

# Surveillance of Antimicrobial Resistance in Bacteria:

## A Veterinary Medicine Perspective

Clyde Thornsberry

Antimicrobial resistance in bacterial species that cause disease in humans has become a favorite topic for both the scientific and the lay public and is a favorite subject for the scientific and lay press media. Antimicrobial resistance in bacteria from animals is also of intense interest to the same groups, mostly because of the concern that animals may develop resistance to pathogens which can then be transmitted to humans thus creating antimicrobial-resistant infections in man.

Antimicrobial-resistant bacteria are not a new emerging problem. These resistant bacteria predate the antibiotic era and have been problems since the inception of the use of antimicrobials. In the 1940s, penicillin-resistant *Staphylococcus aureus* became a problem in various hospitals soon after penicillin was used (1). In the last few years, we have seen marked increases in antimicrobial resistance in some pathogenic species that had principally remained susceptible for many decades, e.g. penicillin-resistant *Streptococcus pneumoniae* and vancomycin-resistant *Enterococcus* species (2,3).

It is not surprising, then, that there has been an increased interest in the surveillance of antimicrobial resistance in both human and other animal bacteria. A task force convened by the American Society for Microbiology concluded "...ASM is gravely concerned about the national and global increase in antibiotic resistance... Currently there is no national or global surveillance system for monitoring antibiotic resistance..." (4). In addition to health concerns, the actual cost of antibiotic resistance is estimated to be in the billions of U.S. dollars (4). These problems have set the stage for a renewed interest in surveillance of antimicrobial resistance.

A true definition of surveillance would probably require that it be a continuous process but most of the options that have been available for gathering data on antimicrobial resistance would not meet that requirement. The traditional options have been as follows:

1. The use of antibiograms generated from susceptibility data from the routine tests done in one institution's laboratory. These antibiograms can be made available to clinicians at any intervals but the most common interval is probably at 6

months. These antibiograms are relatively current but contain data from only one institution using one method and the quality of the data will be dependent on the quality of that laboratory's methods. These data can be used to trend resistance in that institution.

2. The use of peer-reviewed literature. These data are usually of high quality but are dated (often 2 or more years old), are usually from one institution and are generally limited to a few species and few antimicrobials. More often than not, only one method is represented. This option may be very expensive for the amount of data generated.
3. Data collected by public health agencies, e.g. the Centers for Disease Control (CDC), the U. S. Department of Agriculture, and the World Health Organization (WHO). These data are usually limited to only one or two species and a few antimicrobials. These data are usually of high quality, but are dated and very expensive to develop.
4. Data on national isolates that have been tested in a central laboratory. This method is generally considered the "gold standard" of surveillance. The data are usually of high quality and a truer picture of resistance on a regional basis as opposed to one institution or area. The information is, however, dated (often 2 years or more when published) and often limited to a few species and a few antimicrobials. This kind of surveillance is always extremely expensive and most often supported by the pharmaceutical industry.

A new approach to surveillance of resistance has been developed by MRL Pharmaceutical Services. In this novel method, susceptibility data from participant laboratories are gathered electronically and brought to our center where the data is put through an intense series of quality control procedures before being added to the database. The isolates on which the database is constructed comes from institutions that are balanced by geography, demography, and susceptibility testing methods. Thus the data are real-time, and contain all antimicrobials and all bacterial species. The database is on the Internet and can be extensively analyzed, usually by predetermined queries. At the end of 1997, we had more than 100 U.S. institutions participating and an additional 100 or more will be added in 1998. The amount of data gathered is very large and at the end of September, 1997 there were more than 8,000,000 results on more than 500,000 strains, 472 taxa, 83 antimicrobials, and 390,000 patients. The options for analysis of these data

are basically unlimited. This system is called TSN Database US<sup>®</sup>, but TSN is now being developed internationally.

Can these systems be used in veterinary medicine? The basic requirements for an acceptable susceptibility monitoring system is that the data be accurate, reproducible, relatively recent, with multiple options for analysis of the data, and standardized methods are an absolute necessity. Such standards for antimicrobial susceptibility for veterinary bacterial isolates are now in development, but are in the early stages. My recommendation is that, at this time, a veterinary surveillance system should be done using the central laboratory method, in which the important animal bacterial pathogens would be gathered from various areas of the United States (and soon the world), brought to a central laboratory known to use standardized methods and provide accurate, reproducible data, and tested for susceptibility and resistance by MICs to the important antimicrobials. These standard methods should be those that are recommended for animal pathogens by the National Committee for Clinical Laboratory Standards (NCCLS) (5).

One of the most critical components of this surveillance system will be the selection of the specimens to be collected. In my opinion, the specimen should come from animals in all the different environments, e.g. farm, abattoir, laboratory, etc.

In conclusion, we need to establish a national antimicrobial resistance monitoring system for bacteria isolated from animals in which standardized methods for isolation, identification, and susceptibility testing methods are used to generate accurate and timely resistance data. It is only with these quality data that we can develop methods to control the resistance problems. At this time, this is probably best done by testing regional isolates in a selected central laboratory, but when standardized methods are the rule in veterinary laboratories and accuracy and reproducibility results is demonstrated, electronic surveillance methods should be instituted.

## REFERENCES

1. Sherris JC. 1971. The epidemiology of drug resistance, p 50-60. In Proceedings of the International Conference on Nosocomial Infections. American Hospital Association, Chicago, IL.
2. Thornsberry C, Ogilvie P, Kahn J, et al: Surveillance of antimicrobial resistance in *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis* in the United States in 1996-1997 respiratory season. *Diag Microb Infect Disease* 29(4):249-257, 1997.
3. Leclercq R, Derlot E, Duval J, Courvalin P: Plasmid-mediated resistance to vancomycin and teicoplanin in *Enterococcus faecium*. *N Engl J Med* 319:157-161, 1988.
4. Cassell GH: ASM task force urges broad program on antimicrobial resistance. *ASM News* 61:116-120, 1995.
5. National Committee for Clinical laboratory Standards. Performance standards for antimicrobial disk and dilution susceptibility tests for bacteria isolated from animals. Tentative standard M31-T. NCCLS, Wayne, PA.