



***Enterobacter aerogenes* Needle Stick Leads to Improved Biological Management System**

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Abstract

*A laboratory worker who received a needle stick from a contaminated needle while working with a culture containing *Enterobacter aerogenes* developed a laboratory-acquired infection. Although this organism has been shown to cause community and nosocomial infections, no cases of a laboratory-acquired infection have been documented. Lessons learned from the event led to corrective actions that included modification of lab procedures, development of a biological inventory tracking and risk identification system, and the establishment of an effective biological safety program.*

Introduction

The following account of a laboratory-acquired infection (LAI) demonstrates the consequences of improper risk group identification and the need for better tools to identify risks associated with microorganisms. Pacific Northwest National Laboratory (PNNL) has enhanced its Biological Management Program after microbiological work with an unanticipated source of infectious material (*Enterobacter aerogenes*) resulted in an LAI. Before the LAI, the Biological Management Program at PNNL was based on the Occupational Safety and Health Administration blood-borne pathogen standard and the *Biosafety in Microbiological and Biomedical Laboratories* (BMBL). Causal analysis of the LAI and self-assessments of the biological program helped PNNL to identify deficiencies and clarify the need to update processes and procedures. A software program called the Biological

Management System (BioMS) was internally developed by PNNL Information Technology and implemented laboratory-wide. The BioMS program inventories cultures of biohazardous organisms and provides information regarding their risk groups.

Background

As part of environmental isolate growth experiments conducted at PNNL, a suspension of log growth phase *Enterobacter* vegetative cells was injected with a syringe and needle through the septa into anaerobic vials. After the transfer was made, the researcher attempted to dispose of the needle in a sharps container. The syringe accidentally slipped and poked the researcher in the right hand between the palm and the little finger. Three hours later, her hand began showing signs of inflammation around the puncture wound and the incident was reported to management.

The local contracted medical facility that serves the laboratory was closed at the time of the reporting, so the employee was sent to a local hospital emergency room. The initial hospital visit around 5:30 p.m. Monday, about 4 hours after the needle stick, revealed the inflammation had worsened and a 2"x2½" area around the wound was swollen. A 3-week dose of an oral antibiotic (Levaquin) was prescribed and two doses of intravenous Rocephin were administered Monday night and Tuesday morning, along with painkillers.

Tuesday afternoon, the staff member was medically released to come back to work. A few hours

after returning to work, she noticed additional swelling and a red streak developing on her arm. She went back to the hospital and was given a different intravenous antibiotic, Gentamicin, which was administered on Tuesday night and again on Wednesday morning. By Wednesday afternoon, the swelling was reduced and the red streak had disappeared.

The physician's initial diagnosis, based on observations and tests, indicated cellulitis of the hand, which can be potentially serious if the infection spreads into the deep tissue spaces of the hand. The secondary diagnosis was tenosynovitis of the hand, a deep infection that often requires hospitalization. The blood and basic metabolic panel tests came back normal and the prescribed antibiotics eliminated the infection. Therefore, no additional actions were required.

The organism, previously characterized by a collaborative laboratory at Florida State University using DNA sequencing, revealed a close DNA sequence match with *Enterobacter aerogenes*. Since there was no attempt to culture an organism from the wound, this infection cannot be considered a definitive case of *Enterobacter aerogenes*. However, this organism is known to cause nosocomial infections and occasionally a community-acquired infection (Sinave, 2002). There have been no other reported cases of a laboratory-acquired infection with this organism.

The *Enterobacter* isolate was cultured in tryptic soy broth, then centrifuged and washed in a 30-millimolar solution of bicarbonate buffer. The anaerobic vial contained bicarbonate buffer and a concentration of *Enterobacter aerogenes* at 5.0×10^8 organisms per ml. When the needle stick occurred, the syringe was empty with only residual material at the end of the needle. The laboratory worker estimated that no more than 0.1 μl of the solution was accidentally injected into the hand by way of the puncture wound. Given the concentration of organisms, and the amount of culture that was injected, an estimated exposure to 5.0×10^4 organisms caused this infection.

The identified causal factors and corrective actions to this event include the following:

1. At the time of this incident, the laboratory relied solely on the *BMBL* for risk classification of organ-

isms. The *BMBL* does not specifically identify *Enterobacter aerogenes* as an organism that requires BSL-2 work practices and controls. Consequently, BSL-1 precautions, not BSL-2 precautions, had been implemented at the laboratory for work with *Enterobacter*. Since this incident, PNNL's new BioMS maintains current inventories of microorganisms and identifies the risk groups using available risk group sources including international listings. The BioMS helps researchers to identify the proper biosafety level and precautions for use. Researchers are responsible for performing risk assessment based on the specific agent and procedures. In general, volumes of materials are not tracked in the database, only the presence or absence of the material in a particular location.

2. The affected employee waited to report the incident until symptoms and signs appeared. Since this incident, the laboratory has updated a procedure to note that when conducting microbial work, workers are required to immediately report any skin puncture, wound, or laceration to management and to visit the medical services provider for evaluation and continued monitoring.

3. No protective gloves were used. Although Latex, vinyl, or nitrile gloves would not necessarily protect against a needle stick, a reported "wiping" function occurs when a needle passes through the glove that may reduce the amount of infectious material from the outside of the needle (Johnson et al., 1991). The new PNNL BioMS identifies the appropriate risk group and microbiological work practices to be used, including personal protective equipment.

Conclusion

A significant lesson learned from this event was that if an organism is not described in the *BMBL*, this does not mean it is safe to work with it at BSL-1. Any organism in culture-scale numbers may present a problem if injected. The use of sharps creates an increased risk that must be managed through an effective Biological Management Program. This incident, along with input from internal assessments, helped PNNL identify deficiencies and establish a new way of addressing biological hazards in the workplace. PNNL's Biological Safety Program and BioMS have become effective tools for management,

researchers, and support staff, promoting a safer work environment.

References

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