

Biosecurity 101

AnS 190X

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Goals

- Discuss the foundations for biosecurity
- Provide some science behind recommendations
- Provide some resources



High Standard

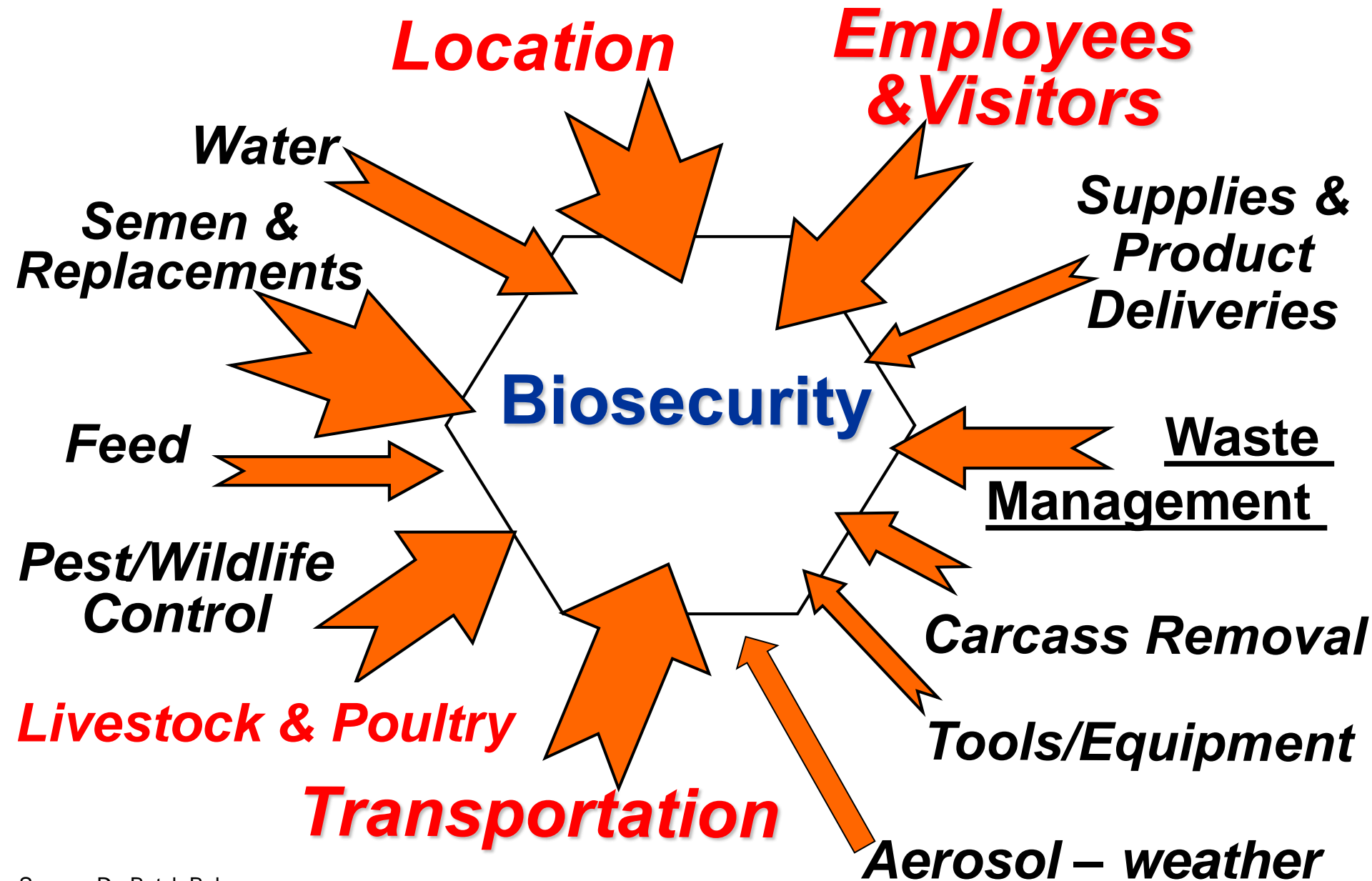


Biosecurity

- Definition: The steps or process for disease prevention.
 - External – New Introductions
 - Internal – Spread within an operation
- Not all risk can be eliminated!
 - BRM – Biological Risk Management
- Work to minimize the opportunities

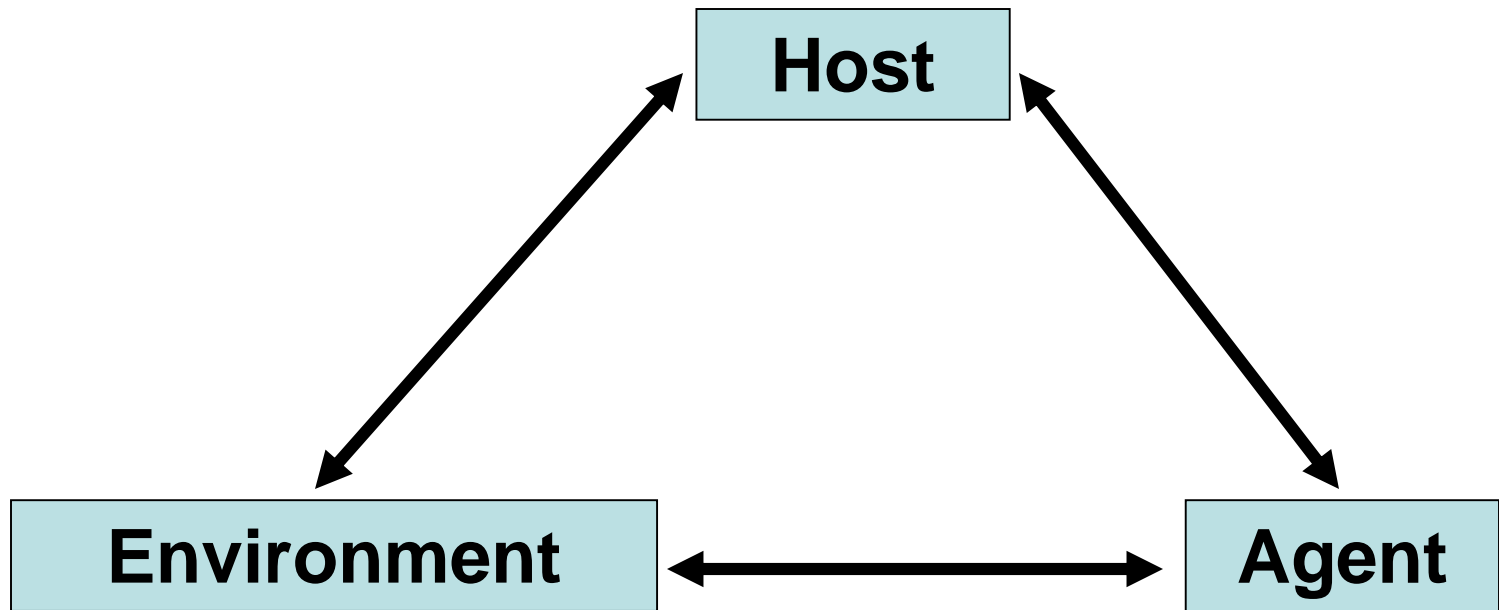


Bio-Exclusion Considerations



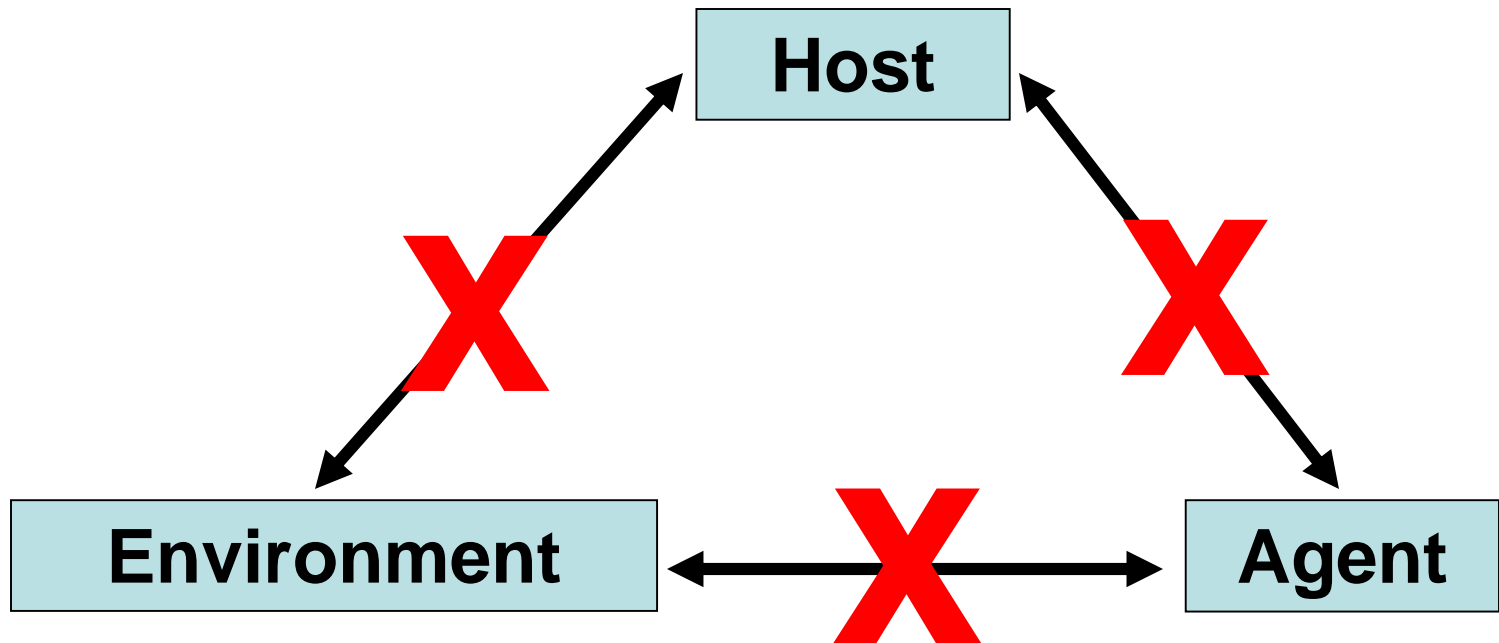
BRM - Foundation

- Disease triad



BRM - Foundation

- Disease triad



BRM - Foundation

- Three basic things to consider:
 - 1) Need to have a disease agent present
 - Live
 - Sufficient numbers
 - 2) Need to have a susceptible host
 - 3) The host must become exposed to the agent in sufficient numbers so as to cause disease
 - Routes of transmission



Routes of transmission

- Aerosol
- Fomite
- Oral
- Vector
- Direct contact
- Zoonotic

Biological Risk Management



TRANSMISSION ROUTE DEFINITIONS

Disease causing agents can be spread from animal-to-animal or animal-to-human and vice versa, through a variety of transmission routes.



• **Aerosol** — Droplets are passed through the air from one animal to another.



• **Direct contact** — A susceptible animal becomes exposed when the disease agent directly touches open wounds, mucous membranes, or the skin through blood, saliva, nose to nose contact, rubbing, or biting.



• **Reproductive** — A subtype of direct contact that includes diseases spread through mating or to the fetus during pregnancy.



• **Fomite** — An inanimate object carrying a disease agent from one susceptible animal to another.

• **Traffic** — A subtype of fomite transmission in which a vehicle, trailer, or human spreads organic material to another location.



• **Oral** — Consuming disease causing agents in contaminated feed, water or licking/chewing on contaminated environmental objects.



• **Vector-borne** — An insect acquires a disease agent from one animal and transmits it to another.



• **Zoonotic** — Diseases transmitted from animals to humans.

Environmental contamination must always be taken into consideration.

transmission_route_def

www.cfsph.iastate.edu



PRRS transmission

Route	ID ₅₀
SQ (parenteral)	~10
Intranasal	~8,000
Artificial Insemination	~31,600
Oral	~158,500
Aerosol	??

Zimmerman 2005



Formula for disease

Infectious Agent (viable and dose)

+ Exposure

+ Susceptible Host

Disease (acute, subacute)



Formula for disease

Infectious Agent (viable and dose)

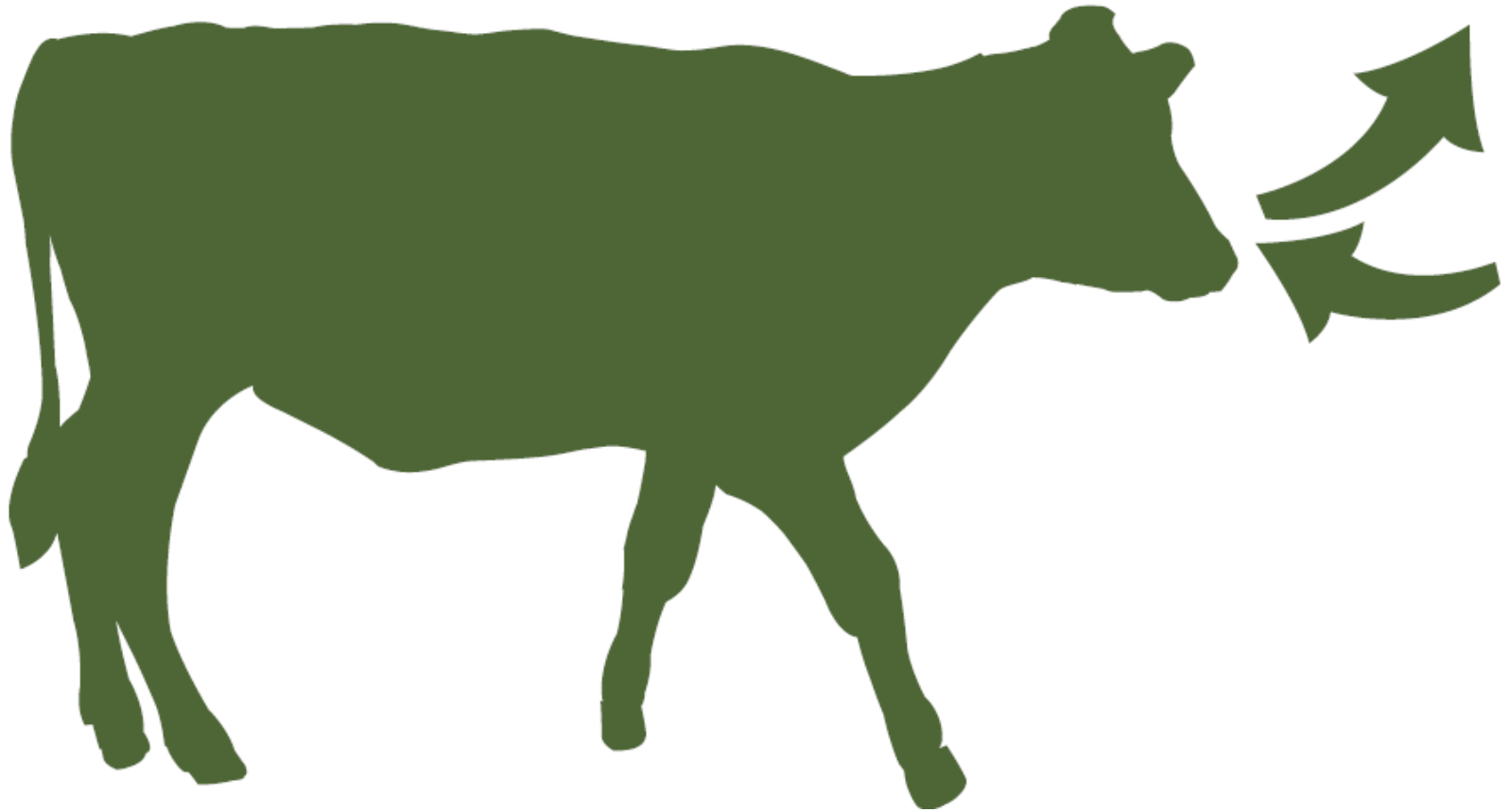
+ Exposure

+ **Susceptible Host**

Disease (acute, subacute)

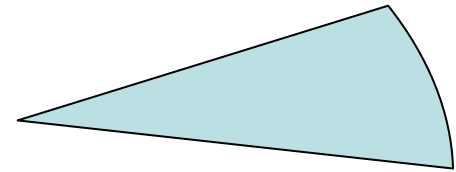


Aerosol Transmission



Aerosol Requirements

- Large numbers of pathogens
 - Circle \rightarrow Area = $\pi * r^2$
- Low temperature
- High humidity
- Low sunlight
- Short travel distance
- Low wind speeds
- Smooth topography



Aerosol transmission

- Aerosol \neq Area spread
- Aerosol = via the air
 - Agent/strain specific
- Area spread = not specific to air, but more related to location



Aerosol - Biosecurity practices

- Location
 - Low livestock density area
 - Preferably at least 2 miles from other livestock or manure spreading areas
- Ventilation
 - Proper maintenance
 - Use dust reduction protocols in confinement (1% fat in feed)
 - Maintain relative humidity <70%
- Air filtration system?



Aerosol

- Air filters



www.reliablefilter.com



HEPA vs. MERV vs.
Disposable



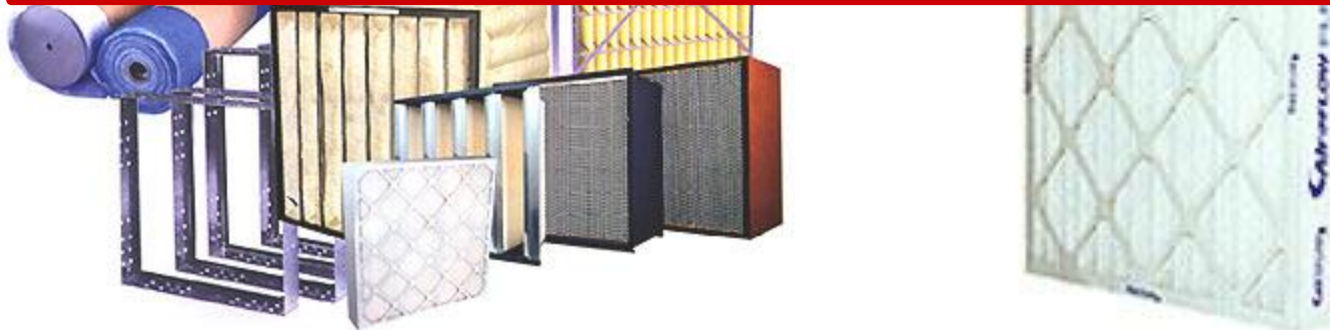
Aerosol

Costs:

\$250 per sow

\$150 per boar

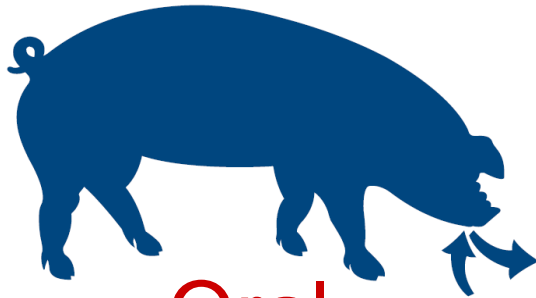
Maintenance \$30 - 40/head/year



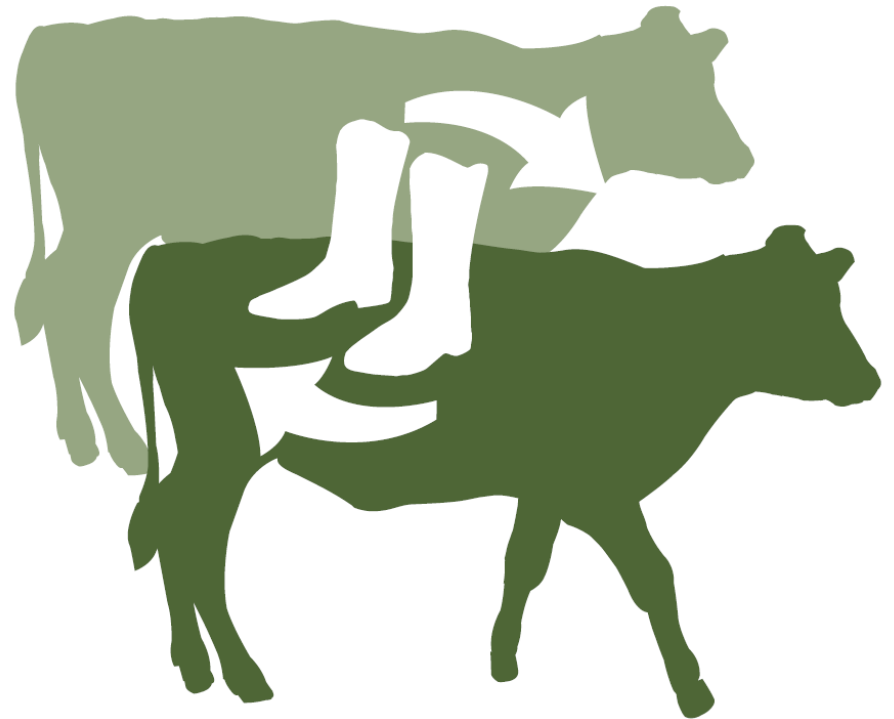
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Fomites & Oral



Oral



Fomites



Fomites & Oral

Fomites are inanimate objects (not alive) that can serve as a means to transport organisms from one animal to another



Fomites



Fumigation of all objects entering the site



Photo: RB Baker

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People



RESTRICTED ENTRY

**This is a
BIOSECURE FACILITY**

**Please Comply
with ALL posted
Biosecurity Signs**

HIGH RISK **MED RISK** **LOW RISK**

Help Keep Our Animals Healthy

THE PENNSYLVANIA STATE UNIVERSITY Department of Veterinary Medicine Commonwealth of Pennsylvania Department of Agriculture



People

- How many people/vehicles enter your farm operation every month?
 - A study in 2001 reported that larger (>2,000 head) swine herds had contact with people and vehicles who had contact with other livestock facilities an average of 807 times each month.

Risk = Frequency X Consequence



People

- *E. coli* Amass et al 2003
- FMDV Amass et al 2003
- TGEV Alvarez et al. 2002
- Showering and putting on clean outerwear prevented transmission in **ALL** cases!



People

- Risk is the same for **sow units** as well as **nursery** and **finishing** sites
- Large systems implement showering at **all** phases



Got boots?

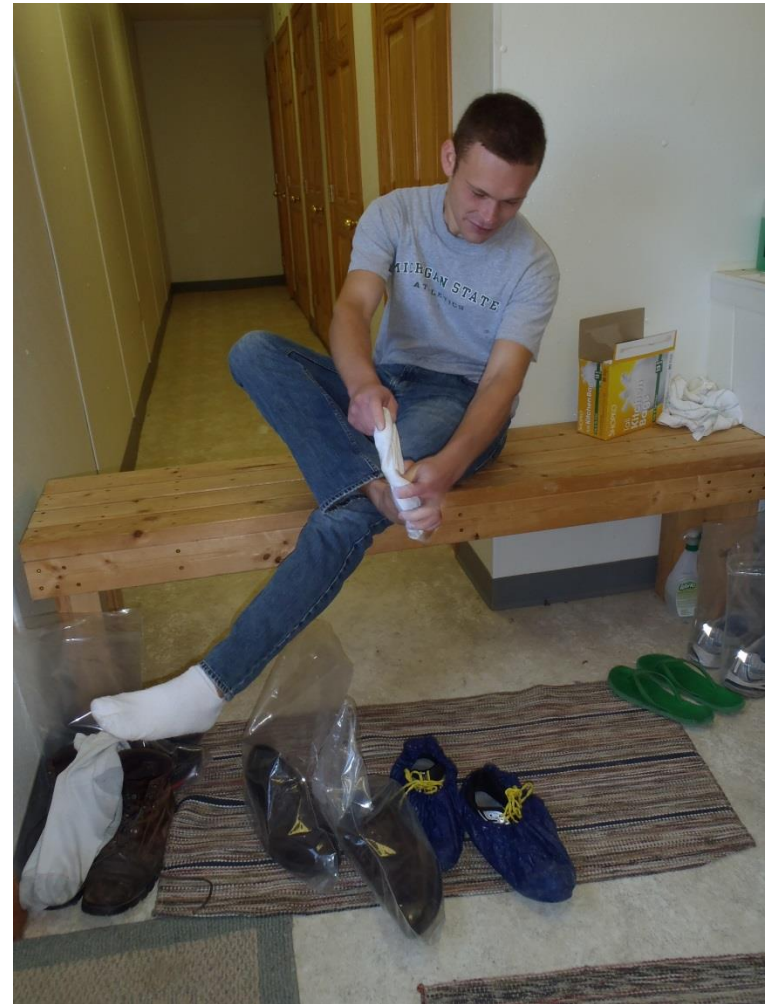


**Help contain disease by wearing
disposable boots and not crossing
the **LINE OF SEPARATION****





Boot Changing Stations



Boots & Coveralls



Boots & Coveralls



Tan, Charcoal, Royal, Navy, White, Red





Hand Washing

- Hand washing decreases contamination
- Availability
 - Location
 - Fully stocked
- Gloves are not a substitute for hand washing
- Signage



Exposure

Variables	N	Swine H1N1*			
		Titer \geq 1:10 n (%)	Titer \geq 1:20 n (%)	Bivariate OR (95% CI)	Multivariate OR (95% CI)
Swine exposure					
Swine workers who use gloves sometimes or never	34	12 (35.3)	7 (20.6)	21 (4.4-100.8)[†]	30.3 (3.8-243.5)[†]
Swine workers who use gloves most of the time or always	14	1 (7.1)	0 (0)	2.8 (0.2-34.2)	2.4 (0.1-40.9)
No swine exposed controls	79	2 (2.6)	1 (1.3)	reference	reference
Smoked in past year >5 packs?					
Yes	14	4 (28.6)	3 (21.4)	4 (1.1-14.5)[†]	18.7 (2.5-141.3)[†]
No	114	11 (9.7)	5 (4.4)	reference	reference

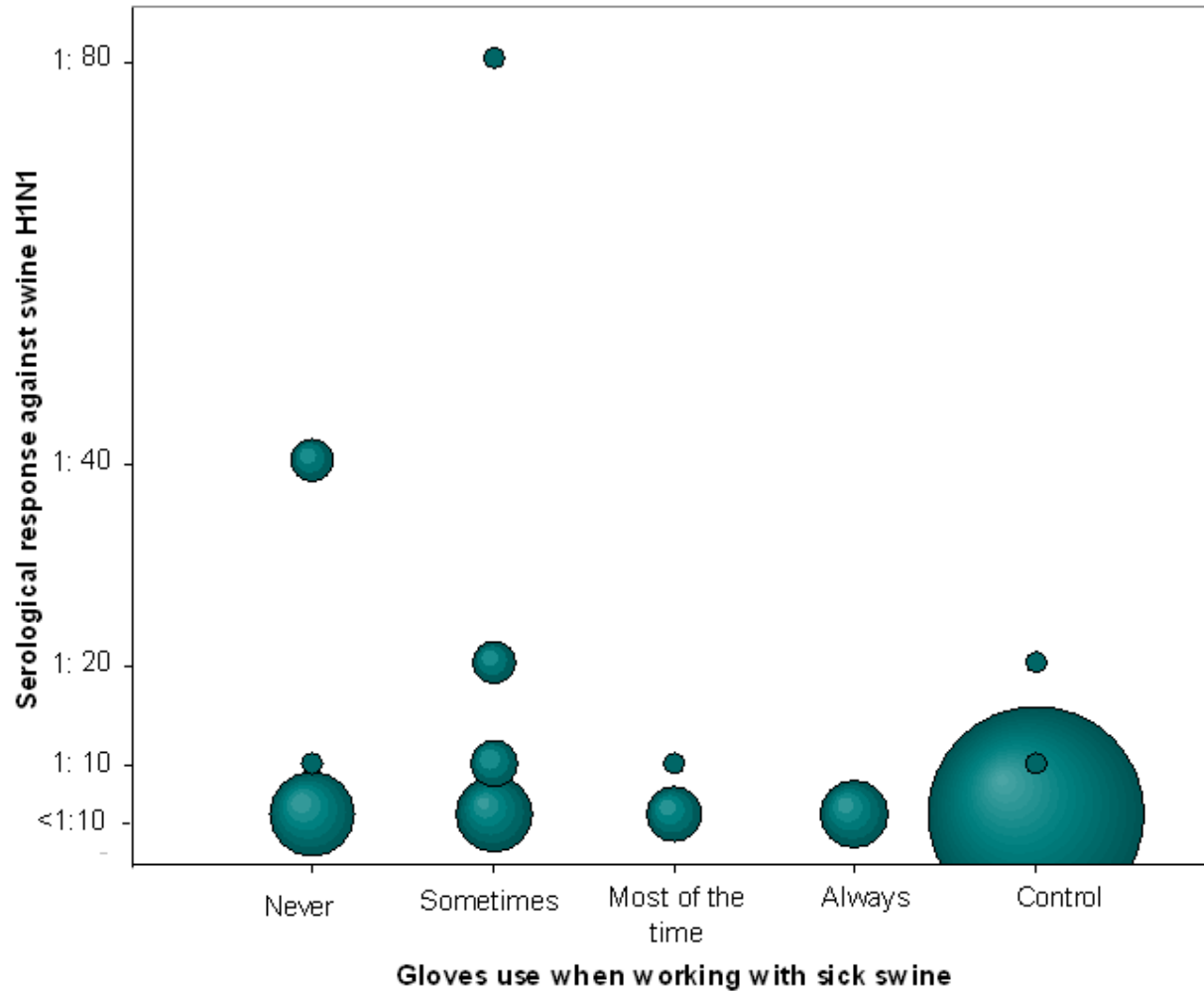
*Using proportional odds model, these titers were grouped: <1:10, 1:10; >1:10

[†] Significant odds for increased serological response, p-value<0.05

Ramirez *et al*, Emerg Inf Dis 2006



Exposure



Ramirez unpublished 2006

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Vehicles

- Clean vehicles only
- Designated parking
- Proper signage
- TQA program



<http://www.biosecuritycenter.org/truckwash.php>

Syntex industries





Photo: RB Baker



Truck wash/heat treatment





Photo: RB Baker





Photo: RB Baker

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Daily Biosecurity Priorities



Photo: RB Baker



Do we know how to clean?

1. Removal of visible organic material
 - Power washing
 - Pressure vs. volume
 - Hot vs. cold
2. Disinfection
3. Drying



Disinfect

1. Read the product label
 - Wear protective gear if needed
2. Disinfect
 - Use label dilutions
 - Allow label contact times (10 minutes)
3. Final rinse (if necessary)
 - Low pressure to remove residue
4. Dry before allowing animals to return



Which one?



Disinfectant Information



IOWA STATE UNIVERSITY®

• www.cfsph.iastate.edu/BRM/disinfectants.htm

Characteristics of Selected Disinfectants

Disinfectant Category	Alcohols	Aldehydes	Biguanides	Halogens: Hypochlorites	Halogens: Iodine Compounds	Oxidizing Agents	Phenols	Quaternary Ammonium Compounds (QAC)
Trade Name	First Choice, Isopropyl Alcohol	Formaldehyde, Formaldehyde Releasants	Chlorhexidine, Chlorhex* Chlorox* Virex*	Blanch* Clorox*	Iodophors* Iodoxin*	Hypochlorite bleach Peracetic acid Bleach* Virex** Oxy-Sol***	Oxy-Sol (Virex)* Phenol* Phen-Sol, Virex*	Quaternary Ammonium Compounds* Phenol* Phen-Sol, Virex*
Mechanism of Action	-Protein denaturation -Cell lysis	-Cellular proteins -Cross-linking	-Alters membrane permeability	-Oxidation of proteins -Oxidative protein denaturation	-Oxidation of proteins -Cell lysis	-Oxidation of proteins -Cell lysis	-Alters cell wall permeability -Oxidation of proteins	-Alters cell wall permeability -Oxidation of proteins
Advantages	-Fast acting -Leaves no residue	-Broad spectrum	-Broad spectrum	-Broad spectrum -Broad contact time dependence	-Broad spectrum -Broad contact time dependence	-Broad spectrum -Broad contact time dependence	-Broad spectrum -Broad contact time dependence	-Broad spectrum -Broad contact time dependence
Disadvantages	-Alcohol evaporation -Flammable	-Carcinogenic -Irritation -Resistant to heat -Only use in well-ventilated areas	-Only function in large pH range -Toxic to fish (external cancer)	-Stabilized by weakly oxidizing agents -Stains -Irritates mucous membranes -Corrosive to metals -Volatile, odorous, irritating	-Corrosive to some metals -Irritates mucous membranes -Volatile, odorous, irritating	-Staining to some extent -Corrosive to some extent	-Toxic to animals -Can cause skin and eye irritation -Not effective for FMD	-Not effective for FMD or Jazsar's -New labeling in use -Effective at high concentrations and high pH (12-14) -Effective over large pH range
Precautions	Flammable	Carcinogenic	Never use over acidic or alkaline pH	Never use over acidic or alkaline pH	Never use over acidic or alkaline pH	Never use over acidic or alkaline pH	Toxic to animals, especially cats	Toxic to animals, especially cats
Relative Efficacy*	Effective	Effective	Effective	Effective	Effective	Effective	Effective	Effective
Myxobacteria	Effective	Effective	Variable	Effective	Effective	Effective	Variable	Variable
Resistant Virus	Effective	Effective	Limited	Effective	Effective	Effective	Effective	Variable
Non-enveloped Virus	Variable	Effective	Limited	Effective	Limited	Effective	Variable	Variable
Spores	Not Effective	Effective	Not Effective	Variable	Limited	Variable	Not Effective	Not Effective
Range	Reduced	Reduced	Reduced	Reduced	Reduced	Reduced	Reduced	Reduced
Efficacy with Organic Matter	Reduced	Reduced	Reduced	Reduced	Reduced	Reduced	Reduced	Reduced
Efficacy with dirt/soil	?	Reduced	?	Effective	?	?	Effective	Reduced
Efficacy with bleach	?	Reduced	Reduced	Reduced	Effective	?	Effective	Reduced

* Information not documented

Disclaimer: Use of trade names does not in any way signify endorsement of a particular product. For additional product names, please consult the most recent Compendium of Veterinary Products.

Bacterial Group Review Table

Gram-Positive Cocci	Gram-Positive Rods	Gram-Negative
Staphylococcus aureus Micrococci Staphylococci Streptococci	Actinomyces Archaebacteria Bacteroides Clostridium Lactobacillus Mycobacteria Streptococcus Staphylococcus Streptomyces Spirillum Tetrahymena Vibrio	Actinomyces—G ⁻ Clostridia—G ⁻ Gram-negative—G ⁻ Lactobacillus—G ⁻
Gram-Positive Bacilli	Gram-Negative Rods (Gram-Negative) & Gram-Negative Cocci	Gram-Negative and Helical/Spiral Bacteria
Actinomyces Bacillus Corynebacterium Diphtheria Listeria Mycobacterium Nocardia	Bacteroides Campylobacter Haemophilus Legionella Pasteurella Shigella Yersinia	Chlamydia Coccidia Diphtheria Mycobacterium Spirillum Spirochetes

The Antimicrobial Spectrum of Disinfectants

Note: Removal of organic material must always precede the use of any disinfectant.

	Acid hydrolytic pH: 2-4 cat: 1-2	Alcohols 70% ethanol isopropyl alcohol	Aldehydes formaldehyde, glutaraldehyde	Alkyl dihalamides chlorhexidine, chlorhex	Biguanides chlorhexidine, chlorhex Virex	Hypochlorites bleach Clorox	Halogens iodophors Iodoxin	Oxidizing Agents peracetic acid bleach	Phenolics Phenol Phen-Sol Virex	Quaternary Ammonium Compounds (QAC)
most susceptible										
apoptogenic	+	+	+	+	+	+	+	+	+	+
gram-positive bacteria	+	+	+	+	+	+	+	+	+	+
gram-negative bacteria	+	+	+	+	+	+	+	+	+	+
pseudomonads	+	+	+	+	+	+	+	+	+	+
ricketsiae	+	+	+	+	+	+	+	+	+	+
enveloped viruses	+	+	+	+	+	+	+	+	+	+
chlamydiae	+	+	+	+	+	+	+	+	+	+
non-enveloped viruses	+	+	+	+	+	+	+	+	+	+
range spores	+	+	+	+	+	+	+	+	+	+
proteobacteria (i.e., FMD)	N	N	N	N	N	N	N	N	N	N
parvovirus	N	N	N	N	N	N	N	N	N	N
acid-fast bacteria	+	+	+	+	+	+	+	+	+	+
bacterial spores	+	+	+	+	+	+	+	+	+	+
coccidia	+	+	+	+	+	+	+	+	+	+
prions	+	+	+	+	+	+	+	+	+	+
most resistant										

LEGEND: + highly effective, + effective, + limited activity, ? no activity, - information not available

*active with composition: hypochlorite, peracetic acid, a strong oxidizing agent; QAC: quaternary ammonium hydrochloride; - does not have activity against oxidase

Adapted from Lumen A/E, Page 107. Based on: Disinfection in Veterinary Practice (1987) Blackwell Scientific Publications, Oxford, England.
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Characteristics of Selected Disinfectants

Disinfectant Category	Alcohols	Aldehydes	Biguanides	Halogens: Hypochlorites	Halogens: Iodine Compounds	Oxidizing Agents	Phenols	Quaternary Ammonium Compounds (QAC)
Sample Trade Names	Ethyl alcohol Isopropyl alcohol	Formaldehyde Paraldehyde Glutaraldehyde	Chlorhexidine Nolvasan® Chlorhex® Virosan®	Bleach Clorox®	Betadine® Providone®	Hydrogen peroxide Peroxyacetic acid Irifectant® Vikon 5® Oxy-Sept 333®	One-Stroke Environ® Pheno-Tek II® Tek-Trol® Pine-Sol, Lysol	Roccal® DIquat® Parvosol® Zephiran® D-256®
Mechanism of Action	•Precipitates proteins •Denatures lipids	•Denatures proteins •Alkylates nucleic acids	•Alters membrane permeability	•Denatures proteins	•Denatures proteins	• Denature proteins and lipids	• Alters cell wall permeability • Denatures proteins	• Binds phospholipids of cell membrane • Denatures proteins
Advantages	•Fast acting •Leaves no residue	•Broad spectrum	•Broad spectrum	•Broad spectrum •Short contact time •Inexpensive	•Stable in storage •Relatively safe	• Broad spectrum	• Good efficacy with organic material • Non-corrosive • Stable in storage • Effective over large pH range	• Stable in storage • Non-irritating to skin • Effective at high temperatures and high pH (9-10)
Disadvantages	•Rapid evaporation •Flammable	•Carcinogenic •Irritation to mucous membranes and tissues •Only use in well ventilated areas	•Only functions in limited pH range (5-7) •Toxic to fish (environmental concern)	•Inactivated by sunlight, some metals •Requires frequent application •Corrodes metals •Irritating to mucous membranes, skin	•Stains clothes or treated surfaces •Inactivated by organic debris and QACs •Requires frequent application •Corrosive	• Damaging to some metals	• Toxic to animals • Can cause skin and eye irritation • NOT effective for FMD	• NOT effective for FMD or John's
Precautions	Flammable	Carcinogenic		Never mix with acids; will release toxic chlorine gas			Toxic to animals, especially cats	
Vegetative Bacteria	Effective	Effective	Effective	Effective	Effective	Effective	Effective	YES—Gram Positive Limited—Gram Negative
Mycobacteria	Effective	Effective	Variable	Effective	Limited	Effective	Variable	Variable
Enveloped Viruses	Effective	Effective	Limited	Effective	Effective	Effective	Effective	Variable
Non-enveloped Viruses	Variable	Effective	Limited	Effective	Limited	Effective	Variable	Not Effective
Spores	Not Effective	Effective	Not Effective	Variable	Limited	Variable	Not Effective	Not Effective
Fungi	Effective	Effective	Limited	Effective	Effective	Variable	Variable	Variable
Efficacy with Organic Matter	Reduced	Reduced	?	Rapidly reduced	Rapidly reduced	Variable	Effective	Inactivated
Efficacy with Hard Water	?	Reduced	?	Effective	?	?	Effective	Inactivated
Efficacy with Soap/ Detergents	?	Reduced	Inactivated	Inactivated	Effective	?	Effective	Inactivated

? Information not documented

DISCLAIMER: Use of trade names does not in any way signify endorsement of a particular product. For additional product names, please consult the most recent Compendium of Veterinary Products.



Cleaning and disinfecting



Clean before or after livestock?

- Clean right **before** next group
 - If it's dirty, it will stay dirty no matter how long you wait
 - Hard on equipment
 - Harder to clean
 - Environment for insects and/or rodents
- Clean right **after** this group
 - If it's clean, it will eventually get dirty if you wait long enough
 - Easier to “re-clean” if necessary
 - Long drying time
 - Have more time to do the job right!



Hot vs. Cold water

- Cold
 - Cheaper
 - Easy to see (no fog)
 - Less sweating
 - **Laundry study** showed 160 °F was just as effective as 72 °F in reducing bacterial counts (Blaser et al, 1984)
- Hot
 - Reduction of labor time!

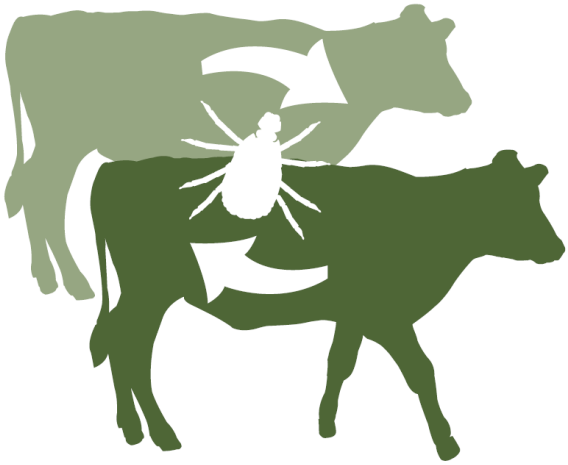


Monitoring

- Regular veterinary herd health visits
 - May include biosecurity audits
 - Cleaning and disinfection checks
- Cultures for specific bacterial organisms
- Testing for specific agents
 - Routine testing
 - Sentinel animals



Vectors



www.pestvictoria.com



Pest control

- Sanitation
 - Garbage
 - Feed spills
 - Manure spills
- Insecticides
- Rodent control
- Pets
 - Cats & dogs



Rodent Control

- <http://rodent.swine.unl.edu/>
- Gravel perimeter
 - 2 – 3 feet wide
 - 6 inches deep
 - ½ - 1 inch rock
- Bait stations
 - Location
 - Professionals?
 - Records



Direct contact



Animals are #1

- Know source
- Minimize sources
 - Average vs. Lowest
- Testing
- Herd health program



Summary



Biosecurity

- Most interventions are expensive
 - Transport ~\$200 - \$400/trailer
 - Shower system ~\$5/employee/day
 - Boar Stud monitoring ~ \$.80/dose
 - Multiplication ~ \$25 per gilt or boar sold
 - Isolation facility/monitoring ~ \$15/gilt
 - Insects and Rodents ~ \$.25/pig
 - Training - ?
 - Filters – Electrostatic & other technologies?



Best Biosecurity

- Look at animals daily preferably 2x/day
- Maximize
 - Management
 - Nutrition
 - Environment
 - Health program (vaccination)
- Routes of transmission



BIOSECURITY



• **THINK!!**



Don't Forget!

Frequency

Risk = X

Consequence





WASH YOUR HANDS

- Wet hands and forearms with warm water
- Add at least 3-5 mls of soap (the size of an olive)
- Lather up and vigorously scrub each side of the hands beyond the wrist for 10-30 seconds, cleaning under rings and scrubbing dirty fingernails
- Rinse under warm water until no soap residue remains
- Turn off running water with a paper towel, not bare hands
- Dry hands with paper towel or hot air dryer



the Center for
Food Security
& Public Health
IOWA STATE UNIVERSITY*



Resources

- **General Disease Information:**
<http://www.cfsph.iastate.edu/>
- **General Prevention: (see left column)**
http://www.cfsph.iastate.edu/Infection_Control/general-prevention-for-producers.php
- **Disinfectant Resources:**
http://www.cfsph.iastate.edu/Infection_Control/disinfectant-resources-for-veterinarians.php



Questions?

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CBP Homeland Security







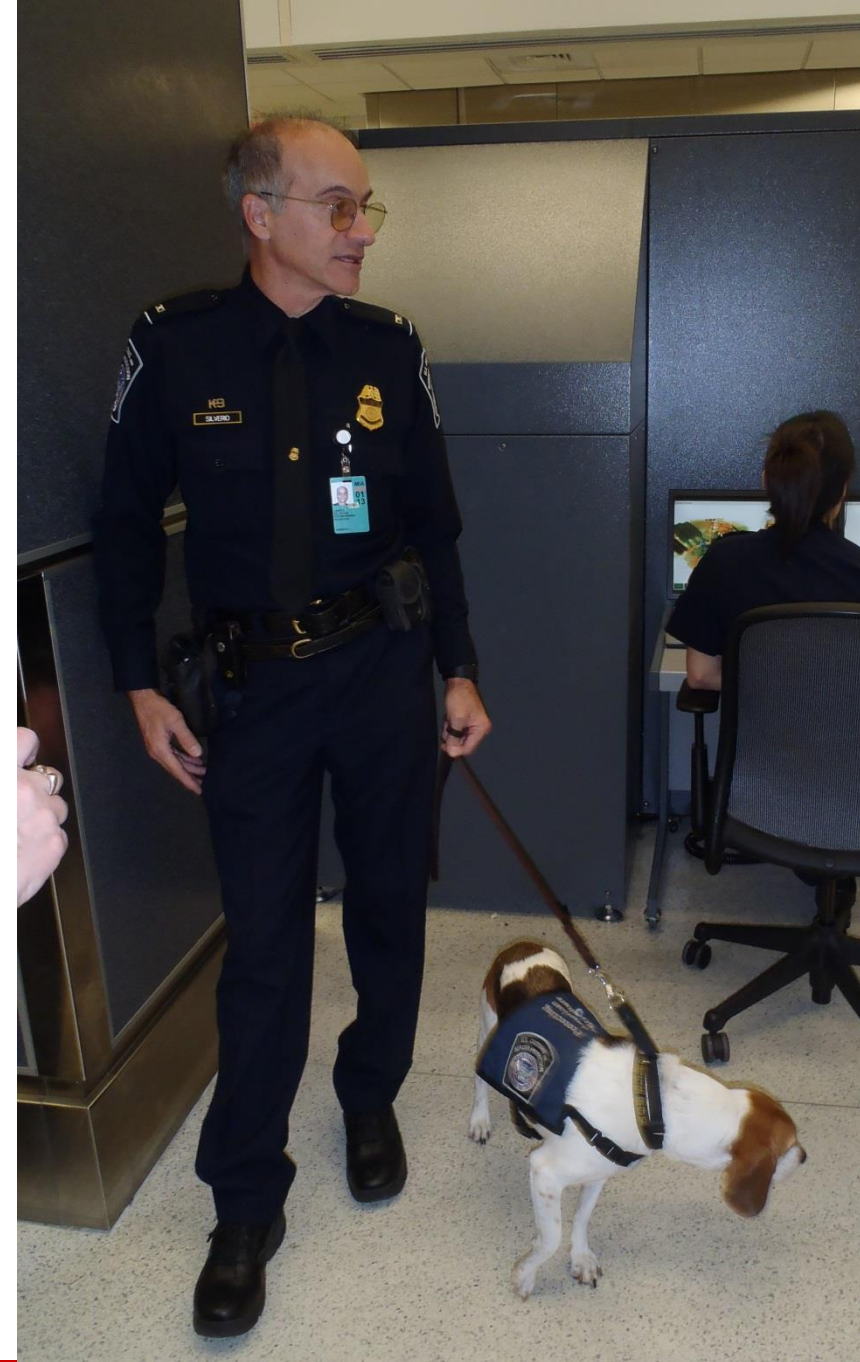




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