American College of Veterinary Preventive Medicine
Model Curriculum of Core Competencies (June 2019)

The Model Curriculum was developed by the ACVPM Continuing Education and Examinations Committees to be used as a guiding document for academic institutions seeking ACVPM-certification of new preventive medicine training programs, or re-certification of existing training programs. The intent of the Model Curriculum is to identify and emphasize specific competencies expected of all ACVPM Diplomates in five core areas: Epidemiology and Biostatistics; Infectious and Parasitic Diseases; Environmental Health and Toxicology; Public Health Administration and Education; and Food Protection. The close collaboration between the Continuing Education and Examinations Committees ensures that preventive medicine training programs will comprehensively address ACVPM core competencies, while adequately preparing exam candidates to demonstrate the level of proficiency required for board certification with the ACVPM.

Epidemiology and Biostatistics
Epidemiology
1. Concepts of Epidemiology
a. Definition of epidemiology
b. Use of epidemiology in veterinary medicine (e.g., surveillance, outbreaks)
c. Hierarchy of evidence
d. Primary, secondary, tertiary prevention
e. Infectious disease epidemiology
i. Natural history of disease

	ii.	Chain of infection
	iii.	The epidemiologic triad
	iv.	Herd immunity
	v.	Mechanisms of disease transmission
	f.	Non-infectious disease epidemiology

2. Causality
   a. Hill's causal criteria
   b. Koch's postulates
   c. Necessary vs. sufficient causes
   d. Interpreting directed acyclic graphs
      i. Cause-effect vs effect-cause
      ii. Effect modification
      iii. Confounding (see Bias)
3. Measuring Disease Frequency
   a. Frequency distributions
   b. Definitions of rates, ratios, proportions
   c. Incidence risk, incidence rate/density (animal-time), prevalence, morbidity, mortality
   d. Rate adjustments (e.g., age-adjusted/standardized)
4. Measures of Association
   a. Definition (e.g., risk ratio, odds ratio, rate ratio, attributable risk, case fatality risk)
   b. Calculations
   c. Interpretation
5. Data Organization and Presentation
   a. Epidemic curves (histograms)
   b. Interpretation of common data presentations (e.g. box plots)
   c. Interpreting 2 x 2 tables
6. Epidemiologic Study Designs
   a. Major study designs (e.g. case-control, cross-sectional, cohort)
      i. Defining characteristics
      ii. Advantages and disadvantages
      iii. Identifying scenarios/research questions suitable for each study type

b.	Sampling methods
	i. Types of random sampling (e.g. stratified, simple)
	ii. Advantages/disadvantages of sampling methods
7.	Risk analysis/Assessment
a.	Define
b.	List and define components (e.g., risk assessment, characterization, management, communication)
c.	Examples
8.	Bias
a.	Definition of bias (random error vs systematic error)
b.	Definitions of internal and external validity
c.	Primary types of bias (confounding, information bias, selection bias)
d.	Types and examples of confounding
	i. Criteria for confounding
	ii. Definitions and examples of methods to control confounding (e.g. restriction, matching, analytic control)
e.	Types and examples of selection bias
f.	Types and examples of information bias
9.	Evaluation and use of Diagnostic Tests
a.	Sensitivity and specificity (conceptual and mathematical definitions)
b.	Predictive values (calculating and interpretation)
c.	Reliability
d.	Parallel and serial testing: definition, calculation and interpretation of combined sensitivity, specificity and predictive value
e.	Interpretation of likelihood ratios
f.	Interpret ROC curves to assess quantitative test
g.	Determine optimal cut-off value
10.	Questionnaire Design and Appropriate Applications
a.	Question types (e.g., open-ended, multiple choice)
b.	Question validity and reliability
11.	Epidemiologic Surveillance
a.	Types/purposes/uses of surveillance
b.	Data sources
c.	Establishing a surveillance system (components and steps)

d.   Surveillance system evaluation
12. Outbreak Investigation
a.   Steps in investigating an outbreak
b.   Developing and interpreting epidemic curves
c.   Interpret data from an outbreak to formulate and test hypotheses
13. Other Applications of Epidemiology
a.   Animal health economics – selection and evaluation of herd health programs
b.   Molecular/Genetic Epidemiology
i.   Definitions and uses in disease surveillance and outbreaks
ii.   Definitions of discriminatory power and strain relatedness
Biostatistics
a.   Measures of central location and spread
i.   Distributions (normal, binomial, Poisson)
ii.   Calculating and interpreting mean, median, mode
iii.   Ranges, percentiles, variance, standard deviation, standard error
b.   Confidence limits/intervals
i.   Required components for calculation of confidence intervals
ii.   Interpretation of confidence intervals
c.   Type I and Type II error
d.   Power and sample size determination
i.   Definitions (e.g., estimating a prevalence, comparing two groups, freedom from disease)
ii.   Assumptions
iii.   When to use
iv.   Variables or parameters that influence calculations
e.   Basic hypothesis testing
i.   Types of tests (e.g., chi-square, z-test, t-test, correlation tests)
ii.   Statistical assumptions
iii.   Basics of test implementation
iv.   Interpretation
v.   Choosing the correct test
f.   Advanced hypothesis testing

	i.	Concepts of tests (e.g., linear regression, logistic regression, ANOVA, survival analysis, non-parametric tests)
	ii.	Interpretation of model coefficients (e.g., odds ratios from logistic regression)
	iii.	Outcome types and scenarios appropriate for each test
	iv.	Modeling and interpreting statistical interaction

Infectious and Parasitic Diseases

1. General terms and definitions (e.g., incubation period, pathogenicity, virulence, zoonosis, anthropozoonosis)
2. Describe agents, hosts, reservoirs, pathogenesis, population signalment, clinical signs, mode of transmission, zoonotic potential, and disease dynamics for key disease categories below
   a. Livestock-associated zoonoses (e.g., anthrax, brucellosis, cryptosporidiosis, leptospirosis, Orf, Q Fever, tuberculosis)
   b. Companion animal-associated zoonoses (e.g., bartonellosis)
   c. Rodent borne zoonoses (e.g., hantavirus, LCMV)
   d. Vector-borne zoonoses (e.g., West Nile virus, Equine encephalitides, borreliosis, babesiosis, anaplasmosis, ehrlichiosis, Chagas); vector ecology and relationship to geospatial distribution of vector-borne disease
   e. Zoonoses of wildlife and other animals (e.g., salmonellosis, diphyllobothrium, tularemia, plague)
   f. High impact non-zoonotic diseases of livestock
      i. Foreign animal and transboundary diseases (e.g., foot and mouth disease, classical swine fever, African swine fever, Rinderpest)
      ii. Diseases with agro-terrorism potential/select agents
      iii. Economically significant production diseases (e.g., PEDv, BVD)
      iv. OIE functions related to listed diseases and associated reporting and trade implications
3. Rabies
   a. Hosts, viral variants
   b. Transmission, incubation, pathogenesis
   c. Global disease burden and epidemiology
   d. Regulations, prevention and control methods
   e. Human pre- and post-exposure immunization regimens
4. Zoonotic disease associated with the young, elderly, pregnant or immunocompromised
   a. Specific diseases of interest

b.	Populations of concern, reasons for susceptibility
c.	Examples of public health messaging for prevention
5. Zoonotic cestodes (taeniasis, cysticercosis, echinococcosis)	
a.	Life cycle, intersection with public health
b.	Paratenic hosts
6. Prion diseases (e.g., bovine spongiform encephalopathy, scrapie, chronic wasting disease, Creutzfeldt-Jakob Disease)	
a.	Pathogenesis
b.	Regulatory surveillance and control methods
c.	Creutzfeldt-Jakob Disease (CJD): types, public health surveillance
7. Infectious diseases of poultry (e.g., avian influenza, Newcastle disease, infectious bursal disease)	
a.	Laboratory methods of diagnosis, differential diagnoses
b.	Surveillance & control
8. Infectious fungal diseases (e.g., histoplasmosis, coccidiodomycosis, blastomycosis)	
a.	Transmission
b.	Risk factors, environmental contribution to disease risk
9. Emerging and re-emerging diseases/infections	
a.	Identify agents
b.	Identify factors contributing to emergence; cite examples
10. Foreign animal disease containment	
a.	Protective interventions (e.g., quarantine and movement control, host elimination, depopulation, vaccination)
b.	Sub-clinical reservoir hosts and/or carriers; implications for disease transmission and outbreak dynamics, diagnostics and detection, prevention
11. State and federal regulatory agencies associated with infectious agent/disease control, prevention, and response	
a.	Agencies/laws that regulate products (e.g., FDA, USDA, USFWS)
b.	Agencies involved with human and animal surveillance and disease control/response
c.	Federal vs. state vs. tribal authority
12. Diagnostic tests and testing methods for infectious pathogens	
a.	General concepts and approaches for typing bacteria and viruses (e.g., serotype, biotype, phage-type, antibiogram, genotyping, Next-Gen, PFGE, AFLP, RAPD, rep-PCR, VNTR, spa-typing, MLST, optical mapping, WGS)
b.	Specific approach and utility for agents in disease surveillance programs (e.g., *Brucella*, influenza, foodborne pathogens such as *Listeria*, *Salmonella*, Shiga toxin-producing *Escherichia coli*)

Environmental Health and Toxicology

Environmental Health

1. Ecology
   a. Ecosystems of the world, fundamentals of ecology, scope of ecology
   b. Energy flow and nature's metabolism – biogeochemical cycles
   c. Ecologic regulation and services
      i. Natural resource management
      ii. Wildlife management and regulations
      iii. Ecosystem services including provisioning, regulating, and cultural services (i.e., positive impacts of natural resources on human health including mental health)
2. Air quality
   a. Monitoring
   b. Normal: EPA standards
   c. Health hazards: human and animal (e.g., health and environmental impact, costs)
   d. Connections with climate change
   e. Noise
   f. Ventilation principles, systems (e.g., describe adequate ventilation, temperature, lighting, humidity for production animals and enclosed animal populations)
   g. Air pollution: priority pollutants, greenhouse effect, climatic effects, sources (indoor and outdoor air pollution); ozone
3. Water quality
   a. Sources, uses, hydrologic cycle, environmental influences on quality
   b. Monitoring
   c. EPA standards (potable and non-potable)
   d. Drinking water (e.g., regulations, treatment, authorities)
   e. Pollutants, contaminants, and sources (e.g., microbiologic, chemical, radioactive)
   f. Health hazards
   g. Eutrophication
   h. Waste water treatment

4. Land
a. Classification (biomes)
b. Land use and natural resources management
i. Mining, extractive industries, energy production, agriculture, conservation
ii. Habitats (human and animal)
iii. The built environment and health (e.g., land use planning, urban sprawl, community design)
iv. Role of the veterinarian as a community health professional in land use planning
v. Land conservation and stewardship; wildlife, recreation, regulations
c. Pollutants and contaminants
d. Monitoring
e. Health hazards
5. Wastes
a. Classification
b. Sources
c. Health hazards (consider all types of waste – e.g., municipal, industrial, hospital, agricultural)
d. Regulations (RCRA)
i. Management – recycling, landfills, composting, animal manure
ii. Disposal of contaminated materials
iii. Decontamination
iv. Energy refuse
v. Shipping and handling
e. Control of biohazards
i. Types
ii. Regulations
iii. Shipping and handling
iv. Decontamination
6. Integrated pest management (e.g., mosquitoes, rodents, ticks, pesticide safety)
7. Climate change and health
a. Impacts on infectious diseases
b. Social impacts, including environmental justice
c. Physical impacts (e.g., extreme weather, flooding and coastal effects, heat illness, desertification, food production and nutrition)

8. Disasters and disaster response
a. Major types of disasters
b. Agents that can cause disasters
c. Health hazards (to humans and animals)
d. Principles of disaster preparedness
e. Principles of disaster intervention
f. Principles and organization of disaster aid
g. Role of the veterinarian in disaster response
9. Energy resources
a. Sources of energy
b. Utilization
i. Usage patterns for various sources of energy
ii. Uses of the various types of energy as related to animal health in urban areas (predominantly companion animals) as opposed to rural areas (predominantly food producing animals)
c. Health hazards involved in each type of energy source
10. Natural resource management
a. Population - human, animal, and wildlife population limitations and trends with regards to environmental health
b. Energy
i. Renewable energy sources
ii. Animal waste as biofuel
c. Land use
i. Land use regulations and land management
ii. Water use
iii. Ecological risk assessment
11. Occupational health
a. Hazards for veterinarians, animal and wildlife workers
b. Health standards applicable to veterinarians
12. Recreational health – prevention and control of diseases associated with recreational activities
13. Non-infectious consequences of animal and human interactions
a. Allergies and hypersensitivities
b. Infestations
c. Venomous arthropods (land and aquatic animals)

d. Anxieties and psychoses and positive mental and physical health benefits	
e. Transmissible intoxications	
f. Trauma, animal bites	
14. Drugs, biologics, and chemicals	
a. Regulations (e.g., FDA, INDA, and NADA, EPA)	
b. Use of human drugs by veterinarians	
c. Surveillance for residues	
d. Regulatory programs and acceptable levels	
e. Disposal of contaminated materials	
Toxicology	
1. Terms and definitions	
a. Toxicant, toxin, toxicity, toxicosis, toxicology, nanotoxicology	
b. Dose/Response, NOAEL, LOAEL, LC50, LD50	
c. Acute vs chronic toxicology	
d. Toxicological endpoints	
e. Developmental/reproductive toxicology	
f. Target vs non-target site, mixed exposures	
g. DNA adducts	
h. ADME (Absorption, distribution, metabolism, excretion)	
2. Regulatory agencies, authorities, and guidelines	
3. Heavy metals (e.g., arsenic, copper, chromium, lead, mercury, iron, zinc)	
4. Pesticides (e.g., fungicides, herbicides, insecticides (DDT), rodenticides)	
5. Mycotoxins (e.g, aflatoxin, zearalenone, fumonisin)	
6. Bacterial toxins	
7. Toxic plants	
8. Emerging contaminants (e.g., endocrine disruptors)	
9. Chemical (ethylene glycol, oil, petroleum, VOCs, Na, N, ionophore)	
10. Use in terrorism and agroterrorism	
11. Radiation	
a. Sources and types	
b. Exposure, dose, shielding	
c. Regulation	

12. Carcinogens (cigarette smoke, asbestos)
13. Uses of information gained from toxicology (e.g., health predictions)

Public Health Administration and Education

1. Organization of public health
    a. Definition of public health
    b. Structure, function, and responsibilities of major federal, state, local, tribal, territorial, and international public health agencies (e.g., local/county/state public health departments, CDC, DHS (Customs Border Protection, Office of Science and Technology), FDA, FEMA, USDA (FSIS, APHIS, Veterinary Services, Wildlife Services), USPHS, military, WHO)
    c. Role of the veterinarian in safeguarding public health (private, public, and corporate practice roles)
    d. Public health positions commonly held by veterinarians
    e. Provide scenarios of public health problems which should include veterinarians and discuss possible roles/functions, reporting chains (e.g., natural disasters, animal disease epidemics, animal control)
2. Administrative aspects of Public Health
    a. Public health program/policy development, design, funding, implementation, resources (federal, state, local)
    b. Program design (objectives, alternatives, priorities, methods)
    c. Program evaluation, including cost effectiveness
    d. Administrative policy and legislation
    e. Political/administrative issues at the practitioner level
        i. Management of public health problems
        ii. Public health prevention and control programs (e.g. food safety, vector-borne disease, dog bite prevention)
        iii. Working with federal/state/local health departments
    f. Funding (agencies involved, mechanisms to apply/receive funding) such as CDC and State Block grants, FDA cooperative agreements to states for Rapid Response Teams
3. Governance aspects of public health
    a. Major legislative and regulatory public health requirements impacting veterinarians
        i. Animal disease surveillance, prevention and control (e.g. TB, brucellosis, rabies)
        ii. Permits for dangerous animals (e.g., non-human primates, large carnivores)

	iii.	Reportable diseases and conditions
	iv.	Import/export and interstate/international movement of animals/animal products
b.		Current Acts and policy papers
	i.	Animal Drug Acts
	ii.	Animal Welfare Act
	iii.	Bioterrorism Act
	iv.	Federal Food and Drug Cosmetic Act
	v.	FDA Food Safety Modernization Act and Veterinary Feed Directive
	vi.	Health Insurance and Portability and Accountability Act (HIPAA)
	vii.	Model State Public Health Act
	viii.	PETS Act
	ix.	Preservation of Antibiotics for Medical Treatment Act
	x.	Preventing Antibiotic Resistance Act
c.		Legislative process – how bills become law
d.		Current policies
	i.	Animal health
	ii.	Biosecurity/agroterrorism
	iii.	Emergency preparedness/response
	iv.	Environmental health
	v.	Food protection
	vi.	Outbreak investigation
	vii.	NASPHV compendia
	viii.	Zoonotic disease control
4. Public health planning, delivery, and evaluation		
a.		Veterinarians in public health activities
	i.	Sources and uses of veterinary workforce/resources to assist in addressing public health problems (federal, state, local, tribal, territorial)
	ii.	Planning a veterinary response for potential public health emergencies
	iii.	Interaction with the public, other healthcare professionals, and private or governmental agencies during a public health emergency
	iv.	Scenarios which require veterinary assistance with a community health problem/emergency
	v.	One Health approaches

	b. Methods of evaluating public health prevention and control programs
5.	Public health education
	a. Veterinarian's roles and responsibilities in educating individual clients and the public concerning public health issues and concerns
	b. Media/methods available for educating clients/public concerning community public health problems
	c. Health risk communication
	i. Relevance to veterinary medicine
	ii. Techniques/tools for communicating disease risk to clients and the general public
	iii. Messaging
	iv. Design, present, and critique a risk communication message to a group of people who are concerned about the potential health impact of an animal related disease
6.	Specific Public Health issues involving animals –private and public practice veterinary roles and responsibilities
	a. Animal bites – epidemiology, targeted prevention/control efforts
	b. Animal population and damage management - domestic and wild
	c. Animal contact venue injury and illness prevention (e.g., agricultural fairs, petting zoos, agri-tourism/farm tours)
	d. Recreational health (e.g., specific threats, role in evaluating sites, outbreak investigation and reporting)
	e. Exotic/wild and potentially dangerous pets
	f. Psychosocial aspects of human/animal interrelationships – human-animal bond, public health programs involving animals; service animals and ADA
	g. Other (e.g., environmental health issues related to feedlots, poultry, swine, and cattle operations, food safety/recalls, community disaster response planning)
7.	Animal Health, Emergency, and Disaster Response
	a. Incidents in previous 3 years – details of response, agencies involved, acts and polices involved, areas for improvment
	b. Agroterrorism and zoonotic threat preparedness efforts
	c. National veterinary stockpile
	d. Indemnity payments
	e. Emergency response agencies (e.g., NIOSH Emergency Response, NAHERC National Animal Health Emergency Reserve Corps, USDA-APHIS-VS National Preparedness and Incident Coordination Center, National Veterinary Services Laboratories (and Foreign Animal Disease Diagnostic Laboratory), AVMA Disaster Preparedness and Response Teams
	f. Disease Specific Responses (agencies, Acts, response type)
	i. Agents

	1. Avian influenza
	2. Foreign animal diseases
ii.	Response actions
	1. Cleaning and disinfection, biosecurity
	2. PPE
	3. Mass depopulation and euthanasia
	4. Disposal
	5. Animal welfare
	6. Risk assessment
	7. Public education and risk communication
g.	NIMS/ICS

Food Protection

1. Definitions, key concepts, examples and roles of the veterinarian
   a. Food security
   b. Food safety
   c. Food defense
2. Policy and regulation
   a. Regulatory responsibilities of U.S. agencies involved in food protection (state, federal) including FDA, USDA-FSIS
   b. Names and functions of major legislation impacting food safety policy and regulation (e.g., FSMA) in the U.S.
   c. Roles of international agencies (WTO, OIE, FAO, WHO)
3. Biological foodborne hazards (including bacterial, viral, and protozoal; including, but not limited to, *Salmonella enterica*, Shiga-toxin producing *E. coli, Listeria monocytogenes, Campylobacter* spp*., Toxoplasma gondii,* norovirus, *Clostridium* spp.)
   a. Pathogen reservoirs
   b. Routes of transmission through the food supply
   c. Organism characteristics relevant to control (e.g., optimal growth temperatures, ability to form spores)
   d. Common pre-harvest, harvest, and food preparation methods of control
   e. Human infection: clinical signs and long-term sequelae

4. Non-biological foodborne hazards (chemical, toxicological, radiological, and physical)
a. Common types of non-biological hazards
b. Route of food contamination for each hazard
c. Methods of control for each hazard
d. Food types with the highest risks of each hazard
5. Pre-harvest food safety
a. Principles of residue avoidance on farms
b. Common methods for on-farm control of foodborne pathogens (e.g., dietary interventions for STEC in cattle)
c. Antimicrobial resistance of foodborne pathogens
6. Food safety in the processing plant
a. Antemortem and postmortem inspection
b. Types of carcass dispositions, and common pathologies within food animals
c. In-plant roles of the inspector and public-health veterinarian
d. Drug residue surveillance within slaughter plants
e. Pathogen testing requirements (e.g., *Salmonella* on raw and ready-to-eat samples, *Listeria* on ready-to-eat samples and *E. coli* O157:H7 on ground product)
f. Sanitary requirements in food processing facilities (e.g., beef, poultry, egg, milk, other dairy products)
g. HACCP application in slaughter plants and food processing facilities, including definitions and common examples of hazards, critical control points, and critical limits within HACCP plans
7. Postharvest food safety and safe food handling
a. Fundamentals/types of food preservation and processing (including pasteurization and irradiation)
b. Labeling of food products
c. Control of food pathogens during food preparation, serving and storage
d. Product safety and consumer exposures including online retail of products and challenges with recall of products
e. Safe methods for thawing frozen foods
f. USDA recommended cooking temperatures
g. Cooling and storing leftovers
8. Foodborne disease surveillance
a. Surveillance mechanisms for common foodborne pathogens and antimicrobial resistance in the U.S, including pathogens, sample sources and methods, and responsible agencies
b. Major trends in the incidence of primary foodborne pathogens in the U.S.
c. Local, state, and national-level methods for outbreak detection in the U.S.

d.   Methods for attribution of illnesses and quantifying burden of disease
9.   Food defense
a.   Components of an operational risk management strategy
b.   Historical examples of terrorist or other attacks on the food supply
c.   Characteristics of foods at high risks of attack
10. Food animal/pet food production
a.   Regulating bodies in the U.S.
b.   Relevant legislation (e.g., Federal Food, Drug, and Cosmetic Act, Food Safety Modernization Act)
c.   FDA recalls (e.g., recall classes, information sources for recalls, specific actions in a recall)
d.   Examples of large recalls (e.g., bacterial contamination, mycotoxicosis, vitamin D toxicosis, melamine-cyanuric acid)
e.   Recent examples of One Health outbreaks (e.g., *Salmonella*-contaminated dog food resulting in human salmonellosis outbreaks) and steps for the consumer to reduce associated risks
11. Principles of food safety during disaster situations
12. Current topics (e.g., bioinformatics, biotechnology, nanotechnology, antimicrobial resistance, global health, detection of pathogens in novel food vehicles)

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