The National Antimicrobial Resistance Monitoring System (NARMS)

Strategic Plan

2011-2015
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Background

Foodborne diseases are an important cause of morbidity and mortality worldwide. Travel, migration, and distribution of contaminated food contribute to the problem of foodborne diseases. Non-typhoidal Salmonella and Campylobacter are the leading bacterial causes of foodborne illness in the United States and many other countries. Each year over two million people in the United States are infected with these bacteria, resulting in tens of thousands of hospitalizations and hundreds of deaths. Certain populations, such as young children (<5 years), the elderly, and the immunocompromised, are at higher risk for infection. Most Salmonella and Campylobacter infections are self-limited, but antimicrobial agents are essential to treat severe illness. Antimicrobial resistance occurs among bacterial foodborne pathogens and is recognized as a global public health hazard. Resistance has also emerged in commensal bacteria, such as Enterococcus and Escherichia coli, which may serve as reservoirs of resistance genes that can be transferred to pathogens of public health importance.

The National Antimicrobial Resistance Monitoring System (NARMS) is a national public health surveillance program that monitors the susceptibility of enteric bacteria to antimicrobial agents of medical importance. The NARMS program, established in 1996, is a collaboration among the U.S. Food and Drug Administration (FDA), the U.S. Centers for Disease Control and Prevention (CDC), the U.S. Department of Agriculture (USDA), and state and local health departments. NARMS has also established collaborations with scientists and surveillance systems monitoring antimicrobial resistance in other countries.


In addition to monitoring, NARMS conducts epidemiologic and microbiologic research studies. Some studies examine risk factors and clinical outcomes of infections with specific bacterial serotypes or subsets of bacteria that exhibit particular resistance patterns. NARMS research studies also focus on understanding the genetic mechanisms of antimicrobial resistance in enteric bacteria and the mechanisms that permit the transfer of resistance between bacteria, on improving methods for isolation and typing, and on developing new methods for antimicrobial susceptibility testing. Additionally, NARMS examines enteric bacteria for genetic interrelatedness using methods such as pulsed-field gel electrophoresis (PFGE) and multilocus sequence typing (MLST). NARMS scientists enter PFGE results into CDC’s PulseNet database or USDA’s VetNet database.
In March 2007, an External Subcommittee of the Science Board to the FDA conducted a review of the NARMS program. This subcommittee made recommendations related to four areas of work performed by NARMS: 1) sampling, 2) research, 3) international activities, and 4) data management and reporting. Included in the report was a recommendation to develop long-range strategic plans. In September 2008, NARMS held an interagency planning meeting in Athens, Georgia to prioritize the Science Board subcommittee recommendations and implement measures to address them. In August 2009, a second meeting was held in Rockville, Maryland to report on progress, and to begin formulating a Strategic Plan.

**Mission**

The National Antimicrobial Resistance Monitoring System (NARMS) is dedicated to the protection of human and animal health through integrated monitoring of antimicrobial resistance among enteric bacteria.

To accomplish its mission, NARMS conducts the following activities:

1. Monitors trends in antimicrobial resistance among enteric bacteria from humans, retail meats, and animals
2. Disseminates timely information on antimicrobial resistance to stakeholders in the U.S. and abroad to promote interventions that reduce resistance among foodborne bacteria
3. Conducts research to better understand the emergence, persistence, and spread of antimicrobial resistance
4. Provides data that assist the FDA in making decisions related to the approval of safe and effective antimicrobial drugs for animals
Overview of Accomplishments, 1996-2009

From 1996-2009, major accomplishments of NARMS include:

1. Documented and communicated antimicrobial resistance prevalence data on more than 40,000 human clinical isolates, 100,000 food-producing animal isolates, and enteric bacteria isolated from over 26,000 retail meat samples.

2. Published annual reports on surveillance findings for each NARMS component.

3. Published Executive NARMS Reports since 2003 to communicate findings to stakeholders and the public. These summarize NARMS data for human, retail meat, and food-producing animal isolates.

4. Improved testing methods to better ensure quality control of results and to facilitate testing. For example, NARMS scientists developed the first standardized in vitro antimicrobial susceptibility testing method for Campylobacter, and incorporated it into the NARMS protocol.

5. Collected and communicated data on risk factors, clinical outcomes, and genetic mechanisms of antimicrobial resistance to the scientific community through publication of peer-reviewed research manuscripts in scientific journals and presentations at scientific meetings.

6. Facilitated international research collaborations on foodborne disease and assisted Mexico (ResistVet), Canada (CIPARS), China, Colombia (COIPARS), and other countries in building surveillance programs for antimicrobial-resistant foodborne pathogens.

7. In partnership with the World Health Organization (WHO), participated in the development of guidance documents and engaged in capacity-building exercises to enhance laboratory-based surveillance of foodborne disease and outbreak detection and response in many countries.
Strategic Goals and Objectives

NARMS has established four strategic goals. These goals build on progress made since NARMS’ inception, with special emphasis on the recommendations made by the FDA Science Board subcommittee review in 2007.

Goal 1: **To develop, implement and optimize a shared database, with advanced data acquisition, analysis, and reporting tools**

The NARMS program needs to develop a shared database that integrates selected data from each NARMS contributor. This integrated database will facilitate data sharing among NARMS partners in a secure environment, and enable more timely reporting and sophisticated analysis of data across sample sources. The work to accomplish this requires scientific input and software development to 1) merge specified data from the three agencies; 2) ensure data integrity; 3) enhance and automate reporting functions; 4) provide controlled export of specified data into other software programs; 5) provide advanced data mining and analysis capabilities; and 6) build in provisions for continuous improvements and future capacity, including increased accessibility of data in various forms to stakeholders and the public.

*Objective 1.1:* To develop and launch the database in three phases after securing the necessary resources (2011-2012)

*Objective 1.2:* To increase access of data to stakeholders (2013)

*Objective 1.3:* To publish surveillance data closer to the time of collection, providing the latest information in the timeliest manner possible (2013)
Goal 2  To make sampling more representative and more applicable to trend analysis

Sound sampling strategies are vital to the success of any monitoring program. NARMS presents many sampling challenges. NARMS was established based on existing public health and food safety infrastructure, which has advantages and disadvantages. NARMS is working towards improving and expanding sampling schemes so that the data will best reflect the U.S. food-producing animal production and distribution system, and capture data on the prevalence of antimicrobial resistance among enteric bacteria along the farm-to-fork continuum. The needs vary by pathogen and source. For some, representativeness may be improved by increasing the number of participating sites, for others by increasing the number of samples or the sampling area within sites.

Objective 2.1: To improve the geographic representativeness of retail meat testing and increase the total number of retail meat samples tested (2011-2013)

Objective 2.2: To modify animal sampling to overcome the biases resulting from the current reliance on USDA’s Food Safety and Inspection Service (FSIS) Hazard Analysis and Critical Control Points (HACCP) compliance sampling, which is risk based and post-processing (2012)

Objective 2.3: To expand the geographic representativeness of human Campylobacter sampling (2011)

Objective 2.4: To build a NARMS component for prospective surveillance of antimicrobial resistance among bacteria isolated from animal feeds (2012)

Objective 2.5: To establish systematic, representative monitoring of antimicrobial resistance among commensal bacteria isolated from humans (2014)
Goal 3:  To strengthen collaborative research projects

Research is a vital component of the NARMS program. Using the rich collection of bacterial strains acquired in the program, in-depth microbiological studies are done to answer specific questions about the microbial status of food-producing animals, their derived meats, and humans. In the past, such research studies have shown the relatedness of isolates and their genes from humans and foods. This work has allowed inferences to be made about the movement of resistance elements through the food supply, as well as the contribution of resistance from antimicrobial use in humans and animals. Laboratory research is needed to better understand the genes that cause resistance, the genetic elements that house them, and other bacterial features associated with resistance. Laboratory research is also needed to evaluate and develop new testing and analytical methods. Epidemiologic research is needed to estimate the burden of illness due to resistant foodborne pathogens, to identify risk factors for acquiring resistant infections, to assess the clinical outcomes of resistant infections, and to help measure the impact of interventions. NARMS scientists have conducted some microbiologic and epidemiologic research to help interpret the monitoring results, but have lacked the resources to fully meet the goal.

Objective 3.1: To determine the prevalence of resistant microbial hazards in food products relevant to FDA’s mission in order to better assess risks to consumers

Objective 3.2: To evaluate and apply existing research tools, and develop new ones, to enhance surveillance of antimicrobial-resistant bacteria

Objective 3.3: To conduct epidemiologic studies focused on the public health impact of resistant foodborne infections

Objective 3.4: To promote training of scientists in the latest technologies and models relevant to the microbiology and epidemiology of resistant foodborne infectious agents

Objective 3.5: To provide surveillance and research results to support the goals of the Interagency Task Force on Antimicrobial Resistance, Healthy People 2020 and other public health programs.
Goal 4: To support international activities that promote food safety, especially those that promote mitigation of the spread of antimicrobial-resistant bacteria and resistance determinants

Foodborne disease and antimicrobial resistance are international issues that should be addressed globally. The global trade in food-producing animals and food products has escalated tremendously over the last decade and is expected to continue to grow. Likewise, antimicrobial resistance in pathogens found in food-producing animals and food products is a global problem.

Integrated surveillance of antimicrobial resistance in enteric pathogens only exists in relatively few other countries including Canada, Denmark, France, the Netherlands, Norway, Sweden, and Korea. Other countries (e.g., Mexico) conduct periodic surveillance for resistance. The surveillance systems share several similarities, many by design, and countries have an opportunity to learn from one another the most efficient practices necessary to understand and mitigate antimicrobial resistance from food-producing animal sources. Since its inception, NARMS has collaborated with several of these antimicrobial resistance monitoring systems, and has worked to help build laboratory capacity for foodborne disease surveillance, including surveillance for antimicrobial resistant bacteria and genetic determinants. Strengthening global surveillance for antimicrobial resistance in the food chain is an important step in preventing and mitigating the emergence of antimicrobial resistance.

Objective 4.1: To support the WHO Advisory Group for Integrated Surveillance of Antimicrobial Resistance (WHO-AGISAR) and the WHO Global Foodborne Infections Network (GFN) to help build international capacity for the surveillance of foodborne disease and antimicrobial resistance.

Objective 4.2: To work more closely with international partners to harmonize antimicrobial resistance testing and reporting, and to facilitate data sharing.

Objective 4.3: To foster international research collaborations, special regional studies, and national pilot projects to characterize unique and common elements in the epidemiology of antimicrobial-resistant foodborne pathogens in different countries.
Challenges and Opportunities

Institutional challenges include financial resource limitations, competing food safety priorities, human resources limitations, information technology constraints, and limitations on laboratory resources needed to investigate evolving scientific issues in a timely manner.

Food safety is becoming a high priority globally. This provides fertile ground for interagency collaborations that can address understudied aspects of food and feed safety issues pertinent to antimicrobial resistance, and may make possible the expansion of NARMS monitoring and the fulfillment of NARMS strategic goals.

Similar trends can be seen in the global arena; there is a growing consensus that food safety is best addressed through global partnerships such as WHO-GFN, WHO-AGISAR, and others. NARMS will continue to work closely with WHO, with other antimicrobial resistance surveillance programs, and with food safety and public health authorities abroad, to harmonize testing and reporting methods to facilitate data sharing and communication with international partners and stakeholders.

Conclusion

The NARMS Strategic Plan is a dynamic roadmap that outlines the program’s commitment to sustained food safety through monitoring and research. The NARMS program is critical to accomplishing the mission of the U.S. Department of Health and Human Services and ultimately in protecting the health of Americans through safer food. NARMS will continue to provide reliable information that is vital to protecting and improving the health of the public we serve.
Links to Additional Information

Additional information about NARMS, including comprehensive annual reports for each NARMS component, can be found on the FDA, CDC, and USDA websites listed below. The FDA website also includes NARMS Executive Reports.

FDA: http://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/NationalAntimicrobialResistanceMonitoringSystem/default.htm

CDC: http://www.cdc.gov/narms/

USDA: http://ars.usda.gov/Main/docs.htm?docid=6750