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# THE BIOSECURITY REPORT

Understanding Biosecurity in Modern  
Poultry Operations

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VAL-CO

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# EXECUTIVE SUMMARY

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Biosecurity is the prevention and control of pathogenic microorganisms from contacting animal or human populations. In the context of modern poultry production, it is essentially keeping the birds separate from the agents causing the disease. Used properly, biosecurity will also minimize the effect of disease and contain the spread of disease, if found. As such, biosecurity is first and foremost a management-based approach. Initial design of biosecurity policies and procedures should incorporate input from veterinarians, state agencies, and national guidelines. An understanding of the major diseases present today will aid the producer in crafting and understanding the biosecurity policy.

Major infectious poultry diseases include, but are not limited to, Newcastle Disease, Salmonella, Mycoplasma, and Avian Influenza. While each of these exhibit different symptoms, they are all highly contagious. Each can be transferred from bird to bird by direct transmission or through contact with particles that have been carried in on the clothing or materials used by farmers. This means that farmers need to pay special attention to their movements, their washing procedures, and their flocks, to ensure that diseases are not spread, and if they are, that they are caught early.

Farmers should have an established set of practices and guidelines that apply to all employees of the farm. To help farmers establish a biosecurity practice, the National Poultry Improvement Plan has outlined habits and routines for farmers to adopt as needed at their own facility. While many practices are common sense, practicing biosecurity deliberately will help keep disease down and birds healthy.

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# CHAPTER ONE: THE ISSUE AT HAND

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Prior to the widespread adoption of modern confinement rearing practices, most poultry operations consisted of backyard flocks of varying domesticity and exhibited poorly-defined policies for monitoring and isolation of birds for disease prevention<sup>1</sup>. With backyard flocks in close proximity to each other and people, diseases tended to spread rapidly during an outbreak and were often underreported due to poor government oversight and reporting practices<sup>2</sup>.

Modern farming practices have reduced the number of backyard poultry rearing operations through concentration of flocks into larger sizes and localized geographic areas, thus reducing the chance of organic spread of disease from direct transmission between neighboring domestic fowl sites. However, these operations are more susceptible to significant economic loss from disease outbreaks than backyard flocks due to the uniformity of genetic stock present, concentration of birds in the rearing environment, and fewer disease-resistance genes present in birds heavily selected for production traits only<sup>3</sup>.

Many economically adverse poultry diseases are not reliant on direct transmission between domestic fowl to spread and are frequently transmitted by carriers such as wild fowl or other domesticated birds, as well as through transmission via fecal material, nasal secretions, and fomites. These factors create potential reservoirs of disease that could survive long after an acute outbreak has been contained and resolved.

## Major Poultry Diseases

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*Newcastle Disease:* Newcastle disease is a viral disease of birds with a wide range of clinical signs from mild to severe, depending on the strain of virus causing the infection. Milder, lentogenic isolates of Newcastle disease are endemic in the United States and frequently cause symptoms including sneezing, coughing, and rales. Severe, velogenic isolates of Newcastle

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<sup>1</sup> Walsh, B. 2006. The Deadly Side Effects of Avian Flu. Time Magazine Feb 19

<sup>2</sup> *Idem.*

<sup>3</sup> Siwek, M. et al. 2010. 'A quantitative trait locus for a primary antibody response to keyhole limpet hemocyanin on chicken chromosome 14—Confirmation and candidate gene approach.' *Poultry Science* 89.9:1850- 1857

disease are endemic in Asia, the Middle East, Africa, Central and South American, and parts of Mexico<sup>4</sup>; these strains are commonly known as Exotic Newcastle Disease (END). END symptoms include sudden death or rapid increase in mortality, sneezing, coughing, gasping for air, nasal discharge, tremors, drooping wings twisting of the head and neck, and swelling around the eyes and neck.

Transmission of Newcastle disease is by inhalation or ingestion as affected birds shed virus in both feces and respiratory secretions. Virus-bearing material, such as litter or manure, can be picked up on shoes or clothing and is often spread between farms by debeaking crews, manure haulers, feed delivery personnel, and others that frequently travel between farms. Chickens are particularly susceptible to END and may experience morbidity and mortality rates up to 100%, with vaccinated flocks showing mortality rates between 30-90%.

*Salmonella*: Salmonella (named after USDA veterinarian Daniel E. Salmon) are a family of bacteria that can cause Salmonellosis in poultry and humans. There are over 2,400 different serotypes of Salmonella, all of which are potentially pathogenic. The major serotypes of concern for poultry are *S. gallinarum* and *S. pullorum* which cause high mortality among poultry, and *S. enteritidis* and *S. typhimurium* which cause Salmonellosis food poisoning in humans. Pullorum disease is spread from infected parent stock to chicks through the egg and results in a high number of dead-in-shell chicks and post-hatch deaths. Clinical signs are variable and non-specific, although presentations with diarrhea often include pasting of the vent. *S. gallinarum* causes Fowl Typhoid, an acute or chronic septicemic disease of adult chickens causing severe respiratory distress and depression culminating in sporadic mortality over a long period. Clinical signs usually include mucoid yellow diarrhea. Transmission is through feces and possibly the egg. The serotypes that cause Salmonellosis in humans usually present asymptotically in chickens, who are carriers of the disease. It colonizes the intestinal and reproductive tracts and is transferred into the egg before the shell forms and also is also present in the carcass. Infected birds may shed intermittently for their entire life span. Lateral transmission is possible through the fecal oral route.

*Mycoplasma diseases*: Chronic Respiratory Disease (CRD) and Infectious Synovitis (IS): CRD and IS are both caused by bacterium from the mycoplasma family. CRD, or airsacculitis, is a long-term disease of the respiratory system in poultry. It is caused by the bacterium *Mycoplasma gallisepticum* and usually onset follows stress challenges to otherwise healthy

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<sup>4</sup> Ibid., p. 2.

birds (debeaking, movement, Newcastle Disease outbreaks, etc.). CRD is spread from parent to offspring through the egg or by contact with airborne dust or droplets contaminated with the bacteria. Incubation is between four days and three weeks. Clinical signs of CRD infection include depression of appetite and respiratory distress in young birds, and congestion, sneezing, and coughing in adult birds. In laying birds, a decrease of 20-30% in egg laying is common. Birds, once infected with CRD, will carry the disease causing bacteria for the rest of their lives, making another outbreak possible anytime stressful conditions are present<sup>5</sup>.

Infectious Synovitis is caused by the bacterium *Mycoplasma synoviae* and is also transmitted from parent to egg and through contact with airborne dust and secretions from infected birds. Clinical signs may not show, but can present as mild respiratory infections, swelling of the joints, and breast blisters.

*Avian Influenza:* Avian Influenza (AI) is a virus that affects wild birds and domestic poultry, including chickens, turkeys, pheasants, quail, ducks, geese, and guinea fowl. Much like the flu for humans, there are many types with differing severity. AI viruses are classified by a combination of two groups of proteins: the hemagglutinin or H proteins, of which there are 18 (H1-H18), and the neuraminidase or N proteins, of which there are 11 (N1-N11). AI strains are also divided into two groups based upon the ability of the virus to produce disease in poultry: Low-pathogenicity AI (LPAI) and high-pathogenicity (HPAI). LPAI strains are asymptomatic or only display minor symptoms in birds. HPAI is often fatal in birds, especially chickens and turkeys, and spreads rapidly<sup>6</sup>. To date, only subtypes containing H5 or H7 have been highly pathogenic. These subtypes are also present in LPAI strains, and have been known to quickly mutate into HPAI strains. The USDA has a policy of eradication of all HPAI strains as well as all H5 and H7 LPAI strains detected in the US<sup>7</sup>. Some strains of HPAI are zoonotic and may be transmitted to humans through direct or indirect means. H5N1 strains that have infected humans are rare, but present with a mortality rate of 60%, making the monitoring and eradication of this disease a high priority worldwide.

Symptoms of HPAI in poultry may include sudden massive die-offs (sometimes with no other symptoms present) respiratory distress – coughing, sneezing – decreased water and feed consumption, ruffled feathers, sinusitis, lacrimation, cyanosis of the head, comb, and wattle,

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<sup>5</sup> McMullin, P. 2004. Poultry Health and Disease. 5M Publishing ISBN 095301505X

<sup>6</sup> USDA APHIS. 2006. National Poultry Improvement Plan: Seventy Years of Poultry Improvement. Program Aid No. 1857

<sup>7</sup> Center for Food Security and Public Health. 2010. High Pathogenicity Avian Influenza. Factsheet HPAI\_H2010: 1

edema of the head, and green and white diarrhea, decreased egg production, or the production of soft-shelled eggs.



PHOTO: RODNEY WHITE, THE DES MOINES REGISTER – AVIAN INFLUENZA RESULTS IN SUDDEN MASSIVE BIRD DIE-OFFS.

There are many other diseases of poultry throughout the world with varying degrees of impact. The diseases referenced herein comprise the most pressing concerns for producers worldwide with the highest potential to impact human safety and farm productivity.

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# CHAPTER TWO: BIOSECURITY

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As producers grapple with the increasing influence of export markets and travel of personnel and fomites worldwide, the need for protection of farms from sources of disease also increases. The key management tool at the modern producers' disposal is biosecurity. Biosecurity encompasses a broad range of management policies and procedures, but the essence of biosecurity involves producers doing everything in their power to reduce the chances of an infectious disease being carried onto their farm by people, animals, equipment, or vehicles.

Biosecurity comes in two different forms, bio-exclusion and bio-containment. Bio-exclusion is external biosecurity that combines all activities that prevent the introduction of disease to a farm, whereas bio-containment is internal biosecurity comprised of efforts to prevent the spread of a disease within the farm and to other farms. All biosecurity has three main goals — isolation, sanitation, and traffic control — and three steps for achieving them — segregation, cleaning, and disinfection<sup>8</sup>.

Most of the procedures involved in good biosecurity are based on common sense approaches to limiting the spread of disease. The USDA has codified the main common sense measures applicable to the poultry industry.

## USDA Common Sense Biosecurity Measures<sup>9</sup>

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These items form a basis from which to build to comprehensive biosecurity policy for your farm:



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<sup>8</sup> Australian Government: Dept. of Agriculture, Fisheries, and Forestry. "National Farm Biosecurity Manual – Poultry Production" May 2009

<sup>9</sup> USDA APHIS. 2007. Biosecurity: Protecting Your Livestock and Poultry. Factsheet



1. Keep your distance – Restrict access to property and livestock to prevent unauthorized entry. Post signs, maintain fencing, keep a visitor's log and only allow approved visitors entry when their presence is absolutely necessary. Have an area for visitors to change into clean clothes and footwear, disposable or farm-maintained. Discourage handling of animals by all visitors. Require and teach biosecurity to family, employees, and all visitors coming into, or involved with livestock or production areas.
2. Keep it clean – Owners, staff, family, and visitors should follow biosecurity practices for cleanliness. Wear clean clothes, scrub boots and shoes thoroughly with disinfectant, and wash hands. Keep equipment and vehicles clean and insist that all machinery and vehicles must be cleaned before entering your property. Maintain programs to control birds and rodents that can carry and spread diseases.
3. Don't haul disease home – If you, your family, or employees have been on other farms, at feed lots, petting zoos, auctions, or other places where there is livestock and poultry, clean and disinfect your vehicle tires and equipment before going home. If you have shown livestock or birds at a fair or exhibition, or are bringing in new animals, keep them separated from the rest of your flock for 30 days after the event. Always change clothes and wash your hands before returning to your animals.
4. Don't borrow disease from your neighbor – Do not share equipment, tools, or other supplies with your neighbors or other livestock or poultry owners. If you do share these items, clean and disinfect them before they reach your property.
5. Look for signs of infectious diseases – You should know what diseases are of concern for your flock and be on the lookout for unusual signs or behavior, severe illness, or sudden deaths. When possible, assess the health of your animals daily. Early detection is important to prevent the spread of disease.
6. Report sick animals – Don't wait. Report serious or unusual animal health problems to your veterinarian, local extension office, or State or Federal animal health officials. The USDA operates a toll-free hotline (1-866-563-7593) with veterinarians to help you.

These rules act as guidelines from which to develop a formal biosecurity policy for producers, tailored to individual needs and abilities. Growers should also consider the distance between production sites. While the exact distances pathogens can travel while airborne is not known, placing sites at least one mile apart is a good start to preventing airborne transmission from site to site.

## Developing Formal Biosecurity Guidelines

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Most biosecurity plans are founded upon the use of barriers that are physical, chemical, and logical. These lines of separation need to be both clearly defined and practical. In many cases, a physical barrier is a shower or bench area where, at the very least, a change of footwear is required. Usually, a low board or low wall indicates where one biosecure zone ends and another begins. Chemical barriers appear whenever the use of disinfectants is required – upon entry to the property, to the house, or during house cleaning. Logical barriers are a set of attitudes and procedures that will limit the travel of personnel between clean and dirty areas of the farm. Logical barriers dictate when feed trucks deliver, what order the houses are inspected in, and directions for movement around the farm.

To help outline what some of these barriers look like in greater detail, the National Poultry Improvement Plan (NPIP) established a set of standards for biosecurity in breeder facilities, hatcheries, grow out facilities, and general cleaning guidelines to help farmers create and maintain a detailed working biosecurity plan appropriate for their individual facility. The standards are summarized below, but the full text is available [here](#).

### NPIP Sanitation Procedures<sup>10</sup> – *Flock Sanitation*

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To aid in the maintenance of health flocks, the following procedures should be practiced:

- Poultry should be started in a house managed to reduce or eliminate exposure to program organisms. Flocks should be maintained in constant isolation from older birds and other animals. Personnel that are entering poultry ready or occupied airspaces should take precautions, washing and/or sanitation of hands, and wearing premise-specific clothing and footwear to prevent the introduction of infection by biological agents that may adhere to shoes, clothing, or hands. Also, sanitation focus must be directed to anything entering occupied or unoccupied air spaces such as cell phones, tool bags, or cigarette lighters.
- Where flocks of different ages must be kept on the same farm, there should be complete depopulation following infection of such premises by any program disease that causes the existence of a carrier population or a reservoir in the environment. Any deviation from the process...must be agreed upon by the enterprise involved, the State Veterinarian, the NPIP/OSA, and the Service in the form of a written documented communication that will outline how the remaining stock will be managed and monitored to assure freedom of the plan disease going forward.
- Poultry houses shall be screened and proofed against free-flying wild birds. Active rodent and insect eradication/control programs are an essential part of the general sanitation program. The area adjacent to the poultry house shall be kept free from

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<sup>10</sup> USDA NPIP. 2016. <https://www.poultryimprovement.org/documents/2016NPIPProposedChangesBooklet.pdf>

accumulated manure, rubbish, and unnecessary equipment. Vegetation surrounding all poultry housing shall be excluded from or minimized in amount for at least three meters' distance to facilitate control of vermin. Dogs, cats, sheep, cattle, horses, and swine should never have access to within three meters of poultry airspaces. Visitors should not be admitted to poultry areas, and authorized personnel should take the necessary precautions to prevent the introduction of disease.

- Structural and operational biosecurity principles shall be in place in each poultry house/airspace to minimize the risk of disease introduction and transmission.
- In areas where the disposal of used poultry litter is problematic and at the discretion of the flock owner, reuse of the previous flock poultry litter is allowable provided the previous flock in the housing was free of the avian pathogens that are officially represented in the Plan disease classifications and the official NPIP top three *Salmonella*'s of human health concern detected during the previous flock or by other monitoring linked to the air space. In order to utilize the option, it is essential the house/air space biosecurity is fully maintained.
- Management of ventilation systems should be done in a manner to optimize moisture removal and reduce excess moisture known to facilitate *Salmonella* replication. Nesting areas should be kept clean, dry, and free of fecal matter.
- When an outbreak of disease occurs in a flock, every effort should be made to identify the causative agent. *Salmonella* cultures isolated should be typed as appropriate to determine specific control measures.
- Introduction of started or mature birds should be managed to reduce the possible hazard of introducing infectious diseases. If birds are to be introduced, the health status of both the flock and introduced birds should be evaluated with recent testing results for applicable plan disease agents prior to movement.
- In all poultry stock, a sound and adequate immunization program, as advised by a poultry health professional, should be adopted.
- Feed should be produced and treated to prevent transmission of program organisms by heating or approved chemical treatment.

### **NPIP Sanitation Procedures<sup>11</sup> – *Hatching Egg Sanitation***

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Hatching eggs should be collected from the nests at frequent intervals and, to aid in the prevention of contamination with disease-causing organisms, the following practices should be observed:

- Cleaned and disinfected containers, such as egg flats, should be used in collecting the nest eggs for hatching. Egg handlers should thoroughly wash their hands with soap and water before, during (if in contact with birds or they become soiled), and after egg collection. Clean outer garments should be worn.

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<sup>11</sup> *Ibid.*

- Dirty eggs should not be used for hatching purposes and should be collected in a separate container from the nest eggs. Slightly soiled nest eggs may be gently dry cleaned by hand.
- Hatching eggs should be stored in a designated egg room under conditions that will minimize egg sweating. The egg room walls, ceiling, floor, door, heater, and humidifier should be cleaned and disinfected after every egg pickup.
- The egg processing area should be cleaned and disinfected daily.
- Effective rodent and insect control programs should be implemented.
- The egg processing building or area should be designed, located, and constructed of such materials as to assure the proper egg sanitation procedures can be carried out, and that the building itself can be easily, effectively, and routinely sanitized.
- All vehicles used for transporting eggs or chicks/poults should be cleaned and disinfected after use.
- Egg collection belts, tables, nest box pads and other egg collection equipment shall be physically cleared of organic material on a very regular basis to facilitate clean eggs.

### NPIP Sanitation Procedures<sup>12</sup> – Hatchery Sanitation

An effective program for the prevention and control of Salmonella and other infections should include the following measures;

- An effective hatchery sanitation program should be designed and implemented.
- The hatchery building should be arranged so that separate rooms are provided for each of the four operations: egg receiving, incubation and hatching, chick/poult processing, and egg tray and hatching basket washing. Traffic and airflow patterns in the hatchery should be from clean areas to dirty ones (i.e. from egg room to chick/poult processing rooms) and should avoid tracking from dirty areas back into clean ones.
- The hatchery rooms and tables, racks, and other equipment in them should be thoroughly cleaned and disinfected frequently. All hatchery wastes and offal should be appropriately managed and disposed of to prevent contamination of subsequent hatches. The equipment used to remove such materials should be cleaned and sanitized after each use.
- The hatching compartments of incubators, including the hatching trays, should be thoroughly cleaned and disinfected after each hatch.

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<sup>12</sup> *Ibid.*

- Only visually clean eggs should be used for hatching purposes.
- Only new or cleaned and disinfected egg cases should be used for transportation of hatching eggs. Soiled egg case fillers should be destroyed.
- Day-old chicks, poults, or other newly hatched poultry should be distributed in cleaned or new boxes and new chick or poult papers. All crates, lifting equipment, and vehicles used for transporting birds should be cleaned and disinfected after each use.

### **NPIP Sanitation Procedures**<sup>13</sup> – *General Cleaning and Disinfecting*

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The following procedures are recommended:

1. In the poultry houses: House Clean Out (HCO)
  - a. Remove all birds from the building. Blow dust from equipment and other exposed surfaces. Empty the residual feed from the feed system and feed pans and remove it from the building. As appropriate, disassemble feeding equipment and dump and scrape as needed to remove feed cake and residue. Clean up spilled feed around the bulk feed bins and physically clean out, if possible. After dry cleaning of the inside of feed bins to remove any residual build-up of feed, it may be beneficial to rinse down and wash out the inside of the feed bins to decontaminate the surfaces and allow to dry.
  - b. Add additional perimeter bait stations and add fresh bait to all as a means of monitoring for rodent activity as your move along with the clean out process.
  - c. If litter is to be removed, remove all litter and manure to an isolated area where there is no opportunity for dissemination of any infectious disease organisms that may be present. Housing where poultry infected with a mycoplasma disease were kept should remain closed for 7 days before removal of the litter after the house is depopulated.
  - d. Wash down – using clean water and avoiding untreated pond or stream water for the process – the entire inside surface of the building and all the installed equipment such as curtains, ventilation ducts, light traps and openings, fans, fan housings and shutters, feeding equipment, and watering equipment. Use appropriate pressure and volume of water to decontaminate the building. Pay specific attention to the area linking of side walls with building floors and/or stem walls to remove all accumulated organic material. Make sure to close up any

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<sup>13</sup> *Ibid.*

drain caps and doorways when building is not actively being worked on at all times during the HCO process. Make sure any chemical cleaning and disinfecting agents deployed in the full HCO process are compatible.

- e. Perform any mechanical or physical maintenance on building and/or equipment necessary including patching up any wild bird or obvious rodent entry points.
  - f. Spray with a disinfectant which is registered by the Environmental Protection Agency as germicidal, fungicidal, pseudomonocidal, virocidal, and tuberculocidal, in accordance with the specifications for use, as shown on the label of such disinfectant.
  - g. If part of an integrated pest management program, apply appropriate insect intervention steps (boric acid, lime, and/or approved insecticides).
  - h. Check for activity, rebait, and redistribute any rodent control baiting stations to all locations around house perimeter and, if necessary, inside the physical housing units keeping in mind the objective should be to never have rodents inside the poultry air spaces. Focus additional control to any areas at the perimeter where rodent activity as measure by bait consumption during HCO was identified.
  - i. Make sure any building end pad areas are completely cleaned and free of organize material from the previous flock prior to adding new bedding or other supplies, birds, or equipment.
2. In the hatchers and hatchery rooms:
- a. Use cleaning agents and sanitizers that are registered by the US Environmental Protection Agency as germicidal, fungicidal, pseudomonocidal, virocidal, and tuberculocidal. Use manufacturer's recommended dilution rates. Remove loose organic debris by sweeping, scraping, vacuuming, brushing, scrubbing, or by hosing surfaces with appropriate water pressure. Remove trays and all controls and fans for separate cleaning. Use hot water for cleaning hatching trays and chick separator equipment. Thoroughly wet the ceiling, walls, and then scrub it with a hard bristled brush. Use a cleaner/sanitizer that can penetrate protein and fatty deposits. Allow the appropriate contact time per the manufacturer's recommendations. Manually scrub any remaining any deposits of organic material until they are removed. Rinse until there is no longer any deposit on the walls, particularly near the fan opening. Use a clean and sanitized squeegee to remove excess water, working down from ceilings to walls to floors and being careful not to re-contaminate cleaned areas. Apply disinfectant.

- b. Replace the cleaned fans and controls. Replace the trays and bring the incubator to normal operating temperature.
  - c. The hatcher should be disinfected prior to the transfer of the eggs.
  - d. If the same machine is used for incubating and hatching, the entire machine should be cleaned after each hatch. A vacuum cleaner should be used to remove dust and down from the egg trays, then the entire machine should be vacuumed, mopped, and sanitized.
3. The egg and chick/poult delivery truck drivers and helpers should use the following good biosecurity practices while picking up eggs or delivering chicks/poults:
- a. Personnel that are entering egg rooms, or poultry redy or occupied air spaces, should take precautions, including washing of and/or sanitation of hands and wearing premise-specific clothing and footwear.
  - b. After loading eggs or unloading chicks/poults, remove the dirty premise-specific outerwear and place into plastic garbage bag before loading in the truck. Be sure to keep the clean clothing and footwear separate from dirty ones. Remove hairnet and disposable boots (is applicable) and discard at farm.
  - c. Sanitize hands using appropriate hand sanitizer.
  - d. Re-enter the truck to return to the hatchery or go to the next farm and repeat the process.

### **NPIP Sanitation Procedures<sup>14</sup> – Fumigation**

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Fumigation may be used for sanitizing eggs and hatchery equipment or rooms as a part of a sanitation program. NPIP/APHIS/VAL-CO disclaims any liability in the use of formaldehyde for failure on the part of the used to adhere to the Occupational Safety and Health Administration (OSHA) standards for formaldehyde fumigation, published in the Dec. 4, 1987, Federal Register (52 FR 46168, Docket Nos. H-225, 225A, and 225B).

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<sup>14</sup> USDA NPIP. 2014. Title 9: Animals and Animal Products. Part 145: §147.21

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## NPIP Sanitation Procedures<sup>15</sup> – *Salmonella and Mycoplasma Infections*

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- The following procedures are required for participation under the US Sanitation Monitored, US M. Gallisepticum Clean, US M. Synoviae Clean, US S. Enteritidis Monitored, and US S. Enteritidis Clean classifications:
- Allow no visitors except under controlled conditions to minimize the introduction of Salmonella and Mycoplasma. Such controlled conditions must be approved by the Official State Agency and the Service.
- Maintain breeder flocks on farms free from market birds and other domesticated fowl. Follow proper isolation procedures as approved by the Official State Agency.
- Dispose of all dead birds by locally approved methods.
- Avoid the introduction of Salmonella, Mycoplasma gallisepticum, and Mycoplasma synoviae infected poultry.
- Prevent indirect transmission from outside sources through contaminated equipment, footwear, clothing, vehicles, or other mechanical means.
- Provide adequate isolation of breeder flocks to avoid airborne transmission from infected flocks.
- Minimize contact of breeder flocks with free-flying birds.
- Establish a rodent control program to keep the rodent population and other pests under control.
- Tailor vaccination programs to needs of farm and area.
- Clean and disinfect equipment after each use.
- Provide clean footwear and provide an adequate security program.
- Clean and disinfect houses before introducing a new flock
- Use clean, dry litter free of mold.
- Keep accurate records of death losses.
- Seek services of veterinary diagnostician if unaccountable mortality or signs of disease occur.
- Adopt and maintain a clean-egg program.
- Use only crates and vehicles that have been properly cleaned and disinfected to haul live poultry to and from the premises.

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<sup>15</sup> *Ibid.*



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# CONCLUSION

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With increasing access to disease worldwide, it is imperative that modern producers take to heart biosecurity and implement it on their production sites. Designate clothing and footwear, control entry of wild birds, rodents, and insects, and practice proper cleaning and sanitation procedures to ensure that diseases are not introduced to the farm or subsequent flocks.

By developing and executing a strict biosecurity practice that consists of physical and logical barriers, farmers can protect their flocks, their farms, their families, and their communities.

There exists no government oversight, international organization, or medicinal company that can offer as much value to individual producers in the fight against disease as the producers themselves may through the careful implementation and adherence to strict biosecurity policies and procedures.



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