying on self-swabbing may need to train subjects in person or use phone or video conference consultation with subjects as they collect the specimens.

We were not able to compare respiratory virus detection results with a gold standard, such as a nurse-collected nasopharyngeal aspirate. The similar prevalence of viruses in the self-collected specimens versus clinical specimens from the same time period suggests that sensitivity is sufficiently high for most research purposes. However, the comparison to clinical specimens could be biased if the true prevalence of viral etiologies for ARI differs between patients who seek care in a clinic versus patients who consult a nurse hotline. Clinical specimens also came from patients of all ages, whereas our sample was restricted to adults.

CONCLUSIONS

Self-collected nasal swabs are feasible for confirming the etiology of ARIs in community-based studies. Care must be taken to ensure that subjects can properly package and ship the specimens for analysis.

Acknowledgments

Financial support. This study was funded by Group Health Research Institute internal funds.

Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

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