

National Program 103 Animal Health Retrospective Review 2011-2015

Executive Summary

The retrospective review was sent to a number of stakeholders for their comments. The compiled comments are included below (see Appendix 1). Specific questions were asked and addressed by reviewers from each commodity addressing the concerns most connected with their industry. However, there were a number of overriding comments that will be summarized in this document.

A strength of National Program 103 (NP 103) recognized by a number of reviews was that the program frequently seeks the input from and engages with a variety of stakeholders in setting priorities. Many strengths were identified with the development and use of innovative technologies with drugs, vaccines, genomics, and diagnostic modalities being common. Overall the reviewers were very complementary of ARS research and its ability to address the concerns of multiple livestock species. The reviewers complimented the response by ARS to emerging threats. Additionally, it was felt that ARS had a strong relationship with other federal agencies for the optimal achievements of the programs goals and collaboration with others is a strong point for the program. Reviewers recognized the importance of the specialized high containment facilities in investigating zoonotic and emerging diseases.

A major weakness of the program perceived by a number of the reviewers was inadequate communication of findings and technologies from the program. This concern was consistently stated throughout the responses. For example, it was felt that although there were 900 publications listed for the period, based on funding and number of scientists, the cost per publication was high. Concern was expressed about the level of funding provided to the program. The current budgetary and personnel constraints was felt to limit the innovative potential of the program. It was recognized that basic research results are often slow due to budget and personnel concerns.

When asked what aspects of the program was most useful for each agency/commodity organization/ institute, each review included the important diseases of their animal species. However, it was acknowledged that the program continues to identify new and existing health threats to each animal species.

The question asking how the program could be improved, again resulted in listing of specific needs for each commodity/industry. Once again, improved methods for outreach was mentioned. In addition, several reviewers stated that one way to address the concerns about communication of data, results and improved outreach would be allowing ARS scientists to travel to meetings. It was also felt that the space/resources was not always adequate to address the response to new and emerging pathogens.

Responses about the applicability of the research accomplishments and how the accomplishments led to practical applications were again very species specific on diseases and

needs. The benefit of ARS long-term research was acknowledged to benefit understanding the disease processes. This was especially true of genetic studies.

Overall, the reviewers were complementary for NP 103 recognizing the success in the program in developing new and innovative technologies to address animal diseases whether new and emerging or long term in nature. Major concerns included communication and budget. Overall, NP 103 appears to be doing a good job addressing animal diseases and the concerns of the animal health industry.

Appendix 1

Responses from Stakeholders on Evaluation Questions

1. General Evaluation of the Program

a. What were the strengths?

- The organization and implementation of research on infectious disease.
- The American Veterinary Medical Association (AVMA) sincerely appreciates the efforts of USDA-ARS researchers and program staff in creating this 5-year summary of its National Program accomplishments. The AVMA supports the use of innovative technologies in the development of drugs, vaccines and diagnostic modalities that assist in the identification, treatment and control of disease.
- The AVMA has identified as a research priority the broad category of infectious and zoonotic diseases, including both respiratory and gastroenteric diseases. In addition, and because of their importance to animal and/or human health, the AVMA has specifically identified brucellosis, tuberculosis, Johne's Disease, and transmissible spongiform encephalopathies as targets. Accordingly, there is great alignment of AVMA research priorities with the Action Plan and the activities of the National Programs in addressing animal health issues during the past five years.
- The progress and outcomes in all components are impressive.
- The program addresses disease that are both serious animal well-being issues and of economical importance to U.S. agriculture.
- Importantly, the program addresses problems in multiple livestock species that are important to animal agriculture in the United States.
- The program is actively investigating threats that may be looming on the horizon e.g. HoBi Like virus, H7N9 Influenza, Chinese Newcastle. Developing a culture and infrastructure for addressing emerging threats to animal health and well-being as well as food safety is important as we continue to become a global society.
- Collaborations nationally and internationally further speak to the vision of looking more broadly for potential threats and solutions.
- Development and application of new technologies, specifically animal genomics, is viewed as a developing strength.
- Priorities within focus areas set based on industry input although there appears to be some variation in how this is done and some Research Component input is stronger than others. For example, priorities very clearly aligned with industry input with respect to biodefense research, less clear with respects to areas like zoonotic disease.
- The facilitation of the immune reagent network is important and will very likely facilitate new discoveries and applications

- Very strong basic research activities. ARS has accomplished a lot and has done well to coordinate and prioritize its basic research.
 - **Component 1** (Biodefense Research)
 - Avian Influenza (AI) discussed and highlighted
 - Swine Influenza (SI) discussed and highlighted
 - **Component 4** (Respiratory Diseases)
 - Swine Influenza (SI) was discussed and highlighted
 - **Component 5** (Enteric Diseases)
 - Corona Viruses were discussed and highlighted
- NP 103 contains a comprehensive listing of research components that demonstrated a high level of relevancy for the beef industry.
- NP 103 evidenced adherence to the program's mission to deliver scientific information and tools to detect, control, and eradicate animal diseases of high national priority.
- NP 103 showed strong collaboration with other federal agencies for the optimal achievement of the program's goals.
- NP 103 developed an integrated animal and microbial genomics research program that can serve as a foundation for future problem solving in veterinary medical research.
- NP 103 resulted in the discovery of new vaccine technologies for priority diseases like Foot-and-Mouth disease that have been transferred and are currently being developed by pharmaceutical companies with the support of ARS scientists.
- NP 103 biodefense research activities ensure access to specialized high containment facilities in order to study zoonotic and emerging diseases, opportunities not available for the average private sector researchers.
- NP 103 seeks the input of a variety of stakeholders in order to improve and further strengthen the research program
- The program thoroughly identifies the areas where critical research into animal diseases is needed, including novel disease treatment areas and challenges.
- ARS research programs engage the stakeholders and generally focus well on the issues of importance to pork production and swine health and well-being. ARS researchers have been very responsive to stakeholder requests for targeted research on emerging disease threats such as pandemic H1N1 and possible impacts of HPAI on swine. ARS researchers are dedicated to quality scientific research even in the face of minimal budgets and, in some cases, outdated facilities. ARS concentrates on basic long-term research projects that are unlikely or impossible to conduct in the private sector. This research often forms the basis for future advances within the industry.
- For swine projects, most if not all of the projects were direct priorities for the industry and accurately reflect the needs of industry. Several projects, such as the PRRS project in Component 2, were part of a bigger industry study that works off of and compliments existing projects. There is a lot of communication between ARS scientists and industry/veterinarians on disease projects and priorities, so the projects are all very relevant and valuable.

b. What were the weaknesses?

- None observed
- Current needs for ensuring the continuing effectiveness of existing antimicrobials, mitigating antimicrobial resistance, and the identification of alternative strategies for prevention, control and treatment of related disease, suggest a need for ongoing and increased attention to these issues within USDA-ARS National Programs. We fully recognize the value of work completed to date and detailed in the 2011-2015 summary, but suggest increased emphasis in this area.
- The accomplishment summary notes approximately 900 publications derived from work completed during the 2011-2015 period. Simultaneously, the National Program reports a yearly budget of approximately \$68 million. A rudimentary assessment translates this to an approximate cost of \$250,000 - \$300,000 per publication, with consideration for expenses associated with workshops, roundtables, and other projects. This estimated cost may be skewed if emphasis was placed on high-risk, high-impact exploratory research, rather than on a more direct applied research portfolio advancing knowledge in small incremental steps. In addition, we recognize costs associated with maintaining facilities, caring for animals, and program administration. Nevertheless, to interested observers, such costs per publication may appear high. To address such concerns, we suggest reports emanating from the Program place additional emphasis on the effectiveness of translation of revolutionary findings to technologies directly affecting animal health and food security. Having that information available also supports efforts of stakeholders to engender support for increased appropriations for the Program.
- In addition, researchers should be encouraged to publish and/or otherwise report both positive and negative findings resulting from their research. We are cognizant of the bias toward positive results that exists in the scientific literature, and are concerned that such bias contributes to unnecessary and unproductive duplication in research effort and may deter scientists from undertaking rationally conceived, but higher-risk, projects. Negative findings that result from sound scientific methodology can be as, if not more, informative than positive findings. Interest exists in reversing the trend toward positive-bias and should be supported by U.S. National Programs by creating related expectations and support for their researchers.
- Progress appears slow in terms of new solutions in Component 6. While progress is evident for the diseases listed in Component 3, Q-Fever is a zoonosis that needs research attention. Foreign Animal Disease readiness is multifaceted; research regarding FMD is impressive yet it seems that a vaccine implementation plan may need more multi-agency planning and cooperation.
- Weakness may be viewed as unrealized opportunities. Specific opportunities to consider include:
 - For many diseases scientific knowledge of the disease process is not the limiting factor; the limitation is on application of available

technology. There is little research activity relating to population-level transmission dynamics or study of the factors that influence human behavior and decision making that influence disease outcomes. For example, we need better understanding of how the system of marketing and transportation affects disease incidence or how economic factors influence the decision of farmers to use proven technology

- The genomics focus area at times appears to be a catch all area. This Research Component really needs to be focused on genomics application.
- One Health – are there opportunities being missed to leverage human focused research (i.e. appeared to be minimal NIH connections).
- The Zoonotic Disease Research Component continues to emphasize old diseases (e.g. TB and Brucellosis). There is little emphasis in the report on emerging zoonotic threats.
- Sometimes, research projects not aligned with the Primary Research Component – e.g. Vitamin D and whole body calcium homeostasis for control of mastitis under animal genomics?
- Priorities within focus areas set based on industry input although there appears to be some variation. For example, priorities very clearly aligned with industry input with respect to biodefense research, less clear with respects to areas like zoonotic and respiratory diseases.
 - Since basic research is relatively slow compared to the speed needed to respond to a disease outbreak, models are an important preliminary countermeasure for responding to outbreaks. FAD modelers are in dire need of data generated by basic research to inform and improve/validate their models. USDA-ARS is in a good position to generate data to inform these disease models, and this would greatly benefit the mission of DHS.
 - Some examples of data that would be useful for modelers include data on viruses survival on Fate and Transport vehicles; also contact rates/transmissibility of HPAI in chickens and wild birds
 - No discussion of funding from federal agencies was provided in the front material of the document, and this is a critical part of the way ARS does business and should be called out in that respect. Recognition was not given to DHS (or any other agencies) for studies that they funded. This impacts our program greatly, in a negative manner. Credit should be given to outside funding sources by being listed and referenced in the Executive Summary. While this was done at a very general level in Appendix 4, and page 5 contains a mention to ARS providing research support to other federal agencies, the truly collaborative nature of the DHS/ARS relationship, especially at Plum Island Animal Disease Center was not mentioned. While it might not be possible to call out every specific funding agreement, characterizing DHS as simply a funding agency in Appendix 4 is inaccurate.

- One partial solution would be to include interagency agreement numbers with each citation listed in Appendix.
- The current budgetary and personnel constraints limit the breadth of the research portfolio and limit the innovation potential of the projects.
- The interagency collaboration and communication that is present during a research project may not be extended past the project's completion, limiting the potential for continued investigation and future development.
- It is presently unclear to us how effective the outreach for communication of the research achievements is to the major stakeholders. Often, we believe that the success of the outreach communication is dependent upon the ability of the various stakeholders to network with the individual researchers.
- The program could probably be improved by extending the network of laboratories; however, this is likely a challenge with the current funding available for the program.
- The lack of adequate funding slows the rate at which research can be undertaken and minimizes the breadth of research projects accomplished. Funding also limits the ability to hire and retain scientists and support staff which also limits the quantity and type of research that can be undertaken. An increased focus on emerging diseases may be necessary going forward (e.g. increased flexibility to take on emerging disease introductions and global assessment of potential pathogens of risk to the swine industry).
- Sometimes, the timeline for completion of a project is much longer than the needed answers. Vaccine and vaccine development research is all long-term and is very important. However, with more and more new and emerging diseases appearing in the United States, having the ability to focus on short-term projects that can have <6-12 month turnaround are very important to provide information to producers to manage such diseases. Projects like the evaluation of H1N1 in pigs helped to immediately support the industry for continued marketing of pork when the public was unsure of food safety. Even more recently, the evaluation of avian influenza strains in pigs helped to allay fears of swine being potential threats of carriers of those strains. These type of projects have high return and value. Having more projects like this, the portfolio can provide immediately usable information for producers.

c. What were the most useful aspects of the Program for your Agency/Commodity Organization/Institute?

- As an equine organization the work on equine piroplasmiasis was outstanding
- Development of new vaccines or other control measures, diagnostic tests, and therapeutic strategies in these areas benefits AVMA members greatly, in addition to fulfilling the mission of the National Program.
- Progress on respiratory diseases affecting both domestic and big horn sheep. Genomic solutions to OPPV. Progress towards a practical solution to MCF transmission. Progress on a blood test for scrapie.

- As an organization that represents veterinarians working in the cattle industry, the strong emphasis on diseases of cattle, including FMD, mastitis, respiratory disease, Brucellosis, leptospirosis, tuberculosis, Johne's disease, and bovine spongiform encephalopathy, is valuable to our membership. Likewise, the focus on bio defense is extremely valuable as this is an area that we have little control over.
- Gap analysis and international research collaboration are the most helpful aspects of the program to DHS. Also, the vector work was of interest to us.
- National Cattlemen's Beef Association (NCBA) would rank the usefulness of the current research components of the Program as follows from most to least useful: Biodefense research; Respiratory Diseases; Animal Genomics; Zoonotic diseases; Transmissible Spongiform Encephalopathies; Parasitic Diseases; and Enteric Diseases. This ranking does not reflect our interest in these areas, but rather takes into account other research that is currently taking place for these component topics in the private sector.
- The program helps to continue to identify new and existing health threats to the poultry industry, such as antibiotic-resistant bacteria or viral mutations increasing virulence. It also helps to condense the current research on topics of interest, providing context and potential methods to control disease.
- Agency/Commodity Organization/Institute? The most useful aspects are the abilities of ARS to respond to industry needs and special requests targeting those issues of most importance to the swine industry. Also the willingness of the researchers to engage with industry stakeholders. ARS research into foreign animal diseases has consistently been high quality and targeted on issues of importance to the industry. The ability of the researchers to respond to emerging disease questions to improve animal health/production or to answer questions regarding potential zoonotic threats or trade implications.
- The research has been very focused on high priority issues for the swine industry and the scientists routinely are in communication about needs, concerns, and upcoming project ideas. It is a very healthy relationship that is beneficial for all parties and provides relevant information for producers and vets trying to manage these diseases.

d. How could the Program have been improved?

- Equine vesicular stomatitis needs further work in controlling yearly epidemics.
- Attendant to concerns about ensuring ongoing effectiveness of antimicrobials and mitigating resistance, development of new antimicrobials and alternative treatment strategies is of great importance to the AVMA. Research involving genetic modification of animals as reported in Component 2, Animal Genomics can be of value to diminish disease susceptibility, as long as it does not adversely impact the general health and well-being of the animal. In addition, research that longitudinally measures the impact of increasingly judicious use on change in antimicrobial resistance (AMR), that identifies alternative tools for conferring immunity, and that explores the contribution of environment (e.g., moisture, ventilation, sanitation, stocking density,

temperature, and isolation/exposure) to incidence and control of disease are all potential areas of increased focus for the National Program.

- Additional work and emphasis on “b.” and “c” above (*see bullets directly below for clarification*) plus additional emphasis on Component 2 for sheep disease conditions.
 - *Progress appears slow in terms of new solutions in component 6. While progress is evident for the diseases listed in component 3, Q-Fever is a zoonosis that needs research attention. Foreign Animal Disease readiness is multifaceted; research regarding FMD is impressive yet it seems that a vaccine implementation plan may need more multi-agency planning and cooperation.*
 - *Progress on respiratory diseases affecting both domestic and big horn sheep. Genomic solutions to OPPV. Progress towards a practical solution to MCF transmission. Progress on a blood test for scrapie.*
- An important way to improve the program would be to better facilitate animal health research results being better translated and shared directly with the end-user (improved methods for outreach).
- The programs could be improved with more data geared towards informing researchers who are collaborating with modelers in order to determine data gaps and strengthen modeling tools. Also, since little is known about transmission of Avian Influenza (AI), research into the fate and transport of AI would be extremely beneficial.
- The program could be improved by increasing the number of vaccine and biotherapeutic countermeasure candidates transitioned to DHS S&T and/or industry for further development.
- Increased funding for individual researchers to travel to meetings to explain their current research achievements to the major stakeholders. This would benefit both the researcher and the stakeholder communities and could result in increased opportunities for establishing future public-private partnerships in research activities.
- The most useful aspects are the abilities of ARS to respond to industry needs and special requests targeting those issues of most importance to the swine industry. Also the willingness of the researchers to engage with industry stakeholders. ARS research into foreign animal diseases has consistently been high quality and targeted on issues of importance to the industry. The ability of the researchers to respond to emerging disease questions to improve animal health/production or to answer questions regarding potential zoonotic threats or trade implications.
- The program addresses and compliments many research areas that the swine industry just cannot do. So that part needs to be maintained. Such research as FAD have to be completed in specified locations so that is critical. However, needs for research and the space/resources to complete that research are not always on the same page. The ability to respond quickly and “on the fly” to emerging diseases in particular is very important. Having the backing and credibility of USDA researchers working on key disease issues is very important. Therefore, having some mechanism in place to make sure that

diseases can be addressed quickly without robbing other program areas of resources will be very important to have in place.

2. Please estimate the applicability of the research accomplishments

a. Current (within 1 year)

- The work on piroplasmosis will be impactful for immediate short term and long term.
- Application of alternative strategies to improve gut health and disease resistance
- Awareness and diagnostics for HoBi virus
- Diagnostics for bovine tuberculosis
- Gap analysis and international research collaborations are helpful to DHS.
- The applicability of the research accomplishments are at a high level for within a one year period of time.
- Complete Genome Sequences of New Emerging Newcastle Disease Virus Strains Isolated from China.
- Improving Infectious laryngotracheitis Vaccines.
- Yeast Extract Feed Supplementation Prevents Clostridial Dermatitis.
- We have certainly seen examples of rapid response to industry needs and the application of current research in such examples as H1N1 and we would hope that we could develop the tools we need and the regulatory framework would allow for Influenza A virus in swine (IAV-S) mitigations to be adopted in real-time (i.e. vaccines).
- In many instances, the initial evaluation of pathogenicity of a disease is immediately applicable as is the new or continued development/upgrading of diagnostic testing. Both of these are very valuable and needed. For influenza, the vaccine associated enhanced respiratory disease (VAERD) studies are immediately applicable as they help to determine the risk/benefit of using killed vaccines in previously infected herds.

b. In short term (2-5 years)

- Respiratory disease research
- Immune reagent network
- *Mycobacterium avium subspecies paratuberculosis* (MAP) vaccines
- Mastitis research
- Better diagnostics: Rift Valley fever (RVF), pseudorabies,
- Vaccines: *M. haemolytica*
- Application of genomics
- Research aimed at the development of products for immediate use (e.g. vaccines & diagnostic tools) would be applicable
- The applicability of the research accomplishments are at a high level for the short term of 2 to 5 years.
- Development of Alternative Strategies to Enhance Gut Immunity and Mitigate the Use of Antibiotics using Dietary Phytonutrients

- Improved Vaccination Protocols to Control Avian Mycoplasmosis
- A Practical Means to Administer Bacteriophage in Commercial Poultry
- Hopefully some of the lessons learned from recent emerging disease experiences could fall into this timeframe. Thanks to ARS and other researchers, we have learned a lot that can be applied at the farm level within the 2 – 5 year time period.
- Vaccine work is both short and long-term work. The initial identification of mechanisms for mode of action on pathogens is good to know and can assist in the management of a disease. However, the development of vaccines is longer-term from initial proof-of-concept to actual development, testing and marketing of a vaccine. A lot of the influenza work fits in this time frame for swine as it shows the continued need for a new vaccine platform for live-attenuated virus vs. the traditional killed products that are now available. This key info helps to support veterinary efforts to change the type of vaccines we can use to manage influenza. The VAERD studies are immediately applicable as they help to determine the risk/benefit of using killed vaccines in previously infected herds.

c. Long Term (6 years or more)

- The work on piroplasmiasis will be impactful for immediate short term and long term
- Vaccines: Johne's disease
- Improved FMD vaccine
- Diagnostics: Leptospirosis
- Advanced application of genomics
- Through basic research, DHS would gain a better understanding about organisms and how they function which is critical to informing countermeasure development decisions.
- Also, data generated from research on the host pathogen interaction would be useful to DHS in many of our project areas.
- The applicability of the research accomplishments are at a high level for the long term of 6 years or more.
- Artificial Insertion of Genetic Materials from Reticuloendotheliosis Virus (REV) into Marek's Disease Virus (MDV) reduces its pathogenicity.
- I think this is where a lot of the research conducted by ARS resides. Much of the work ARS researchers conduct results in long-term benefits and basic understanding of disease processes. Much of the genetic information we've learned will result in changes and adaptations that take a prolonged period to come to market. The basic research undertaken by ARS will be converted into longer-term products and innovations that would otherwise be unlikely or impossible if left to the private sector.
- Improving the Safety of an Efficacious Recombinant (new generation) Marek's Disease Vaccine
- Further Observations on Serotype 2 Marek's Disease Virus-induced Enhancement of Spontaneous Avian Leukosis Virus-like Bursal Lymphomas in ALVA6 Transgenic Chickens

- Comparative Genome Analysis of Avian *Pasteurella multocida* Reveals Candidate Genes Involved in Fitness and Pathogenicity
- Genome Sequences of *Ornithobacterium rhinotrachealis* to Support Development of Novel Countermeasures Against Poultry Respiratory Disease
- Comparative Metagenomic Analysis of the Intestinal RNA Virome and Bacteriome from Sentinel Birds Placed on Selected Broiler Chicken Farms
- Within this category fit most of the vaccine development for any disease. It takes time to perform the initial trials and then the concept has to be passed on to a manufacturer for further development, testing and final marketing. Other longer-term project include the genomic evaluation of PRRS and identification of genetic markers for resistance. The concept is great and needs to be pursued, but it will take time for genetics companies to adopt and implement a gene marker into their breedstock that can then produce replacement animals for producers. It is a long-term event to get to that point.

3. Examples of how the accomplishments led or could lead to practical applications in animal health relative to your stakeholder needs

- Equine piroplamosis and work on eliminating carrier state will have a huge impact.
- Accomplishments detailed in the 2011-2015 report will assist veterinarians in developing better disease prevention, control, and treatment programs for the animals under their care. This includes, but is not limited to, utilization of new diagnostic techniques and strategies, application of improved vaccination protocols, increasingly judicious use of therapeutic agents, and educating producers and others on good biosecurity and animal care practices.
- The accomplishments thus far with OPPV will likely lead to quicker, more effective elimination of this disease in many flocks through testing and management.
- With positive outcomes from additional work and success on a blood test for scrapie, the national scrapie eradication program should be expedited and the cost of the program would lower for federal, state and industry partners.
- Findings respiratory diseases in domestic and big horn sheep are beginning to help impact regulatory solutions to shared habitat. Likewise with MCF, research and hopefully the transfer of technology, sheep and bison will hopefully be able to share habitat safely.
- Alternative mastitis/infectious disease management.
- Decreased antimicrobial usage.
- New vaccines against economically important diseases e.g. respiratory disease and Johne's disease.
- Bluetongue and BTVE8 are both diseases of interest to DHS. The framework for studies on white-tailed deer and big horn sheep could be useful to DHS as well, giving us the capability to look at diseases in wildlife. Also of interest is the genetic evolution and re-assortment of swine virus and how they could affect humans through their influence on human influenza viruses.

- Development of a “leaderless” Foot-and-Mouth Disease (FMD) vaccine platform which is safer than current FMD vaccine technologies will allow for the capability to rapidly manufacture millions of FMD vaccine doses in this country without the fear of vaccine virus escape. This could be crucial in establishing the necessary surge capacity for FMD vaccine for emergency use in an FMD outbreak. USDA APHIS has stated that vaccination will be an important response tool for FMD outbreak management.
- The discovery of a new interferon and its potential application in cattle as a bio-therapeutic candidate to inhibit the FMD virus could increase protection against and slow the spread of FMD in cattle during an FMD outbreak.
- The development of diagnostic tests to screen imported animals and animal products to prevent the introduction of HoBi-like viruses into the United States could aid in protecting the naïve U.S. cattle herd against this emerging disease.
- A genomics approach can be used to discover naturally expressed antimicrobials and provide new tools to fight infectious diseases in cattle.
- Identification of regions in the genome of cattle associated with bovine virus diarrhea (BVD). PIs (scientists) will contribute to the future development of a means to reduce the impact of persistent infections.
- The USDA licensing and approval of new TB diagnostic tests for cattle and deer could result in a more rapid and less laborious means for herd testing than current test methods.
- The complete genomic sequences of *Mannheimia haemolytica* serotypes A1, A2, and A6 is likely to lead to new control methods for Bovine Respiratory Disease (BRD) in cattle. BRD currently accounts for 65-80% of the morbidity and 45-75% of the mortality in some U.S. feedlots.
- Anthelmintic resistance is a major problem in controlling parasites in cattle. Research at ARS to develop vaccines against parasites will help to reduce the reliance on drugs that are becoming ineffective in controlling parasites due to resistance problems.
- An improved diagnostic test for *Anaplasma marginale*, a tick-borne bacterial pathogen for cattle, will aid in maintaining herds with *A. marginale* free status. Additional work with this bacteria may result in a future vaccine.
- ARS scientists have made significant contributions to the better understanding of the atypical forms of BSE in cattle and have resulted in science-based control programs within the regulatory arena. The topic of alternatives to medically important antibiotics has grown in scope over the past five years, and we see some of the emerging research concerning feed additives as having strong potential to improve broiler flock health, gut nutrient absorption, and productivity within the near future. We also see the monitoring and genotyping of novel virus mutations of diseases such as Newcastle Disease Virus as beneficial because it allows vaccine development to stay current and impactful for the industry.
- Pandemic H1N1 – research helped us understand the role of swine in the transmission and potential zoonotic implications.

- PRRS genomics research is increasing our understanding of host interactions and enlightening possible routes to enhance immunity and minimize impacts to producers.
- SIV research in general has greatly increased our understanding of the role swine play in influenza mutation and transmission.
- FAD research is leading to the development of new vaccines and diagnostics that will be critical should the U.S. industry face an FAD introduction
- Alternatives to antibiotics are potentially important as the use of antibiotics becomes further restricted.
- Most if not all of the applications for diseases of swine are in play in one form or another. For PRRS, we are better prepared to identify foreign strains with our current diagnostic tests, we are also able to predict what the clinical severity of such a disease would be. This helps in planning steps for the prevention and exclusion of such viruses into the United States. The information from influenza virus research is being utilized to assess the current surveillance data and how this can change over time, why different vaccine and vaccine platforms are needed and also how to best monitor emerging strains (especially avian influenza) as it enters the United States. All of these activities for influenza in swine help veterinarians to be better prepared to manage and deal with changes in the virus. The diagnostic test and reagents work is critical to be able to accurately and quickly detect common and emerging diseases of swine. Having a bank of immune reagents is key to assess immunity to diseases of interest as well as providing a standard set of reagents for all labs to have access to. Continued work in FMDV for vaccines is critical as we look at ways to protect the industry in the event that virus is found. ARS is unique in being able to perform and address these disease challenges at Plum Island facility.

Program and foresight

4. Describe your vision of future research within the Program

a. In your own research area

- Control of yearly outbreak of equine vesicular stomatitis and equine herpes virus outbreaks.
- Additional focus on the *areas mentioned above – *see bullets listed directly below for clarification** plus further investigation under each of the components on sheep disease issues.
 - *Progress appears slow in terms of new solutions in component 6. While progress is evident for the diseases listed in component 3, Q-Fever is a zoonosis that needs research attention. Foreign Animal Disease readiness is multifaceted; research regarding FMD is impressive yet it seems that a vaccine implementation plan may need more multi-agency planning and cooperation.*

- *Progress on respiratory diseases affecting both domestic and big horn sheep. Genomic solutions to OPPV. Progress towards a practical solution to MCF transmission. Progress on a blood test for scrapie.*
- We would like to see more collaboration and coordination with other agencies, more inclusive research, and funding other areas of research (e.g. infectious disease modeling in livestock). We would like to work together to find better ways of sharing information on existing research agendas, that will allow both agencies to mine helpful information on ongoing and future research projects to inform other research agendas, and potentially establish collaborations that allow us to use our differing mission spaces to fulfill mutually needed objectives (i.e. investing in genomics to inform vaccine, biotherapeutic and diagnostic platform development).
- Scientific research provides the basis for many of the decisions that impact the beef cattle industry. The Department of Science and Product Solutions at the National Cattlemen’s Beef Association is comprised of the following check-off funded research program areas: Beef Safety; Human Nutrition; Product Enhancement; and Sustainability. The check-off funded research does not include any pre-harvest animal health or production based research. Our current policy budget is very limited to independently perform the type of research outlined by the research components of the National Program 103—Animal Health and we are appreciative of the discoveries made through the program. NCBA remains especially supportive of continued research work in the topic areas of biodefense research, animal genomics, respiratory diseases, and the transmissible spongiform encephalopathies.
- I foresee the continued active communication and collaboration with USDA ARS in research priority development both short and long-term. This is critical as each organization has their own respective areas of priority and focus (ARS and National Pork Board) which have been very complimentary to each other. The need to continue to share project areas and focus is needed especially with funds becoming less and less for all of swine research, so making the most of what we each have will be more and more important.

b. In the area of animal health in general

- The responses we have provided to many of the questions above are relevant to this inquiry. In addition, the agency is encouraged to ensure that the National Program is positioned to adjust research priorities in the event of an animal health emergency. Cases in point are the identification of Porcine Epidemic Diarrhea Virus in the United States in 2013 (and its subsequent and devastating spread) and the 2015 outbreak of Highly Pathogenic Avian Influenza.
- In addition to improved methods for expeditious identification and confirmative diagnosis of emergent and potentially emergent diseases, and their prevention, control, treatment (where prudent) and eradication, better methods are needed for emergency depopulation and management of resulting mortality. We request that USDA consider related needs when developing future Action Plans and attendant research priorities.

- ARS, working with their partners and collaborators, are in the unique position to tackle the difficult health issues that face the industry and society now and have a high likelihood of facing in the future. Scoping these issues and focusing on the hard problems is what the agency does well.
- Application of genomics, proteomics, xxxomics to the field.
- Antimicrobial use – alternatives.
- Understanding antimicrobial resistance and methods to control.
- Understanding anthelmintic resistance and methods to control.
- Understanding the dynamics of the gut microbiome in relation to pathogenic infections.
- Measuring pain, discomfort, and stress.
- Enhanced coordination described in 4a (*see bullet listed directly below for clarification*) could be applied to this question as well.
 - *We would like to see more collaboration and coordination with other agencies, more inclusive research, and funding other areas of research (e.g. infectious disease modeling in livestock). We would like to work together to find better ways of sharing information on existing research agendas, that will allow both agencies to mine helpful information on ongoing and future research projects to inform other research agendas, and potentially establish collaborations that allow us to use our differing mission spaces to fulfill mutually needed objectives (i.e. investing in genomics to inform vaccine, biotherapeutic and diagnostic platform development).*
- While developing an aggressive animal disease research agenda is critical for successful outcomes, it is also important to allow enough flexibility in the program to allow for targeted research responses to unknown disease events or emerging diseases. The ARS research programs should seek to innovate as well as to collaborate with the work of academia, other Federal agencies and the private sector in order to build on achievements and sustain a competitive agricultural economy in the United States.
- There may be some interest into how changing climate conditions could affect the pattern and behavior of certain diseases. For example, is there potential for some pathogens to survive better or worse inside or outside the host in warmer climates? We also envision increased attention to the gut microbiome's impact on bird immunity and disease resistance; this is an area which is rapidly expanding in both human and livestock medicine.
- My vision would be that ARS continues to be responsive to the agriculture industry stakeholders and continues to engage those stakeholders collaboratively. It will be necessary to enhance the opportunities to leverage research dollars through collaboration with private industry and universities. ARS will need to have the capability and flexibility to respond to emerging disease issues that threaten animal health, public health or export markets. I would hope that the stakeholders could work with ARS to bring additional funding to enhance the research already undertaken at the agency.
- The areas of animal health will remain very similar to past years. A lot of disease issues have not changed. However, what will change is the need to be

able to incorporate evaluation of emerging diseases (also with Swine Health Information Center) as part of the ongoing strategy for swine disease research. Already we have Seneca Valley Virus as a disease of concern and getting concerted effort on this and whatever is next is important.

Some other general comments with respect to the accomplishment 2011-2015 report to share:

- Within the report, the 2011 “impact survey” was of little value. We feel a better design of the survey and analysis of the results would likely have resulted in more useful information.
- A variation of Appendix 1 broken down by research component area would also be valuable.
- Would like to see impacts for each priority component. e.g.
 - Research led to development of new vaccine, or diagnostic assay, or novel and effective therapy, or improved market access.
- The report did not clearly identify linkages across discipline within ARS. Identifying and describing where researchers are leveraging expertise across ARS is would be valuable