

Occupational and Environmental Concerns of Veterinary Pharmaceuticals, Biologicals and Antibiotics

Kelley J. Donham MS, DVM, DACVPM
Emeritus Professor
College of Public Health, University of Iowa

319-530-6002 kelley-donham@uiowa.edu

Nebraska July 13, 2022

Topics De Jour

- **Pharmaceuticals used in livestock production & Human Health Risks**
- **Where do they get it**
- **Regulations of use**
- **How are people exposed**
- **Immunization products**
- **Antibiotics**
- **Hormones**
- **Needle sticks**
- **Prevention**

So what is used in Animals & why (emotional vs. factual perspective)



Product	Why Used
Biologicals	Increase immunity to infections (all animals)
Antibiotics	<ul style="list-style-type: none">• Treatment of infections• Growth promotion• Prevention
Hormones:	<ul style="list-style-type: none">• Treatment – obstetrics, catabolic state• Estrous synchronization• Growth promotion

Where do producers get Vet Drugs?

- Most over the counter from local farm store (except DVM Rx)
- Farm service and supply companies
- Online
- Mail order



Regulation and Control of Drugs Used in Animals

- **USDA and FDA**
 - Regulate for safety and effectiveness
 - USDA – Animal Vaccines
 - FDA – Animal and Human Drugs.
- **Vet Rx drugs** require a veterinarian to properly diagnose, treat, and administer the drug according to labeled directions
- **FDA Veterinary Feed Directive** – (2017- Vet oversight to reduce low level antibiotics for growth)
- **Veterinarians can use drugs** approved for humans in pets, **non** food animals

Prevention of Animal Drugs in the Food Chain (Producer, Regs, Vets)

- **On the farm**
 - **Producer**
 - **Vet**
 - **USDA**

- **At the processing/slaughter plant**
 - **Sampled for bacteria, hormone & antibiotic residues before a food item**
 - **USDA: Meat**
 - **FDA: Milk, Eggs**

- **At the Store**
 - **USDA - randomly sampling**
 - **Local Health Departments**



How are Producers Exposed?

- Needle sticks
- Direct contact
- Inhalation
- Prevention for allergic workers
 - PPE
 - Respirator
 - safety glasses
 - nitrile gloves



Self Injection Injuries

- > 80 % of farmers self report self injecting^{1,2} in previous year
- Current techniques need to change
- Particularly if using injections with **oil based adjuvant**

References

1. Sustainable Farm Families program participants
2. RIST Sheep Health courses participants

Stuck by One of These Needles?

- Multiple use needles common in cattle and swine = **Hazard**
- Trauma (large bore, barbed needle)
- Contaminated (feces & skin surface organisms)
- Toxic/infectious material in syringe
- Highly concentrated products for large animals



Human Hazards from Animal Biologics (Immunization Products)



- Biologics (e.g., vaccines) used to prevent infections
- Hazards from:
 1. Inflammation
 - Oil adjuvants
 2. Infection from the product

What biologic injections may cause harm to humans?

- Live products infections:
 - RB51 – Cattle Brucellosis
 - Erysipelas – Swine
 - Contagious Ecthyma – Sheep
- Killed products = Inflammation
 - E Coli
 - Johne's disease – Cattle, Sheep
 - (disease like Crohn's in humans)
 - Circo virus – Swine



Accidental Inoculation with Gudaire vaccine in ovine



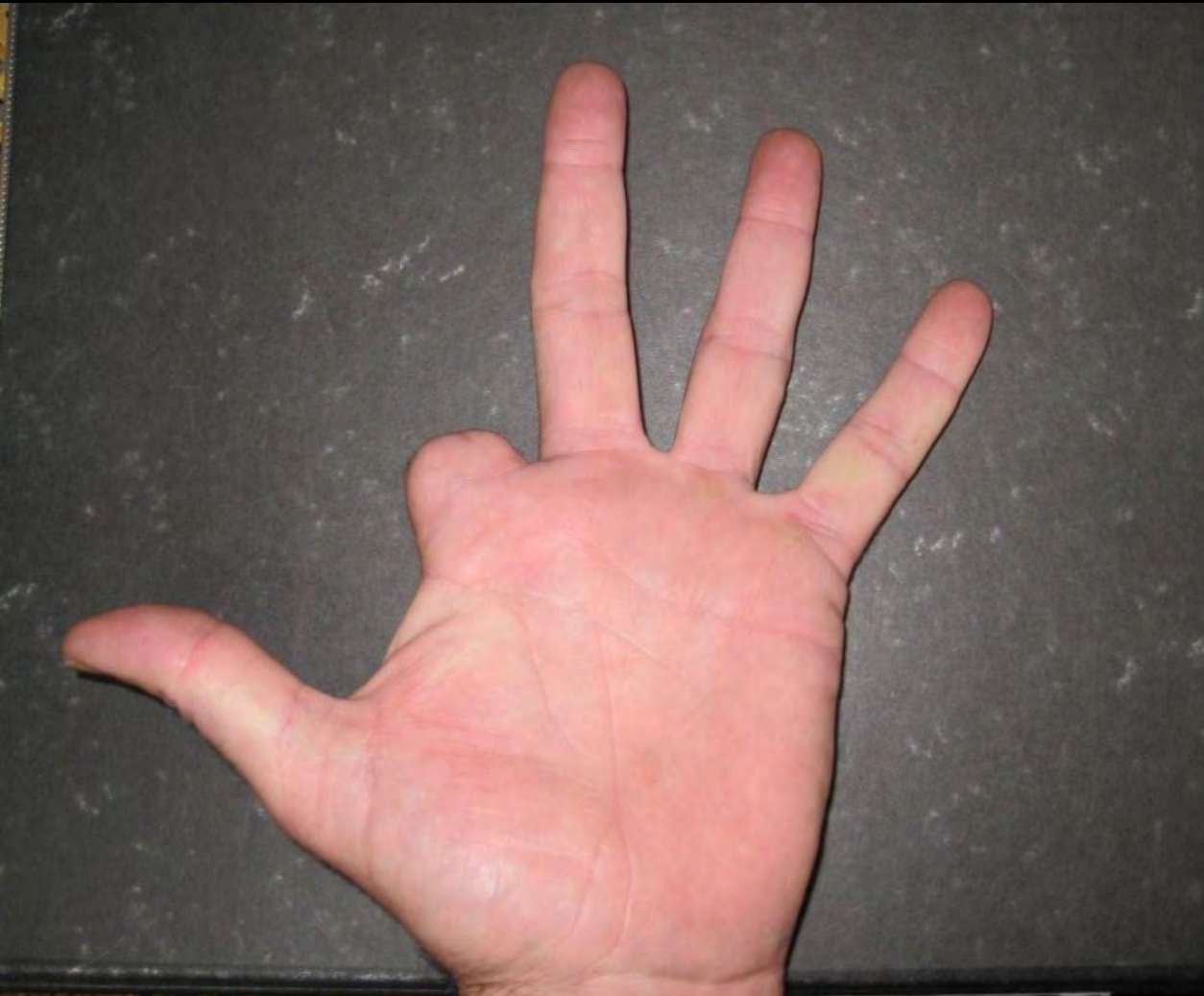
4 operations over 5 months after self injection of Gudair vaccine



5 months after self injected Gudair Vaccine

Oct

Accidental Vaccination with Gudair vaccine



- **Oil adjuvant** is
Mobile &
inflammatory
in tissue

- **4th operation**
to amputate
finger saved
the hand

Hazards of Antibiotic Use

Use of antibiotics in Agriculture

■ In Animals

■ Treatment –

- Specific antibiotic
- Specific condition
- Specific dose
- Specific length of time

■ Prevention – used @ treatment levels in an outbreak

■ Growth Promotion

■ Orchards

Streptomycin use in apple orchards did not increase abundance of mobile resistance genes

Duffy et al; *FEMS Microbiology Letters*, Volume 350, Issue 2, January 2014, Pages 180–189

■ Ethanol plants

- Paulus 2013, *J Amim.Sci* 91(5) pp2395-404.

Antibiotics as feed/water additives

- Sub-therapeutic levels
 - Faster growth with less feed (1% – 4% gain)
- Treatment levels
 - For sick animal
 - Prevent herd outbreak
- Risks – Resistant infections in animals, producers, public



Tilmicosin (Micotil)

Possible Acute hazard !



- ❖ 34-year-old farmer administered Micotil® to cows for respiratory infection.
- ❖ Put syringe in his pocket
- ❖ Cow kicked him driving 2 cc into his inner thigh.
- ❖ In 15 minutes feeling ill.
- ❖ Taken to his local hospital.
- ❖ Died 2 hours later of cardiac failure

Tilmicosin (Micotil®)

- A macrolide antibiotic
- Used in ruminants for respiratory infections
 - 81,000 beef feeding operations in U.S.
 - 65,000 dairy farms
- Cardio-toxic to primates, horses, pigs
 - Calcium channel blocker
- Sx:
 - Pain at injection site
 - Chest pain
 - Ventricular arrhythmia
 - Hypotension

Tilmicosin (Micotil[®]) poisoning cases

- **2,392 cases world-wide from 1992-2000**
- **2,200 reports U.S. (2017)**
 - **Mostly spray to the eyes, nose, mouth, skin (strong irritant)**
- **25 deaths (16 possible suicides)**
- **700 – 1400 mg fatal to humans (2 – 4 cc)**
- **Rx only from DVM**

<https://www.avma.org/News/JAVMANews/Pages/171115j.aspx>

Tilmicosin (Micotil[®]) – Treatment

- **Slow the absorption (ice packs, tourniquet)**
- **Dog studies**
 - **IV Calcium**
 - **Dobutamine (Beta agonist)**
- **Get to the ER**
- **Cardiac monitoring**
- **Avoid**
 - **Epinephrine**
 - **Beta blocker/sympatholytic (e.g., propranolol)**

Tilmicosin (Micotil[®]) – Prevention

- **Responsible people:**
 - Veterinarians, Health Care Providers, Farmers, Employers, Workers, drug companies
 - **Substitute to safer antibiotic**
 - Enrofloxacin (Bytril) Class fluoroquinolone
 - Tulathromycin (Draxxin) Class Macrolid
 - Florfenicol (Nuflor) Class Chloramphenicol
 - **Proper restraint of animals**
 - **Education: includes emergency procedures**
 - get signature of understanding
 - **Proper storage**
 - **Proper sharps disposal**
 - **One dose per syringe fill**
 - **Keep needle cover on until use**
 - **Do not carry loaded syringe in pocket, mouth**

1. Chronic Health Risks of Antibiotics

Antibiotic resistance

1. General

- **Animals rapidly develop resistant gut flora**
- **Build-up of resistant organisms in the environment**
 - **↑ Shedding**
 - **↑ Mutation/ transduction/conjugation**

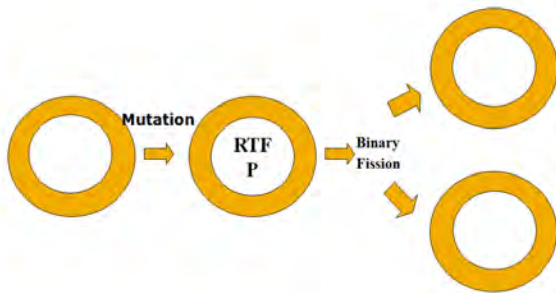
http://www.bsas.org.uk/about_the_bsas/issue_papers/antibiotic_use_in_farmed_livestock/

2. Chronic Health Risks of Antibiotics

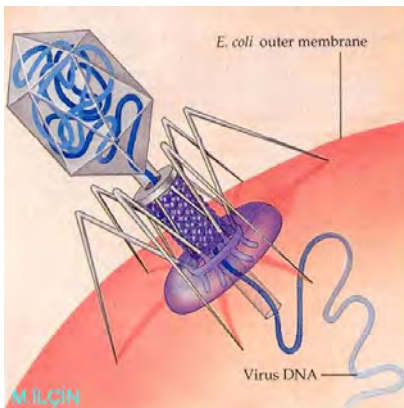
2. **Occupational contact - animals/feed/environment**
 - **Farmers rapidly take on resistant patterns of animals**
3. **General public (low risk)**
 - **Food chain**
 - **Water contamination**
4. **Health effects?**
 - **Enhanced growth of existing resistant pathogens**
 - **Methicillin Resistant S. aureus ? (MRSA)**

How Bacteria Gain Antibiotic Resistance

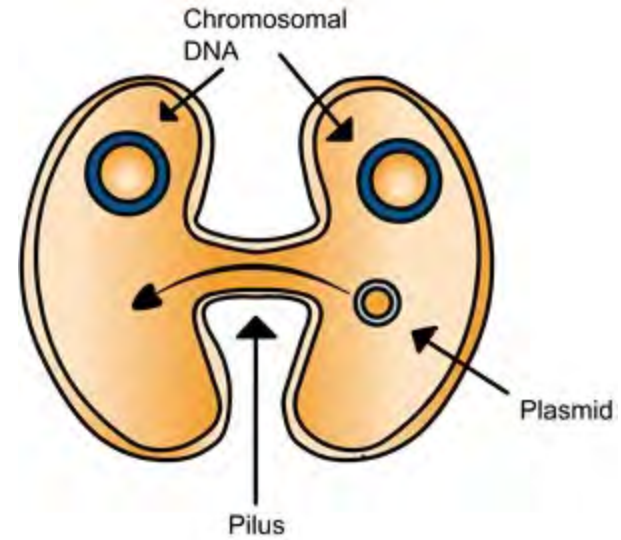
CHANCE MUTATION & BINARY FISSION



Bacterial phage



CONJUGATION



Methicillin Resistant Staph aureus (MRSA)

- Is this the “smoking gun” for overuse of antibiotics?
- Pigs, Cattle, Poultry, Pets
- Swine strains also resistant to tetracyclines



Environmental Risks:

- Found in lagoons, drainage ditches, drainage wells, test wells, and field tiles:
- Antibiotics, resistant bacteria, pharmaceuticals, and trace minerals (Cu, Se) from animal feeds



Hormones Used in Livestock

Treatment

1. Oxytocin (may cause abortion in women)
 1. Dystocia
 2. Milk let down
2. Prostaglandins (may cause abortion in women)
 1. Not cycling , pyometra, Retained placenta
 2. Synchronization
3. Anabolic Steroid (Trenbelone) (misused in body builders)
Increased appetite, manage stress in cattle



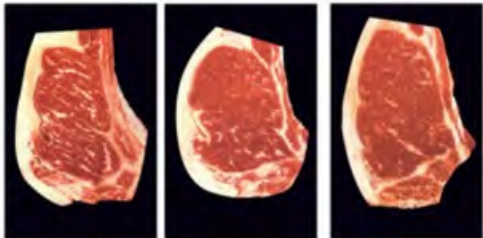
Cow being transported.

Hormones Used for Production

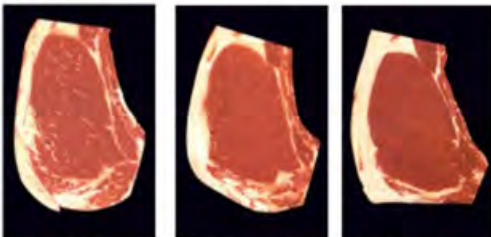


Increased Growth/ on less feed

- **Estrogens** (growth promotion in steers & meat quality)
- **Progesterone & testosterone** (used to increase performance in Heifers, or synchronized)
- **Bovine Growth Hormone** – Dairy Cows increased milk production
- **Ractopamine** (Beta Adrenergic agonist (adrenalin-like) swine and Cattle)



Moderately Abundant Slightly Abundant Moderate



Modest Small Slight



Prevention of of Needle Sticks



Donham, K, Rendell, D. Health Risks to Veterinarians and Associated Personnel: Handling Pharmaceuticals and Biologicals. The American Assoc. Bovine Practitioners Proceedings, 42:14-17, 2009.

1. Restraint and Animal Handling facilities
2. Often a two person job
3. Safety and Humane considerations

Not This



Temple Grandin

This



Better
this



Needle Sticks: Consequences and Prevention

Kelley J. Donham MS, DVM, DACVPM

Professor and Director, Iowa's Center for Agricultural Safety and Health, University of Iowa

kelley-donham@uiowa.edu

David Rendell BVSc MACVSc MRCVSc

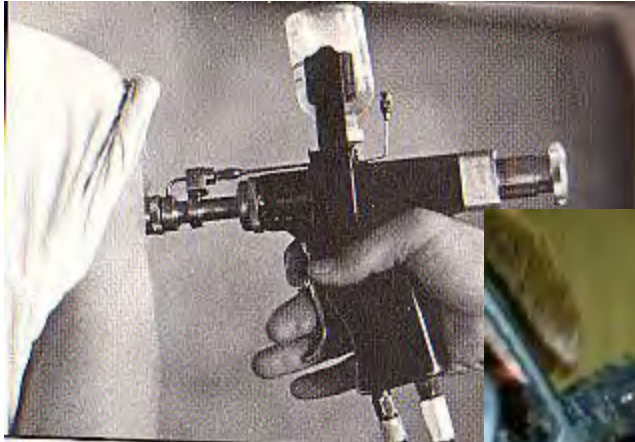
170 Mt Baimbridge Rd, Hamilton, Victoria 3300, Australia. drendell@bigpond.net.au



Proper equipment, Technique, and good cattle dogs = increased safety



Prevention - Needle-Free Injection



Needle-Free Injection System Available



David Cook of Felton International demonstrated the new Pulse® needle-free, cattle-injection system.
Photo courtesy of Felton International

Prevention of Accidental Needle Sticks – General

- (See Micotil prevention above)
- **Veterinarians**
 - Consider substitution of safer drugs
 - Proper restraint
 - Educate clients to whom you dispense
- **Employers**
 - Proper storage
 - Proper training (includes emergency procedures)
 - Proper sharps disposal
- **Workers**
 - Proper animal restraint
 - One dose per syringe fill
 - Keep needle cover on until use
 - Do not carry loaded syringe in pocket, mouth



Safe and effective sheep and cattle injection training program



David Rendell DVM and Associates
Veterinary consultants and practice
"Livestock Logic", Hamilton, Victoria, Australia
<http://www.livestocklogic.com.au/david-rendell/>

- 6mm (*1/4 Inch*) 18g needle
 - lambs
 - most vaccines

Longer needles increase risk of injury



- Conventional 12mm (*1/2"*) needle
 - mature woolly animals
 - intra muscular injections



Even better if
can avoid
putting arm
through rail



Raised walkway
safer

Key Points - 1

- Most animal products available OTC
- FDA and USDA regulate animal products for animal safety and effectiveness, and food safety
- Needle sticks are a major risk
 - Acute toxicity (Tilmicosin)
 - Inflammation from adjuvants
 - Trauma
 - Environmental infections
 - Infection with live vaccines

Key Points - 2

- Hormones and antibiotics used for growth promotion. (antibiotics may be part of antibiotic resistance in humans)
- Prevention
 - Substitute for hazardous products
 - Good animal handling facilities
 - Safe Injection training of workers
 - Sharps management
 - Needleless injection

Thanks for your attention Lets keep these folks alive and well.



Questions? Email to Kelley-donham@uiowa.edu

Post Test: Vet Pharmaceuticals

1.

- Many animal vaccines, antibiotics, hormones are available over the counter.
 - True
 - False
 - Don't know

2. If an accidental needle stick occurs, which of the following pharmaceuticals may result in a medical emergency

- The hormone Estradiol (an estrogenic hormone) used for growth promotion in steers
- The antibiotic streptomycin
- **Tilmicosin (micotil)**
- Swine leptospirosis vaccine

3. Which two of the following will cause a risk for abortion in women from an accidental needle stick.

- Tilmicosin (micotil)
- Prostaglandins
- Bovine Growth hormone
- Oxytocin

4. Which are possible practices to help prevent needle sticks in livestock production operations
- Never carry a syringe in your mouth or put it in your pocket.
 - Always put the needle cover back on following injections.
 - Use the “one handed approach”
 - Have and maintain a functional and effective sharps container and management thereof.
 - Effective animal restraint.
 - None of the above
 - All the above

5. Which of these animal vaccines may cause an infection with the vaccine agent in the syringe from an accidental needle stick.

- **RB51 Brucellosis vaccine**
- E Coli vaccine
- Swine Circo virus vaccine
- Leptospirosis vaccine