The overall goal of this meeting was to bring together epidemiologists, representatives from human and animal diagnostics, and leaders of national data collection initiatives to discuss current practices for antimicrobial resistance (AMR) profiling and approaches for sharing the multiple types of complex data involved.

I. Current capacity and existing surveillance efforts for AMR profiling.
Several veterinary laboratory networks were tasked by the National Action Plan for Combating Antibiotic-Resistant Bacteria to create a “regional public health laboratory network that provides a standardized platform for resistance testing and advanced capacity for genetic characterization of bacteria.” Following the release of this initiative, workgroups were formed, which have since initiated pilot studies. State and regional public health teams are also beginning to recognize the need to integrate data collected from animal and public health, making this a critical time to coordinate and standardize practices.

Key players in animal health AMR data collection represented at the meeting were:
- FDA Veterinary Laboratory Investigation and Response Network (Vet-LIRN)
- USDA APHIS National Animal Health Laboratory Network (NAHLN)
- NCBI Pathogen Detection/Pathogen Browser team
- CDC NCEZID Division of Foodborne, Waterborne, and Environmental Diseases
- Corporate veterinary diagnostic labs
- State and academic veterinary diagnostic labs
- Pharmaceutical industry

The American Veterinary Medical Association (AVMA), USDA, FDA, CDC, and state public health agencies are currently supporting judicious use initiatives for animal health, including for food and companion animals. These efforts to advance the monitoring of use and resistance among animals would benefit from standardized data collection and having more specific antibiograms grouped by syndrome.

Phenotypic antibiotic susceptibility testing (AST) capacity in veterinary diagnostics is somewhat fragmented due to varying platforms and the lack of comprehensive interpretation cutoffs for animals. Some laboratories are able to routinely generate these data on bacterial isolates, whereas others will only provide it if the client pays an extra fee. Both NAHLN and Vet-LIRN are subsidizing this capacity for selected laboratories in their networks and collecting surveillance data from incoming clinical submissions for selected hosts and pathogens. Isolates from these studies are being banked, and NAHLN is further subsidizing the development of secure messaging of the AST data being collected as part of their study.

The most commonly used commercial broth microdilution system among the Vet-LIRN and NAHLN networks is the Thermo Fisher Sensititre platform. These networks largely consist of public and academic laboratories. Other laboratories and the larger corporate entities may be using different platforms, such as the Giles Scientific BIOMIC or the bioMérieux VITEK system. Corporate veterinary diagnostic labs have large amounts of data but would need to dedicate resources for extraction. One corporate representative indicated that they have frequent client requests for summary data.

Bacterial whole genome sequencing (WGS) capacity in veterinary diagnostic laboratories is varied but mostly harmonized around the FDA GenomeTrakr and CDC PulseNet procedures. Vet-LIRN is currently subsidizing this capacity in 5 state veterinary diagnostic labs (LA, NY, OH, SD, and WA), which are all using the Illumina MiSeq platform and submitting data to NCBI Pathogen Browser via FDA’s GenomeTrakr program. The number of isolates being sequenced for the Vet-LIRN surveillance project is
limited to a small proportion of those being collected due to funding constraints. The automated processes established through NCBI for WGS data analysis allow for quickly compiling of AMR surveillance data. Preliminary results from the Vet-LIRN pilot are very concerning regarding the degree of resistance being seen, particularly in companion animals. Vet-LIRN is currently assessing a smaller platform (Illumina iSeq) for potential future deployment throughout their network of 43 laboratories.

Culture-Independent AMR testing was presented as primarily conducted for academic research projects. This is a rapidly emerging technology that may facilitate environmental sampling and healthy humans and animal screening once it becomes more widely established and refined.

II. Best practices for data integrity and confidentiality.
No formal guidelines exist aside from those established by Health Level Seven International (HL7). The CDC National Healthcare Safety Network (NHSN) uses this standard and is an example of healthcare facilities embracing data reporting in a secure way that tracks hospital-associated infection rates and fosters continuous improvement. The key overarching themes that emerged from discussions were de-identification and minimum metadata requirements. It was generally agreed that voluntary metadata entry fields are typically not useful for surveillance and not even analyzed. A general consensus was also reached on the need to have reduced granularity of location in order to allow enhanced metadata to be provided, for example giving a regional-level location and providing information about animal age, breed, husbandry, etc., which could provide meaningful information for outbreak investigations without compromising diagnostic client or owner confidentiality. A tiered system with a third party protector of identifiable information was discussed as another safeguard option for confidentiality: ideally would ideally independent, non-publicly funded organization (not subject to Freedom of Information Law requests).

The National Antibiotic Resistance Monitoring System (NARMS) is the most centralized national resource for surveillance of human clinical and food production AST and WGS data and would be an ideal location for animal health data. NCBI is actively integrating animal, human, and environmental data in its beta released Pathogen Detection database, which is based on WGS data but also includes optional metadata and AST fields.

III. Major barriers and gaps identified.
Lack of clear goals and the availability of few success stories are obstacles to obtaining buy-in from the various stakeholders involved. Animal owners (particularly producers), veterinarians, and the laboratories have concerns about unknown future applications of their data and breaches of client confidentiality. Logistic barriers identified include limited capacity for isolate banking and WGS in animal health laboratories. There are no standardized diagnosis codes, and multiple laboratory information management systems are used. Information technology challenges were noted to affect not only academic/state labs but corporate entities as well. Finally, no environmental sampling of veterinary hospitals or active surveillance of healthy animals is supported on a national scale.

IV. Next steps and opportunities.
• For rapid outbreak response, communication between animal and public health entities is essential. State-level data sharing pilot projects between veterinary diagnostic laboratories and public health departments are needed to establish data sharing protocols. Ideally, these would result in memoranda of understanding or similar agreements on how data will be shared in real-time during outbreaks and what metadata will be provided.
• For long-term surveillance in order to track changes and improvements and provide data to stewardship and continuing education initiatives, incorporation of animal health data into NARMS and Pathogen Browser is a priority. Some discussions and initial steps toward integration of Vet-LIRN surveillance data into NARMS were started at this meeting.
• Improvement of stakeholder awareness and acceptance of AMR data sharing was the third strategic priority identified. Scientific publication, communication of findings with the popular press, and AVMA are avenues to reach key audiences, with the goal of having veterinarians and the public see how the data can be useful in protecting the health of animals and the public.