Antimicrobial Resistance in Michigan: A Summary of Select Data

The U.S. Centers for Disease Control and Prevention (CDC) has defined the antimicrobial resistance problem as a "major blooming public health crisis."\(^1\) Drug resistant bacterial infections affect hundreds of thousands of Americans and cause tens of thousands of deaths each year. These infections are painful, difficult to treat, and this ‘silent epidemic’ costs the U.S. health care system many billions of dollars annually.

Antibiotic-resistant infections have become significant threats to citizens of MICHIGAN:

Drug-resistant *Staphylococcus aureus*:

- Although primarily affecting ill people in hospitals, Methicillin-resistant *Staphylococcus aureus* (MRSA), a drug-resistant bacteria, is infecting a growing number of people in the community and outside hospitals, including healthy athletes and children. A recent study in the *Journal of the American Medical Association* demonstrates that MRSA alone infects more than 94,000 people and kills nearly 19,000 annually in the United States – more deaths than those caused by emphysema, HIV/AIDS, Parkinson’s disease, and homicide.\(^2\)

- Hospitalizations for or complicated by MRSA infections cost nearly double that for non-MRSA stays – $14,000 for MRSA stays compared with $7,600 for non-MRSA stays. The average length of stay in the hospital for a patient with MRSA infection was more than double that for non-MRSA stays – 10.0 days versus 4.6 days.\(^3\)

- A disturbing development in antimicrobial resistance is centered in the state of Michigan. Michigan is home to 7 of only 9 cases nationwide of *Staphylococcus aureus* (*S. aureus*) which have not only tested resistant to methicillin -- thus classifying as methicillin-resistant *S. aureus* (MRSA) -- but also have tested resistant to vancomycin, the primary drug used to treat MRSA and a drug of last resort for these infections.\(^4\) These cases of Vancomycin-resistant *S. aureus* (VRSA) are thought to occur when certain genes move from another resistant organism, Vancomycin-resistant *Enterococcus* (VRE), to MRSA.

- VRSA cases are thought to dominate in Michigan partly due to three factors: a large population of patients with conditions that predispose them to dual infections (caused by both *S. aureus* and *Enterococcus* species) where this genetic transfer can occur; a large number of *Enterococcus* species with an easily-transmissible genetic component; and a high rate of treatment with vancomycin in the patient population at risk.\(^5\)

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\(^1\) Dr. Fred Tenover, quoted in “The Bacteria Fight Back” *Science*, July 18, 2008.


\(^5\) Dr. Fred C. Tenover. “Vancomycin-Resistant *Staphylococcus aureus*: A Perfect but Geographically Limited Storm?,” *Clinical Infectious Diseases*, March 1, 2008; 46:675-7
Drug-resistant “gram negative” bacterial infections:

- Serious and life-threatening infections due to antibiotic resistant “gram negative” bacteria are on the rise across the United States. Gram negative bacteria primarily are differentiated from gram positive bacteria, like MRSA, by a cell wall that is particularly adept at preventing antibiotics from entering the bacteria. These infections, primarily acquired in hospitals and long term care settings, are extremely difficult to treat and cause significant numbers of illnesses and deaths. Bacteria in this group include: *Escherichia coli* (E. coli), *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, and *Acinetobacter*.

- In March 2009, CDC published guidelines for detection and control of *E. coli* and *Klebsiella* species with increasing resistance to a subclass of antibacterial drugs known as carbapenems. Carbapenems are among the most potent antibiotics currently available and are often considered the “last line of defense” in the treatment of antibiotic resistant bacteria. Studies have shown that the mortality rate from infections caused by carbapenem resistant Klebsiella species is roughly 40%. CDC described this problem as “another in a series of worrisome public health developments regarding antimicrobial resistance among gram-negative bacteria [that] underscores the immediate need for aggressive detection and control strategies.”

- Noteworthy, these organisms are difficult to detect with the automated testing systems currently used in most hospital laboratories.\(^7\)

- Of critical importance, there are few to no approved antibacterial drugs currently available to treat many gram negative bacterial infections and few to no new drugs in the pipeline; drug discovery in this area is extremely difficult due to challenges in overcoming the gram negative bacteria’s cell wall.

Other issues related to antibiotic use:

- *Clostridium difficile* (*C. diff.*) is spawning infections in hospitals in the U.S. and abroad that can lead to severe diarrhea, ruptured colons, perforated bowels, kidney failure, blood poisoning and death. It is a common cause of antibiotic-associated diarrhea, accounting for 15-25% of all episodes. CDC estimates there are 500,000 cases of *C. diff.* infection annually in the U.S., contributing to between 15,000 and 30,000 deaths. Elderly hospitalized patients are at especially high risk and mortality in these patients may exceed 10%. The disease is very difficult to treat and recurs in at least 20% of cases, even when treated appropriately.

  - Deaths from *C. diff.* in Michigan have increased steadily over the past few years. There were 30 in 2000, 35 in 2001, 61 in 2002, 52 in 2003, 105 in 2004, and 173 in 2005.\(^8\)

  - There were 10,570 hospital discharges in 2006 in Michigan that included *C. diff.* as a diagnosis, according to the Agency for Healthcare Research and Quality (AHRQ). The cost per *C. diff.* patient  

\(^6\) CDC MMWR “Guidance for Control of Infections with Carbapenem-Resistant or Carbapenemase-Producing Enterobacteriaceae in Acute Care Facilities” March 20, 2009 / Vol. 58 / No. 10  
\(^7\) K. F. Anderson, et al.; Evaluation of Methods to Identify the *Klebsiella pneumoniae* Carbapenemase in *Enterobacteriaceae*; Journal of Clinical Microbiology, August 2007, p. 2723-2725, Vol. 45, No. 8  
\(^8\) CDC Wonder Death Certificate Data, cited in a July 28, 2008 communication to Senator Sherrod Brown

Updated December 28, 2009
in a hospital is estimated by CDC to be at least $3,500, making the annual healthcare cost for C. diff. in Michigan nearly $37 million.9

Public health laboratory capacity:

A key factor in any state’s ability to detect, monitor and control antimicrobial resistance is laboratory capacity. In Michigan, the state public health laboratory routinely monitors antimicrobial resistance only in targeted organisms (Mycobacterium tuberculosis, Neisseria gonorrhoeae, and Salmonella species). Currently, the detection and control of most infections caused by resistant organisms is largely dependent on activities that occur in private sector patient care facilities, with passive reporting of outbreaks or unusual occurrences to public health authorities. The increasing dependence on automated instrumentation in clinical laboratories is a concern; these instruments may not detect a new pattern or mechanism of resistance, and fewer hospital microbiologists maintain manual skills to recognize them. The Michigan public health laboratory has provided support to assure the quality of and strengthen the capacity for testing in private sector laboratories by offering antibiotic resistance education programs and limited surveillance in the past. Although funding for these activities has been inconsistent, the state in 2009 hired a full-time antimicrobial resistance microbiologist to continue and expand best practices.

Michigan’s public health laboratory has technical capability for testing antimicrobial resistance in other organisms. Targeted funding for reagents and equipment to detect and characterize emerging resistance patterns, including implementation of molecular testing methods, is needed to expand the detection, monitoring and surveillance of antimicrobial resistance.

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Updated December 28, 2009