

## **Beef Cattle Priorities**

### **1. Bovine Respiratory Disease Complex including BVD**

- Duration: Long Term
- Rank: 1
- Rationale: Most significant cause of beef production loss  
Reproductive losses secondary significance.

#### Research Priorities:

- Host-pathogen interaction/synergy of agent with other factors
- Altered host response
- Novel preventatives and therapeutics
- Surveillance for pathogens & host factors for early intervention

#### Alignment of initiative with USDA Priorities

- Global Food Security
- Food Safety
- Climate change (environment)?

#### Funding

- Public: All USDA (ARS/NIFA); DHS; NIH; NSF; DOD; State Universities
- Private: All Philanthropic foundations (Gates, Noble); Animal industry
- Public/ Private: All Producer organizations, state cattle associations
- International: All OIE, QUADS countries, USAID (BARD)

#### Notes/details

- Intervention: capture at neonate stage (health calf), emphasizes health over cost.
- Synergy of agent with environmental factors and among agents (virus + bacteria)
- Failed immune system vs. enhance immune system
- Stressors (neuro/endocrine/immune pathway)
- Use above stress info to predict which animals are at risk (e.g., stress markers)
- How to measure stress, define stress
- Evaluate altered host response, contributing factors
- Improved diagnostics, vaccines, delivery
- Diagnostic testing at individual animal and herd levels
- Surveillance of infectious agent and diversity of factors in animal populations (fresh calf, comingled sales), including surveillance for emerging diseases
- Establish health baseline for herds

### **2. Mycobacterial diseases (TB and Johnes)**

- Duration: Long Term
- Rank: 2
- Rationale: Disease related production loss, market barriers

Research Priorities:

- Diagnostics
- Vaccines
- Herd management / national control program
- Wildlife / Livestock Interface

Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety

**Funding**

- Public/ Private: 1, 2, 3, 4
- International: 1, 2, 4
- Other: USAHA / AAVLD 1, 2, 3, and 4

**Notes/details**

- Rapid, accurate, inexpensive, animal-side test needed
- Objective slaughter test (a) serum / meat juice test to enhance slaughter surveillance and (b) rapid lesion identification test to improve turn-around time for trace-back

**3. Vector-borne Diseases**

- Duration: Long Term
- Rank: 2
- Rationale: Economic consequence due to animal loss, market disruption and loss of consumer confidence.

Research Priorities:

- Virus / Vector Ecology and Host Relationship
- Integrated approach to prevent importation of disease
- DIVA vaccine and companion diagnostics
- Improved surveillance and modeling

Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change

**Funding**

- Public/ Private: 1, 2, 3, 4
- International: 1, 2, 3, 4

**Notes/details**

- Understanding the virus and vector ecology of vector-borne disease is critical to develop approaches to regionalize disease management to prevent disruption of interstate and international trade and protect consumer confidence in the food supply.

- Improving surveillance of vector-borne disease with Mexico in particular and other trading partners is critical to preventing introduction of exotic disease to the US cattle herd and wildlife.
- Potential threats include: Tick Cattle Fever, BTV, EHDV, VSV, and RVF.

#### **4. Infectious Reproductive Disease**

- Duration: Long Term
- Rank: 2
- Rationale: A huge economic impact on cattle production despite limited success with diagnostic assays and preventives.

##### Research Priorities:

- Impact of immune status on protecting reproductive function
- Altered interaction of immune function and endocrine modulators
- Novel diagnostics, preventatives and therapeutics
- Efficacy of current tools: diagnostics and vaccines

##### Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety
- Climate Change

##### **Funding**

- Public: 1, 2, 3, and 4
- Private: 3, and 4
- Public/ Private: 1, 2, 3, and 4
- International: 1, 2, 3, and 4

##### **Notes/details**

- Strong consensus of group. Focus on pathogens: BVDV, IBR, Trich, Lepto, Bluetongue/EHDV, and Brucella.
- Reproductive disease should be defined to include infertility, sub-fertility, early embryonic death, fetal mummification, abortion, congenital defects and production of nonviable offspring.

#### **5. Minimize Impact of Emerging Infectious Diseases**

- Duration: Long Term
- Rank: 3
- Rationale: Ensure food security, continuity of business, and public health

##### Research Priorities:

- Biosecurity
- Evidence for accurate disease transmission assessments

- Bio-economic decision tools for outbreak response
- Define and mitigate risks at livestock/wildlife interfaces

Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety
- Climate Change

**Funding**

- Public: USDA, DHS, DOD, DOI, DOT, State universities, local/state govt.
- Private: pharmaceutical. industry, diagnostic labs, philanthropic funds, commodity groups
- Public/ Private: above
- International: OIE, GFRA, QUADS, FAO
- Other: Media

**Notes/details**

- FMD prevent and response (optimize depopulation vs. vaccination)
- Continuity of business
- Minimize impact of emerging diseases on production
- Biosecurity includes containment, decontamination, rapid diagnostics, vaccination, prevent introduction.
- Transmission includes vectors, fomites, feed, airborne and water, direct contact, wildlife interface
- Biosecurity = prevent introduction and spread of infectious agents
- Evidence consists of pathogen surveillance under various environmental conditions, shedding rates, and transmission pathways
  - - Effect of countermeasures on disease control
  - - Risk of consuming vaccinated/recovered product
  - - Effective public communication during disease event
  - - Wildlife interface = baseline, what is current landscape

**6. Animal Well Being**

- Duration: Long Term
- Rank: 6
- Rationale: Anticipation of impact of ballot initiatives and consumer preference trends

Research Priorities:

- PAIN - measurement & control
- STRESS - relationship to disease and productivity
- HEALTH - maintenance/surveillance
- ECONOMICS - cost/benefit of mitigation

Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change
- Nutrition and childhood obesity?

**Funding**

- Public: 1, and 3
- Private: 4
- Public/ Private: 2
- International:
- Other: Consumer and activist organizations

## **Poultry Breeder/Layers Priorities**

### **1. Housing Systems Influence on Health/Welfare**

- Duration: Short term
- Rank: 1
- Rationale: Housing systems influence on health and welfare is poorly understood; economic, political, and consumer implications

#### Research Priorities:

- Effects on disease incidence (mortality, morbidity, & stress)
- Alternative disease control and treatment methods
- Internal and external parasite load & control
- Incidence of SE and overall bacteria load in eggs

#### Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety
- Climate Change
- Nutrition and Childhood Obesity

### **Funding**

- Public: 1-4

### **Notes/details**

- There is great concern that ranking priorities will cause USDA AFRI to only fund the top one item rather than funding the best science among the top few priorities. The new RFA system is discouraging for new faculty; lack of opportunities for single investigators, difficult to get on consortium grants. Thus, the recommendations made by this group need to be taken with the above in mind.
- NIFA should look at the NIH model for training and career development grants (T32, T35, and K awards). Loan forgiveness for DVMs entering research and practice in underserved areas, especially poultry (NVMSA).
- \*\*\*Avian influenza and Newcastle disease are not listed as priorities as it was felt these topics would be covered regardless.\*\*\*
- Decisions to legislate production practices should be based on scientific evidence.
- Evidence-based quantitative and qualitative measures of animal well-being are essential.
- Due to conflict of interest, public institutions are the only ones that can do this type of research.

### **2. Salmonella Enteritidis (SE)**

- Duration: Short term
- Rank: 2

- Rationale: reduction of testing costs, reduction of food-borne illness, vaccine failures on rise

Research Priorities:

- Evaluate immunity from different live or killed vaccine regimens
- Evaluate serologic methods to measure immunity
- Host genetic resistance
- Evaluate new and emerging isolates

Alignment of initiative with USDA Priorities:

- Food Safety
- Global Food Security

**Funding**

- Public: 4
- Private:
- Public/ Private: 1, 2, and 3

**Notes/details**

- This is a very important issue in the egg industry due to forthcoming FDA egg safety rules.
- Presently we're seeing vaccine failures; increase in egg-positive flocks that have been vaccinated. SE isolates appear to be evolving and vaccines are not as effective.
- Primary breeders need better diagnostic methods to discriminate among various Salmonella species (SE, ST, S. hadar, S. infantis, S. virchow) for export; regulatory issues.
- Research in this area is a very critical need for food-borne illness prevention.

**3. Tumor Viruses**

- Duration: Long Term
- Rank: 3
- Rationale: Ongoing evolution of MDV and ALV, cost to the industry is ~\$200 million in the US and \$1 billion worldwide annually

Research Priorities:

- Survey and pathotyping of MDV and ALV field isolates
- New and improved MD vaccines
- Host genetic resistance
- Improved detection methods of ALV

Alignment of initiative with USDA Priorities:

- Global Food Security

### **Funding**

- Public: 1
- Private:
- Public/ Private: 2, 3, and 4
- International:
- Other:

### **Notes/details**

- Need to maintain a credible source of testing to resolve export disputes. Retention of expertise in the US is essential for solving current and future problems.
- Vaccines contaminated with ALV and REV continues to be a major concern.
- Recent MD outbreaks in Rispens-vaccinated flocks, which is causing great concerns of new virulent strains.

## **4. Colibacillosis**

- Duration: Long Term
- Rank: 4
- Rationale: losses are significant and affects ~30+% flocks, it is the primary bacteriological problem in layers

### **Research Priorities:**

- Develop an effective mass-applied vaccine
- Determine risk factors for increased incidence of disease
- Host genetic resistance
- Non-traditional control and treatment measures

### **Alignment of initiative with USDA Priorities:**

- Global Food Security

### **Funding**

- Public: 2
- Private:
- Public/ Private: 1, 3, 4
- International:
- Other:

### **Notes/details**

- Should consider bacteriophage, botanicals, pre- and probiotics, etc. for non-antibiotic control measures.
- This is a major disease problem in veterinary surveys for the last 5 years.
- Primarily occurs as a secondary infection, and is a major cause of mortality for other disease outbreaks.
- Although this is the number one bacteriological health issue for layers, colibacillosis is ranked below SE because it is less of a food safety and regulatory issue.

## 5. *Mycoplasma gallisepticum* (MG)

- Duration: Long Term
- Rank: 5
- Rationale: present preventative measures are either not effective or are pathogenic to non-target species (e.g., turkeys, broilers)

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### Research Priorities:

- Mass applied and effective vaccines that are safe for all poultry
- Surveillance and pathotyping of current MG isolates
- Rapid and more specific diagnostics/ better surveillance
- Diagnostics to differentiate field strains from vaccines

### Alignment of initiative with USDA Priorities:

- Global Food Security

## **Funding**

- Public: 2
- Private:
- Public/ Private: 1, 3, and 4

## **Notes/details**

- This continues to be a problem in the industry due to vaccine failures.
- Vaccine use is restricted when layers or pullets are in proximity of broilers and turkeys.
- Diagnostic challenges include non-specific reactions and limited available reagents due to a single US supplier.

## 6. Infectious Laryngotracheitis (ILT)

- Duration: Long Term
- Rank: 6
- Rationale: Continued outbreaks in vaccinated flocks, evolving ILTV, current CEO vaccines are a threat to revert to virulent forms

### Research Priorities:

- Pathotyping of field strains
- Safe and effective vaccine development
- Fundamental understanding of host resistance
- Differentiation of field strains from vaccines

### Alignment of initiative with USDA Priorities:

- Global Food Security

### **Funding**

- Public: 1, 3
- Private:
- Public/ Private: 2, and 4
- International:
- Other:

### **Notes/details**

- Outbreaks have occurred in vaccinated flocks in multiple locations.
- Better coordination among research groups should be encouraged or is needed.
- Pathotyping of Ohio strain is needed.
- Likely to be a high priority for broilers, not much research directed for layers.
- Evaluation of immune response for eye-dropping FVAX and CEO ILT vaccines.
- Improved vaccine delivery systems are needed for all diseases.

## **Poultry/Broilers/Meat**

### **1. Functional Genomics for Disease Resistance**

- Duration: Long Term
- Rank: 1
- Rationale: In the era of post-genomics, the information needs to be applied for practical uses

#### Research Priorities:

- Identify how Innate immunity influences disease resistance
- Identify markers of adaptive immunity leading to better immune
- Apply bioinformatics tools to analyze genomics data for poultry
- Improved understanding of host/pathogen interaction

#### Alignment of initiative with USDA Priorities:

- Global food security

#### **Funding**

- Public: 3
- Private:
- Public/ Private: 1, 2, and 4
- International: 1 and 3
- Other:

#### **Notes/details**

### **2. GI disease/Integrity/Host Microbial Interactions**

- Duration: Long Term
- Rank: 3
- Rationale: Gut diseases are the most important economic factor to commercial poultry

#### Research Priorities:

- Improved vaccines or other controls to prevent coccidia
- Improved understanding Coccidia/clostridial (inc GD) interaction
- Understand contributions of Microbioma to gut health
- Better understanding of GI Immunity

#### Alignment of initiative with USDA Priorities:

- Global food security

#### **Funding**

- Public:
- Private:

- Public/ Private: 1, 2, 3, and 4
- International: 1,2,3,4
- Other:

### Notes/details

#### **3. Diseases Affecting World Trade**

- Duration: Long Term
- Rank: 2
- Rationale: AIV, NDV, VVIBD, ILT, Salmonella, and other diseases that are known to affect trade

#### Research Priorities:

- Develop vaccines (tools) to prevent transmission
- Antigenic and genetic characterization of evolving viruses
- Rapid multiplex diagnostics for poultry pathogens
- Improved understanding of the epidemiology of the virus

#### Alignment of initiative with USDA Priorities:

- Global food security and 3) Climate change

### **Funding**

- Public:
- Private:
- Public/ Private: 1,2,3,4
- International: 1,2,3,4
- Other:

### **Notes/details**

#### **4. Respiratory Disease Complex**

- Duration: Long Term
- Rank: 4
- Rationale: IBV, E coli, lentogenic NDV, ILTV, Mycoplasma are important players in the respiratory complex diseases of commercial poultry

#### Research Priorities:

- Improved vaccines, mass vaccination, improved safety, cross protection
- Better control of E coli and other secondary bacterial infections
- Better understanding of emerging viral and bacterial pathotypes
- Role of immune competence in multifactorial diseases

Alignment of initiative with USDA Priorities:

- Global food security

**Funding**

- Public:
- Private:
- Public/ Private: 1, 2, 3, and 4
- International: 1, 2, 3, and 4
- Other:

**Notes/details**

**5. Vaccines and Their Limitations**

- Duration: Long Term
- Rank: 5
- Rationale: Current vaccines are not meeting the needs of the industry

Research Priorities:

- 1. Need for improved immunomodulators for poultry vaccines
- 2. Improved vaccines to more effectively block pathogen transmission
- 3. Improved DIVA strategies
- 4. Improved strategies to overcome maternal antibody

Alignment of initiative with USDA Priorities:

- Global food security

**Funding**

- Public:
- Private:
- Public/ Private: 1,2,3,4
- International: 1,2,3,4
- Other:

**Notes/details**

**6. Tumour Viruses: (Marek's, ALV, REV)**

- Duration: Long Term
- Rank: 6
- Rationale: Continued evolution of new strains threatens to overwhelm current control strategies

Research Priorities:

- Improve genetic resistance of birds
- Surveillance for field isolates for lack of protection
- Develop more efficacious vaccine (sterilizing immunity)
- Diagnostics-differentiate exogenous/endogenous ALV

Alignment of initiative with USDA Priorities:

- Global food security

**Funding**

- Public:
- Private:
- Public/ Private: 1,2,3,4
- International: 1,2,3,4
- Other:

**Notes/details**

## Dairy Priorities

### 1. Lameness

- Duration: Long Term
- Rank: 1
- Rationale: Rising welfare issue in industry. Contributes to high removal rate. Predisposes to other diseases.

#### Research Priorities:

- Mechanisms of Disease (environment, nutrition, genetic)
- Digital Dermatitis (etiology, prevention)
- Better management of clinical cases (extension)

#### Alignment of initiative with USDA Priorities:

- Food safety
- Global food security
- Climate change

#### Funding

- Public: NIFA, ARS, land grant universities
- Private:
- Public/ Private:
- International: EU, UK
- Other:

#### Notes/details

- Welfare issues

### 2. Johnes

- Duration: Long Term
- Rank: 2
- Rationale: 68% in all heads, 95% in herds >500. Economic impact. Food safety (zoonotic) Trade.

#### Research Priorities:

- Diagnostics (rapid, accurate, early detection)
- Vaccination
- Management of infected animals (subclin., extension)
- Disease resistance and genetics

#### Alignment of initiative with USDA Priorities:

- Food safety
- Global food security
- Climate change

### **Funding**

- Public: NIFA, ARS, land grant universities
- Private:
- Public/ Private:
- International: (All) EU, NZ, Asia
- Other:

### **Notes/detail**

- Caps been an effective approach.
- Many species, beef, sheep, cervids, dairy.
- Human health issues?

### **3. TB**

- Duration: Long Term
- Rank: 3
- Rationale: Re-emerging national threat. Potential of major economic impact. Impact on trade / transportation. National and International trade

#### **Research Priorities:**

- Diagnostics
- Vaccines (cattle and others)
- Management (wildlife, controls, security, extension)
- Epidemiology (movement issues, political)
- Unregul dairy pro zoonot

#### **Alignment of initiative with USDA Priorities:**

- Food safety
- Global food security
- Climate change

### **Funding**

- Public: (All) NIFA, ARS, Land grants, States, CAP, APHIS
- Private: (1, 2) Pharma
- Public/ Private:
- International: (All) UK IR NZ
- Other:

### **Notes/details**

#### **4. Mastitis**

- Duration: Long Term
- Rank: 4
- Rationale: Major animal health issue with high economic impact. Numerous research potential. Over reliance on antibiotics.

##### Research Priorities:

- Prevention -- vaccines, nutrition, immunomodulation
- Genetic Resistance
- Management -- antimicrobial and alternatives, long-term impact, Ex
- Diagnosis -- rapid, accurate, cowside

##### Alignment of initiative with USDA Priorities:

- Food safety
- Global food security
- Climate change

#### **Funding**

- Public: NIFA, ARS, land grant universities (all)
- Private: Pharma, dairy industry, (all)
- Public/ Private: (all)
- International: NMC, IDF, global problem, CBMRN
- Other: establish fund (research foundation Pharma, Dairy)

#### **Notes/details**

- Use of check off dollars or new sources of funding? New approaches.

#### **5. Transition Cow**

- Duration: Long Term
- Rank: 5
- Rationale: Economic impact, impact on many disease states. Animal welfare focus. Transition cow impacts neonate health.

##### Research Priorities:

- Immune function (define, predict, modulate)
- Nutrition (Immune effect, prevent metabolic diseases)
- Management (diets transition, behavior, housing, extension)
- Metabolic balance and overall health

##### Alignment of initiative with USDA Priorities:

- Food safety
- Global food security
- Climate change

### **Funding**

- Public: NIFA, ARS, land grant universities
- Private: Pharma, Nutritional Companies
- Public/ Private:
- International: EU, AUS, NZ, CA
- Other:

### **Notes/details**

- Focal point for animal welfare.

## **6. Infertility**

- Duration: Long Term
- Rank: 6
- Rationale: Increasing problem leading to economic impact. Growing cause of removal of animals.

### **Research Priorities:**

- Infectious diseases / prevention strategies
- Reproductive failure (better def of causes / importance)
- Management (Evaluation of Sync programs, extension)

### **Alignment of initiative with USDA Priorities:**

- Food safety
- Global food security
- Climate change

### **Funding**

- Public: NIFA, ARS, land grant universities
- Private: Dairy industry
- Public/ Private:
- International:
- Other:

### **Notes/details**

## Equine Priorities

### 1. Emerging & Re-emerging Diseases

- Duration: Long Term
- Rank: 1
- Rationale: Threaten biological and commercial health of US horse industry, including international and interstate movement.

#### Research Priorities:

- Epidemiology: identification of risk factors
- Immune response & vaccine development
- Diagnostic tests: rapid, accurate, stall-side
- Pire (1st); EHV-1; EEE-WEE; CEM; VS; Lyme; EPE; EIV

#### Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change
- Childhood Obesity

#### Funding

- Public:
- Private:
- Public/ Private: 1,2,3,4
- International: 1,2,3,4
- Other:

#### Notes/details

- Potential economic impact of Piroplasmosis is extremely high and is considered the most important disease to focus on at this time: new and improved efficacious vaccines
- CEM: new and improved efficacious vaccines
- EHV-1: new and improved efficacious vaccines
- Strangles:
- Lyme's:
- Equestrian activities are part of a healthy, childhood exercise activity to contribute to reducing obesity.

### 2. Non-infectious diseases of economic importance

- Duration: Long Term
- Rank: 2
- Rationale: Equine health, safety, welfare & utility. Economically critical for industry and the public.

Research Priorities:

- Epidemiology to identify risk factors
- Foundational mechanistic pathophysiology
- Diagnostics, Prevention & therapeutics
- Laminitis (1); Colic (2); lameness/arthritis (3); airway disease...

Alignment of initiative with USDA Priorities:

- Global Food Security
- Childhood Obesity

**Funding**

- Public:
- Private:
- Public/ Private: 1,2,3,4
- International: 1,2,3,4
- Other:

**Notes/details**

- Basic, mechanistic foundational research on pathophysiology is a critical gap for this area. This is a major area for horse utility; loss of use has been demonstrated by USDA. Encompasses main reasons for death or loss of use.
- Huge opportunity to use horse as dual-purpose model for human studies (orthopedic diseases; vascular; respiratory diseases; soft-tissue diseases; allergic diseases)

**3. Reproductive & Developmental Health**

- Duration: Long Term
- Rank: 3
- Rationale: Improved production efficiency, welfare, utility

Research Priorities:

- Developmental musculoskeletal diseases
- Foal health (e.g., immunology; diarrhea; reparatory; sepsis )
- Genital tract disease (e.g., CEM; EAV; endometritis/ placenta)
- Infertility & embryonic development

Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change
- Childhood Obesity

**Funding**

- Public:
- Private:
- Public/ Private: 1,2,3,4

- International: 1,2,3,4
- Other:

#### **Notes/details**

- Application of new genomic and molecular approaches to study mechanisms associated with male and female infertility.
- Population management through application of new knowledge gained from genomic and molecular approaches.
- A reduction in foal diseases will improve the overall productivity of the industry.

#### **4. Equine Genomics**

- Duration: Long Term
- Rank: 4
- Rationale: Population sustainability & improvement of equine health

##### **Research Priorities:**

- 1. Develop novel genetic tools & resources for research
- 2. Identify genetic mechanisms for diseases
- 3. Characterize genotypic & environmental effects on phenotype
- 4. Develop molecular diagnostic tests and pharmacogenomic approaches

##### **Alignment of initiative with USDA Priorities:**

- Global Food Security
- Climate Change
- Childhood Obesity

#### **Funding**

- Public:
- Private:
- Public/ Private: 1,2,3,4
- International: 1,2,3,4
- Other:

#### **Notes/details**

- The recently completed sequencing & annotation of the equine genome provides a platform for accelerated advances and application of novel approaches to understand disease mechanisms, develop novel tools and also select for disease resistant populations. Benefits reach much further than just horses, but also other agricultural species, as well as the human population through comparative genomics.

## 5. Foreign Diseases & Zoonoses

- Duration: Long Term
- Rank: 5
- Rationale: Protect domestic population; Prevent disastrous economic impacts from foreign diseases; Minimize/avoid trade barriers

### Research Priorities:

- Piroplasmosis; BT; AHS;
- Host-vector- pathogen-environment interactions
- Develop tools (Diagnostics, etc.) for surveillance
- Immune response & vaccine development strategies

### Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change
- Childhood Obesity

### **Funding**

- Public:
- Private:
- Public/ Private: 1,2,3,4
- International: 1,2,3,4
- Other:

### **Notes/details**

- It is important to always maintain an ongoing program for FADs to offset potential economic consequences.

## 6. Nutrition & Metabolic Disorders

- Duration: Long Term
- Rank: 6
- Rationale: Enhancing health & utility, such as reducing equine obesity & associated disease, colic, parasitism, and laminitis.

### Research Priorities:

- 1. Biology of nutrition, including feed efficiency;
- 2. Patho-physiology of the gastro-intestinal tract
- 3. Effect of nutrition on gastrointestinal health - colic; enteritis
- 4. Parasite control programs (environmental; genetic; anthelmintics)

### Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change
- Childhood Obesity

## **Funding**

- Public:
- Private:
- Public/ Private: 1, 2, 3, and 4
- International: 1, 2, 3, and 4
- Other:

## **Notes/details**

- Additional science-based information on balanced nutrition is needed.
- Need to re-examine impacts of parasitic diseases on horses; resistance to anthelmintics.
- Feed efficiency and waste management is an important concern.
- Industry background for all topics: Horses are an important livestock species in the US. The horse industry directly produces goods and services of \$38.8 billion and has a total impact of \$101.5 billion on US GDP. The industry directly provides 460,000 full-time equivalent jobs. Spending by suppliers & employees generates additional jobs for a total employment impact of 1.4 million jobs. There are horses in every state with over 70% of horse owners living in communities of 50,000 or less. 2 million people own horses. Support rural communities. Working horse roles in agriculture are very important. Currently there are approximately 9.2 million horses in the US with tens of millions more worldwide. For example, there over 66 million donkeys and mules alone.
- USDA Priority Areas with strong equine implications:
- Global Food Security & Hunger; Climate Change; Equine could be good model to study obesity in humans;
- Build infrastructure and tools to be prepared for the future (e.g., foreign animal diseases)
- Genome sequencing is opening exciting new frontiers but much fundamental, basic biology of equine systems is missing and may hinder progress.
- Non-infectious diseases (colic; laminitis; multiple musculoskeletal conditions...);
- Infectious diseases (emerging/re-emerging (African Horse Sickness; Equine Herpes Virus; Piroplasmosis...);
- Poor knowledge of equine immune system
- More Population studies needed with economic impacts; equine disease databases needed beyond just regulatory diseases (are we effective, are we having an impact ?);
- Positive: stronger level of collaboration among equine researchers (e.g., genetics panel); continue to foster...
- Host-pathogen-environment interactions; foal diseases effect foal crop;
- CAFO's; nutrients/ manure
- Welfare (including Youth development and positive impact of equine interactions; horse therapy); also abandoned horses;
- Use equine as model for human diseases, including immunology / and stem cell immunomodulation...

- Systems-based approach for Prevention / epidemiology/ risk factors/ associations with management; link to genomics; what are the best practices?
- Where do horse research fit within the current priority framework?

## Goat Priorities

### 1. Gastrointestinal Parasites (worms and protozoa)

- Duration: immediate and long term
- Rank: 1
- Rationale: Reported as top industry priority as part of NAHMS needs assessment; high morbidity, high mortality, high economic impact.

#### Research Priorities:

- Genetics—host and parasite
- Diagnostics—field typing, molecular diagnostics
- Vaccines—with *Haemonchus* as the first priority
- Discovery and approval of pharmaceuticals and alternatives, including phytochemicals and nutraceuticals.
- Control of disease through management, including nutritional, grazing management.

#### Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change

#### Funding

- Public: 1
- Private:
- Public/ Private: 2, 3, 4, 5
- International: 1, 3, 4, 5
- Other:

#### Notes/details

- US partners: ARS, NIFA, Southern consortium for small ruminant parasite control, FDA Minor Use Animal Drug Program NRSP7, Dept of State (ISN/BEP)
- Private partners: Industry partners such as ADGA, pharmaceutical companies, American Goat Federation
- International partners: OIE, World Bank, USAID, Asia Development Bank, FAO
- Allied interests: ongoing research in Denmark, Australia, New Zealand, and Scotland

### 2. Species Specific Approvals for Necessary Pharmaceuticals

- Duration: long
- Rank: 2
- Rationale: Food safety and production issue as it relates to extra-label use due to lack of approved safe and effective medications for goats

#### Research Priorities:

- Therapeutic antibiotics (for mastitis, respiratory disease, lameness)

- Anthelmintics (new classes)
- Pain and analgesics (for animal well-being, including tattooing, dehorning, castration, and trauma)
- Biologics (toxoplasma, respiratory vaccines)

Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety

**Funding**

- Public:
- Private: 2 and 3
- Public/ Private: 1, 2, 3, and 4
- International:
- Other:

**Notes/details**

- Public: ARS, NIFA, Minor use animal drug program
- Private: MUMS, pharmaceutical companies, such as AlPharm, Pfizer, Merial, Elanco

**3. Control Measures for Caseous Lymphadenitis**

- Duration: long
- Rank: 3
- Rationale: Identified as the second priority in NAHMS due to production losses and food safety issues

Research Priorities:

- Vaccine to reduce and/or eliminate disease in goats
- Improved diagnostic test
- Identification of host genetic factors associated with bacterial shedding
- Ecology of the organism (host pathogenesis, vectors, fomites, environmental persistence)

Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety

**Funding**

- Public: 3 and 4
- Private:
- Public/ Private: 1 and 2
- International: 2
- Other:

### Notes/details

- Public/private: ARS, NIFA, CVM for sequence analysis of multiple strains
- Private partners: pharmaceutical companies as CRADA partners
- International: research collaborations with Brazilian researchers

## **4. Mastitis Control and Treatment**

- Duration: long
- Rank: 4
- Rationale: Major economic losses to goat producers due to decreased production and inability to market milk, food safety, lack of data on specific issues of mastitis in goats

### Research Priorities:

- Management factors (teat dipping, nutrition, housing, milking equipment and protocols)
- Therapeutics, identification of effective treatments for lactating and non-lactating does
- Bacterial ecology and animal health (particularly coagulase-negative Staph)
- Develop a vaccine (special emphasis on coagulase-negative staph)

### Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety

### Funding

- Public: 1 and 3
- Private: 1 and 2
- Public/ Private: 4
- International: 2
- Other:

### Notes/details

- Public partners: ARS, NIFA
- Private partners: ADGA, Morris Animal Foundation
- International partners: collaborators in France and Brazil

## **5. Q fever (*Coxiella burnetti*)**

- Duration: long
- Rank: 5
- Rationale: Zoonotic (select) agent, results in production losses, potential for mass euthanasia programs, loss of public confidence in safety (as H1N1 scenario)

Research Priorities:

- Determine prevalence of coxiella
- Improved diagnostics (including phase I vs. phase II)
- Ecology of the bacteria (transmission, interaction with host genetics, wildlife and interspecies interface)
- Management methods for controlling shedding to reduce the zoonotic potential

Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety
- Climate Change

**Funding**

- Public: 1, 3, and 4
- Private:
- Public/ Private: 2
- International:
- Other:

**Notes/details**

- Public partners: ARS, NIFA, HHS (CDC), State Department, Department of Defense
- Private partners: as CRADA partners for diagnostic tests or pharmaceuticals developed by USDA

**6. Eradicate Scrapie**

- Duration: long
- Rank: 6
- Rationale: lack of goat-specific data results in total herd depopulation following scrapie exposure

Research Priorities:

- Identify routes of transmission of caprine scrapie
- Improved diagnostic testing, especially live animal testing
- Identify genetic factors affecting resistance and incubation time
- Interspecies transmission (including strain variation)

Alignment of initiative with USDA Priorities:

- Global Food Security

**Funding**

- Public: 1, 2, 3, and 4
- Private:
- Public/ Private:
- International:
- Other:

**Notes/details**

- ARS/NIFA

## Swine Priorities

### 1. PRRS Elimination

- Duration: Long Term
- Rank: 1
- Rationale: \$600M+ losses to pig industry

#### Research Priorities:

- Vaccine platforms; viral host-cell pathogenesis; immunology
- Diagnostics; surveillance
- Ecology, epidemiology
- Genetics of PRRS resistance/susceptibility

#### Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety

### Funding

- Public: priority research areas 1-4
- Private: priority research areas 1-4
- Public/ Private: priority research areas 1-4
- International: priority research areas 1-4
- Other:

### Notes/details

- Game plan for implementing res; why rationale for the priority
- Pen side diagnostics; multiplex assays; DIVA based diagnostics; PRRSV vaccines
- Expanded informatics
- Immune modulators
- Ecology (win herd); area spread; transmission; epidemiology (between herds)
- PRDC influence of coinfections; polymicrobial infection
- Food Safety = animal health; morbidity/mortality issues
- Infrastructure; next gen scientists
- PRRS elimination = extension

### 2. Emerging and Zoonotic Diseases

- Duration: Long Term
- Rank: 2
- Rationale: \$1.6B loss from H1N1 in 2009

#### Research Priorities:

- Swine influenza, MRSA, etc.
- Diagnostics, pathogenesis, transmission
- Microbial genomics; bioinformatics

- Vaccine platforms; intervention strategies

Alignment of initiative with USDA Priorities:

- Global Food Security
- Climate Change

**Funding**

- Public: priority research areas 1-4
- Private: priority research areas 1-4
- Public/ Private: priority research areas 1-4
- International: priority research areas 1-4
- Other: APHIS surveillance infrastructure

**Notes/details**

- Risk analysis; updated models for disease spread (population level) and economic impact
- Advanced planning for emergency disease - bioinformatics, diagnostics and epidemiology, surveillance infrastructure; rapid response infrastructure; biosecurity
- MRSA impact (Campy, C difficile); prevalence vs. risk
- Risk analysis and communication
- Feral swine issues; inter-species transmission; host adaptation, pathogenesis
- Vaccine and interventions - use for industry, feral swine
- One Health model - interface with human medicine

**3. Optimize Health of Growing Pig**

- Duration: Long Term
- Rank: 3
- Rationale: Area of greatest opportunity for improving economics of production efficiency; prevention wastage; animal well-being

Research Priorities:

- Polymicrobial infections;
- Microbial genomics, bioinformatics
- Vaccine platforms; therapeutics; delivery mechanisms
- Diagnostics, surveillance

Alignment of initiative with USDA Priorities:

- Global food Security
- Food Safety
- Bioenergy
- Climate Change

**Funding**

- Public: priority research areas 1-4

- Private: priority research areas 1-4
- Public/ Private: priority research areas 1-4
- International: priority research areas 1-4
- Other:

#### **Notes/details**

- Endemic diseases - bacterial, mycoplasma, polymicrobial infections (impact w PRRS and SIV)
- Enteric, respiratory and systemic diseases (PCVAD, MHYO, bacterial infections - H parasuis, Actinobacillus suis, APP), Lawsonia, rotavirus, TGEV, etc.
- Salmonella, E. coli
- Sharing of diagnostic lab information to better understand disease complexity; develop better diagnostics and vaccines
- New opportunities for health surveillance, e.g., oral fluids, meat juices

#### **4. Periparturient Production Efficiency**

- Duration: Long Term
- Rank: 4
- Rationale: High wastage; mortality, morbidity, growth efficiency; carbon footprint

##### Research Priorities:

- Polymicrobial infection;
- Immune modulators
- Lactation performance
- Microbiome

##### Alignment of initiative with USDA Priorities:

- Global Food Security
- Childhood Obesity
- Food Safety
- Climate Change

#### **Funding**

- Public: priority research areas 1-4
- Private: priority research areas 1-4
- Public/ Private: priority research areas 1-4
- International: priority research areas 1-4
- Other:

#### **Notes/details**

- Microbiome - influence of gut microbiome on nutrition and feed efficiency (carbon footprint), immune and vaccine responses; differences with age (sow, piglet);

- Epigenetic effects; influence of diet and feed additives, growth and immune modulators
- NAHMS survey quantification and expansion (current only 6 years)
- One Health model - interface with human medicine

## **5. Healthy Pig Production with Restricted Antimicrobial Access**

- Duration: Long Term
- Rank: 5
- Rationale: Strategies to avoid negative consequences on animal health and well-being as demonstrated in other countries

### Research Priorities:

- 1. microbiome, metagenomics
- 2. alternatives to antibiotics/antimicrobials
- 3. nutrient utilization and feed efficiency
- 4. alternative management strategies

### Alignment of initiative with USDA Priorities:

- Global Food Security
- Childhood Obesity
- Food Safety
- Climate Change

### **Funding**

- Public: priority research areas 1-4
- Private: priority research areas 1-4
- Public/ Private: priority research areas 1-4
- International: priority research areas 1-4
- Other:

### **Notes/details**

- Subclinical infections; emerging and reemerging organisms and disease issues
- Bioinformatics;
- Animal welfare well-being issues
- Risk cost/benefit analyses
- Pre- and pro-biotics; nutritional interventions

## **6. Foreign Animal Diseases**

- Duration: Long Term
- Rank: 6
- Rationale: 25% exports; industry losses (response more expensive than diseases, eg., UK)

Research Priorities:

- Rapid detection; bioinformatics
- Biosecurity
- ASF, CSF, FMD, PRV, and VSV
- Vaccine, immune interventions

Alignment of initiative with USDA Priorities:

- Global Food Security
- Food Safety
- Climate Change

**Funding**

- Public: interactions with DHS, APHIS, EPA; priority research areas 1-4
- Private: priority research areas 1-4
- Public/ Private: priority research areas 1-4
- International: priority research areas 1-4
- Other:

**Notes/details**

- Surveillance, detection, rapid response, recovery, DIVA vaccines, innate immune modulators
- Bed/pen side tests; expanded tests for specific diagnosis; improved diagnostic tools
- Work with centers of excellence; ARS, university partnerships w sister agencies.
- Biosecurity - bio-exclusion, bio-containment; bio-management
- Access to BSL4 facilities (Canada Winnipeg); personnel travel restrictions

## Sheep Priorities

### 1. Research on bighorn/domestic sheep compatibility

- Duration: Long Term
- Rank: 1
- Rationale: Research gaps in the pathology behind bighorn sheep die off, which jeopardizes 80% of domestic sheep industry

#### Research Priorities:

- Determine normal commensal populations of respective tract in both species.
- Determine etiological agents in bighorn
- Determine nutritional, genetic/genomic, stress factors in bighorn
- Determine preventative/therapeutics for both spp.

#### Alignment of initiative with USDA Priorities:

- Food Security
- Climate Change

#### Funding

- Public:
- Private:
- Public/ Private: 1-4; ARS, APHIS, CEAH, NGO's, ASI, Tribes, states, universities
- International: Canada, muflon endemic regions
- Other: 1-4; BLM, USFS, USF&W

#### Notes/details

- Also aligns with the Secretary's goals of sustaining rural communities and linking national forests and private working lands.

### 2. Eradicate Scrapie

- Duration: Long Term
- Rank: 2
- Rationale: The ongoing eradication efforts need to be expedited

#### Research Priorities:

- Develop live animal/preclinical diagnostics
- Determine how to mitigate environmental contamination by prions
- Determine transmission potential of new strains
- Determine whether goats are a transmission reservoir

#### Alignment of initiative with USDA Priorities:

- Food Security

### **Funding**

- Public:
- Private:
- Public/ Private: 1-4; ARS, APHIS, States, Universities, sheep and goat industries
- International:
- Other:

### **Notes/details**

- Also aligns with the Secretary's goals of sustaining rural communities and linking national forests and private working lands.

### **3. Control and Prevention of Ovine Progressive Pneumonia in Sheep**

- Duration: Long Term
- Rank: 3
- Rationale: Significant cause of trade barriers, early culling, mastitis, carcass defects, and production losses

#### **Research Priorities:**

- Determine immunogenetic markers of disease progression
- Develop viral molecular and pen side diagnostics
- Determine mechanism of disease transmission
- Determine method to block transmission

#### **Alignment of initiative with USDA Priorities:**

- Food Security

### **Funding**

- Public:
- Private:
- Public/ Private: 1-4; ARS, APHIS, States, Universities, sheep industry
- International: 1 and 3; EMBRAPA
- Other:

### **Notes/details**

- Also aligns with the Secretary's goals of sustaining rural communities and linking national forests and private working lands.

### **4. Prevent malignant catarrhal fever in bison and cattle**

- Duration: Long Term
- Rank: 4
- Rationale: Highly prevalent, asymptomatic disease in sheep; why is there high susceptibility with high mortality in bison?

Research Priorities:

- Determine pathogenesis of MCF in bison
- Produce a vaccine for bison and cattle
- Determine viral shedding factors in sheep
- Determine genetic factors for disease resistance

Alignment of initiative with USDA Priorities:

- Food Security
- Climate Change

**Funding**

- Public:
- Private:
- Public/ Private: 1-4; ARS, APHIS, NSF, sheep and bison industry
- International: 1-4; University of Zurich, Liverpool University, Morton Res. Inst.
- Other:

**Notes/details**

- Also aligns with the Secretary's goals of sustaining rural communities and linking national forests and private working lands.

**5. Genetic/genomic Solutions to Economically Significant Sheep Diseases**

- Duration: Long Term
- Rank: 5
- Rationale: Need alternatives to complement/replace current prophylactic or control measures

Research Priorities:

- Determine markers for internal parasites, sore mouth, foot rot
- Develop diagnostic tests to detect markers

Alignment of initiative with USDA Priorities:

- Food Security
- Climate Change

**Funding**

- Public:
- Private:
- Public/ Private: 1-2; ARS, Sheep and goat industries, states, universities
- International: 1-2; International sheep genomics consortium
- Other: Minor use animal drug program, SCSRCP

### Notes/details

- Also aligns with the Secretary's goals of sustaining rural communities and linking national forests and private working lands.

### **6. Improved diagnostics for ovine Johnes, Q fever, and Brucella ovis**

- Duration: Long Term
- Rank: 6
- Rationale: Improved diagnostics would enhance control and management of these endemic diseases

#### Research Priorities:

- Develop, evaluate, validate molecular and serological diagnostics
- Standardization across NAHLN labs
- Develop early detection pen side tests

#### Alignment of initiative with USDA Priorities:

- Food Security
- Climate Change

### **Funding**

- Public: CDC, DHS, DoD (Q Fever)
- Private:
- Public/ Private: 1-3; ARS, sheep and goat industries, states, universities
- International:
- Other:

### **Notes/details**

- Also aligns with the Secretary's goals of sustaining rural communities and linking national forests and private working lands.
- Q Fever is a select agent and is on the second tier of the National Veterinary Stockpile list.
- Q Fever is a zoonotic disease

## Specialty Species Priorities

### 1. Tuberculosis Rapid Diagnostic Tools

- Duration: Long term
- Rank: 1
- Rationale: Need single application diagnostic that does not require re-handling of animals

#### Research Priorities:

- Develop rapid diagnostics with high sensitivity and specificity to detect TB in specialty farmed species
- Develop reagents for characterization of immune responses in specialty farmed species
- Couple rapid diagnostics with epidemiologic tools in infected herds to develop evidence-based knowledge for controlling TB

#### Alignment of initiative with USDA Priorities:

- Global food security

#### Funding

- Public: Zoonotic agent with public health implications. National Eradication Program in traditional domestic livestock. Potential partnership with state regulatory agencies. Interagency cooperation.
- Private: Source of samples or non-infected herds.
- Public/ Private:
- International:
- Other:

#### Notes/details

- Tuberculosis is a re-emerging disease in the U.S. with serious zoonotic implications on public health. The skin DTH test used in many states requires recapture of the animals 72 hr later for evaluation of responses at the injection sites. Re-handling or recapture of wildlife or specialty farmed species is impractical or associated with animal injuries or losses. Soil-born mycobacteria can cause false positive responses on current diagnostics. A rapid test that is highly sensitive and specific that could be conducted without requiring re-handling of livestock is needed.

### 2. Prevent Sheep-Associated Malignant Catarrhal Fever in specialty farmed species

- Duration: Long term
- Rank: 2
- Rationale: MCF causes significant economic losses in specialty farmed species and currently has no vaccines and limited diagnostics. MCF can also adversely affect other domestic livestock species.

Research Priorities:

- Develop vaccine against sheep-associated MCF
- Define pathogenicity and host immune responses
- Define mechanisms of transmission
- Develop appropriate diagnostic tools for specialty farmed species

Alignment of initiative with USDA Priorities:

- Global Food security

**Funding**

- Public:
- Private:
- Public/ Private: Industry supports research by donations and financial support. Public funds
  
- International: Networking. Other countries have losses due to MCF.
- Other:

**Notes/details**

- Malignant catarrhal fever causes severe economic losses in impacted herds. Clinical infection is lethal in bison, destroying entire herds and causing a severe financial impact on owners. The disease particularly impacts small herd owners. MCF is restricting the ability of herd owners to sell livestock from impacted herds and is causing a negative impact on the sheep industry due to the role of sheep as reservoir hosts. Currently there are no vaccines or effective prophylactic treatments to mitigate the economic impact of MCF in an infected herd. Current knowledge and available diagnostics are not sufficient to prevent transmission of MCF from sheep to other specialty farmed species.

**3. Epizootic Hemorrhage Disease/Bluetongue**

- Duration: Long term
- Rank: 3
- Rationale: EHD and Bluetongue serotypes are endemic in the U.S. EHD/BTV causes significant economic losses in specialty farmed species. EHD/BTV are infecting and causing economic losses in traditional domestic livestock.

Research Priorities:

- Develop vaccine(s) to protect against EHD and/or BTV. A DIVA vaccine would be a long-term priority.
- Characterize virus persistence in vectors and mechanisms of transmission
- Develop new diagnostics that allow differentiation of EHD or BTV serotypes
- Develop mechanisms for vector control that prevent transmission.

Alignment of initiative with USDA Priorities:

- Global Food security
- Climate Change

**Funding**

- Public:
- Private:
- Public/ Private: Industry supports research by donations and financial support. Public funds needed to maintain long-term research program
- International: Networking. Other countries are having issues with BTV.
- Other:

**Notes/details**

- Not only is EHDV/BTV a threat to cervidae across the nation, but it annually infects and kills sheep and cattle. Thousands of deer both in captivity and in the wild are negatively impacted by EHDV/BTV each year. Current knowledge regarding which vectors are capable of maintaining and transmitting disease, viral life cycle in the vector, and pathophysiology of the disease in the host is limited or unknown. Producers apply insecticides to animals and premises but data is not available on which pesticides are effective and most beneficial application regimens. Current vaccines are limited and efficacy/safety is uncharacterized.

**4. Bacterial Pneumonia - Pasturella/Fusobacteria**

- Duration: short term
- Rank: 4
- Rationale: Fusobacteria and Pasturella are causing significant economic losses (mortality and morbidity) in specialty farmed species

Research Priorities:

- Characterize etiology and pathogenesis of pneumonia in specialty farmed species
- Develop vaccine(s) to prevent bacterial pneumonia in specialty farmed species
- Comparative genomics to define species differences in susceptibility

Alignment of initiative with USDA Priorities:

- Global Food Security

**Funding**

- Public:
- Private:
- Public/Private: Industry supports research by donations and financial support. Public funds
- International:
- Other:

## Notes/details

- Pneumonia in specialty-farmed animals/wildlife/domestic stock is a poorly understood disease process that can affect individual animals or cause widespread disease within a herd or community. Fusobacterium or Pasturella are known etiologic agents that cause disease in domesticated livestock yet have different pathogenesis in specialty farmed animals that can lead to pneumonia. Pneumonia issues are a problem in free-ranging bighorn sheep and causing controversy and conflict between domestic livestock and wildlife. Understanding the causative agents leading to the disease and the disease process is important in reducing economic losses, preventing disease, and maintaining herd health and viability.

## **5. Parasite Control**

- Duration: Long Term
- Rank: 5
- Rationale: All specialty farmed species have issues with parasites, lack of approved anthelmintic, effective dosages and regimens, food withdraw times, and parasite resistance to anthelmintic treatment.

### Research Priorities:

- Develop anthelmintics and/or treatment regimens that are effective in specialty farmed species to prevent abdominal parasites.
- Characterize residue issues and withdrawal time for anthelmintic regimen.
- Develop new anthelmintics that are effective in specialty farmed species
- Characterize mechanisms of parasite resistance to anthelmintics.

### Alignment of initiative with USDA Priorities:

- Global Food Security

## **Funding**

- Public:
- Private:
- Public/ Private: Industry supports research by donations and financial support. Public funds
- International: Networking with international research efforts. Parasite resistance issue in many countries.
- Other:

## **Notes/details**

- In the cervid industry, parasitism is a constant problem causing economic losses through decreased production and feed efficiency leading to a decrease in herd health and performance. Diagnosing the parasitism affecting a herd is possible, yet no therapies of treatment with dosages and withdrawal times are available. Anthelmintics on the market are designed for domesticated species and not for specialty farmed animals. Controlling and treating parasitism is of utmost importance for basic herd health and improvement in the cervid industry nationwide.

## 6. Tools and Resources

- Duration: Long Term
- Rank: 6
- Rationale: There is a lack of species-specific reagents, genomics, physiology, etc. to address disease issues in specialty farmed species

### Research Priorities:

- Development and characterization of reagents (cross-reactive or species specific) to allow characterization of immune responses
- Acquisition of genomic data on species or species-specific pathogens to allow bioinformatics approach to problems
- Characterization of physiologic responses to drugs, drug metabolism and excretion, and effective dosages related to route of delivery

### Alignment of initiative with USDA Priorities:

- Global Food Security

### Funding

- Public:
- Private:
- Public/ Private: Industry supports research by donations and financial support. Public funds needed to maintain long-term research program
- International:
- Other:

### Notes/details

- Specialty farmed species are potentially at higher risk for emerging diseases, as well as early sentinels of disease in wildlife hosts. At present evidence-based veterinary care and translational research of these species is limited and frequently relies on incomplete knowledge or assumed similarity to other more characterized domestic species. Currently available research reagents are extremely limited because available reagents have not been well characterized in their usefulness in specialty farmed species or do not cross-react at all. In order to further develop appropriate treatment regimens, diagnostics, and preventative measures for these specialty species, it is crucial to expand our basic knowledge of: genomics, host response, normal physiologic parameters, and response to chemotherapeutic agents. This lack of knowledge relate to animal health, welfare, and food safety needs.

## Turkey Priorities

### 1. Clostridial dermatitis (turkey cellulitis)

- Duration: Long Term
- Rank: 1
- • Rationale: Consistently, year-to-year several industry surveys indicate that this is the top priority affecting turkey health.

#### Research Priorities:

- Risk factors for introduction
- Pathogenesis of infection
- Prevention, vaccines for breeders and meat birds
- Other control strategies, probiotics, antibiotic alternatives

#### Alignment of initiative with USDA Priorities:

- Global Food Security

#### Funding

- Public: 2
- Private:
- Public/ Private: 1, 3, and 4
- International:
- Other:

#### Notes/details

- Clostridial dermatitis (CD) remains a major disease issue across all geographic regions; as the survey average increased to a score of 3.8 (from 3.3 in 2008) and ranked #2 (from #3), from 3.1 and #5 in 2007, respectively. Analysis indicates range of concern; 69% of respondents score CD a 4 or 5 (severe), 13% score it a 2 or 1 (mild). CD is most commonly seen in, but not limited to, commercial male turkeys nearing market age. The prevalence and severity of CD continues to increase. CD is estimated to cost the US turkey industry in excess of \$50 million annually. Opinions vary as to risk factors and potential causes of the problem.
- Reference:
  - Gobbles, February 2009, Vol. 65, No. 12.
  - Committee Meeting of Transmissible Diseases of Poultry, USAHA Proceedings, October 2009,

### 2. Pre-harvest, food safety

- Duration: Long Term
- Rank: 2
- Rationale: Pre-harvest control of Salmonella and Campylobacter is critical to assuring a safe product for consumers.

Research Priorities:

- Identification of risk factors
- Control: vaccine development and other mitigation strategies

Alignment of initiative with USDA Priorities:

- Food Safety
- Global Food Security

**Funding**

- Public:
- Private:
- Public/ Private: 1 and 2
- International:
- Other:

**Notes/details**

- Food safety remains a top priority for the administration, USDA and Congress. Turkey growers and integrators need to better understand pathogens that may emerge or expand in numbers on farms. Possible areas of research include housing type, ventilation, manure handling, bedding, air quality, age, breed, vaccine and vaccination strategies. Control of these pathogens could have an impact on contamination levels in processing plants and therefore public health.

**3. Influenza in Turkey Breeders**

- Duration: Long Term
- Rank: 3
- Rationale: Turkeys are uniquely susceptible to infection with influenza A viruses, particularly breeders.

Research Priorities:

- Identification of risk factors
- Pathogenesis including immunopathogenesis
- Within and between flock transmission, interspecies introductions
- Prevention strategies: vaccination, biosecurity addressing risks

Alignment of initiative with USDA Priorities:

- Global food Security

**Funding**

- Public: 1, 2
- Private:
- Public/ Private: 3 and 4
- International:

- Other:

### Notes/details

- Turkey breeders are a unique poultry host reared under high biosecurity levels but because of close contact with workers, ample opportunity is provided for fomite exposure, and their active reproductive state provides increased physiological susceptibility to infectious agents resulting in devastating egg production drops. Turkey breeders have been increasingly infected by strains of influenza A viruses particularly those associated with swine, wild aquatic birds, live poultry markets and human hosts. There is a need to understand risk factors associated with virus spread between farms (between flock risks) and transmission between birds (in flock risks) especially for swine influenza viruses and human pandemic H1N1 virus; and develop comprehensive mitigation strategies to interrupt virus spread and transmission. Improved prevention strategies are needed including new or enhanced biosecurity methods to address unique risk factors, improved vaccines and vaccination protocols that will provide broad protection against emerging influenza field viruses, and education programs to deliver mitigation strategies to farmers and their employees. Unique preventative strategies should be developed and implemented to address trade barriers for export of fertile turkey eggs and turkey products.

## **4. Enhanced gut health**

- Duration: Long Term
- Rank: 4
- Rationale: Understanding and improving the gut microbiome is critical to health and production.

### Research Priorities:

- Develop approaches to microbial community analysis
- Understanding host/pathogen interactions in the gut
- Create strategies to manage gut health
- Developing diagnostics for gut pathogens

### Alignment of initiative with USDA Priorities:

- Global Food Security

- Public: 2
- Private:
- Public/ Private: 1, 3, and 4
- International:
- Other:

### Notes/details

- Proper gut function is critical to turkey performance and health, and numerous poultry diseases have their origins in the gut. The next generation of nucleic acid

sequencing provides a powerful method for the discovery of novel microorganisms in complex environmental samples. A metagenomic approach to determining the gut microbial community will allow the production of databases available to industry, government, and university researchers. Further, metagenomics will allow detailed analyses of the effect(s) of treatment strategies, management decisions, and nutritional interventions on the gut microbiome.

## **5. Histomoniasis**

- Duration: Short term
- Rank: 5
- Rationale: Blackhead has re-emerged as a significant disease for the turkey industry negatively impacting production and welfare.

### Research Priorities:

- Identify risk factors for the disease
- Develop new therapeutics for treatment
- Develop prevention strategies and prophylactics

### Alignment of initiative with USDA Priorities:

- Global Food Security

### **Funding**

- Public:
- Private:
- Public/ Private: 1, 2, and 3
- International:
- Other:

### **Notes/details**

- Blackhead, also known as Histomoniasis, increased to position #11 in a survey of turkey production veterinarians in 2009 (#16, 2008; #22, 2007). It is one disease with no efficacious drug approved for use in turkeys. There were 67 reported cases of blackhead. Losses to blackhead have been severe and sporadic cases are occurring in North America. The disease can be devastating in the individual flocks affected. Dimetridazole was extremely efficacious and previously approved for use in turkeys for the prevention and treatment of blackhead; it was banned in 1987. The lack of any legal treatment for histomoniasis is of concern, especially in the case of valuable turkey breeder candidate flocks. Losses to blackhead have been severe in several areas of Europe, and sporadic cases are occurring in North America. A concern about the continuity of expertise in this field was noted.

## **6. Understanding the adaptability of pathogens to current treatments**

- Duration: Long Term

- Rank: 6
- Rationale: The continuing development of pathogen resistance has resulted in the need for novel strategies to keep animals healthy.

Research Priorities:

- Identifying mechanisms of bacterial resistance to treatment
- Develop novel antimicrobials
- Develop strategies for preserving the efficacy of treatments

Alignment of initiative with USDA Priorities:

- Global food Security

**Funding**

- Public: 1
- Private:
- Public/ Private: 2 and 3
- International:
- Other:

**Notes/details**

- Over the past 10 years the US animal agriculture industry has been continually challenged by a narrowing list of antibiotics available for use in livestock and poultry. There is a need both for new antimicrobial agents as well as a better understanding of how to preserve the efficacy of current and future antimicrobials. The turkey industry welcomes honest discussion of science-based, pragmatic options to maintain animal health.