Development and Assessment of the STATPack™ Emergency Response System

Noel Johnson
University of Nebraska Medical Center
ndjohnso@unmc.edu

Ann Fruhling
University of Nebraska at Omaha
afruhling@mail.unomaha.edu

ABSTRACT

The STATPack™ is a telemedicine consultation and emergency response system which was developed to increase statewide laboratory responsiveness to public health emergencies. Although several emergency response management information systems have been created for diagnostic laboratories at the national level, most states in the U.S. do not have the capability to share critical public health microbiology laboratory information at local levels, especially in rural communities. This paper offers a description and preliminary assessment of the STATPack as it is being deployed by the Nebraska Public Health Laboratory and should be recognized as research in-progress. Initial experiences with this emergency response system have been encouraging.

KEYWORDS

Public health laboratory, eXtreme programming, telemedicine, bioterrorism, emergency response system.

INTRODUCTION

Threats of bioterrorism and high-profile disease outbreaks have accelerated the efforts of public health laboratories to establish better communication networks with private clinical laboratories. During a health-related event, timely interpretation and dissemination of information are essential to reducing morbidity and mortality. Because the bulk of infectious disease testing in the U.S. is done in private clinical labs, better integration with state public health laboratories is expected to improve both the timeliness and validity of disease reporting.

The STATPack™ (**S**ecure **T**elecommunications **A**pplication **T**erminal **P**ackage) is a telemedicine consultation and emergency response system developed by information technology experts at the University of Nebraska Omaha (UNO) in collaboration with health professionals from the Nebraska Public Health Laboratory (NPHL). The intent of this system is to increase statewide laboratory responsiveness to public health emergencies by enhancing laboratory network connectivity throughout Nebraska.

Because this system is still a work in progress, definitive evaluation is not yet possible. Continued development of STATPack™ is guided by lessons learned from distance consultation on clinical cases, and deployment as an emergency response system (ERS) in a recent statewide bioterrorism exercise. Improvements continue to be made, using eXtreme programming (XP) methods, in response to policy development and feedback from various stakeholders. Although the evolving technology presents a moving target for evaluation, this paper is a current assessment of the STATPack based on preliminary experiences in Nebraska.

BACKGROUND

The Nebraska Public Health Laboratory is located on the eastern border of the state in Omaha, Nebraska. It is the only public health laboratory in a state with an area of 77,000 square miles and a population of 1.75 million residents (U.S. Census Bureau, 2004). Nebraska's population is disproportionately concentrated along its eastern border, mainly in the Omaha area (42% of the state's population), while the state extends 500 miles to the west.

The initial impetus behind the development of STATPack emerged from the anthrax bioterrorism events of 2001. Laboratory cultures of micro-organisms such as anthrax, which are reportable because of their public health significance, are generally submitted to state public health laboratories for confirmation and archiving. But sending a suspect microbiologic sample to NPHL from remote areas of the state in a timely manner can be problematic, particularly during a typical winter in the midwest, for example, when Nebraska's interstate highways may be closed due to severe weather. Officials from NPHL felt that a presumptive diagnosis of anthrax could be rendered more efficiently from a digital image received electronically. Emergency response time for public health authorities in this type of scenario would be greatly improved.

Although several emergency response management information systems for healthcare initiatives have been created at the national level, most states in the U.S. do not have the capability to share critical public health microbiology laboratory information at local levels, especially in rural communities. The STATPack™ system was created to address the needs of a state public health laboratory for electronic diagnostics consultation, critical information sharing, and alert notification, in the case of a bioterrorism event or other public health emergency (Fruhling, Sambol, Hinrichs and de Vreede, 2006).

METHODS

This evaluation relies primarily on literature review and subjective feedback from current system users. In addition, STATPack[TM] usage history has been reviewed to assess the system's performance during electronic consultations between client laboratories and the NPHL. More recently, STATPack[TM] was tested by the NPHL as part of a statewide bioterrorism exercise and the results are presented here. A survey instrument has been developed to assess user acceptance of this technology. Results and interpretation of this survey are expected to be completed in the spring of 2006.

SYSTEM DESCRIPTION

The STATPack™ application is a secure, HIPAA compliant, web-based network system that uses client/server technology to connect the state's geographically dispersed microbiology laboratories to the Nebraska Public Health Laboratory. According to the project manager, eXtreme programming methodology was used to develop the system. EXtreme programming operates on iterative development, working in frequent consultation with the user, and having small and frequent releases (Beck, 1999). The XP approach offers advantages of flexibility, rapid prototyping, low overhead, and methodology suited for small to medium size projects. The initial information technology team consisted of two computer science student developers, an on-call senior research technologist professional and a project manager. In addition, the STATPack™ user team consists of the Director of the University of Nebraska Center for Biosecurity who is also a physician, the Assistant Director of the Nebraska Public Health Lab (NPHL) and two NPHL health professionals.

Equipment for STATPack™ consists of a dedicated computer terminal with network connection, a flat screen/ speaker unit, a mini-virtually indestructible keyboard, a high-resolution digital camera, a bio-safe plexi-glass specimen container, and a microscope interface kit attached to a microscope (Fruhling and Vreede, 2006). The digital camera captures macroscopic images of culture plates and the microscopic interface kit works with the microscope to capture microscopic images using conventional light techniques or fluoroscopic imaging. The images, along with text messages, can be sent to NPHL with routine, urgent, or emergency notification. A corresponding pager alert system notifies contacts immediately if a suspicious sample is found. The NPHL can also use STATPack to alert laboratories throughout the state when a microbiolgic "agent of concern" has been detected.

STATPACK IMPLEMENTATION

In June 2003, the first STATPack prototype was deployed for field evaluation. Currently in Nebraska, 14 clinical diagnostic laboratories are equipped with STATPack. In addition, the system is now operational in 3 non-clinical labs; the Nebraska Department of Agriculture (NDA) food testing laboratory, the Nebraska Health and Human Services System (NHHSS) water and environmental testing laboratory, and the University of Nebraska–Lincoln (UNL) Veterinary Diagnostic Center. According to the Assistant Director of NPHL, connection with these non-

clinical laboratories "is just another aspect of preparedness. You don't know if (an infectious or toxic agent) is going to be in the water, food, or livestock" (APHL, 2005).

In Nebraska, public funds have been used to provide all necessary equipment and a .5 FTE staff member within NPHL to support the system. There are no costs to the "client" laboratories for equipment or consultation service although some labs have had to absorb the costs of installing an additional network connection. The STATPack™ development team at UNO reports that network security in Nebraska is highly variable from one hospital to the next. Installation of the system must be coordinated through the Information Technology personnel at each site.

Since its introduction, NPHL has documented ten cases where referring laboratories have used the STATPack for distance consultation on cases of suspected public health significance. The microorganisms most frequently encountered have been *Francisella tularensis* and *Bacillus* spp (anthrax suspects). In addition, STATPack™ has been used to help identify less significant but technically challenging cultures such as *Clostridium perfringens,* and various fungal growths.

At this stage of implementation, NPHL has not discouraged the occasional use of STATPack for consultation on routine cases. The prevailing wisdom has been that STATPack clients need to "put their hands" on the system from time to time to maintain proficiency. The stakeholders recognize that, as Turoff states; "An emergency system that is not used on a regular basis before an emergency will never be of use in an actual emergency" (Turoff, Chumer, Van de Walle and Yao, 2004).

SYSTEM REFINEMENTS

The project manager chose eXtreme programming methodology to develop the STATPack™ system because the requirements of the system were vague, evolutionary, and changing. The ERS application was a conceptual idea of one of the key stakeholders. It was expected to be a new and innovative laboratory emergency response system; no similar systems existed to evaluate or re-engineer. The system development team had to deal with changing software and technical requirements. For example, after the initial deployment of several STATPack systems to client laboratories, the NPHL users requested that they be able to pan the client cameras and control zoom functions remotely (Fruhling and Vreede, 2006).

Until recently, images captured by STATPack clients could, by design, only be sent to NPHL. The reasons for this policy were to prevent private laboratories from using the images for anything other than public health purposes, and to preserve the security of the system. The NPHL decided to change its policy in response to multiple requests from laboratorians to use these images for a variety of reasons. A number of hospital laboratories, for example, expressed an interest in using STATPack images for teaching. Furthermore, the NHHSS environmental testing laboratory wanted to share its STATPack images with the Environmental Protection Agency (EPA) laboratories, while the Veterinary Diagnostic Center expressed an interest in sending images to the National Veterinary Service Laboratories (NVSL). In response to these requests, the system has been changed so that clients can now save STATPack™ images and distribute them as needed. Albeit, the hospital laboratory directory does have oversight on who receives the images. It can be argued that this refinement not only increased the usefulness of STATPack to NPHL client laboratories, but also increased the utility of STATPack™ as an ERS.

The NPHL participated in a statewide TEREX 2005 (bioterrorism) exercise on November 3, 2005. The STATPack™ component of this exercise consisted of an emergency notification sent to nine facilities. Emergency notification produces an audible alarm at each STATPack™ terminal. The message was successfully sent from NPHL and received by all nine participating laboratories. All laboratories responded to the message within 15 minutes however, two of the labs were unable to reply through STATPack™. The developers at UNO have addressed this problem by adding a simplified "Reply" button to all of the STATPack™ systems.

DISCUSSION

Healthcare professionals regard the STATPack™ as a "telemedicine" system.

"Telemedicine is the use of electronic communication and information technologies to provide health care when distance separates the medical professional from the patient. It also includes educational and administrative uses of these technologies in support of health care, such as distance learning and administrative videoconferencing" (Association of Telehealth Service Providers, 2000).

One of the biggest pitfalls of telemedicine evaluation is that the technology is constantly evolving. This is certainly true of the STATPack™ system. A review of the current literature suggests that STATPack™ falls under the general category of "telepathology". Although it may be difficult to evaluate, the feasibility of telepathology applications such as STATPack has been proven, and is currently regarded as a "mature application" of telemedicine (Bashshur, 2005).

Two of the primary design objectives of an emergency response system, as expressed by Turoff, are to create a system that is "easy to learn" and which is able to capture "the history of what took place without imposing added load on the participants" (Turoff et al., 2004). The STATPack™ meets these objectives in that the user interface is designed much like an e-mail account (which is familiar to most users) with a history of messages and images sent and received. Each message is stamped with time, date, and user identification, so that a crisis event can be captured for later analysis.

A hoped-for by-product of any laboratory integration project is greater referral of abnormal test results to the state public health laboratory so that emerging public health threats are identified quickly (APHL, 2005). It's too early to tell whether the deployment of STATPack™ has increased the number of reportable cases referred to NPHL from private laboratories.

User acceptance of STATPack™ is recognized as being critical to the overall success of the system. Developers have endeavored to make the system simple to operate while minimizing the "footprint" of the equipment within the client laboratory. Informal discussions with current STATPack™ users have been encouraging. For example, most laboratorians have expressed confidence in their ability to get an immediate response from the NPHL using the STATPack™ in an emergency situation. Others have commented that although the STATPack™ system is not used very often, it was "reassuring" to have an instant link to the NPHL. Although STATPack™ is generally regarded as "easy to learn", several laboratorians have expressed uncertainty in their ability to capture and send images from the microscope interface.

A survey questionnaire has been developed to measure user attitudes about perceived usefulness and ease of use. It is also intended to assess whether these perceptions might be influenced by factors such as the user's geographic distance from the NPHL, computer experience level, and overall capacity of the client laboratory. In the end, we may learn that perceived usefulness of STATPack™ correlates most closely with user attitudes toward bioterrorism preparedness in general. This survey has been administered to 39 current STATPack™ users and results will be available within the coming months (spring 2006).

CONCLUSION

Threats of bioterrorism and high-profile disease outbreaks have accelerated the efforts of public health laboratories to establish better communication networks with private clinical laboratories. The STATPack™ is a telemedicine consultation and emergency response system being deployed in Nebraska to establish a direct link to the state's public health laboratory. The purpose of this system is to increase statewide laboratory responsiveness to public health emergencies by enhancing laboratory network connectivity. Because this emergency response system is still a work in progress, definitive evaluation is not yet possible, but the intuitive appeal of STATPack™ is supported by preliminary experiences in Nebraska.

REFERENCES

1. U.S. Census Bureau (2004) estimate. Available at:
    http://quickfacts.census.gov/qfd/states/31000.html

2. Beck, K. (1999) Embracing change with extreme programming, IEEE Computer, 32:10, pp. 70-8.

3. Fruhling, A., Sambol, A., Hinrichs, S. and Vreede, G.J. (2006) Designing an Emergency Response System for Electronic Laboratory Diagnostics Consultation, *39th Hawaii International Conference System Sciences.*

4. Fruhling, A. and Vreede, G.J. (2006) Field Experiences with eXtreme programming: Developing and Implementing an Emergency Response System, (accepted by *JMIS* for publication in 2006).

5. Association of Public Health Laboratories (APHL) (2005) Linking Laboratories One by One to Strengthen America's Emergency Response System. Available at: http://aphl.org/article.cfm?articleID=77

6. Turoff, M., Chumer, M., Van de Walle, B. and Yao, X. (2004) The design of a dynamic emergency response management information system (DERMIS), *Journal of Information Technology Theory and Application,* 5:4, pp. 1-35.

7. Association of Telehealth Providers (2000) Telemedicine FAQ. Available at: http://www.atsp.org

8. Bashshur R., Shannon G. and Hasan, S. (2005) Telemedicine Evaluation. *Telemedicine and e-Health,* 11:3, pp. 296-316.