

# Knowledge and Practice of Foodborne Disease Clinical Specimen Testing and Reporting in North Carolina, 2004

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## Abstract

**Background:** Detection of foodborne disease outbreaks relies on health care practitioners (HCPs), infection control practitioners (ICPs), and clinical laboratorians to report notifiable diseases to state or local health departments.

**Methods:** To examine knowledge and practices about notifiable foodborne disease reporting among HCPs and ICPs in western North Carolina and among clinical laboratorians statewide, participants responded to a self-administered questionnaire about foodborne pathogen testing and reporting, referencing *Campylobacter*, shiga-toxin producing *Escherichia coli*, and other organisms.

**Results:** Three hundred seventy-two of 1442 health care providers participated in this survey. Of 372 study participants, fewer than 20% knew that both the clinician and the laboratorian were legally responsible for reporting the study pathogens. Most laboratorians identified the ICP (57%) as responsible for reporting. There was a lack of understanding about which infections and test results were reportable.

**Limitations:** The response rate was very low, particularly among HCPs; participants may have been biased towards those with a particular interest in foodborne disease or surveillance. This descriptive study cannot be used to determine rates of reporting among the medical community.

**Conclusions:** Although not legally obliged to report, ICPs were found to play a significant role in disease reporting. Dissemination of surveillance information and training through the established network of North Carolina ICPs may be ideal for improving foodborne disease surveillance in this state.

**Key words:** Foodborne disease, surveillance, reporting

Foodborne pathogens are responsible for an estimated 76 million illnesses, 325 000 hospitalizations, and 5200 deaths annually in the United States.<sup>1</sup> Reporting of foodborne disease by physicians and laboratories (passive surveillance) is the backbone of outbreak detection; local health departments also identify outbreaks by those affected in the community. Passive surveillance in the US has been shown to be inadequate for many foodborne diseases when compared to other sources of data.<sup>2-8</sup>

Additionally, the US food supply has been targeted in at least two successful deliberate releases of biological agents.<sup>9,10</sup> Enhancement of disease surveillance, laboratory identification, and outbreak detection and control are needed to prepare for bioterrorist acts involving the food supply.<sup>11</sup> Therefore, the foodborne disease reporting system in North Carolina should be described and evaluated in order to identify areas to improve foodborne disease reporting and better protect North Carolina citizens.

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In North Carolina all clinical laboratory facilities and physicians are required by state law to report certain diseases/organisms to the state or the local health department. While not legally mandated to report communicable diseases, infection control practitioners (ICPs) also may play an important role in the passive surveillance system. Clinical surveillance for foodborne illness in North Carolina is conducted through clinician reports to the local health department via a mail-in card reporting system, which should be preceded by a phone report for diseases reportable within 24 hours. Most laboratory-based diagnoses are reported at the state level to the General Communicable Disease Control Branch of the Epidemiology Section via mail, phone, fax, or Internet. Foodborne diseases that are currently notifiable in North Carolina include *Campylobacter*, *Escherichia coli* (*E. coli*) O157:H7 (Shiga-toxin producing *E. coli*, STEC), foodborne *Clostridium perfringens*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Salmonella*, *Shigella*, *Vibrio vulnificus*, *Vibrio* other, and the category "foodborne other or unknown."<sup>12</sup>

The NC State Laboratory of Public Health accepts clinical specimens for the isolation of enteric microorganisms from public health care providers. Fecal specimens are examined for the presence of enteric pathogens including *Salmonella* serotypes, *Shigella*, *Campylobacter*, *Yersinia*, and *E. coli* O157:H7. Reference isolates are accepted from public and private health care providers for identification and/or serotyping. The State Laboratory of Public Health also participates in the Centers for Disease Control and Prevention PulseNet System,<sup>13</sup> which permits detection of foodborne outbreaks within a state or widespread and diffuse outbreaks across states or countries.<sup>14</sup>

Although passive surveillance systems are relatively incomplete,<sup>2</sup> consistent disease reporting is thought to provide enough information to discern important occurrences of excess disease. However, it is important to ensure that these passive components of the notifiable disease reporting system are operating efficiently to detect outbreaks, bioterrorist incidents, and emerging infectious diseases. In this study, we describe the knowledge and practices of foodborne disease reporting and screening as well as diagnostic testing among North Carolina health care practitioners (HCPs), ICPs, and laboratorians.

## METHODS

### Survey of Health Care and Infection Control Practitioners in Western North Carolina

Health care practitioners and ICPs were surveyed in 2004. Contact information for HCPs in western North Carolina came from a database compiled by the Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill (UNC-Chapel Hill) and maintained by the NC Medical Board. All medical and osteopathic doctors (excluding residents), physician assistants, and nurse practitioners whose professional status was "active" were included. Health care practitioners with at least 8 hours per week of direct patient care and a business address in 1 of the 19 counties in western North Carolina were included in the study. A list of ICPs in hospitals located in western North Carolina was

obtained from the Statewide Program for Infection Control and Epidemiology at UNC-Chapel Hill. Surveys, an introductory letter, and an Institutional Review Board fact sheet were mailed to HCPs and ICPs in western North Carolina. Nonresponding individuals were mailed another survey package 4 weeks after the original mailing. Nonresponders to the second mailing were sent an identical mailing 8 weeks after the original, for a total of 3 mailings. Health care practitioners included in the analysis practiced in internal medicine, pediatrics, family practice, general practice, obstetrics/gynecology, and emergency department specialties.

### Survey of Laboratories in North Carolina

Laboratories statewide were contacted in 2004 through NC Micronet, a database designed for rapid dissemination of emergency information to clinical microbiologists in North Carolina. Laboratories were included in the study if they had fecal specimens submitted for bacterial screening in 2003. The survey was posted on a secure server/Web site at the State Laboratory of Public Health, and the contact person on the NC Micronet list at each laboratory was e-mailed survey information, an introductory letter, and an Institutional Review Board fact sheet and was asked to participate. Contacts who did not complete the survey within 2 weeks received a reminder e-mail, and contacts who did not complete the survey within 4 weeks of the initial e-mail were contacted by telephone. Because laboratory surveys were sent electronically, the resources existed to survey laboratories statewide.

### Survey Content and Data Analysis

This survey was modeled closely after the Centers for Disease Control and Prevention's FoodNet surveys.<sup>15</sup> All study participants were asked questions about the diagnostic testing and reporting requirements of *Campylobacter*, Shiga-toxin producing *E. coli*, *Salmonella*, *Shigella*, and infection with *Vibrio* species. Some questions also included *L. monocytogenes* and *Yersinia* infection.

The major domains of the survey included practice information (specialty, setting, location); foodborne disease experience (number of patients seen with acute diarrheal illness in past 30 days, clinical history of last patient seen with acute diarrheal illness, factors relating to requesting/not requesting a stool specimen, location of bacterial stool culture testing); and reporting practices (who in the facility reports positive test results to the local and state health departments). Questions about foodborne illness and prevention patient education, confidence in diagnosing, and treating foodborne illness as well as confidence in the local health department's ability to investigate disease outbreaks also were asked. The survey contained both closed and open-ended questions as well as a 5-point Likert scale.

Data from HCP and ICP surveys were manually entered into a Centers for Disease Control and Prevention EpiInfo database and reviewed for accuracy and completeness. Laboratorian surveys were downloaded into a Microsoft Access database. Data frequencies and proportions were examined.

All participants provided informed consent for the survey.

This study was approved by the University of North Carolina at Chapel Hill's Biomedical Institutional Review Board.

## RESULTS

### Survey of Health Care and Infection Control Practitioners in Western North Carolina

Surveys were sent to 1442 HCPs in western North Carolina. There were 319 respondents who fit the inclusion criteria; 53 respondents worked less than 8 hours per week and were excluded from the analyses (response rate: 319 of 1389, 23%). Respondents included physicians (228 of 319, 72%), nurse practitioners (55 of 319, 17%), and physician assistants (36 of 319, 11%). Among physicians, 38% were in family practice (87 of 228), 16% were in internal medicine (36 of

228) or a subspecialty (7%, 16 of 228), 13% each were in the emergency department and pediatrics (30 and 29 of 228, respectively), and the remainder were in obstetrics/gynecology (10%) or pediatric subspecialties (3%). Medical specialties for 18 participants were unknown.

Surveys were sent to ICPs at 21 facilities in western North Carolina and 11 responded. Seven of the responding ICPs worked in a hospital while the remaining 3 worked in more than one setting (eg, a hospital and long term care facility).

### Diagnostic Testing Knowledge and Practice

The majority of HCPs noted that stool samples were tested at their hospital laboratory (74%, 227 of 306); 21% reported that screens were performed at independent laboratories (65 of 306); and 5% (14 of 306) did not know. Thirteen participants

**Table 1.**  
**North Carolina Laboratories and Health Care and Infection Control Practitioners in Western North Carolina Who Report That the Laboratory Screens for These Pathogens**

Enteric Bacterial Pathogen	Laboratories No. (%) (N=42)	Health Care Practitioners No. (%) (N=319)	Infection Control Practitioners No. (%) (N=11)
<i>Salmonella</i>			
Yes	39 (100)	270 (90)	11 (100)
No	0	1 (<1)	0
Don't know	...	26 (9)	0
<i>Shigella</i>			
Yes	40 (100)	266 (89)	11 (100)
No	0	1 (<1)	0
Don't know	...	31 (10)	0
<i>Campylobacter</i>			
Yes	34 (87)	239 (81)	7 (78)
No	5 (13)	7 (2)	2 (22)
Don't know	...	48 (16)	0
<i>E coli</i> O157/STEC			
Yes	22 (60)	143 (53)	5 (50)
No	15 (40)	51 (19)	4 (40)
Don't know	...	76 (28)	1 (10)
<i>Vibrio</i>			
Yes	11 (35)	60 (23)	4 (44)
No	20 (65)	66 (25)	4 (44)
Don't know	...	137 (52)	1 (11)
<i>Yersinia</i>			
Yes	16 (43)	4 <sup>†</sup>	...
No	21 (57)		
Don't know	...		
<i>L monocytogenes</i>			
Yes	3 (10)	...	...
No	26 (90)		
Don't know	...		

† Noted as part of an "other" response, percentage not calculable

failed to respond to this question.

In general, HCP respondents identified the same pathogens as part of a routine screen. (See Table 1.) About half thought *E coli* O157:H7 was tested for routinely. Fewer thought *Vibrio* species were included in the routine screen, and many respondents were unsure about *Vibrio* and *E coli* O157:H7. Two individuals noted that *E coli* O157:H7 was screened for in cases with bloody stool. In an open-ended response, 4 individuals said *Yersinia* and 4 said *Giardia* testing were part of the screen.

Most ICPs (10 of 13) noted that stool samples were tested routinely at their hospital laboratory while several (3 of 13) indicated that the samples were tested by independent laboratories. According to most (8 of 9) of the ICPs, hospital laboratories conducted all stool screens, and 1 ICP reported 90% of cultures being conducted there. An additional ICP reported that all routine cultures were performed at a commercial laboratory.

### Knowledge of Reporting Requirements

Among HCPs, 45% to 57% incorrectly thought that only clinicians were responsible for reporting, depending on the pathogen (Figure 1), while 13% incorrectly thought that only the laboratorian was responsible for reporting these diseases (range, 12% to 14%). On average, 5% to 7% of HCPs correctly noted that both clinicians and laboratorians were legally responsible for notifying the health department of these pathogens. An additional 21% to 31% did not know who should report the study pathogens. Eight percent of HCPs (24 of 296) incorrectly identified *Campylobacter* as nonreportable, 8% (22 of 289) correctly identified *Yersinia* as nonreportable, and 1% to 3% of HCPs incorrectly identified the remaining diseases as nonreportable.

Among ICPs, almost half (4 of 11) incorrectly thought that

only the clinician was responsible for reporting infections with the study pathogens; a few (2 of 11) incorrectly thought that only the laboratorian was responsible for reporting these pathogens; the same proportion (2 of 11) correctly thought that both the clinician and the laboratorian were responsible for reporting; and some (4 of 11) thought some other person was responsible for reporting. *Yersinia* infection was correctly identified as nonreportable by 1 ICP. No ICP identified *Campylobacter*, STEC, *L monocytogenes*, Salmonellosis, Shigellosis, or *Vibrio* as “not reportable.”

### Reporting Practices

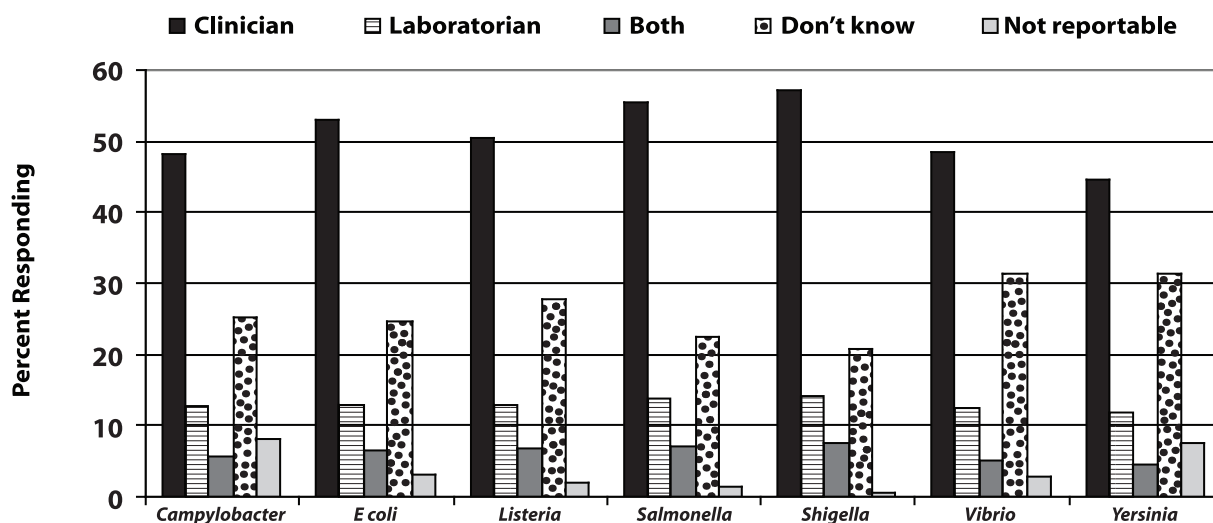
When asked who in the facility completes the state’s communicable disease report card, HCPs reported that the physician (38%, 121 of 315), nurse (14%, 45 of 315), nurse practitioner (6%, 19 of 315), physician assistant (3%, 9 of 315), or another provider who saw the patient (3%, 10 of 315) completed the disease report card. However, 15% of respondents (48 of 315) did not know who completed the card in their office. Another 29 HCPs (9%) said that ICPs, the laboratory (8%, 24), or the office manager or other administrative personnel (<2%, 6) completed the card.

Infection control practitioners may report notifiable diseases to the health department, but they are not legally required to do so. Nevertheless, most of the Infection control practitioners (8 of 11) noted they completed the disease report card; 2 reported that the physician and 1 reported that the laboratorian completed the card.

### Survey of Laboratories in North Carolina

E-mails giving the Web site for the survey were sent to 108 clinical diagnostic laboratories in North Carolina. Forty-eight laboratories responded and 42 fit laboratory inclusion criteria,

**Figure 1.**  
Percent of Western North Carolina Health Care Practitioners Who Think Clinicians and/or Laboratorians Are Legally Responsible for Reporting *Campylobacter*, *E coli* O157/STEC, *L monocytogenes*, *Salmonella*, *Shigella*, and *Vibrio* Species, and *Yersinia* to the Health Department.



for a response rate of 41% (42 of 102). The participating laboratories were primarily hospital or medical-center based laboratories (39 of 42), but 2 were independent commercial laboratories, and 1 was a military base laboratory.

### Diagnostic Testing Knowledge and Practice

We asked laboratorians about pathogens included in their routine enteric screen and most reported including *Salmonella*, *Shigella*, and *Campylobacter*. Fewer included *E coli* O157:H7, *Yersinia*, and *Vibrio*. Routine screening for *L monocytogenes* was rare. (See Table 1.)

When a positive result was determined for a foodborne pathogen, more than half of laboratorians (25 of 40) forwarded isolates to the State Laboratory of Public Health within 24 hours. Several (3 of 40) forwarded isolates weekly while others (4 of 40) never sent isolates, and the remaining respondents forwarded isolates monthly, yearly, within some other time frame, or whenever needed. Some sent isolates to the county health department (n=8), presumably to forward to the State Laboratory of Public Health.

### Knowledge of Reporting Requirements

For *Campylobacter*, *L monocytogenes*, Shiga-toxin producing *E coli*, *Shigella*, and *Salmonella*, 36% to 41% of 39 respondents from clinical diagnostic laboratories incorrectly thought that only the laboratorian was responsible for reporting (Figure 2); 26% to 32% incorrectly thought only the clinician was responsible for reporting; and 5% incorrectly thought *L monocytogenes* was nonreportable. For *Vibrio*, 33% of laboratorians thought only laboratories were responsible for reporting, 33% thought only clinicians were responsible, and 3% thought *Vibrio* was nonreportable. For *Yersinia*, 28% said only the laboratorian was responsible for reporting, and 31% said only the clinician was responsible; 10% correctly thought *Yersinia* was nonreportable. For all study pathogens, an average of 27% (range, 23% to

28%) of respondents (n = 9-11) identified both clinician and laboratorian as responsible for reporting.

### Reporting Practices

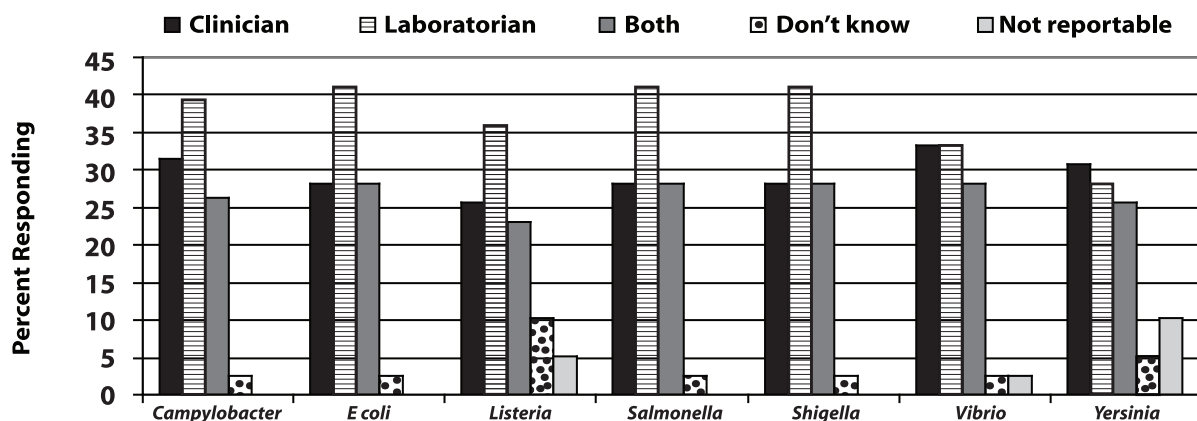
The majority of laboratorians (21 of 38) reported notifiable test results to the health department by mail. Some (10 of 38) used a fax, 1 individual each reported using the telephone and the Internet, and some (5 of 38) did not know how data was reported. When asked who in their laboratory actually reported notifiable results, most laboratorians (23 of 41) said the ICP was responsible while others (15 of 41) said the microbiologist was responsible. One each said the laboratory manager was responsible, automated computer reporting was used, or he/she notified an epidemiology clinic.

## DISCUSSION

This survey of participants in the North Carolina communicable disease reporting system identified gaps in knowledge of foodborne disease testing and deficiencies in foodborne disease reporting practices. All of the pathogens included in this survey are part of the routine bacterial stool culture screen at the State Laboratory of Public Health, but hospital and independent laboratories may include different pathogens. Survey results indicate HCPs and ICPs were uncertain about the pathogens included in a routine screen at the laboratories used by their office or facility. Lack of knowledge about the routine panel at their reference laboratory could result in significant underdiagnosis and underreporting of foodborne pathogens if clinicians assume diagnostic tests will be performed on stool samples because they are considered "routine," when they are not actually part of the routine screen at their particular reference laboratory.

The routine screening practices of laboratories to identify the pathogens in the survey are comparable to those of the

**Figure 2.** Percent of North Carolina Laboratorians Who Think Clinicians and/or Laboratorians Are Legally Responsible for Reporting *Campylobacter*, *E coli* O157/STEC, *L monocytogenes*, *Salmonella*, *Shigella*, and *Vibrio* Species, and *Yersinia* to the Health Department.



national foodborne surveillance sites of FoodNet, where most laboratories routinely culture for *Salmonella*, *Shigella*, and *Campylobacter* species, but fewer routinely culture for *E coli* O157:H7 (57%) and *Y. enterocolitica* (50%). Fifty percent of FoodNet sites routinely test for *Vibrio* species,<sup>16</sup> which is more than among the North Carolina laboratories surveyed. In a study of laboratories in Gulf Coast states, only 22% of stool specimens submitted to laboratories with *Vibrio* culturing capability were screened for *Vibrio* species, and only 24% of the laboratory directors in these facilities knew that the organism was reportable in their state.<sup>17</sup> There may be a potential for underdiagnosis of this infection in North Carolina and other US states due to lack of testing. The costs in materials and labor of testing stool samples may continue to be one barrier to reporting.<sup>17</sup>

A limitation of the present study was the low response rate among HCPs (22%) and laboratorians (39%) and the small number of ICPs (n=11). Since respondents may have more interest and knowledge in foodborne illness testing and reporting compared to other clinicians and laboratorians, the data presented here may overestimate the knowledge and practices around foodborne disease testing and reporting. Data on the workplace setting of nonresponders was not available.

Participants seemed aware of the most frequently tested foodborne pathogens but they were deficient in knowledge of reporting requirements. All pathogens included in the survey are reportable in North Carolina except *Yersinia*. Eight percent of HCPs, 1 ICP, and 10% of laboratorians correctly thought *Yersinia* was not a reportable diagnosis. Three percent to 5% of laboratorians incorrectly thought *L monocytogenes* and *Vibrio* species were not reportable, and 8% of HCPs incorrectly thought *Campylobacter* was not reportable. *L monocytogenes* was added to the North Carolina notifiable disease list in 2001.

An average of 57% of HCPs knew the clinician was responsible for reporting notifiable diseases to the health department whereas an average of 64% of laboratorians knew that reporting the study pathogens was their responsibility. Health care practitioners may be expected to report confirmed cases less often than laboratories because there is a delay in obtaining diagnostic confirmation from the laboratory and patients may no longer be under the clinician's treatment. Only 6% of HCPs and 25% of laboratorians recognized that both clinicians and laboratorians were required to report notifiable diseases. Schramm,<sup>18</sup> who assessed the origins of confirmed case reports in Vermont in the late 1980s, found that 71% of case reports were from laboratories, 10% from nurses including ICPs, 10% from physicians' offices, and 9% from elsewhere. Thus, recognition by laboratorians of their responsibility to report may be key in the passive surveillance system. In North Carolina physicians are required to report "after the disease or condition is reasonably suspected to exist."<sup>12</sup> In many circumstances, reasonable suspicion of a foodborne acute diarrheal illness may be difficult to define without laboratory confirmation.

Most laboratories forward foodborne pathogen isolates to the State Laboratory of Public Health within 24 hours, but some forward them less frequently or never. As part of the Centers

for Disease Control and Prevention PulseNet system, the State Laboratory of Public Health serotypes some foodborne pathogens. Thus, especially in the context of a foodborne disease outbreak, timely forwarding of isolates by laboratories should be encouraged.

Limited knowledge among laboratories about the legal responsibility for reporting notifiable results may reflect the fact that many hospital laboratories depend on ICPs to report laboratory results under surveillance. Nevertheless, since reporting is the legal responsibility of the clinical laboratory, our findings indicate a need to educate laboratorians on the communicable disease reporting process and requirements.

The study also points to a need to increase awareness and knowledge among HCPs. The vital role played by clinicians in state surveillance systems is undisputed.<sup>19-21</sup> The HCP's interaction with the patient is the front line of disease surveillance. Studies in the US and elsewhere have found that knowledge of the reporting system is deficient among physicians with low rates of reporting notifiable disease,<sup>3,22</sup> suggesting that increased communication with physicians could enhance passive reporting.<sup>22</sup>

This survey is the first study to examine notifiable disease testing and reporting awareness in North Carolina. To our knowledge it is also the first assessment of awareness of reporting requirements among participants in the disease reporting system through which foodborne illness due to a biological attack may be likely to first appear: ICPs, clinical diagnostic laboratorians, and primary care physicians and health care professionals.

The study results indicate that ICPs play a significant role in reporting diseases though they are not currently legally obligated to report in North Carolina. Infection control practitioners were identified by 9% of HCPs, 73% of ICPs, and 57% of laboratorians as being the persons who actually submitted reports of disease to the health department. Many ICPs actively monitor their institution's laboratory and clinical data to identify reportable cases. Dissemination of surveillance information and training opportunities through the well-established network of ICPs may offer opportunities to improve foodborne disease surveillance in North Carolina. Formally incorporating ICPs into the disease reporting structure also may enhance the passive surveillance system. Reaching HCPs who do not have contact with an ICP is an issue that needs further exploration. Efforts to facilitate disease reporting for HCPs also should be considered. For example, a printed statement on laboratory test results could serve to remind laboratorians and HCPs which pathogens are included in a routine stool culture screen and increase indirect communication between the laboratory and HCPs. Laboratory results for reportable positive pathogens also could include a reporting reminder to the HCP or, for computerized laboratory results, could provide an Internet link for web-based reporting. **NCMJ**


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