Evaluation of a Statewide Foodborne Illness Complaint Surveillance System in Minnesota, 2000 through 2006

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ABSTRACT

Foodborne outbreaks are detected by recognition of similar illnesses among persons with a common exposure or by identification of case clusters through pathogen-specific surveillance. PulseNet USA has created a national framework for pathogen-specific surveillance, but no comparable effort has been made to improve surveillance of consumer complaints of suspected foodborne illness. The purpose of this study was to characterize the complaint surveillance system in Minnesota and to evaluate its use for detecting outbreaks. Minnesota Department of Health foodborne illness surveillance data from 2000 through 2006 were analyzed for this study. During this period, consumer complaint surveillance led to detection of 79% of confirmed foodborne outbreaks. Most norovirus infection outbreaks were detected through complaints. Complaint surveillance also directly led or contributed to detection of 25% of salmonellosis outbreaks. Eighty-one percent of complainants did not seek medical attention. The number of ill persons in a complaint’s party was significantly associated with a complaint ultimately resulting in identification of a foodborne outbreak. Outcome confirmation was related to a complaint’s ability to identify a common exposure and was likely related to the process by which the Minnesota Department of Health chooses complaints to investigate. A significant difference (P < 0.001) was found in incubation periods between complaints that were outbreak associated (median, 27 h) and those that were not outbreak associated (median, 6 h). Complaint systems can be used to detect outbreaks caused by a variety of pathogens. Case detection for foodborne disease surveillance in Minnesota happens through a multitude of mechanisms. The ability to integrate these mechanisms and carry out rapid investigations leads to improved outbreak detection.

Foodborne illnesses affect an estimated 76 million people and cost up to $30 billion each year in the United States (1, 17). Many illnesses in outbreak and nonoutbreak situations stem from food eaten outside of the home (13, 15, 16, 19). The complexity of the food supply increases the number of control points needed to prevent foodborne illness and increases the possibility of contaminated product reaching the consumer. Thus, early detection of outbreaks is critical for reducing the burden of foodborne illnesses by abating the source of contamination and identifying common contributing factors that could be controlled to prevent future outbreaks (20).

A foodborne outbreak is defined as the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food. However, no standard methods exist for detecting and reporting these events (2). In the United States, state and local health departments are responsible for investigating foodborne illnesses. Detection of foodborne outbreaks typically occurs through one of several ways: identification of a cluster of cases through pathogen-specific surveillance, investigation of consumer complaints of suspected foodborne illness, or report of clusters of illness by health care providers or institutions.

Pathogen-specific surveillance is based on reports of diagnostic laboratory tests or individual case reports from doctors’ offices to public health agencies. The use of molecular typing by pulsed-field gel electrophoresis and the sharing of subtype patterns on a national basis through PulseNet has greatly increased the sensitivity of outbreak detection for Salmonella and Escherichia coli O157:H7 (6, 7, 18). A drawback of pathogen-specific surveillance is that it is dependent on an ill person seeking health care. However, individuals suffering from enteric illnesses often do not seek health care, and many of those who do are never tested. One estimate suggests that for every case of salmonellosis reported to the health department through laboratory surveillance, 38 are unreported (4, 17). Pathogen-specific surveillance also suffers from long lag times. The interval from illness onset and report to a health department may be 2 to 3 weeks (3, 10). Lengthy lag times are problematic; a survey of local and state epidemiologists revealed that delayed notification was a major barrier to investigation of foodborne disease cases (12).

Investigation of consumer complaints of suspected foodborne illness also provides information for public health
surveillance systems. Complaint systems are the only way to
detect outbreaks caused by nonreportable pathogens and
emerging pathogens (5). Nonreportable illnesses include
those caused by many of the common agents of foodborne
ilness such as norovirus and Clostridium perfringens and
less frequently recognized but potentially emerging food-
borne pathogens such as enterotoxigenic E. coli. Direct
reporting of exposure at the time of illness also may allow
complaint systems to be used to detect outbreaks faster than
pathogen-specific surveillance systems.

Little work has been done to systematically investigate
the efficacy of complaint systems for detecting foodborne
illness outbreaks and the type of information that should be
collected. In this study, we analyzed the Minnesota
Department of Health (MDH) foodborne illness complaint
system. The objectives of the study were to quantify sources
of case detection for confirmed foodborne outbreaks, to
compare characteristics of outbreak- and nonoutbreak-
associated complaints, and to evaluate what information
regarding the complaint should be collected to allow
detection of an outbreak.

MATERIALS AND METHODS

In Minnesota, the model developed for foodborne illness
outbreak detection and investigation involves centralized inter-
viewing of ill individuals at the MDH. Outbreak investigations are
done primarily by the MDH with support from local health
departments. A few larger local health departments in Minnesota
conduct their own investigations, but always with input and
and collaboration from the MDH. Data on foodborne illness cases are
stored in a central database at the state level. The database indicates
whether information on the case was received through pathogen-
specific surveillance. Case alerts not received through pathogen-
specific surveillance are received through provider reports of
illness clusters, reports from institutions, reports of complaints
from restaurants, or in the majority of cases direct consumer
complaints to the MDH foodborne illness hotline.

The MDH has run a statewide foodborne illness complaint
hotline since 1998. Residents of Minnesota are encouraged to call a
toll-free number when they suspect they have a food-related illness. Individuals also can e-mail a complaint to the MDH via the
MDH Web site. Local health departments are asked to either forward complaint callers to the MDH or fax a completed case
report form. Complaints also are occasionally forwarded to the
MDH from food establishments. A standard intake form is used to
record complainant information. Questions cover demographics of
the caller, illness information, suspected food product or
establishment, and names and contact information for other
members of the dining party (if applicable). When illness is
limited to members of a single household, a 4-day food history is
obtained, focused on meals eaten outside of the home. When
illness is reported among members of multiple households,
information is taken only on meals common to members of the
different households. All information collected is entered into the
MDH complaint database. Complaints involving multiple house-
holds, instances of multiple independent complaints about the same
restaurant, and reports of clusters of illness are evaluated by the
MDH foodborne illness supervisor, and outbreak investigations are
initiated with the appropriate state or local health agencies. No
automatic detection algorithm is used to detect multiple complaints
about the same restaurant; rather, the MDH staff must review
incoming data regularly to find common complaints.

The MDH staff conducts standard interviews for all
foodborne illness cases detected through pathogen-specific sur-
veillance for a variety of reportable pathogens, including Salmonella, Shiga toxin–producing E. coli, Shigella, Campylo-
bacter, Listeria monocytogenes, Vibrio spp., Yersinia spp., Cryptosporidium, and Cyclospora. All restaurants that affected
persons reported eating at within the 7 days prior to illness onset
also are entered in to the MDH complaint database.

Data from the MDH complaint database and summaries of
confirmed gastroenteritis outbreaks from 2000 through 2006 were
used for this study. A confirmed foodborne outbreak was defined
as an incident in which two or more persons experienced a similar
illness after ingestion of a common food or meal and for which an
diagnostic test confirmed the pathogen in those affected persons.
Laboratory-based surveillance is used for this study. A confirmed foodborne outbreak was defined
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diagnostic test confirmed the pathogen in those affected persons.
Laboratory-based surveillance is used for this study.
significant. The Wilcoxon–Mann-Whitney test was used to test the difference between number of persons in a complainant group that were ill and total number of persons in a complainant group that were exposed. A logistic regression model was used to estimate associations between variables of interest from univariate analyses. Variables were included in the logistic regression model when they were significant in the univariate analysis at $P < 0.05$. The outcome of this model was a determination of whether a complaint was outbreak associated. Number exposed in a group and number ill in the same group were highly correlated. We chose to include number ill in our multivariate model because this number was likely to be more reliably provided. Number ill was categorized into one, two, or three or more.

We also evaluated a caller’s ability to identify the source of their illness by examining the suspected incubation period of illness of callers. Callers were asked about illness onset time and suspected meal time. Suspected incubation periods were calculated by taking the difference between these times. These incubation periods do not always represent the true incubation period of a caller’s illness because we used a suspected meal time as the starting point. Median incubation periods for outbreak and nonoutbreak complaints were compared using a Wilcoxon–Mann-Whitney test.

**RESULTS**

From 2000 to 2006, 332 confirmed foodborne outbreaks occurred in Minnesota; 261 (79%) were detected solely from consumer complaints. Most of the complaints (162, 62%) were about food establishments, and 99 (38%) were about an event (Table 1). Of complaints about establishments, 12 (7%) were initially made to the establishment (and subsequently forwarded by the establishment to a health department) (Table 1). Eight (2%) additional outbreaks were detected through a combination of complaints and other surveillance methods. The remaining outbreaks were detected through pathogen-specific surveillance, health care provider reports of clusters of illnesses due to nonreportable pathogens, and reports from institutions, which includes places such as schools and long-term care facilities (Table 1).

Sixty-one percent of outbreaks were caused by norovirus or suspected norovirus. The complaint system detected almost all of the outbreaks caused by nonreportable agents such as norovirus, *C. perfringens*, *Bacillus cereus*,...
Staphylococcus aureus, and scombroid toxin (Table 1). Complaints also contributed to detection of outbreaks caused by reportable pathogens. For example, five Salmonella outbreaks (14%) were found solely through consumer complaints, and complaints contributed to outbreak identification in another four Salmonella outbreaks (11%) (Table 1).

From 2000 to 2006, the MDH foodborne illness complaint system received 5,414 complaints. Most of these were received directly by the MDH (Fig. 1). We were able to identify complaints in the database associated with 236 of the 269 confirmed outbreaks that were found solely through complaints or with the aid of complaints. Of the 33 outbreaks for which associated complaints could not be identified, 25 were reported to the MDH from local health agencies and were not entered into the surveillance database. The remaining eight outbreaks were found through direct consumer complaint calls, but no entry in the database could be found. Some outbreaks were associated with multiple independent complaints, resulting in 359 complaints (7%) being designated as outbreak associated. Of the 236 outbreaks identified in the complaint database, the majority (165, 70%) resulted from one complaint, with 146 (88%) of these complainants reporting illness from multiple households with a clear common exposure. In outbreaks that resulted from one complaint reporting common exposure the median number of ill persons was five, which was higher than that for outbreaks detected through multiple complaints except for one outbreak that was detected based on information from 12 individual calls (Table 2).

The predominant symptom of callers into the complaint system was diarrhea (83%), followed by cramps (77%), vomiting (66%), fever (25%), and bloody stool (4%). Among all callers to the complaint system, 870 (19%) had visited a health care provider. Health care visits also were stratified by the number of ill persons associated with a complaint. For the vast majority of calls, only one person was ill. As the number of ill persons reported in a complaint increased, the percent of ill persons visiting a health care provider decreased: 22% for one ill person, 15% for two ill persons, and 11% for three or more ill persons ($P < 0.001$). Although it was not possible to evaluate the frequency of physician visits by etiology, callers with both vomiting and diarrhea were more likely to visit a physician than were callers with other symptoms, 562 (25%) versus 308 (13%), respectively ($P < 0.001$). An examination of lag times for complaints and reports obtained through pathogen-specific surveillance revealed that lag times were much shorter for reports received through the complaint system, with a median time of 2 versus 19 days, respectively ($P < 0.001$).

Complaint callers associated with an outbreak differed from nonoutbreak complaint callers by several characteristics (Table 3). Outbreak-associated complainants were slightly older (45 versus 41 years, respectively; $P = 0.0002$) and were more likely to have diarrhea and fever than were those complainants whose calls were not outbreak associated. More nonoutbreak-associated complainants also had sought medical care than did complainants whose calls were associated with an outbreak, 834 (19%) versus 36 (13%), respectively ($P < 0.001$). The median number of ill persons and the median number of exposed persons were both higher for outbreak-related complaints (Table 3). These two items were highly correlated.

The logistic regression model included age, number of ill persons, and incidence of fever, diarrhea, bloody stool, physician visit, and physician call. Only age and number ill remained associated with outbreaks in the final model. The odds of being an outbreak-associated complaint were 1.02 times higher (95% confidence interval [CI], 1.02 to 1.03) for every year increase in age of a caller. The odds of a complaint being outbreak associated were 15.8 times higher (95% CI, 11.1 to 22.5) for complainants reporting three or more people ill than those with just one person ill in the group. The odds of a complaint being outbreak associated were also higher for complainants who reported two people ill compared with those who reported just one person ill, with an odds ratio of 3.53 (95% CI, 2.38 to 5.23).

Of the 5,414 complaints, 4,198 had complete time data that could be used to calculate an incubation period. We

### TABLE 2. Number of outbreaks in complaint database by the number of individual complaints associated with that outbreak in the complaint system and median number of ill persons per complaint

<table>
<thead>
<tr>
<th>No. of complaints</th>
<th>No. of confirmed outbreaks</th>
<th>Median no. of ill persons per complaint (1st, 3rd quartiles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1$^a$</td>
<td>143</td>
<td>5 (3, 12)</td>
</tr>
<tr>
<td>1$^b$</td>
<td>22</td>
<td>2 (1, 3)</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
<td>2 (1, 4)</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>2 (2, 3)</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>2 (2, 2.5)</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3 (2, 3)</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>2 (1, 3)</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>2 (2, 3)</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>7 (5, 9)</td>
</tr>
<tr>
<td>Total</td>
<td>236</td>
<td></td>
</tr>
</tbody>
</table>

$^a$ One complainant reported illness from multiple households.

$^b$ One complainant reported illness from a single household.
further excluded 109 complaints because illness onset times preceded the meal time. The remaining 4,089 complaints included 264 outbreak-associated complaints. Median suspected incubation times were 27 h for outbreak-associated complaint callers and 6 h for nonoutbreak-associated complaint callers ($P < 0.001$).

**DISCUSSION**

The aim of this article was to examine the usefulness of a complaint-based surveillance system for detecting foodborne illness outbreaks and to describe characteristics of such a system. Our analysis revealed that consumer complaint systems are an effective surveillance tool for detection of foodborne illnesses caused by various agents, including reportable pathogens. Complaint systems can be used to enhance pathogen-specific surveillance and provide the primary means of outbreak detection for nonreportable and emerging pathogens for which clinical laboratory diagnosis is not available.

The use of a complaint-based surveillance system can also speed up investigations; investigators do not have to wait for cases to be reported through pathogen-specific surveillance. When complaint systems are in place, the lag time between illness and reporting to the health department is decreased, which can lead to more timely investigations and follow-up by health departments. This shorter lag time is especially important when items that are rapidly consumed, such as fresh produce, are the cause of the outbreak. Shorter lag times may lead to more accurate food histories because memories of events are more accurate closer to when the illness occurred. Improved information on exposures could lead to more reliable identification of linked cases and clusters of illness.

Our data also indicated that high priority should be placed on callers reporting multiple illnesses. The number of ill persons was significantly correlated with an outbreak-associated complaint. This issue is related to the ability of the caller to determine a common exposure for their illness when more people are involved and the response of the health departments in targeting investigation of calls with clear common exposures. These types of calls represent events that are highly likely to have been outbreak associated and can easily be detected through a complaint system that collects the proper information to allow timely follow-up.

The majority of callers to the MDH complaint surveillance system never sought health care, so they would not have entered the pathogen-specific surveillance stream. There also appeared to be an inverse relationship between callers with an outbreak-associated complaint and the likelihood of seeking health care. Callers with more ill persons in their group were less likely to seek medical care, which could indicate that those who were part of a larger outbreak were better able to self-identify a cause and thus did not seek medical care. Another possibility involves norovirus infection outbreaks, which usually result in large numbers of ill individuals with less severe symptoms who would not need medical attention. Whatever the cause, it is clear that the vast majority of callers to complaint systems would never enter the laboratory-based surveillance stream.

In a previous study, persons who attributed their illness to a meal eaten outside the home were likely to identify a meal eaten within 5 h as the source of illness, even when such a short incubation period was inconsistent with their symptoms (8). Our analysis revealed a similar result, with a median incubation period of 6 h for nonoutbreak-associated complaints. However, for outbreak-associated complaints the median incubation period was 27 h. A large proportion of outbreak-associated complainants had a clear common source of exposure, such as a common event or many ill person from one meal with no other exposures, making identification of a source much easier. Those without a common exposure, which accounted for the majority of nonoutbreak-associated complaints, tended to suspect the last meal eaten. When callers had enough information, they were very adept at identifying a common exposure. When this information was not available, the callers were likely mistaken about the suspected cause of illness, supporting the need to collect detailed food histories.

This study had several limitations. Several outbreaks identified through complaints could not be linked to callers in the complaint database, and some callers may have been
part of an outbreak that was never investigated by the health department. These limitations would tend to make differences between outbreak- and nonoutbreak-related calls harder to detect. Even with these limitations, this analysis indicates the potential benefits of using consumer-driven complaint systems for foodborne illness surveillance. This review of a robust complaint system revealed the various ways outbreaks can be found and the type of information that is needed to maximize the chance of finding clusters of illness. Information on a caller’s illness, eating establishments visited, and the number of people ill is necessary to find food-related outbreaks. Contact information for the caller is essential for follow-up investigations. Complaint systems fill many of the gaps in traditional laboratory surveillance. Using both systems together will make it much easier for health departments to find and prevent cases of foodborne illness. In addition to combining both surveillance methods, health departments must act on gathered data. The success of the MDH in detecting a large number of foodborne outbreaks is due to their ability to aggregate data from various sources and then aggressively follow up potential cases.

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REFERENCES