This manual was written primarily for veterinary students and those who teach swine diseases. It also may be of interest to veterinary practitioners, veterinary technicians, and others interested in swine diseases in production systems. This manual attempts to update, condense and simplify the great mass of information available. Only basic material appropriate for students is included. More detailed information is available via an array of texts, websites, and scientific publications.

Disease topics are listed as individual entities. The student should be reminded that in reality, the occurrence and severity of disease outbreaks are strongly influenced by production practices, housing, environment, nutrition, and genetics. Diseases may occur concurrently in modern production systems with large populations of animals; for example, porcine respiratory disease complex (PRDC) is usually a co-infection with *Mycoplasma hyopneumoniae* and/or other bacteria or viruses. Diagnostic methods for disease complexes are usually more complicated than finding a single agent. Likewise, control of disease frequently involves not only specific intervention, but also modification of environment, husbandry, and production practices. For this reason, the prevention and control sections in this manual refer to specific agents but are not always appropriate or complete in terms of control of disease complexes. Swine practitioners expend considerable effort in diagnosis, herd investigation, and understanding the interactions of risk factors before implementing cost-effective control strategies. These activities are beyond the scope of this manual but our vision is that this manual will serve as a foundation on which to build a better understanding of the complexities of disease in swine populations.

Familiarity with the organization of the manual will make it more useful. The table of contents lists the diseases and conditions of swine covered in this manual. Most sections are based on the nature of the etiologic agent, and all are preceded by their own table of contents. The time-saving index at the back of the book lists each major disease by name, often cross-referenced with a synonymous name.

A section on exotic (foreign to the US) diseases is provided for ready reference. Any of these diseases may be introduced to the US as a consequence of international trade in swine, pork products, and other contacts. A basic knowledge of these diseases is a good defense against US epidemics.

Several tables are included. Some are designed to help in differential diagnosis. Others list major diseases of a single body system and permit a rapid overview of diseases of that system. The tables may be of special value in preparing for board exams.

Comments on the manual and how it can be made more useful are encouraged and appreciated. They can be mailed to Dr. Kent Schwartz, 1642 Veterinary Medicine, Iowa State University, Ames, Iowa 50011 or e-mailed to kschwart@iastate.edu.
# Table of Contents

## SECTION I: Diseases Caused by Bacteria, Mycoplasmas and Spirochetes

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Disease</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Actinobacillus pleuropneumoniae</em> (APP)</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td><em>Actinobacillus suis</em></td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Anthrax</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Atrophic Rhinitis (Progressive Atrophic Rhinitis)</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Brucellosis (Swine Brucellosis)</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>Clostridial Diarrhea</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td>Colibacillosis (<em>E. coli</em> Diarrhea)</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>Edema Disease</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>Erysipelas (Swine Erysipelas)</td>
<td>21</td>
</tr>
<tr>
<td>10</td>
<td>Greasy Pig Disease (Exudative Epidermitis)</td>
<td>23</td>
</tr>
<tr>
<td>11</td>
<td><em>Haemophilus parasuis</em> (Glasser’s Disease)</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>Leptospirosis</td>
<td>27</td>
</tr>
<tr>
<td>13</td>
<td>Mycoplasmal Pneumonia (Enzootic Pneumonia)</td>
<td>29</td>
</tr>
<tr>
<td>14</td>
<td>Pneumonic Pasteurlosis (<em>Pasteurella multocida</em>)</td>
<td>31</td>
</tr>
<tr>
<td>15</td>
<td>Proliferative Enteritis (Porcine Proliferative Enteritis, Ileitis, Intestinal Adenomatosis, Garden-hose Gut)</td>
<td>33</td>
</tr>
<tr>
<td>16</td>
<td>Salmonellosis</td>
<td>35</td>
</tr>
<tr>
<td>17</td>
<td>Streptococcal Infections</td>
<td>39</td>
</tr>
<tr>
<td>18</td>
<td>Swine Dysentery and Spirochaetal Colitis (<em>Brachyspira</em> [previously <em>Serpulina</em> and <em>Treponema</em> <em>hyodysenteriae</em> and <em>Brachyspira pilosicoli</em>)</td>
<td>41</td>
</tr>
<tr>
<td>19</td>
<td>Tuberculosis</td>
<td>45</td>
</tr>
</tbody>
</table>

## SECTION II: Domestic Viral Diseases

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Disease</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Encephalomyocarditis</td>
<td>49</td>
</tr>
<tr>
<td>21</td>
<td>Hemagglutinating Encephalomyelitis (Vomiting and Wasting Disease)</td>
<td>51</td>
</tr>
<tr>
<td>22</td>
<td>Inclusion Body Rhinitis (Porcine Cytomegalovirus Infection)</td>
<td>53</td>
</tr>
<tr>
<td>23</td>
<td>Influenza (Swine Influenza; Swine Flu)</td>
<td>55</td>
</tr>
<tr>
<td>24</td>
<td>Parvovirus</td>
<td>57</td>
</tr>
<tr>
<td>25</td>
<td>Porcine Circovirus Associated Diseases (PCVD, PCVAD)</td>
<td>59</td>
</tr>
<tr>
<td>26</td>
<td>Porcine Picornaviruses (Enteroviruses)</td>
<td>63</td>
</tr>
</tbody>
</table>
Table of Contents

Chapter 27: Porcine Reproductive and Respiratory Syndrome (PRRS) ........................................................... 65
Chapter 28: Pox (Swine Pox) .......................................................................................................................... 69
Chapter 29: Pseudorabies (Aujeszky’s Disease) .............................................................................................. 71
Chapter 30: Rotaviral Enteritis ....................................................................................................................... 73
Chapter 31: Transmissible Gastroenteritis (TGE) ........................................................................................... 75
Chapter 32: Vesicular Stomatitis ..................................................................................................................... 77

SECTION III: Parasitic Diseases .................................................................................................................. 79

Chapter 33: Coccidiosis ................................................................................................................................. 81
Chapter 34: Kidney Worm Infection .............................................................................................................. 83
Chapter 35: Louse Infestation (Pediculosis) .................................................................................................... 85
Chapter 36: Lungworm Infection (Metastrongylosis) ..................................................................................... 87
Chapter 37: Mange (Sarcoptic Mange) ........................................................................................................... 89
Chapter 38: Mycoplasma suis (Eperythrozoonosis) .......................................................................................... 91
Chapter 39: Nodular Worm Infection (Oesophagostomiasis) ......................................................................... 93
Chapter 40: Roundworm Infection (Ascariasis) .............................................................................................. 95
Chapter 41: Thorny-headed Worm Infection ................................................................................................. 97
Chapter 42: Threadworm Infection (Strongyloidosis) ..................................................................................... 99
Chapter 43: Trichinellosis ............................................................................................................................. 101
Chapter 44: Whipworm Infection (Trichuriasis) ........................................................................................... 103

SECTION IV: Nutritional Deficiencies ....................................................................................................... 105

Chapter 45: Nutritional Deficiencies
  Iodine Deficiency (Goiter) ............................................................................................................................ 107
  Iron Deficiency Anemia ................................................................................................................................. 107
  Parakeratosis ............................................................................................................................................ 107
  Rickets and Osteoporosis ............................................................................................................................. 108
  Vitamin E/Selenium Deficiency .................................................................................................................... 108

SECTION V: Toxicooses and Poisonings .................................................................................................... 111

Chapter 46: Mycotoxicooses ........................................................................................................................ 113
  Aflatoxicosis ............................................................................................................................................... 113
  Ergotism ..................................................................................................................................................... 114
  Fumonisin Toxicosis ................................................................................................................................ 114
  Trichothecene Toxicoses ............................................................................................................................ 114
Chapter 47: Plant and Chemical Poisonings ................................................................. 115
  Cocklebur Poisoning .......................................................................................... 115
  Phenylarsonic (Organic Arsenical) Poisoning .................................................. 115
  Pigweed Poisoning ............................................................................................ 115
  Salt Poisoning (Water Deprivation; Sodium Ion Toxicosis) .............................. 116
Chapter 48: Toxicities Caused by Gases ................................................................. 117
  Ammonia Toxicity ............................................................................................... 117
  Carbon Monoxide Toxicity ................................................................................. 117
  Hydrogen Sulfide Toxicity ................................................................................ 117

SECTION VI: Miscellaneous Lesions, Conditions, and Syndromes .................. 119

Chapter 49: Miscellaneous Lesions, Conditions, and Syndromes
  Atresia Ani ......................................................................................................... 121
  Aural (Ear) Hematoma ..................................................................................... 121
  Cystitis and Pyelonephritis .............................................................................. 121
  Dermatosis Vegetans ......................................................................................... 121
  Ectopic Ossification of Mesentery ................................................................. 121
  Epitheliogenesis Imperfecta ............................................................................. 121
  Hemorrhagic Bowel Syndrome (HBS) ............................................................ 122
  Hernias, Inguinal and Umbilical ...................................................................... 122
  Hydronephrosis ............................................................................................... 122
  Hypogalactia or Mastitis, Metritis, Agalactia (MMA) ....................................... 122
  Hypoglycemia in Neonatal Piglets ................................................................. 122
  Megacolon ......................................................................................................... 123
  Mortality in Sows ............................................................................................. 123
  Osteochondrosis ............................................................................................... 123
  Pityriasis Rosea ................................................................................................. 123
  Porcine Stress Syndrome (PSS) ...................................................................... 123
  Prolapses .......................................................................................................... 124
  Pustular Dermatitis ........................................................................................... 124
  Rabies ................................................................................................................ 124
  Ringworm .......................................................................................................... 125
  Shoulder Ulcers in Sows .................................................................................. 125
  Skin Necrosis of Piglets ................................................................................... 125
  Splayleg (Spraddleleg) ..................................................................................... 125
  Sunburn and Photosensitization ...................................................................... 125
  Torsion and Volvulus ....................................................................................... 126
  Vestibular Syndrome ....................................................................................... 126
  Vices (Tail Biting, Ear Biting, Flank Biting, Navel Sucking) ......................... 126
  West Nile Virus ............................................................................................... 126

Chapter 50: Ulceration of the Pars Oesophagea (Gastric Ulcers; Ulcers)........... 127
SECTION VII: Exotic Viral Diseases ................................................................. 129
Chapter 51: African Swine Fever ................................................................. 131
Chapter 52: Blue Eye Disease (Paramyxovirus) ......................................... 133
Chapter 53: Classical Swine Fever (Hog Cholera) ....................................... 135
Chapter 54: Foot-and-Mouth Disease (FMD) .............................................. 137
Chapter 55: Japanese B Encephalitis ........................................................... 139
Chapter 56: Porcine Epidemic Diarrhea ....................................................... 141
Chapter 57: Vesicular Exanthema of Swine (San Miguel Sea Lion Viral Disease) ......................................................... 143

SECTION VIII: Tables ...................................................................................... 145
Anthelmintics and Parasiticides for Swine .................................................. 147
Arthritis in Young Pigs and Associated Etiologic Agents ......................... 148
Clostridial Diseases ...................................................................................... 149
Diarrheal Diseases ...................................................................................... 150
Diarrheal Disease at Various Ages ............................................................. 152
Disease Associated with Central Nervous System (CNS) Signs ............... 153
Diseases Associated with Hemorrhage in Intestine .................................... 154
Internal Parasites ....................................................................................... 155
Mycoplasma-Related Diseases ................................................................. 156
Reproductive Failure - Considerations when Farrowing Rate is Low ........ 157
Reproductive Failure by Infectious Causes ................................................. 158
Respiratory Diseases .................................................................................. 159
Skin Lesions and Diseases ........................................................................ 161
Vesiculating Viral Diseases ....................................................................... 163

SECTION IX: Appendix A ................................................................................ 165
Abbreviations and acronyms ..................................................................... 167
Swine industry terminology ....................................................................... 169

SECTION X: Index ........................................................................................... 171
**Actinobacillus suis**

**Definition**
An infectious disease characterized by hemorrhages and embolic lesions at multiple sites, more obviously in the lungs, and often by serous or serofibrinous exudates in the thorax and abdomen.

**Occurrence**
Outbreaks occur predominantly in immunologically naïve populations. These include primary and secondary specific pathogen free (SPF) pigs or in segregated early weaned (SEW) pigs. Most outbreaks are in recently weaned pigs and in grow/finish pigs derived from an SEW system. Outbreaks occur in both younger and older swine and, less often, in conventionally raised pigs.

**Historical Information**
There have been reports of the disease since 1962. In the 1980s, after management techniques were introduced that minimized exposure of neonates to many endemic pathogens, the incidence of Actinobacillus suis infections appeared to increase in the US industry. Misdiagnosis of the disease as Actinobacillus pleuropneumoniae (APP) infection or other septicemias likely contributes to under-reporting of the true prevalence of the disease.

**Etiology**
The etiologic agent, *Actinobacillus suis*, is only now being studied in detail. It is a Gram-negative, nicotinamide adenine dinucleotide (NAD)-dependent, non-motile coccobacillus. It is aerobic and facultatively anaerobic. All isolates appear to be of a single serotype. Strains from swine appear to be clearly different from those isolated from horses.

Thus far there is no serologic test to reliably identify infected swine and establish *A. suis*-free herds. Antibodies to *A. suis* and *A. pleuropneumoniae* may cross-react with some serologic tests.

**Epidemiology**
The epidemiology is not completely understood but carrier pigs probably introduce *A. suis* into herds. It can be isolated from the nasal cavity and tonsils of many healthy pigs and has been found in the reproductive tract of healthy sows. It is believed to be an “early colonizer” of neonates. Less than optimal environmental conditions or concurrent diseases may increase the ability of *A. suis* to cause disease.

**Pathogenesis**
Invasion probably occurs through the tonsil and spreads through the bloodstream. This is suggested by the presence of the organism in emboli in the vasculature at many lesion sites. The agent’s pathogenic effect is probably a result of production of hemolysin and other toxins similar to those produced by *A. pleuropneumoniae*.

**Clinical Signs**
The first signs of an outbreak may include sudden death of young pigs with lesions attributed to a bacterial septicemia. Sick piglets are febrile, breathe rapidly, and may have congested or cyanotic extremities. Cyanosis, arthritis, enteritis, and rarely necrosis of the feet, tail and ears have been reported and are similar to other causes (streptococcal, erysipelas, salmonella) of bacterial septicemia. Occasionally, infected pigs may show central nervous system (CNS) signs including tremors, shaking or paddling. Mortality within affected litters can be high, up to 50%.

Older growing pigs and adults can have similar signs but may also have signs of acute respiratory distress. Lethargy or depression, anorexia, and rarely irregular reddened skin lesions that resemble those of erysipelas may be observed. Pregnant sows may abort.

**Lesions**
Lesions are similar in pigs of all age groups. They include petechial and ecchymotic hemorrhages in many organs. Frequently, lesions are present in the lungs as disseminated foci of hemorrhagic to necrotizing pneumonia, the latter more marked in older piglets and growers. A consistent lesion in all age groups is serous or serofibrinous exudate in the abdominal and thoracic cavities. Poly-arthritis may occur in grow/finish pigs.

Microscopic lesions occur in many major organs. These develop around small colonies of *A. suis* within the vascular emboli or thrombi. Occasionally there are eosinophilic clubs surrounding the colony. Both gross and microscopic lesions are typical of embolic, bacterial septicemias.

**Diagnosis**
History, signs and lesions are suggestive of the diagnosis but it should be confirmed by culture of *A. suis* from multiple organs. Serologic diagnosis is unreliable because antibodies to *A. suis* and APP may cross react.

**Control**
Autogenous vaccines have been used but have not been evaluated critically. Because there are multiple types of lipopolysaccharides (LPS) in *A. suis*, the LPS profile of the vaccine strain must match that of the pathogen. Although unproven, vaccines against APP may offer some cross-protection.

*Actinobacillus suis* is sensitive to many antibiotics including ampicillin, amoxicillin, oxytetracycline and others. Sick pigs should be treated parenterally as soon as possible. The exposed group can be treated by medicating the water.
## Internal Parasites

<table>
<thead>
<tr>
<th>Common and/or scientific names of parasitism and parasite</th>
<th>Usual location and gross length</th>
<th>Intermediate hosts or direct cycle</th>
<th>Mode of infection</th>
<th>Treatment*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ascariasis</strong> <em>Ascaris suum</em></td>
<td>Small intestine, bile ducts, stomach 15-30 cm</td>
<td>Direct</td>
<td>Orally from contaminated environment</td>
<td>All</td>
</tr>
<tr>
<td><strong>Coccidiosis</strong> <em>Isospora suis</em></td>
<td>Small intestine</td>
<td>Direct</td>
<td>Orally from contaminated environment</td>
<td>None</td>
</tr>
<tr>
<td><strong>Eperythrozoonosis</strong> <em>Mycoplasma suis</em></td>
<td>On erythrocytes 0.8-1.0 mm</td>
<td>Intermediate hosts. Possible direct</td>
<td>Larvae in earthworms. Prenatally, orally; skin penetration by juveniles</td>
<td>FBZ, AVE, LVM</td>
</tr>
<tr>
<td><strong>Kidney worm infection</strong> <em>Stephanurus dentatus</em></td>
<td>Adults in perirenal fat, kidneys, ureters walls. Juveniles in ectopic sites. 20-45mm</td>
<td>Earthworms. Also direct</td>
<td>Larvae in earthworms. Prenatally, orally; skin penetration by juveniles</td>
<td>FBZ, AVE, LVM</td>
</tr>
<tr>
<td><strong>Lungworm infection</strong> <em>Metastrongylus spp.</em></td>
<td>Posterior border of diaphragmatic lobes of lungs. 20-50 mm</td>
<td>Earthworms. Also direct</td>
<td>Larvae in earthworms with encysted larvae.</td>
<td>DCV, FBZ, AVE</td>
</tr>
<tr>
<td><strong>Thorny-headed worm infection</strong> <em>Macracanthorhynchus hirudinaceus</em></td>
<td>Small intestine, usually ileum Up to 30 cm</td>
<td>Direct</td>
<td>Prenatally, transcoloastrally, orally, cutaneously</td>
<td>None</td>
</tr>
<tr>
<td><strong>Threadworm infection</strong> <em>Strongyloides ransomi</em></td>
<td>Small intestine of suckling pigs 3.3 - 4.5 mm</td>
<td>Direct</td>
<td>Prenatally, transcoloastrally, orally, cutaneously</td>
<td>DCV, FBZ, AVE, LVM, TBZ</td>
</tr>
<tr>
<td><strong>Whipworm infection</strong> <em>Trichuris suis</em></td>
<td>Cecum and large intestine 5-8 cm</td>
<td>Direct</td>
<td>Ingestion of embryonated ovum</td>
<td>DCV, FBZ</td>
</tr>
<tr>
<td><strong>Gullet worm</strong> <em>Gongylonema pulchrum</em></td>
<td>Subepithelium of esophagus, tongue</td>
<td>Ingesting of beetle with encysted larvae.</td>
<td>Ingesting of beetle with encysted larvae.</td>
<td>FBZ, AVE, LVM</td>
</tr>
<tr>
<td><strong>Red stomach worm</strong> <em>Hyostrongyulus rubidus</em></td>
<td>Stomach &lt; 10 mm</td>
<td>Direct</td>
<td>Ingestion of larvae</td>
<td>DCV, FBZ, AVE, TBZ</td>
</tr>
<tr>
<td><strong>Thick stomach worms</strong> <em>Ascarops strongylina and Physocephalus sexalatus</em></td>
<td>Stomach</td>
<td>Dung beetles</td>
<td>Ingestion of encysted larvae.</td>
<td>FBZ, DCV</td>
</tr>
<tr>
<td><strong>Hookworm</strong> <em>Globocephalus urosubulatus</em></td>
<td>Small intestine of feral and pastured swine in southern US</td>
<td>Direct</td>
<td>Larvae born in digestive tract</td>
<td>DCV, FBZ, AVE, LVM</td>
</tr>
<tr>
<td><strong>Liver flukes</strong> <em>Fasciola hepatica</em></td>
<td>Liver of pigs on pastures used by sheep. 30 mm</td>
<td>Larvae from fresh leaf.</td>
<td>Not practical due to encysted larva {raw garbage, wild animal carcasses, etc.}</td>
<td>None</td>
</tr>
<tr>
<td><strong>Trichinosis</strong> <em>Trichinella spiralis</em></td>
<td>Muscle of many mammals, especially swine and bears</td>
<td>Many mammals</td>
<td>Many mammals</td>
<td>Not practical due to encysted larva {raw garbage, wild animal carcasses, etc.}</td>
</tr>
<tr>
<td><strong>Pork measles</strong> <em>Taenia solium</em> (a tapeworm of man)</td>
<td>Cysticercus cellulosae in skeletal and cardiac muscles of swine. &lt; 18 mm</td>
<td>Swine</td>
<td>Ingestion of human feces containing gravid proglottids</td>
<td>None</td>
</tr>
</tbody>
</table>

Key: DCV=dichlorvos, FBZ=fenbendazole, AVE=avermectin, LVM=levamisole, PIP=piperazine, PRT=pyrantel tartrate, TBZ=thiabendazole.