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PAPER

Improving and Enhancing Telephone-based Disease Surveillance Systems in Local Health Departments

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Preface

This report presents the findings of a project designed to identify system-level characteristics associated with consistently timely responses in telephone-based disease surveillance systems (also known as public health disease reporting systems) in local health departments (LHDs). The contents of this report will be of interest to a broad range of individuals working directly in public health or on public health systems research, as well as individuals interested more generally in systems-level performance measurement. In particular, this report has direct relevance to public health professionals at the state and local levels who are involved in assessing and improving their systems for detection and response to urgent case reports.

This work was prepared for the U.S. Department of Health and Human Services Office of the Assistant Secretary for Preparedness and Response (ASPR), for which Lara Lamprecht, serves as project officer. The research was conducted in the RAND Health Center for Domestic and International Health Security. A profile of the Center, abstracts of its publications, and ordering information can be found at http://www.rand.org/health/centers/healthsecurity/. RAND Health is a division of the RAND Corporation. More information about RAND is available on our Web site at http://www.rand.org.

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Acknowledgements

This report is one part of a larger project being conducted by the RAND Corporation, with funding from the U.S. Department of Health and Human Services, to examine exemplary public health practices, learn from public health experiences, and develop exercises to improve public health preparedness. Many people at RAND helped shape our thinking and approach to this work. We would like to acknowledge and thank the entire RAND team for its efforts. We are especially grateful to Jesse Reyes and Rebecca Hazard for their help during the early phases of the project and to Kristin Leuschner for her editorial assistance.

The project described in this report involved the participation of hundreds of professionals in 74 local health departments across the U.S. We are deeply grateful for their openness and willingness to participate in this project. We also would like to acknowledge the considerable assistance and guidance provided to us from William Raub and Lara Lamprecht, both of the Office of the Assistant Secretary for Preparedness and Response (ASPR) at the U.S. Department of Health and Human Services. Their commitment to build and improve upon the US public health system's infrastructure was the driving force that shaped this work.

Acronyms

24-7	Twenty four hours a day seven days a week
CDC	US Centers for Disease Control and Prevention
GAO	US Government Accountability Office
HHS	US Department of Health and Human Services
LHD	Local health department
OIG	Office of the Inspector General
SPHA	State public health agency
TBDS	Telephone-based disease surveillance

Chapter 1: Introduction

An incident requiring urgent public health involvement can occur anywhere and anytime, so it is important for local health departments[1] (LHDs) to have the capability to respond to urgent case reports whenever they arise. Urgent case reports are any reports that could represent a serious public health threat that requires an immediate response (e.g., novel infectious disease outbreak or bioterrorism). The Centers for Disease Control and Prevention (CDC) has encouraged LHDs to develop telephone-based disease surveillance (TBDS) systems that are capable of receiving and responding to urgent case reports from healthcare professionals 24 hours a day, 7 days a week (24-7). There are two basic types of TBDS systems: 1) automated systems that rely on automated controls to receive and manage calls and; 2) live systems that rely on human beings to receive and manage calls.

In 2003, the CDC established new performance recommendations regarding TBDS systems (CDC, 2003). Three of the key recommendations set forth by CDC were that LHDs should:

- be capable of receiving urgent case reports 24-7;
- be able to respond to urgent case reports with a trained public health professional within 30 minutes of receiving the report; and

[1] Appendix A includes a glossary of all terms.

- have written protocols in place that describe the response and triage procedures action officers should follow when initially responding to urgent case reports.

Implicit in these recommendations are the expectations that responses will be consistent, timely, and accurate. First, in order to be capable of receiving urgent case reports 24-7, LHDs must be able to consistently receive reports at all times of the day and night no matter how many calls come in. Second, urgent case reports by definition suggest a need for an immediate response from public health. Third, responses need to be accurately targeted according to the type of calls received in order to ensure that cases are routed to the appropriate action officer.

The CDC's performance recommendations were not accompanied by guidance on how LHDs might evaluate their TBDS systems to ensure compliance. To fill this gap, the RAND Corporation was asked, in a prior study, to develop tests for LHDs to use in order to evaluate the ability of their TBDS systems to comply with the CDC's recommendations. RAND pilot-tested these approaches in a convenience sample of 19 LHDs from across the country (Dausey et al., 2005a).

The findings generated from these pilot tests set the stage for the research described in this report. The pilot tests revealed dramatic variability in both the structure of TBDS systems as well as the ability of these systems to consistently

respond to case reports in a timely manner (Dausey et al., 2005b). The tests also revealed variability in the use, availability, and content of protocols designed to guide staff in responding to and triaging urgent case reports. Specifically, respondents seemed unclear regarding what questions to ask *callers*, what advice to provide callers, and how to triage the case report after hanging up with the caller. These findings raised two questions that are central to the focus of the current study:

- Are there system characteristics that are better or worse at ensuring consistently fast responses to urgent case reports?
- What types of information do staff protocols contain and what are the features of innovative or exemplary protocols that LHDs currently use?

Objective of This Study

The primary objective of this project was to identify system-level factors associated with consistently timely responses to urgent case reports placed to LHDs. By system-level factors, we refer to the TBDS systems that LHDs have in place to receive and respond to urgent case reports. A secondary objective was to describe protocols that LHDs use to respond to and triage urgent case reports after they are received.

Overview of Study

To attempt to answer the questions described above, we engaged in three separate but related tasks. First, it was apparent that in order to conduct this research, we needed to have a better understanding of telephone-based response systems in public health as well as in other sectors. We needed to understand how these systems functioned, the different technologies that were used, and the infrastructure in place to support these technologies.

To understand telephone surveillance systems more broadly, we carried out a literature review and conducted case study analyses of 24-7 telephone response systems in five non-public health agencies. These case studies not only helped us to identify and frame the types of questions that we wanted to ask about TBDS systems in LHDs, but also provided information about systems and practices outside of the domain of public health that could potentially be applicable in public health settings.

Second, to identify TBDS system characteristics associated with consistently fast responses, we identified a stratified random sample of 74 LHDs from across the country. We began by interviewing the health director or a designee to learn about the structure of their TBDS systems. This step was necessary in order to relate information about the systems that were in place to how well a LHD performed on test calls. Interview questions were guided by what we learned in

the literature review and case studies on non-LHD systems. We asked each director to consent to have us test his/her LHD TBDS system, adapting the methods developed for the previous study (Dausey et al., 2005a).

Third, we conducted a review of protocols from LHDs that reported they had written protocols and were willing to share them with us. We searched these protocols for guidance to action officers on: what questions to ask callers, what advice to provide callers, and how to triage urgent case reports.

Outline of this Report

The remainder of this report is divided into five chapters. In Chapter 2, we discuss the methodologies used in each of the steps described above. In Chapter 3, we discuss the results of the literature review and case study analyses of 24-7 telephone response systems in non-public health agencies. In Chapter 4, we discuss our quantitative analyses of the TBDS system factors associated with consistently fast responses to urgent case reports. In Chapter 5, we describe our analysis of the protocols that LHDs were willing to share with us. Finally, in Chapter 6, we present a discussion of our overall findings as well as a series of recommendations to LHDs on how to improve TBDS system performance.

Chapter 2: Methods

In this chapter, we describe the methods used in each of our analyses. We discuss the methods used for the literature review and case studies, describe the test call process, and outline the protocol review. Results from these analyses are found in Chapters 3 through 5.

Literature Review and Case Studies

We began by first conducting a literature review to identify other research that has examined telephone response systems. We developed a search matrix of key words that included terms such as "telephone response system", "24-7 response" and "urgent reports". We then applied this search matrix to academic publication search engines such as PubMed and JSTOR. We focused our attention on research related to telephone response systems both within public health settings and in settings outside of public health. We excluded all articles from consideration that did not directly deal with telephone response systems.

We used a slightly modified search matrix and applied it to standard search engines, including Google and Yahoo, to help us identify agencies outside of public health that had telephone response systems designed to respond to urgent inquiries 24-7. We developed a comprehensive list of all agencies and organizations that met our criteria and then chose a convenience sample of five to

study more closely: United Way of Connecticut; New Jersey Department of Environmental Protection; Rapid Response, Inc.; MedAire and OnStar. We selected these five organizations because they were all distinctly different from one another, operated telephone response systems that functioned 24-7, and appeared to have the greatest similarities to the TBDS systems in LHDs.

The primary method of data collection for the case studies was a 30 to 45 minute semi-structured telephone interview with a representative from each of the five organizations. The questions covered in the semi-structured interview included:

- System Characteristics and Response
    - How is the telephone response system structured?
    - How are calls received (e.g., answering service, use of pagers, etc.)?
    - Is there more than one telephone number to receive urgent calls?
    - How many individuals are on-call at any given time to respond to urgent calls?
    - Is there a formal protocol for triaging calls?
    - Does the system rely on live respondents 24-7 or is the system automated?
    - What is the systems surge capacity?
- Education and Awareness
    - What agencies or individuals are the principal users of the system?
    - How are potential users educated about the system and the appropriate telephone number to call?
- System Evaluation
    - Is the system tested to evaluate its performance?

    - If so how often is the system tested?
- Exemplary Practices and Other Exemplar Agencies
    - Are you aware of any recognized exemplary practices for 24-7 telephone-based response systems?
    - Are you aware of other agencies that may have innovative 24-7 telephone-based response systems in your sector (e.g., poison control, environmental response, HAZMAT)?

In addition to these interviews, we also reviewed documents that interviewees from these agencies shared with us, as well as information gleaned from targeted internet searches and through information contained on their web pages.

Test Calls

Each of the 74 LHDs we tested participated in a series of test calls to evaluate their TBDS systems. In this subsection, we describe the sampling, data collection and data analysis procedures used in conducting the test calls.

Sampling

In order to establish our sampling frame, we used a publicly available directory from the National Association of County and City Health Officials (NACCHO), which is the most comprehensive list of local LHDs in the U.S. (NACCHO, 2005). We excluded listings described as clinics or nursing homes as well as duplicate entries (n=336) leaving us with a sample of 2464 LHDs. We

sought to balance sampling by the total number of LHDs in a given region and sampling based on the size of the population served by LHDs.

Size of Population Served. Because a large number of LHDs in some regions serve very small populations, sampling by the total number of LHDs would have resulted in over-sampling small rural ones. In addition, our previous work suggested that very small LHDs (e.g., those taken together that serve a population of less than 7,200 people and cover less than one half of one percent of the total U.S. population) are fundamentally different than their larger counterparts (Lurie et al., 2004). For example, these LHDs often rely on a single individual to receive case reports, and nearly all of the clinicians are known to the health director, who may spend more time on clinical responsibilities than in public health. We therefore excluded the 369 LHDs that served fewer than 7200 people, and stratified the remaining sample both by region and size of population served. After removing these LHDs, the resulting sample size was 2095. This approach allowed us to draw a sample of LHDs that were representative of the systems that cover most of the U.S. population.

Region of the Country. The four regional categories we used were the standard categories created by the US Census Bureau (e.g., Northeast, South, Midwest, West—US Census Bureau, 2006). We divided LHDs into quartiles based on size of the population served: small (7,200-149,250 people), medium (149,251-465,000), large (465,001-1,145,000), and extra large (greater than

1,375,000). Each size stratum therefore represents 25% of the U.S. population. We placed our two stratification variables in a matrix with the columns representing the four population sizes and the rows representing the four regions. This matrix resulted in 16 different cells or strata. We then used simple random to select LHDs.

Data Collection

We adapted our methodology from that used in our prior study, a complete description of which can be found elsewhere (Dausey et al, 2005a; Dausey et al., 2005b). Briefly, we contacted the health directors identified in our random sample to request their participation and obtain informed consent. Health directors that agreed to participate were interviewed about the systems they had in place to answer, triage and respond to urgent telephone case reports and about any protocols in place for these processes that they would be willing to share with us. In some instances, directors referred our questions about their TBDS systems to a designee, such as the head of epidemiology. The LHDs that we could not get in contact with after four or more email and telephone attempts, or that declined to participate, were replaced by another LHD in the randomly selected sample.

Using disposable cell phones, a trained test caller contacted participating LHDs over the course of three to four months using a disguise to avoid detection (e.g., asserting that he or she was a doctor or nurse at a local health care facility

calling about an urgent case). We found that, when testing this many LHDs, it was extremely cumbersome and expensive to change the area code to match that of each LHD, and often when we tried to do so, all of the numbers in the immediate area code had been taken. Thus, we made calls from phones from four different area codes.

Based on power analyses from our previous work, we placed either five or ten calls to an LHD. LHDs that responded in less than 30 minutes to all of their calls received only five test calls because the probability was extremely low that on the sixth test call the result would be any different ($p=0.0025$). LHDs that had intermittent performance received a total of ten test calls. All calls to LHDs were placed either during normal business hours (Monday-Friday from 8am-5pm) or after hours (Weekdays after 5pm and weekends).

We recorded information on data elements that were components of existing CDC performance recommendations or surfaced as important factors during our literature review and case studies. Using a standard form, we recorded information for each call, such as: whether the caller initially reached a live person or an automated system; whether the caller had to hang up and dial a second number before reaching an action officer; and whether the caller was transferred to the action office with a *warm transfer* (e.g., immediately transferred to an action officer) or required a *callback* (e.g., left a number to be called back). All calls concluded with a *debriefing* in which the caller told the action officer that the call

was a test that required no further action and then asked the action officer a few questions about his or her LHDs TBDS system.

We also identified whether the phone number called was the LHD's general number, a general communicable disease line, or a dedicated 24-7 LHD line for urgent case reports. We recorded whether LHDs had one dedicated number to receive all urgent case reports 24-7, or whether there were multiple options to report urgent cases and no clear 24-7 line. In instances where LHDs had multiple numbers, we placed calls to all of these numbers.

At the conclusion of the data collection period, we interviewed the health directors of five LHDs that answered all calls within 30 minutes and asked why they thought they achieved this level of success and what factors they felt might be responsible for it.

Data Analysis

In order to understand the TBDS system-level characteristics that were associated with good performance, we analyzed the data at both the LHD and individual call level. Our analyses at the LHD level allowed us to determine which factors were associated with the ability of a LHD to respond to calls, consistently hereafter referred to as 'consistency'. In addition, the LHD analysis allowed us to examine which TBDS factors predicted the amount of time to reach an action officer. The individual call level analysis allowed us to further examine whether

specific factors predicted the amount of time to reach an action officer, including whether the call was made during or after business hours.

We first examined descriptive statistics regarding the time to reach an action officer, using 30, 60, 240 and >240 minutes, and never responded as outcome variables. We chose 240 minutes as a cutoff point because this constituted half of a normal working shift (e.g., four hours). We reasoned that callbacks that took longer than this in real life might not reach the original caller because of shift changes. We used the other time endpoints because, despite the CDC recommendation of 30 minutes or less, there is no universal agreement about what the appropriate time to reach an action officer should be and no scientific evidence to support the current standard. Outcomes at both the LHD and individual call levels were estimated using non-response weights to permit generalization to LHD performance across the country.

In addition to calculating the mean time to reach an action officer, we created a three-level categorical variable to describe consistency: "excellent consistency" for LHDs in which the time to reach an action officer was 30 minutes or less for all test calls we placed to them; "fair consistency" for LHDs in which an action officer responded to every call, with one or more calls taking between 30 and 240 minutes; and "poor consistency" for LHDs that had at least one call in which the action officer was reached in more than 240 minutes or was never reached.

For analyses at the LHD level, we modeled the associations between LHD characteristics and time to reach an action officer. We used ordinary least squares regressions for continuous outcomes (e.g., mean time to reach an action officer) and logistic regression to examine dichotomous outcomes (e.g., whether the action officer was reached within 30 minutes each time).

For analyses at the call level, we modeled the associations between time to reach an action officer and TBDS system variables, and conducted separate analyses for daytime and after hour calls. We used logistic random effects regressions, with the random effects specified at the LHD level. For these regression analyses, we used the full set of test calls in the sample, which effectively over-sampled LHDs whose performance was inconsistent in the first five calls. All analyses were conducted in STATA 9.0. All study procedures were approved by the RAND Human Subjects Protection Committee.

Protocol Review

Given the lack of information on written protocols for 24-7 response, we endeavored to collect any protocols that LHDs use for the processes of disease reporting and response. To identify existing protocols, we asked the health directors (or designees) we interviewed whether they had, and would share, formal written protocols for:

- questions that should be asked of medical personnel when they report an urgent case report by phone?
- advice that should be provided to medical personnel when they report an urgent case report by phone?
- triaging urgent case reports?

We abstracted data about the type and structure of information in each protocol. Two individuals separately reviewed each protocol to ensure that all protocols were reviewed consistently. Reviewers met to discuss and resolve any disagreements and inconsistencies. Protocols that did not contain any information on the three areas listed above were excluded from the analyses. We were not able to make any judgments about whether or not the practices identified in the protocols were associated with better responses to urgent case reports because we did not attempt to assess the quality of the interaction between the caller and the action officer.

Chapter 3: Literature Review and Case Studies

This chapter presents findings from our literature review and from case studies of a convenience sample of five organizations outside of public health with 24-7 telephone-based response systems similar to those used by LHDs. These case studies were conducted to help us identify and frame the types of questions to be asked about TBDS systems in LHDs. The literature review and case studies also provided us with information about systems and practices outside of the domain of public health that could potentially be applicable in public health settings.

Literature Review

The literature related to emergency response in public health is in its infancy; however, there is a growing literature on the evaluation of emergency response times in emergency medicine. We could only find two publications that dealt with this issue directly in public health. One such study, by Jajosky and Groseclose (2004), describes the role of TBDS systems in identifying public health emergencies. The other study was conducted by the Office of the Inspector General (OIG) (U.S. Department of Health and Human Services, 2005), and describes the TBDS systems in a convenience sample of 18 state health departments. Neither study sought to test or assess the ability of TBDS systems to receive urgent case reports.

While the literature related to 24-7 emergency response in public health is thin, there is quite a robust stream related to 24-7 emergency response in the fields of emergency medicine and emergency management, as well as research on the effectiveness of the emergency response infrastructure (Cambell et al., 1997; Blackwell and Kaufman; 2002, Davis 2002; Hale 1997). In addition, there is a growing literature on the evaluation of emergency response in emergency management (Jain and McLean, 2003; Mrvos and Krenzelok, 2005) and the technological platforms used (Graves 2004; Horan et al., 2005). This literature reveals a common set of problems (e.g., protocols were not followed or understood, calls are sometimes dropped). Unfortunately, the literature does not offer solutions.

With regard to 24-7 operations specifically, the Government Accountability Office released a report in October 2006 that identified opportunities to enhance collaboration at 24-7 operations centers that are staffed by multiple DHS agencies (GAO, 2006). The findings in the report are particularly relevant to state health departments as they try to consolidate all of the disease surveillance information gathered by LHDs.

Case Studies

Our case study interviews focused on five organizations that currently use some kind of 24-7 response system:

- *United Way of Connecticut* is a statewide social services organization that operates a 2-1-1 telephone system providing information 24-7 as well as referrals for social services and crisis intervention. The system is funded by the Connecticut Department of Social Services.
- The *New Jersey Department of Environmental Protection* operates a 24-7 emergency response hotline that is used to report environmental incidents in New Jersey.
- *Rapid Response, Inc.,* an affiliate of Environmental Waste Management, Inc., conducts 24-7 emergency hazmat response in Southeastern New York, Pennsylvania, New Jersey, Delaware and Maryland.
- *MedAire* provides remote medical care and travel assistance and operates a 24-7, state-of-the-art Global Response Center which provides remote emergency assistance to its clients in different time zones around the world.
- *OnStar* provides in-vehicle safety, security, and information services on more than 50 models of GM automobiles (OnStar, 2007). OnStar uses satellite and cellular technology to link the vehicle and driver to the OnStar Center 24-7.

Key Features of Individual Organization's 24-7 Systems

Our case studies focused on four main areas of interest: characteristics and response capabilities of the organization's 24-7 system, education and awareness

surrounding the system, evaluation or testing of the system's effectiveness, and any exemplary practices used. We will first briefly describe the system characteristics, response capabilities, and evaluation means used for each organization's system, and then in the next section will discuss these findings as a group, along with the organizations' educational efforts and exemplary practices.

United Way of Connecticut. The United Way of Connecticut's 2-1-1 system was the first such system in the country. It has had 24-7 access since the mid-1990s and has gained national recognition as a model (United Way of Connecticut, 2007). In 2006, the system received calls from more than 300,000 people in Connecticut (United Way of Connecticut, 2007) and achieved an abandonment rate of less than 5% and an answer rate of less than 30 seconds (Hogan, 2005).

When callers contact the Connecticut 2-1-1 system, they are prompted to press numbers on the telephone keypad to be routed either to: 1) child-care related issues; 2) crisis intervention; or 3) other issues. The Connecticut 2-1-1 system tries to connect all callers to a live person immediately.

Unlike some other states' 2-1-1 systems, which may route calls from one call center to another in cases of high demand, Connecticut has one central call center. In instances when high surge is anticipated, more call specialists are added. If a call comes through and all call specialists are busy, the call is put into a queue and

callers can: 1) key in a number for immediate attention if they are in crisis; 2) stay on the line; or 3) leave a voicemail message.

Training for call specialists is extensive. Specialists must undergo a four-week training course before beginning to answer calls and are also trained to handle crisis intervention calls (Hogan, 2005). All call specialists have social service backgrounds and are accredited by the American Association of Suicidology. In addition, call specialists are trained to identify different levels of lethality of a call as well as signs that a situation needs immediate medical attention. Call specialists are also trained to follow the Standards for Professional Information and Referral, which are distributed by the Alliance of Information and Referral Systems.

The system is continually monitored and collects data on response rates, abandonment rates, and length of calls. A supervisor can receive the status of every call every 18 seconds. In addition, the 2-1-1 system uses surveys to check quality assurance. Callers are asked to answer a quick survey at the end of the call and a random sample of callers is asked if they would be willing to fill out a paper survey.

New Jersey Department of Environmental Protection. The New Jersey Department of Environmental Protection (DEP)'s 24 hour hotline is housed in a communications center along with the State Police and New Jersey Department of

Transportation's 24 hour hotlines. The 24-7 DEP hotline averages over 90,000 calls a year related to a wide variety of situations (Van Fossen, 2005).

The goal of the system is for callers to always be able to reach a live person right away, but if all operators are busy, callers are put in a queue. Once a call is received by an operator, the operator listens for certain decision points and follows 25 standard operating procedures (SOPs) to route the call to the appropriate division (Van Fossen, 2005). The division then follows the SOPs to decide whether an on-call duty officer should be contacted. Operators receive 12 weeks of training before they begin to receive calls.

The DEP hotline is exercised several times a year with announced and unannounced tests in which someone calls with a particular problem and then the response is monitored. Operators are also trained to handle DEP radios that serve as a backup to the phone system (Van Fossen, 2005). These radios were one of the few communications systems that functioned during 9/11.

Rapid Response, Inc. (RRI). RRI's telephone response system uses a service that forwards calls through a single number to a network of office phones, cell phones, and pagers (Bliss, 2006). During business hours, the call is answered by a small team of responders in the office and after hours the call is forwarded to a series of pagers worn by a team of responders. If all responders are out on calls

and no one is available to respond to an incoming call, the caller is referred to another hazmat response service (Bliss, 2006).

If one person is busy, the call is forwarded to another responder. The responder first verifies that an agreement is in place between the caller and RRI. If the caller is not an existing client, the responder collects the relevant contractual information. Then the responder asks a series of questions regarding the emergency to determine the type of response that will be employed. All responders are well trained in hazmat cleanup and to comply with the EPA's Spill Prevention, Control and Countermeasure (SPCC) rules (Bliss, 2006).

RRI records information about the number of calls that it receives and how quickly they are answered. In addition, the company asks for client feedback after each incident, giving them a measure of how effective the response was (Bliss, 2006).

MedAire. MedAire, established in 1985, was the first company to provide immediate, real time 24-7 medical assistance to clients in remote locations around the world. Today, MedAire serves more than 2,000 clients worldwide (MedAire, 2007). MedAire has two Global Emergency Call Centers which manage over 4,000 cases a month (MedAire, 2007).

MedAire calls are answered by communication specialists, who assist callers when possible and transfer the call to a relevant party when needed.

Communications specialists are trained to follow formal protocols that differ, depending on the emergency. Since MedAire's clients are mostly aircraft, boats and international travelers, calls can be received through landlines and a variety of other ways (Giles, 2006). For instance, airborne aircraft can contact MedAire by telephone or onboard electronic messaging service, while ships at sea can contact MedAire by satellite phone or radio transmission.

While MedAire does not have different phone numbers for business and after hours calls, the company does use different call numbers depending on the nature of the emergency and the client that is making the call. Multiples numbers are used, in part, to build redundancy in the system, but also because some clients want to have a dedicated number to use.

When a call is received, the call system routes the call to the first available communications specialist. If no communication specialist is available at that number, the system automatically reroutes the call to another phone number after a set number of rings. This process continues until someone answers the phone and at no point does the call go to voicemail (Giles, 2006). Having two separate call centers also allows for seamless functioning should there be some technical problems at one of the call centers. Should the telephone system fail, MedAire has the capacity to receive requests via email, satellite phones and radio.

MedAire remains proactive in checking and maintaining its system to ensure that the company does not miss a call. Many clients also have contractual agreements regarding how quickly the call must be answered. In addition, MedAire undergoes ISO9000 certification every six months to ensure quality process management. During every call, all information is immediately entered into a database that keeps track of the nature and number of all reported incidents.

OnStar. Calls enter the OnStar system from subscribers who have the system installed in their GM automobile. A subscriber can initiate a call either by telephone or by pushing the "OnStar" button in the vehicle; the system is also activated automatically when an airbag in deployed in the vehicle (Onstar, 2006).

The OnStar system functions differently depending on how the call is initiated. If the call is initiated by phone, the call is answered by an automated phone tree system. The first option on the tree is to report an emergency, in which case the call is forwarded to the emergency response unit. The OnStar system uses one telephone number and the same protocols are in place for business and after hours calls since the company services a wide area and people drive all the time.

When the OnStar button is pushed or the airbag is deployed, the call goes directly to the OnStar response unit. In the event of an airbag deployment, the

incoming call is immediately flagged as an emergency and a response is initiated through local public safety agencies. Since the vehicles with OnStar are also equipped with a Global Positioning System, the location of the vehicle appears on a display monitor in front of the responder. In all cases, a responder asks about the nature of the emergency, and if there is no voice response from the subscriber, an emergency unit is automatically sent.

Responders are trained to follow a protocol that tells them what to do in various situations. Each call center and employee has a list of daily and monthly goals, and call logs are reviewed and analyzed to see how many calls are received each day and what kind of responses are initiated (Onstar, 2006).

Overall Findings from Case Studies

System Characteristics and Response. The organizations in these case studies all rely on different types of telephone response systems. However, most of the organizations use telephone systems that reroute calls if an operator is busy to ensure that a caller eventually reaches a live person. Two of the organizations offer voicemail as an option to their calls and only one relies on the use of pagers. None of the organizations use an answering service to respond to calls.

Two of the organizations rely on their telephone system to automatically reroute the call to an available operator, if needed, so that the call is not dropped. However, three of the organizations do not have a procedure in place to ensure

that a call is always transferred to a person. Two of the organizations let callers decide whether they will stay on the line if an operator is not available.

Four out of the five organizations use a single telephone number. Only MedAire uses multiple telephone numbers, and this is primarily because some of their clients ask for dedicated telephone numbers. However, whether a company uses a single or multiple telephone number, all of the organizations have formal protocols in place for triaging calls. In addition, the people responding to calls in all of the organizations go through extensive training to respond to calls.

Interestingly, when asked about how they would deal with instances in which there may be a high surge of calls, three of the organizations said that they do not have any formal plans in place and two of the organizations indicated they would to simply add more operators. MedAire has the most redundancies built into its telephone system in case of failure. The New Jersey Department of Environmental Protection also has future plans to use radios as a backup in case of system failure.

System Evaluation. Out of the five organizations, only the New Jersey Department of Environmental Protection conducts formal tests of its system to determine its effectiveness. The Connecticut 2-1-1 system and Rapid Response Inc. measure the effectiveness of their systems through surveys and continuous monitoring of their telephone system. MedAire and OnStar use continuous

monitoring of their telephone systems to evaluate their performance. System monitoring differs from formal testing because monitoring only involves observation of existing functioning while testing involves some attempt to manipulate the system to invoke a response.

Education and Awareness. We were interested in how these organizations have raised awareness about their 24-7 services because LHDs must also find ways to educate their target audiences about how to access their 24-7 disease surveillance systems. The organizations had varying experiences as they tried to educate the public and other agencies about their 24-7 response. When the 2-1-1 system was originally established in Connecticut, there was an extensive marketing campaign to educate the public about the differences between 2-1-1 and 9-1-1. Now the 2-1-1 system uses print advertising because it is much less expensive than TV ads and also relies on government agencies to advertise the system if the agencies are using it for a campaign (e.g., anti-smoking). The NJ Department of Environmental Protection initially used press releases to advertise the number to the public and now hands out stickers and publishes the number on its website. MedAire and Rapid Response Inc. have relied on more traditional forms of advertising or marketing to professional organizations at their meetings. OnStar, in many ways, has had the easiest time getting word out to the public about its services since GM does most of the advertising for OnStar as part of their car promotions.

Exemplary Practices. When asked to identify exemplary practices for 24-7 emergency response, respondents provided the following answers:

- "No question, the most important practice for responding to emergencies in this field is answering the phone. Answer it quickly and always. No matter how good a system is, if people can't access it, it's of no use."
- "Always try to connect callers to a person rather than an answering machine."
- "You have to have a good team of people on the other end of the line. It doesn't require a sophisticated system if you have a group of responsible people that know how to do their jobs."

In addition, we learned that Voice-Over-Internet-Protocol (VOIP) is an emerging technology in 24-7 emergency response. The technology is costly; however, VOIP allows for much more flexibility than a traditional telephone system (including the ability to handle more three-way calls and easily forward calls from one number to another seamlessly). Lastly, we learned that some small, rural states and some agencies that cannot afford to operate a 24-7 hotline on their own have joined together with other states and agencies to combine their efforts and share the cost. This may be an option for some LHDs.

Chapter Conclusion

This analysis began as a fact finding exercise to ascertain whether LHDs could learn from other organizations' experiences with 24-7 response. The five organizations that we chose to examine in-depth are a sample of organizations that are involved in crisis intervention, environmental protection, hazardous material (hazmat) response, provision of emergency medical services, and in-vehicle safety, security, and information services.

All of these organizations have the same goal that LHDs have with regard to their telephone disease surveillance systems: providing timely, reliable 24-7 access to qualified experts. While each of the five agencies took different paths to achieve that goal, Table 1 summarizes the primary lessons learned from their experiences related to system characteristics and response; education and awareness; system evaluation; and best practices.

Table 1: Lessons Learned from the 24-7 Response of Non-Public Health Agencies

System Characteristics and Response	Try to structure the system so that callers reach a live person, especially during an emergency
	Use a Single Telephone Number instead of Multiple Numbers
	Use Formal Protocols for Triaging Calls
	Extensive Training Required of Telephone Operators
	Build Redundancies into the System in Case of Failure
Education and Awareness	Use press releases, print advertising, government agencies and traditional advertising mechanisms to increase public awareness
System Evaluation	Evaluate the system through continuous monitoring, surveys, or formal exercises
Exemplary Practices	Try to ensure that a live person is reached during every call
	Use Formal Protocols for Triaging Calls
	Think creatively about how to offer 24-7 services including new technologies or coordinating with other agencies/states to combine efforts

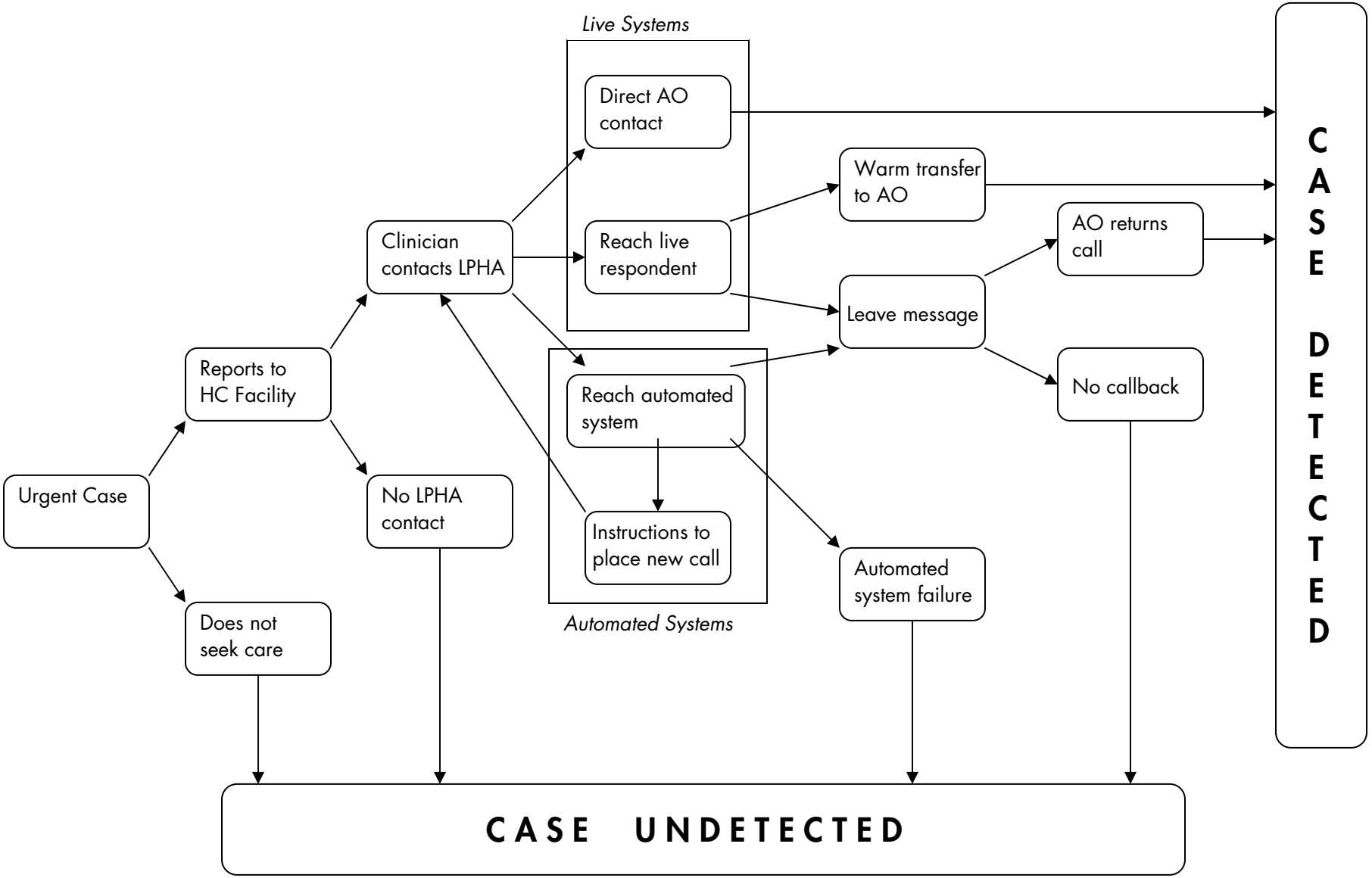
Chapter 4: Test Calls

In this chapter, we describe analyses that attempt to empirically link system performance with system characteristics. Specifically, we were interested in examining the consistency and timeliness of LHD response to urgent case reports and the characteristics of TBDS systems associated with those responses.

Based on our previous research, we developed a basic model for how TBDS systems function and the anticipated responses of these systems. Figure 1 presents a schematic of that model. As we follow the figure from left to right, we move from responses that are less under control of LHDs to those responses directly controlled by LHDs.

TBDS systems in LHDs are first activated when someone seeks health care for a medical condition and a clinician contacts a TBDS system. Of interest to us is what happens after a health care professional initiates contact with a LHD to report an urgent case. Once this contact happens, the structure and function of TBDS systems are tested. In our previous research as well as in our literature review and case studies, we identified two basic types of generic systems: 1) automated systems that rely on automated controls to receive and manage calls and; and 2) live systems that rely on live contacts to receive and manage calls.

Figure 1: Typical call response pathway for handling an urgent case



In live systems, the caller either reaches an action officer directly or reaches a live respondent who triages the call directly to an action officer or takes a message and has an action officer provide a callback. Thus, the hallmark of live systems is that all initial contacts with these systems are with live, as opposed to, automated respondents. Live respondents are individuals whose job it is to screen calls and to triage them appropriately—often based on the type of case as well as the urgency of the case. Live respondents can be LHD staff members or can be external to the LHD. For example, some live respondents are shared across multiple agencies or organizations (e.g., individuals working for privately contracted answering services) while other live respondents might work for other public agencies that receive calls for an entire local area (e.g., county emergency management agency, sheriff's dispatch, or through a common local number used for city services).

Automated systems rely on pre-established computer algorithms to route calls. A common example of an automated system is a telephone tree that requires the caller to listen to prompts and then press certain numbers to be routed appropriately. Automated systems rely on voicemail and other features to record messages for the action officer.

Based on the limited data in our previous research, we hypothesized that systems using live respondents would yield more consistent and timely responses than systems without such respondents. This hypothesis was supported by our initial analyses of our previous data as well as the fact that automated systems have more avenues that can result in failed calls than those using live respondents.

We referred to this model in developing the test call methodology used in this study. As discussed in detail in the Methods chapter, our approach involved trained test callers who used a disposable cell phone to contact participating LHDs over the course of three to four months. The callers asserted that they were either a doctor or nurse at a local health care facility calling about an urgent case. The test focused on the following issues:

- Whether LHDs responded in less than 30 minutes to all of their calls;
- Whether the caller initially reached a live person or an automated system;
- Whether the caller had to hang up and dial a second number before reaching an action officer;
- Whether the caller was immediately transferred to an action officer;
- Whether the phone number called was the LHD's general number, a general communicable disease line, or a dedicated 24-7 line for urgent case reports; and
- Whether LHDs had one dedicated number, multiple options, or no clear 24-7 line.

Characteristics of Participating LHDs

We contacted 124 LHDs; of those, 25 did not respond to repeated attempts to be contacted, four had recently merged with another LHD and were no longer responsible for handling urgent case reports, three agreed to participate but could not participate in the study time window, and 18 declined to participate. The most common reason for

refusing to participate in our study was the perceived burden it placed on staff. Therefore, of the total 120 eligible LHDs we contacted, we recruited 74 (61.7%).

Table 2 provides LHD sample characteristics by geographic region and population size. An analysis of our non-responders revealed that they were more likely to be small LHDs or located in the south and northeast regions of the United States.

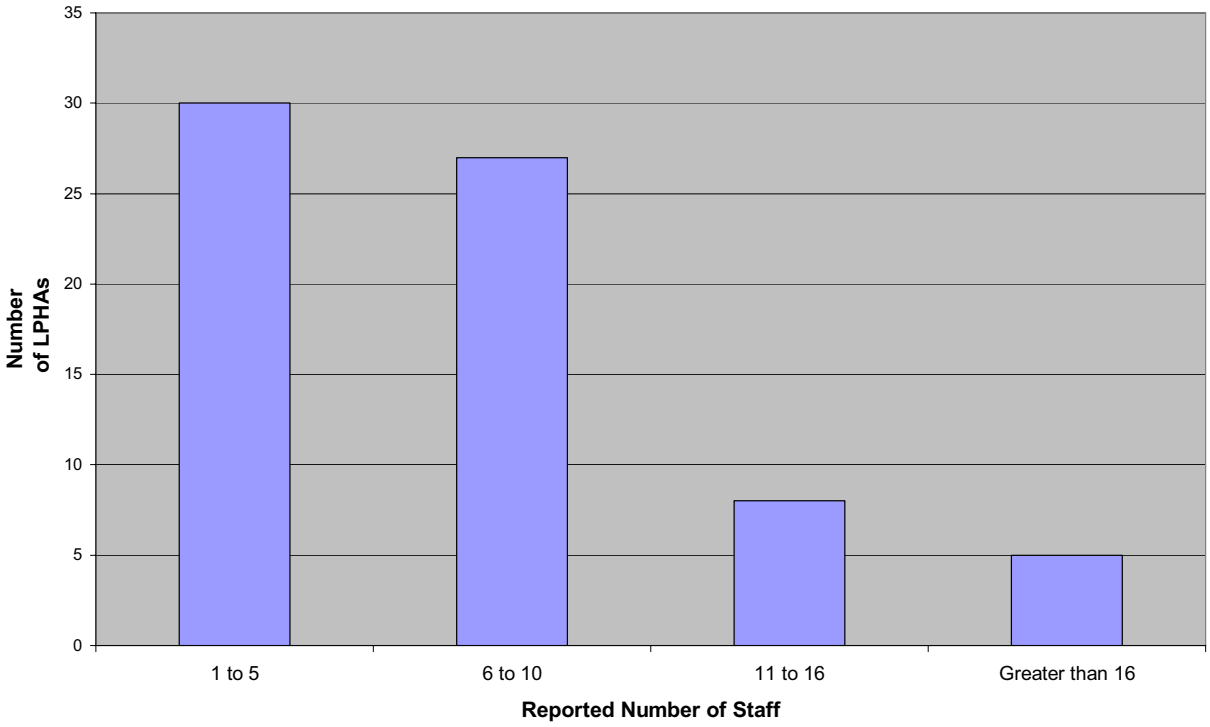
Table 2: LHD Sample Characteristics (n=74)

Region	N (%)
Northeast	10 (13.5)
South	24 (32.4)
Midwest	19 (25.7)
West	21 (28.3)
Population Served	
Small	17 (22.9)
Medium-Large[2]	38 (51.4)
Extra Large	19 (25.7)

During our initial recruitment interviews, we gathered information on the number of LHD staff that are available to respond to urgent case reports. As displayed in Figure 2, most LHDs reported that they have between one to ten staff members to respond to case reports (median=6), while only five LHDs had 16 or more staff members (mean=11.4). The number of staff members available to respond to case reports at a LHD was not significantly associated with the size of the population served (correlation coefficient=0.1852).

[2] Please note that for purposes of test call analysis, we collapsed the two middle categories of population served by the LHD. Small (7,200-149,250 people), medium-large (149,251-1,145,000), and extra large (greater than 1,145,000).

Figure 2: Number of LHD Staff Members Able to Respond to Urgent Case Reports



The following sections describe results from our call response analysis. Please note that all analyses in the remainder of this chapter are weighted using the sampling weights outlined earlier, unless noted otherwise. Therefore, weighted percentages are listed but these percentages do not directly translate to actual numbers of LHDs when calculated.

Overall LHD and Individual Call Response

Tables 3 and 4 list the distribution of key predictor and outcome variables used in our call analysis. In total, 596 calls were placed to our 74 LHDs.

Was the Call Answered by a Live Person?

Over 76% of calls (n=455) placed to participating LHDs were responded to by a live person, 13% (n=76) connected using an automated system, and 5% (n=32) were

directed to a staff member's pager. Nearly 17% (n=96) of calls were terminated without immediately reaching the action officer and the caller was required to call a second number.

Did the System Use a Dedicated 24-7 Line?

Forty-eight percent (n=286) of test calls were placed to a dedicated 24-7 phone line, while 35% (n=209) were placed to a specific communicable disease department line.

Table 3: Distribution of Predictor and Outcome Variables at the LHD Level (N=74)

	Variable	Statistic
Predictor		
	Mean # (SD) of calls responded to by a live person	0.75 (0.21)
	Mean # (SD) of calls responded to by an automated system	0.13 (0.22)
	Mean # (SD) of calls responded to by LHD	0.18 (0.17)
Outcome		
	Mean (#)of calls responded to ≤ 30 mins by LHD	0.78 (0.22)
	Number (%) all calls responded to ≤15 mins by LHD	9 (12.8%)
	Number (%) all calls responded to ≤30 mins by LHD	22 (30.1%)
	Number (%) all calls responded to ≤60 mins by LHD	27 (36.5%)

Table 4: Distribution of Predictor and Outcome Variables at the Call Level (N=596)

	Variable	Statistic
Predictor		
	Number (%) of calls responded to by a live person	455 (76.4%)
	Number (%) of calls responded to by an automated system	76(12.7%)
	Number (%) of calls which required dialing a second number	96(16.2 %)
	Number (%) of calls placed to a general LHD line	113(19.0%)
	Number (%) of calls placed to a communicable disease (CD) line	196(32.9%)
	Number (%) of calls placed to a 24-7 line	286(48.0%)
Outcome		
	Mean # (SD) calls completed in $\leq$ 30 mins	0.75 (0.43)
	Number (%) of calls responded to in any amount of time (at individual call level)	545 (91.4%)

Could Callers Consistently Reach an Action Officer Within 30 Minutes?

During the recruitment interviews, 48% (n=30) of the LHDs estimated that the caller would consistently be able to reach an action officer within 30 minutes. Of the 30 LHDs that had estimated they could carry out consistent call connection within 30 minutes, 30% (n=9) succeeded in doing so. Examining different cut points for timeliness revealed that 13% of LHDs (n=10) callers reached the action officer in under 15 minutes every time; 30% (n=23) in under 30 minutes; and 36% (n=28) in under 60 minutes. Table 5 lists the distribution of LHDs that were able to respond to all calls by these different cut points by size of population served. Compared to medium sized LHDs, a greater percentage of small and extra large LHDs were unable to respond consistently and in a timely way.

Table 5: Consistency of Time to Action Officer by LHD Size (relative percentage in parentheses)*

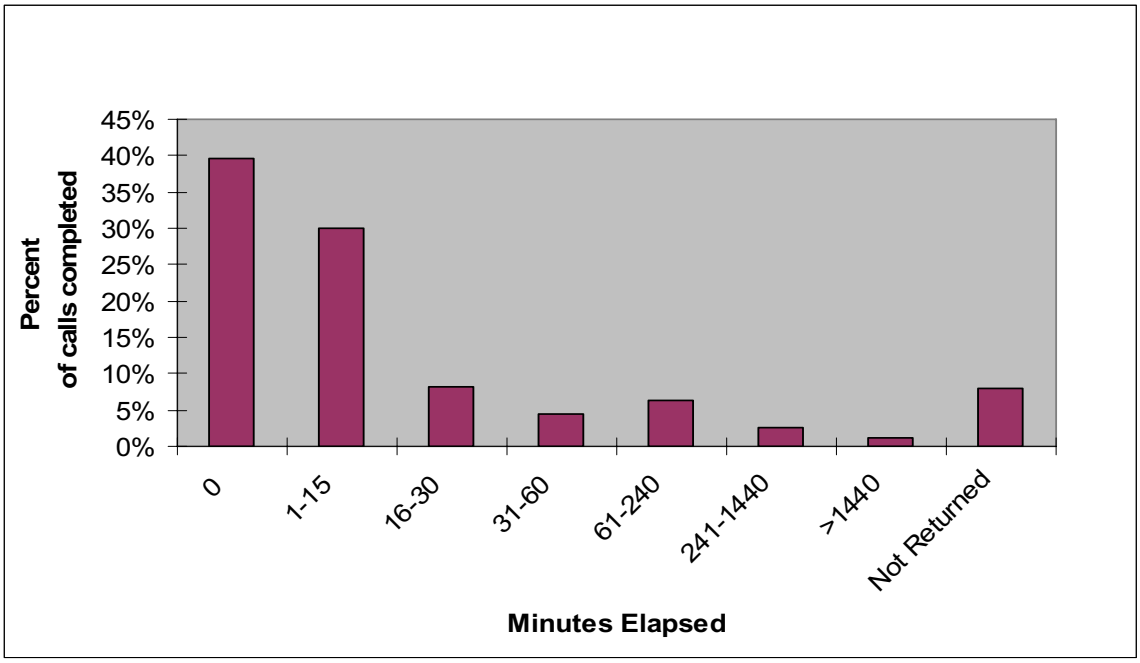
All Calls Reached an Action Officer in:	LHD size		
	Small	Medium-Large	Extra-Large
15 minutes	1 (5.9)	8 (21.1)	1 (5.3)
30 minutes	3 (17.6)	15 (39.5)	5 (26.3)
60 minutes	4 (23.5)	17 (44.7)	7 (36.8)

*Un-weighted results

How Long Did It Take to Reach an Action Officer?

Figure 3 shows the distribution of time elapsed before call completion (e.g., connection with an action officer). The average time to reach an action officer was 63 minutes. This average is skewed because of calls that took long periods of time before they were responded to by an action officer. The median response time, in contrast, was eight minutes. It is critical to note, however, that both of these measures of central tendency present an overly optimistic appraisal because we could not include calls that never reached an action officer (and thus have missing data) in the analysis. Nearly 40% of the LHDs we tested (n=28) had at least one call that ended without ever reaching an action officer. It is notable that only one of the participating LHDs serving over one million people had excellent performance, which we define as the consistent ability for callers to reach an action officer in 30 minutes or less for all calls (not shown in figure).

Figure 3: Distribution of Time to reach an Action Officer



LHD-Level Analyses

What Factors Influenced Call to Call Consistency?

We tested multiple system characteristics (e.g., reaching a live person, calling a pager line, getting an automated system or call-down list, or being required to call multiple numbers), but found that only one variable—whether a live person first answered the phone—was a consistently significant predictor of call-to-call consistency. Specifically, we found that having a call first answered by a live person significantly decreased the probability that a LHD would have poor consistency (e.g., one of their calls never reached the action officer or response time was >240 minutes). LHDs that had at least one or more calls out of ten test calls responded to by a live person were 43% percent less likely to be rated in the category of poor call-to-call consistency ($p<.01$).

What Factors Influenced Call Response Time?

We also analyzed factors hypothesized to have an influence on call time response. We found that LHDs that fielded 10% more of their test calls with a live person had a shorter average response time of about 37 minutes ($p<.01$). We also found that response by a live person was protective against a LHD dropping a call ($p<.05$). In both the ordinary least squares model and the multinomial logit model, systems that required callers to call more than one telephone number before reaching an action officer, and those handled by automated systems, were not significantly related to timely call response.

What Factors Influenced the Ability to Reach an Action Officer Within 30 Minutes or at All?

In total, we placed 596 calls to our sample of 74 LHDs. For these calls, we examined which factors influenced whether a test caller reached an action officer within 30 minutes or at all (Table 6). Similar to our analyses at the LHD level, these analyses revealed that reaching a live person is the strongest predictor of reaching an action officer within 30 minutes. Specifically, we found that calls responded to by a live person were five times more likely to reach an action officer within 30 minutes and seven times more likely to be responded to at all ($p<.01$) compared to all calls that did not connect directly with a live person. Interestingly, we also found that calls placed to dedicated 24-7 response lines were not more likely to result in reaching an action officer in a timely manner (or at all) regardless of the time period in which the call was placed.

Table 6: Relationship of Each Predictor Variable with LHD Call Response Time

Predictor Variables	Call Response Improvement	Call Response Consistency§	
	Average Difference in Response Time (minutes)	Excellent vs. fair consistency	Poor vs. fair consistency
% of calls responded to by live person	-3.71*** (0.92)	1.01 (0.02)	0.94*** (0.02)
% of calls requiring callers to call more than one telephone number	-1.84 (1.19)	1.04 (0.03)	0.97 (0.02)
% of calls responded to by auto system	-1.07 (0.77)	1.02 (0.02)	1.01 (0.02)
Population served: 149,251-1,145,000 (middle size)	-27.5 (36.2)	3.66 (2.49)	0.91 (0.63)

§ Excellent consistency: all calls responded to in ≤30 minutes; Fair consistency: at least one call >30 minutes but none dropped; Poor consistency: one or more calls responded to in >240 minutes or dropped.
Standard errors (SE) in parentheses; all results include sampling weights.
***p<.01; **p<.05

Table 7 further assesses factors contributing to reaching an action officer in a timely fashion during business hours and after hours, and whether these vary by time of day. For calls placed during business hours (n=391), we found once again that live systems were predictive of more timely responses ($p<.01$) as well as whether or not the caller was able to reach an action officer at all. If a call was placed on a communicable disease telephone line during business hours, the likelihood of connecting with an action officer in 30 minutes was double that of other calls ($p<.10$).

During after hours time periods, (n=205), the ability to connect with a live person is even more important than during business hours; calls that were responded to by live connection were six times more likely to be responded to by an action officer within the 30-minute window compared to calls placed through other pathways ($p<.01$). The use of an automated system after hours contributed to poor call response, as calls to an automated system were ten times less likely to be completed at all compared to other types of calls placed ($p<.05$).

Table 7: Factors Related to Likelihood of Individual Call Response-Multivariate Regression Analyses

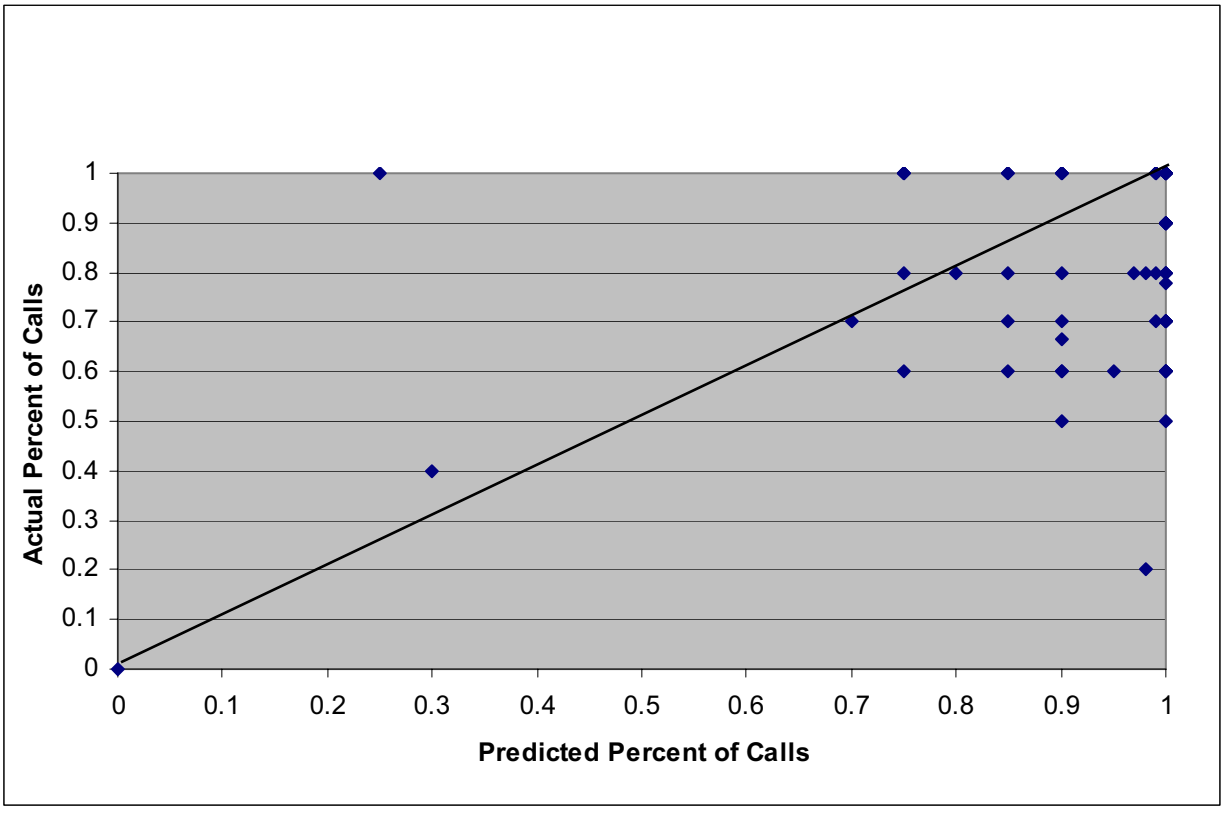
Predictor Variables	Odds Ratios (OR) for all calls		OR for business hours calls		OR for after hours calls	
	Call responded to≤ 30 mins	Call responded at all	Call responded to≤ 30 mins	Call responded to at all	Call responded to ≤ 30 mins	Call responded to at all
Response by live person	4.90(1.21)***	7.06(2.49)***	5.15(1.21)***	8.09(4.62)***	6.57(3.74)***	6.60(4.60)***
Response by auto system	0.62(0.22)	0.50(0.23)	0.94(0.37)	1.3(0.94)	0.23(.20)*	0.10(0.10)**
Response by communicable disease (CD) line	1.2(0.43)	2.15(1.15)	2.08(0.81)	3.22(2.42)	1.18(1.53)	1.09(1.66)
Response by a 24-7 Line	1.0(0.35)	1.32(0.68)	1.07(0.36)	1.68(1.10)	2.46(3.18)	1.7(2.46)
Rho (intercluster correlation at LHD level)	0.15(0.07)	0.32(0.11)	0.03(0.07)	0.36(0.15)	0.46(0.13)	0.45(0.16)
N (% of total calls)	596 (100%)	596 (100%)	391 (65.6%)	391 (65.6%)	205 (34.4%)	205 (34.4%)

Business hours: 9am-5pm local time; After hours: all other times
Standard Errors (SE) in parentheses; All results include sampling weights.
***p<0.01, **p<0.05

How Well Had LHDs Predicted Their Ability to Respond to Calls Consistently Within 30 Minutes?

During recruitment interviews (pre-test call), we asked LHDs to assess their ability to respond to calls consistently within 30 minutes 24-7. Figure 4 charts the relationship between their predicted success using this guideline and their actual performance. Points to the right of the prediction line indicate overestimation of responsiveness within 30 minutes, while points to the left indicate underestimation. In general, LHDs estimated better response than our test calling revealed.

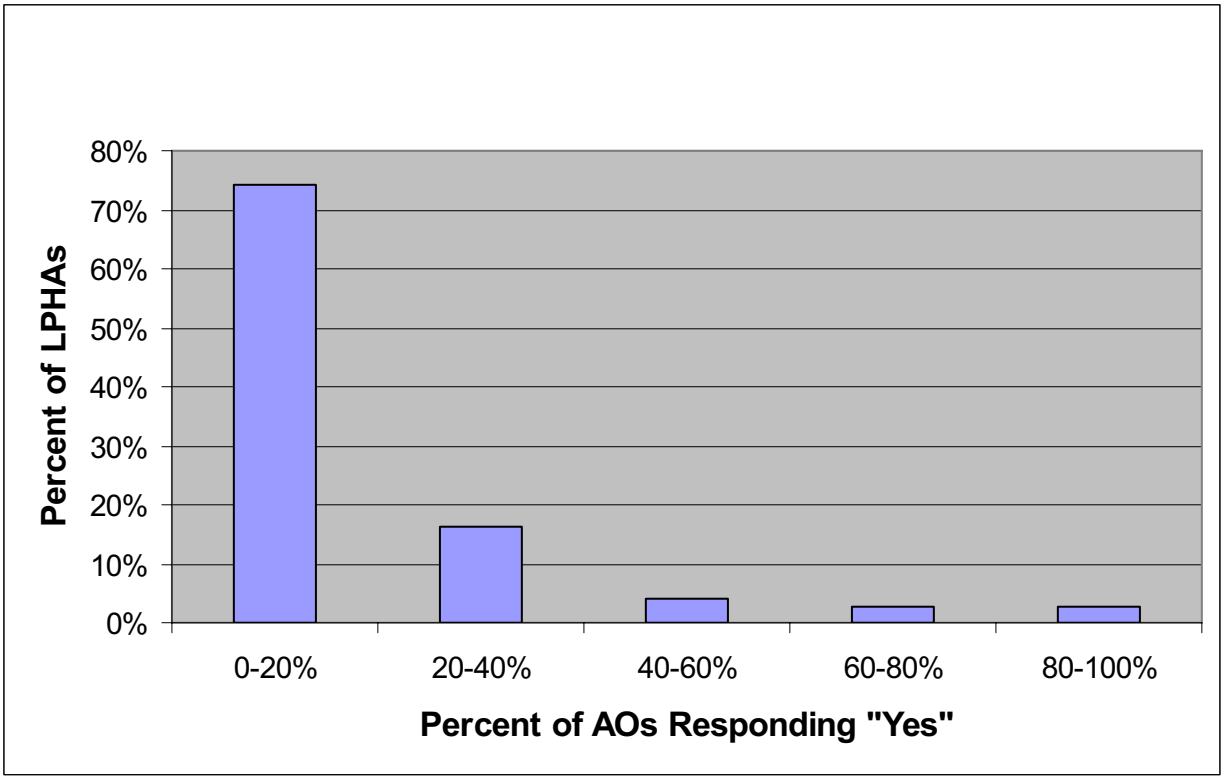
Figure 4: Comparison of LHD Predicted vs. Actual Percent of Calls Reaching an Action Officer within 30 Minutes



What Processes Did LHDs Have for Recording Calls for Review and Quality Assurance and for Triaging Cases?

For all calls that were responded to, our test callers conducted a brief interview to ask the action officer about some key aspects of their TBDS. Figure 5 shows the percent of action officers who indicated that their LHD has a process of recording calls for review and quality assurance. For nearly 75% (n=55) of our LHDs, fewer than 20% of the action officers that responded to the series of test calls within that LHD indicated that their agency had a quality assurance process.

Figure 5: Percent of Action Officers (AO) Reporting Use of Call Recordings for Quality Assurance Purposes



For nearly 84% (n=62) of LHDs, most action officers who responded to the series of test calls (80-100%) within that LHD indicated that they had protocols for triaging cases. Among approximately 54% (n=42) of LHDs, 80-100% of the staff who responded to the test calls in that LHD reported that their agency had a way to initiate three-way calls, a feature that can be critical to timely response and follow-up on an urgent case. For almost 92% (n=68) of LHDs, the majority of staff who responded to the calls (80-100%) indicated that their LHD had a backup officer for handling urgent case reports.

What Factors Might Explain the Results for LHDs with Excellent Performance?

In brief follow-up interviews with LHDs (n=5) that had excellent performance, LHD directors described several factors that may have explained their results. All interviewees reported that they communicate clear, high expectations to their staff regarding timely call handling. In addition, they stressed the importance of creating a culture in which employees both enjoyed their work and felt responsible for its quality.

Four of the five interviewees reported that they regularly tested their systems, provided feedback to their staffs and regularly updated call lists (which included at least one back-up person in the event that the primary action officer could not be reached). One LHD employed an automated call system activated by the person answering the phone. This system sequentially calls down a list until a

live person is reached. Four LHD directors indicated that they were stimulated to improve their telephone response systems because of performance expectations and measures set forth by their states; one of these indicated that his budget was in part contingent on performance on a series of measures. One LHD director stated that the stimulus came from a survey of community physicians, which indicated dissatisfaction with responsiveness of the LHD.

Chapter Conclusion

In this chapter we set out to answer one of the primary questions that drove this research: are there system characteristics that are associated with better performance in consistently fast responses to urgent case reports? We found that live systems were more reliable and faster than automated systems, both during the day and after-hours. We also found that having a dedicated communicable disease line was not associated with better performance. In the final chapter of this report, we highlight the implications of these findings for public health settings and provide recommendations for how LHDs can improve their TBDS systems.

Chapter 5: Protocol Review

The CDC recommends that all LHDs have written protocols that outline procedures for responding to and triaging urgent case reports. It has not, however, provided guidance to LHDs about what information these protocols should contain, nor has it identified any exemplary practices that could be considered by LHDs for inclusion in their protocols. To date, there remains no research at all on this topic. We attempted to begin to fill this gap by reviewing the protocols of a small sample of LHDs to identify potential exemplary practices.

Given the lack of information on written protocols for 24-7 response, we endeavored to collect any protocols that LHDs use for the processes of disease reporting and response. In particular, we were interested in protocols regarding:

- questions that should be asked of medical personnel who provide an urgent case report by phone;
- advice that should be provided to medical personnel who provide an urgent case report by phone; and
- the triaging of urgent case reports.

In this analysis, we were particularly interested in describing protocol features that were innovative and appeared to facilitate appropriate and timely disease response. It should be noted that this part of the study is pilot. Since we did not receive protocols from all LHDs who reported that they had these in place, we are limited in the conclusions that we can draw about the association between

having a written protocol and the speed of response during the test calls. However, our findings highlight key protocol components that may be useful for LHDs interested in modifying their system for better response.

Overview of Results

We found that 71% of LHDs had protocols for questions that should be asked, 69% had protocols for advice that should be provided, and 67% had protocols for triaging processes. The use of protocols had considerable variation across geographical regions, with regions three and four using protocols disproportionately more for advice that should be provided and for triaging processes. In many instances, LHDs combined protocols for asking questions and giving advice. However, many departments did not have formally written triage processes but relied on staff training to guide these decisions.

Further, the responses given by LHD management differ significantly from the information we gathered from our test call debriefings of action officers, as described in the previous chapter. We found that only 71% (n=53) of all LHDs had all of their staff give consistent responses (yes or no) to the question, "Does your LHD have a formal procedure for triaging case reports?" This finding indicates that despite the widespread existence of TBDS protocols at LHDs, the knowledge and use of these protocols by action officers is inconsistent.

Of the 52 LHDs that reported that they had at least one protocol in place to respond to phone reports, 20 shared protocols with us to review. Of these protocols, approximately 16 were actually protocols addressing disease response and TBDS systems. Many of these protocols had worksheets for recording patient information, a listing of staff numbers for reporting during and after business hours, and a chart of when to report specific diseases. However, very few of these protocols explicitly described the phone response system structure in any detail.

Key Features of Protocols

Infectious Disease Reporting and Response Protocol

One of the participating LHDs uses a very precise and comprehensive protocol for disease reporting that includes all steps from notification and initial response to investigation, data flow, and post-event response. This protocol is unique in that it contains the full response process and defines LHD tasks clearly.

The notification process is described as a two-level process in which there is an initial level of notification for preliminary investigation, and a confirmatory level that includes reporting to the state. The protocol explicitly defines the response within and outside the LHD, and includes both primary and secondary phone numbers for reaching key staff. All staff members are also instructed to carry Blackberry devices for 24-7 access. In addition, the investigation process includes

explanations of how to use questionnaires and sampling for epidemiologic surveillance.

Another unique feature of this reporting and response protocol is its use of an incident command structure (ICS) for disease reporting. In the ICS, the disease team roles and responsibilities are articulated with an organizational chart. ICS duties also include descriptions of phone duty coverage.

Disease-Specific Screening Forms

Some LHDs utilize very specific disease screening forms. One of the LHD has developed a one-page screening form that include a checklist for relevant symptoms as well as testing recommendations. This type of form appears easy to use because it does not require going to multiple sources or worksheets in order to gather all of the relevant information on a case and to pursue next steps for addressing the potential infectious disease.

Epidemiologic Algorithm and Flowchart for Disease Response and Management

A useful feature of one of the LHD protocols is an easy to follow epidemiologic algorithm decision trees to direct staff on how to provide an appropriate call response and follow-up for disease management. These decision trees offer an understandable schematic on what guidance the action officer should share with the medical personnel regarding how to handle further reporting or screening.

The LHD also outlines a general flowchart for the overall disease reporting and investigation procedure. This flowchart follows two paths: 1) for immediate reportable diseases; and 2) for health issues in which notification is appropriate in a three-day window. The immediate reportable disease pathway includes the non-voicemail numbers or direct phone numbers for key LHD personnel and describes the key steps with time bounds: 1) LHD attempts to contact and interview case in less than three hours if during business hours or less than 12 hours if after hours call; 2) determination if contact needs testing and/or prophylaxis; 3) if yes, notification by LHD for contact of exposure; and 4) provision of instructions for testing and/or prophylaxis of contacts. The three days notification pathway includes voicemail numbers for staff and similarly feeds into the remaining components of the immediate reportable disease path described.

Clear Listing of Reportable Conditions and Tiers of Response Timing

Another helpful feature of the disease reporting protocols is the combination of a simple worksheet for recording patient background, symptoms data and a matrix of reportable conditions. One department shared a listing of reportable conditions that includes phone symbols next to immediate reportable diseases and descriptions of when to report the disease (e.g., factors related to certain strains of the disease).

Descriptions of Available Technologies for Disease Reporting

One department has developed an explicit protocol for establishing a communication network to ensure prompt responses to disease reports. This protocol describes all modes of communication including the use of cell phones, mobile radios, internet, fax, and pagers. It clearly delineates that the executive director of the LHD activates 24-hour notification process. In this protocol, the cell phone is identified as the communication method offering the most flexibility during public health emergencies and is responsible for linking the Emergency Operations Center with the Health Department Operations Center.

In addition to this description of the communications network for reporting, this LHD has a clear protocol for medical personnel to contact the LHD in the case of an emergency. The protocol includes instructions on how the LHD uses the various communication methods (e.g., who has the cell phone or pager) to respond.

<u>After-Hour Call Procedures with On-Call Relief Schedules</u>

One LHD went beyond the typical protocol for documenting after-hour call procedures, particularly for their epidemiologist staff. While many LHDs in this study shared forms that outlined a few steps for handling after-hours calls, one protocol included preparations and instructions for on-call physicians and epidemiologists, phone etiquette, and call origination guidelines. This protocol

acknowledges the need to ensure that there is sufficient coverage of LHD staff to respond to calls 24-7, particularly during an emergent or outbreak event.

Checklist for Testing 24-7 System

One of the participating LHDs includes a useful process for testing the 24-7 response system. In this protocol, the LHD is instructed on the key steps to assess the quality and speed of response. These steps entail developing scripts to test the system, testing the system during and after normal business hours, and ensuring that the test caller is connected with the on-call or back up action officer within 30 minutes. In addition, the checklist calls for the development of an after action report, which is disseminated to LHD staff and includes debriefing and incorporation of lessons learned into appropriate written protocols. Another unique feature of this protocol is its descriptions of scenarios that identify diverse call originators: medical provider, general public, law enforcement, and a public health lab.

Chapter Conclusion

As described earlier, CDC has recommended that all LHDs have written protocols for processing urgent case reports. While our sample size and representation precludes concrete conclusions linking specific features of protocols with actual call response, our protocol analysis revealed that some LHDs have protocol components consistent with exemplary practices identified through our

case study review. These include having built in communication redundancies, ensuring an actual person answers the phone, having formal process for triaging, evaluating the system through constant monitoring, and creatively collaborating with other agencies to streamline response.

Chapter 6: Discussion

This research advances our understanding of public health preparedness in three ways. First, our analyses of TBDS systems provides critical information on the ability of LHDs to receive and process urgent case reports and the factors that can be enhanced or modified to facilitate more timely and consistent responses. Second, the testing strategy employed in this study highlights the potential for developing performance measures and indicators to evaluate LHDs on other domains of preparedness. Third, the protocol reviews contained in this report represent the first effort to study the protocols and processes that LHDs have in place to respond to urgent case reports after they have been identified.

Key Findings from the Analysis of Telephone Systems

Prior to this study, there was little information on how LHDs respond to urgent case reports despite the CDC performance recommendations for LHDs to regularly test these systems. For those LHDs that were able to test their systems and identify gaps, there was little guidance on how to improve them. In Chapter 4, we presented the results of our analyses of the ability of LHDs to meet these recommendations. To help inform this part of our research we began by trying to identify existing research on LHD systems (of which there was very little) and as

described in Chapter 3, we conducted case studies of telephone response systems in areas other than public health.

Our case studies along with our previous research in this area, suggest that telephone response systems that rely on live respondents are the most reliable types of systems. We found that nearly 30% of participating LHDs were able to consistently connect the caller with an action officer within 30 minutes, confirming that a consistent, timely response is achievable by LHDs. In our quantitative analyses, one key factor—whether the caller reached a live person when they called, regardless of who that person was—was a strong predictor of excellent performance, both in terms of time to reach an action officer and in the consistency in doing so. While CDC has focused attention on the presence of a single, 24-7 line for urgent case reports, this feature of a health department's system was less important than the ability to directly connect with a live person. This finding suggests that LHDs may be able to improve their performance by ensuring that they use a system in which a live person answers the phone at all times.

The use of live person response is most critical during after hours time periods. Having an actual person, rather than an automated system answer a phone when a caller is trying to respond to an urgent case is most critical after business hours.. Most LHDs had some difficulty responding to our test calls after

business hours (either weekday nights or weekends); establishing a system of live coverage at all times of the day may improve timely response.

LHDs have a variety of options for providing a live person capability. Our finding about the importance of ensuring that callers connect with a live person may raise concerns about the additional staffing resources that might be necessary to establish such a system. However, our analysis of LHD systems and their response, coupled with our post-test call interviews, indicates that structuring a system to guarantee a "live connection" is possible through a variety of mechanisms, including forwarding calls to another local entity, such as a sheriff's dispatch or local poison control center, or hiring an answering service. Many LHDs have identified opportunities for creative resource sharing (e.g., partnering with local hospitals or poison control centers) and proper staffing coverage (e.g., on-call relief schedules, clear staff roles via protocols). The non-public health agencies that we studied reported similar strategies for creative resource sharing.

Only focusing on ensuring that calls are answered by live person systems is insufficient. It is important to note that having a live person answer the call will not in and of itself guarantee successful performance. Our interview data, protocol review, and post-test call interviews with LHDs with consistently timely performance suggested that regular monitoring and evaluation of urgent case report processing is an important component to response improvement, as is

regular testing, or drilling, of the system. However, our test call debriefing interviews with action officers indicate that most LHDs do not engage in quality assurance or performance monitoring efforts.

Implications for Performance Measurement

Public health preparedness has highlighted the need for objective measures of performance in public health. Performance measurement is a critical prerequisite for quality improvement, and is essential if LHDs are to improve their preparedness. Our prior work (Seid, 2006) highlighted that health departments often do performance measurement, but often do not complete the rest of the quality improvement cycle. The level of performance documented in this study is amenable to improvement using quality improvement methods.

This study again confirms that objective measures of public health performance can be developed and used. Future work will need to focus on how health departments can improve performance in this and other measures, and on the development of additional, objective measures of public health system performance. Most critical is the development of measures for areas that are widely regarded as critically important.

Protocol Review

Our protocol review revealed a number of innovative practices that LHDs have implemented to guide initial responses to urgent case reports. However,

more research is needed to help identify practices that are most likely to lead to successful responses. This may be an area in which LHDs could use more guidance from the CDC.

Recommendations

The study findings yield important considerations for updating the recommendations for LHDs to improve their TBDS systems in a way that is consistent with existing recommendations while allowing necessary flexibility to achieve these goals efficiently given resource constraints. Moreover, the guidance on TBDS system improvement offers the added benefit of strengthening local public health systems (e.g., training staff for urgent case report response enhances overall staff capacity; building infrastructure for one health department function builds it for other functions) and provides a template for objective measurement of preparedness.

Our findings in this study suggest four actions which LHDs could take to improve their TBDS systems. In addition, we have included one recommendation regarding the current CDC standards:

1. **Ensure that there is a pathway to connect medical personnel with live response**. LHDs that were most successful in their timely call response (within 30 minutes) had clear plans to ensure that medical personnel connected with a person rather than machine, including partnering with another health agency in the community in order to share staff.
2. **Revisit resource allocations for 24-7 response**. Given that a dedicated 24-7 line did not confer benefits of a speedier response (particularly in

larger LHDs), LHDs that do use these systems may want to consider whether resources for disease surveillance are better targeted to guaranteeing that staff are available to respond to calls directly at all times of the day.

3. **Build a structure for continuous testing and quality improvement for disease reporting and response**. This might entail recording urgent case report calls and reviewing them in staff meetings for speed and quality of response, conducting in-house regular test calls to a LHD TBDS system, and keeping detailed logs of call response to identify gaps in 24-7 coverage.
4. **Examine existing protocols for evidence of staff coverage for live response, and clarify staff roles so that there are no gaps in 24-7 live coverage**. Protocols that appeared comprehensive in ensuring live coverage included detailed staff charts, call response flow diagrams, and easy to use disease reporting forms.
5. **Re-examine the current CDC 24-7 response performance standards.** One of the key standards is that all LHDs have a dedicated 24-7 line; however, our study findings did not find an added value to this system feature. Thus, we recommend that the current standards should be revisited to determine which standards are appropriate and most beneficial to ensuring timely connection with an action officer. In addition, LHDs would benefit from standards that include guidance or possible strategies to achieving 24-7 coverage.

Our research suggests that LHDs have not yet begun to regularly test their TBDS systems despite the CDC's recommendations to do so. Testing is especially important because most LHDs overestimated the ability of their TBDS system to perform. This study does not lead to a recommendation about the process by which this testing should be done. Options included the CDC testing state and LHDs, state health departments testing LHDs in their state, and self evaluations by LHDs. Regardless, all LHDs should be required to report annually on the results of their tests, regardless of the entity performing them.

Our research suggests that it may be prudent to revisit some aspects of the current CDC recommendations regarding TBDS. For example, our research did not find any significant difference between LHDs that had a separate dedicated 24-7 telephone line to receive urgent case reports and those LHDs that had more than one line to receive urgent case reports.

It is also not clear what the standard should be in terms of the acceptable length of time for a caller to reach an action officer. The CDC set a standard of 30 minutes, and has subsequently considered changing this standard to 15 minutes. Many LHDs maintain that either standard is unrealistic; however, even when setting the bar at 60 minutes, there are still a significant number of LHDs unable to meet this standard.

Limitations and Directions for Future Research

There are some limitations to the approach used in this study. Although the sample was drawn to represent LHDs throughout the United States (excluding those that were very small), the relatively small sample size limited our statistical power to identify other potential success factors. We based our selection of predictor variables on prior work and our case studies; however, there may be other relevant predictors that were not measured here.

This research sets the stage for several avenues of future research. First, among these is the potential to identify and develop additional performance

measures of public health systems and to test these measures using approaches similar to those outlined in this report. A large gap that remains when examining TBDS systems deals with the appropriateness of response once an action officer connects with a caller. Our protocol review was meant to advance the discussion on this issue by identifying existing practices in LHDs regarding what questions action officers should ask callers, what advice they should provide callers, and how calls should be triaged within LHDs.

Conclusion

The field of public health is moving towards performance measurement, accountability and quality improvement. In this regard, we are particularly encouraged by our ability to identify factors that were associated with consistently high performance. Improving performance on this dimension of public health responsibility may be amenable to classical quality improvement approaches, which stress the use of multiple small cycle tests of change and measurement in order to achieve an aim, followed by regular assessment of performance to ensure that the improvements are maintained. Developing and improving measurement of other core LHD processes and functions will likely be necessary to achieve improvements in those domains. This study provides insight into how LHDs can begin to improve their 24-7 telephone response to potentially urgent cases.

Appendix A: Glossary

Action officer – Public health professional whose responsibility is to respond to concerning case reports placed by health care workers to public health disease reporting systems. Action officers can be public health agency directors, epidemiologists, bioterrorism coordinators, doctors, nurses, etc. Action officers should have sufficient training, and clinical knowledge to be able to respond appropriately to 80% of all the calls made to a public health agency.

Bioterrorism – The intentional release of a biological agent into an environment with the intent to harm the living beings in that environment. Abbreviated as BT.

Callback – A call received from an action officer as a follow-up to a message from a caller.

Caller – Individuals working for the testing agency responsible for placing test calls and recording the responses.

Debriefing – The act of revealing the nature of the test, its goals, and its sponsors, including the names of the exercise coordinator and the people at the public health agency who provided their consent. Debriefing is the point at which the caller tells the action officer responding to a call that the call is only a test and requires no further action.

Detection – Occurs when the staff members at a public health agency being tested become aware of the test.

Disguise – The use of role-playing during a call to enhance the realism of the call. A disguise typically involves a caller pretending to be a health care worker calling a public health agency about a concerning case.

Epidemiologist – An investigator who studies the occurrence of disease or other health-related conditions or events in defined populations. Disease control is often also considered to be a task for the epidemiologist, especially in certain specialized fields, such as malaria epidemiology.

Local health department (LHD) – A term used to signify all public health agencies below the state level (e.g., county, municipal, etc.).

Public health professional – A person who works for a public health agency who has knowledge and training in public health.

Telephone-based disease reporting system – A system developed by a public health agency to receive case reports from health care workers, usually by telephone.

Urgent case report – A case report that could potentially represent a severe public health threat.

Warm transfer – A call that is transferred directly from a receptionist or answering service at a public health agency to an appropriate action officer.

References

Blackwell T, Kaufman J. Response time effectiveness: comparison of response time and survival in an urban emergency medical services system. Academic Emergency Medicine 4: 288-295, 2002.

Bliss, Mike (2006). Personal communication, January 27, 2006.

Campbell J, Gridley T, Muelleman R. Measuring Response Intervals in a System with a 911 Primary and an Emergency Medical Services Secondary Public Safety Answering Point. Annals of Emergency Medicine 29: 492-496, 1997.

Centers for Disease Control and Infection. Performance Criteria for Public Health Disease Reporting Systems Operating Twenty-four Hours per Day, Seven Days per Week (24-7); 2003. Available at: http://www.cdc.gov/epo/dphsi/8city.htm.

Dausey DJ, Lurie N, Diamond A, Meade B, Molander R, Ricci K, Stoto M, Wasserman J. Tests to Evaluate Public Health Disease Reporting Systems in Local Public Health Agencies. Santa Monica, CA: RAND Corporation, 2005a.

Dausey DJ, Lurie N, Diamond A. Public Health Response to Urgent Case Reports. Health Affairs, August 30, 2005b.

Davis, S. (2002). "Virtual Emergency Operations." Risk Management, Vol. 49, Issue 7: 46-52.

GAO, (2006). Homeland Security: Opportunities Exist to Enhance Collaboration at 24-7 Operations Centers Staffed by Multiple DHS Agencies. GAO-07-89.

Giles, Heidi (2006). Personal communication, March 31, 2006.

Graves R. Key Technologies for Emergency Response." Proceedings of the First International Workshop on Information Systems for Crisis Response and Management ISCRAM2004 (Eds. B. Carle and B. Van de Walle), Brussels May 3-4, p. 133-138, 2004.

Hale J. A layered communications architecture for the support of crisis response. Journal of Management Information Systems 14: 235-255, 1997.

Hogan, Mary (2006). Personal communication, December 16, 2005.

Horan T, McCabe D, Burkhard R, Schooley B (2005). Performance information systems for emergency response: field examination and simulation of end-to-end rural response systems. Journal of Homeland Security and Emergency Management 2: 1-20, 2005.

Jain S, McLean C. "Simulation for Emergency Response: A Framework for Modeling and Simulation for Emergency Response." Proceedings of the 35th Conference on Winter Simulation: Driving Innovation. p. 1068-1076, 2003.

Jajosky RA, Groseclose SL. Evaluation of Reporting Timeliness of Public Health Surveillance Systems for Infectious Diseases. BMC Public Health 4:29, 2004.

Lurie N, Wasserman J, Stoto M, Myers S, Namkung P, Fielding J, Valdez RB. Local Variation in Public Health Preparedness: Lessons from California. Health Affairs W4: 141-151, 2004.

MedAire, (2007). "Who We Are." Available on-line at:

http://www.medaire.com/compinfo.html. Accessed on January 2, 3007.

Mrvos R, Krenelok KP. Realtime testing of a regional poison information center's disaster plan. Journal of Homeland Security and Emergency Management 2: 1-3, 2005.

National Association of County and City Health Officials (NACCHO). Who's Who in Local Public Health: NACCHO Membership Directory 2005. NACCHO: Washington DC, 2005.

OnStar (2006). Personal communication with staff member identified as "John". March 31, 2006.

OnStar, (2007). " Welcome to OnStar." Available on-line at:

http://www.onstar.com/us_english/jsp/index.jsp. Accessed on January 2, 2007.

Rapid Response Inc. (2007). "An Affiliation that Works Hand in Hand." Available on-line at: http://www.ewmi-info.com/rri/rri-affil.html. Accessed on January 2, 2007.

Seid M, Lotstein D, Williams VL, Nelson C, Lurie N, Ricci K, Diamont A, Wasserman J, Stern S. Quality Improvement: Implications for Public Health Preparedness. Santa Monica, CA: RAND Corporation, 2006.

United Way of Connecticut (2007). "About 2-1-1." Available on-line at: http://www.infoline.org/AboutUs/Default.asp. Accessed on January 2, 2007.

U.S. Census Bureau. Statistical Groupings of the States and Counties. Available at: http://www.census.gov/geo/www/GARM/Ch6GARM.pdf. Last accessed 4 April 2006.

U.S. Department of Health and Human Services. Status of State 24-7 Urgent Disease and Public Health Emergency Reporting Systems. Office of the Inspector General. February, 2005.

Van Fossen, Bob (2005). Personal communication, December 21, 2005.