Sanitation and proper use of animal health equipment used in processing and treatment of beef cattle should be a primary concern of both veterinarians and producers to ensure product quality and safety. Bacterial and viral nosocomial infections can occur in cattle as a result of improper sanitation of facilities and equipment. Zoonotic illnesses can occur in animal caregivers as a result of improper sanitation. Environmental contaminants such as Escherichia coli and Salmonella spp are spread between cattle by improperly sanitized equipment. Improper injection location, changing of needles, and inadequate cleaning of syringes can lead to injection site blemishes, scar tissue, or bacterial infections, which affect the quality and safety of the end product.

**BIOSECURITY: ISOLATION, TRAFFIC CONTROL, AND SANITATION**

The goal of a biosecurity plan is to prevent or control cross-contamination of feces, urine, saliva, and so forth between animals to prevent or control the spread of pathogens between animals. This plan should consider direct as well as indirect animal contact. Indirect contact considerations include animal to feed transmission and animal to equipment transmission. The 3 components of biosecurity are isolation, traffic control, and sanitation.
Isolation is the most important step in disease control, because it prevents direct contact between diseased or potentially infected cattle and healthy cattle. Preventing commingling of new cattle and existing groups of cattle is crucial to an effective biosecurity plan. Facilities used to segregate cattle should be cleaned between groups and disinfected if deemed appropriate.

Traffic control includes all traffic on an operation, animals, people, and vehicles or equipment. Animals to consider include all domesticated animals as well as rodents, birds, and other wildlife. Fecal contamination of feedstuffs such as silage or ground hay can be controlled by limiting traffic to the silage pit and hay pile to the loader designated to load feed. Another major concern of traffic control is limiting rendering truck access to an area of the yard that is away from all cattle and feeding activities.

Sanitation refers not only to the disinfection of people and equipment entering an operation but the cleanliness of people and equipment on the operation. Prevention of fecal–oral contamination is the primary goal of sanitation. Balling guns and drench guns are of primary concern for disinfecting between animals. Before disinfection, the equipment should be cleaned with soap and hot water at the end of each day and stored in a dry area.

Another major biosecurity consideration is loaders that are used to load feedstuffs. If these loaders are used for handling manure, dead cattle, or other nonfeedstuff products, they should be cleaned and disinfected before loading feedstuffs. Processing and treatment areas should be cleaned at the end of each day. This strategy reduces the likelihood of fecal–oral contamination not only of the cattle but of the caregivers as well.

The first step in sanitation is the removal of organic matter, primarily feces. Any blood or saliva present should also be removed. Disinfection should follow this cleaning. Physical contact between the disinfectant and proper contact time are crucial to ensure proper disinfection. The selected disinfectant should kill a broad spectrum of bacteria, viruses, protozoa, fungi, and spores. Other selection considerations include safety to both humans and animal, effect on equipment (corrosiveness), effect on environment, and cost (Tables 1 and 2).

**VETERINARY EQUIPMENT SANITATION**

Equipment used for processing and treating cattle should be cleaned and disinfected daily, after use. If this equipment becomes grossly contaminated with feces or other material while being used, it should be cleaned immediately.

Equipment such as balling guns and drench guns should be thoroughly cleaned at the end of each day and stored in a clean, dry environment. Disinfecting this equipment between animals is recommended. The disinfectant solution should be changed when it becomes cloudy or visibly contaminated to maintain effectiveness. Increased morbidity and mortality in feeder cattle have been associated with improper sanitation of this equipment in a feedyard hospital system having a high prevalence of *Salmonella* infection. Cohort cattle that did not go through the hospital system were found to have zero prevalence for *Salmonella* spp.

Disinfecting of blood-contaminated equipment between animals is essential. This strategy reduces the risk of transmission for pathogens such as bovine virus diarrhea virus, bovine leukemia virus, and various other blood-borne pathogens. Disinfection also reduces bacterial contamination and risk of disease transmitted animal to animal. This equipment includes dehorners, castration equipment, and various instruments used for minor surgical procedures. Thorough cleaning is necessary, followed by storage in a clean, dry area. Banding castration equipment should be kept free of feces.
<table>
<thead>
<tr>
<th>Compound</th>
<th>Chlorine 0.01%–5%</th>
<th>Iodine Iodophor 0.5%–5%</th>
<th>Chlorhexidine 0.05%–0.5%</th>
<th>Alcohol 70%–95%</th>
<th>Oxidizing 0.2%–3%</th>
<th>Phenol 0.2%–3%</th>
<th>Quaternary Ammonium 0.1%–2%</th>
<th>Aldehyde 1%–2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>Clorox</td>
<td>Tincture/provodine</td>
<td>Nolvasan</td>
<td>Vikron S</td>
<td>Lysol</td>
<td>Roccal-D</td>
<td>Wavicide</td>
<td></td>
</tr>
<tr>
<td>Bactericidal</td>
<td>Good</td>
<td>Good</td>
<td>Very good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Very good</td>
</tr>
<tr>
<td>Viricidal</td>
<td>Very good</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
<td>Excellent</td>
<td>Fair</td>
<td>Fair</td>
<td>Very good</td>
</tr>
<tr>
<td>Envelope viruses</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nonenvelope viruses</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Bacterial spores</td>
<td>Fair</td>
<td>Fair</td>
<td>Poor</td>
<td>Fair</td>
<td>Fair</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Fungicidal</td>
<td>Good</td>
<td>Good</td>
<td>Fair</td>
<td>Fair</td>
<td>Fair</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
</tr>
<tr>
<td>Effective in organic matter</td>
<td>Poor</td>
<td>Fair</td>
<td>Fair</td>
<td>Poor</td>
<td>Fair</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
</tr>
<tr>
<td>Inactivated by soap</td>
<td>No</td>
<td>Yes/no</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Effective in hard water</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Contact time (min)</td>
<td>5–30</td>
<td>10–30</td>
<td>5–10</td>
<td>1–30</td>
<td>10–30</td>
<td>10–30</td>
<td>10–30</td>
<td>10–600</td>
</tr>
<tr>
<td>Residual activity</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Fair</td>
<td>Fair</td>
</tr>
</tbody>
</table>

Adapted from Bek TJ, Griffin D, Kennedy J. Selection and use of disinfectants. NebGuide G1410: Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln; 2000 and Data from Refs. 5–9
and other gross contaminates between animals. Thorough cleaning at the end of the day is appropriate.

Cleaning and disinfection of obstetric equipment is an often neglected area. All obstetric equipment, calf pullers, chains, straps, head snares, and so forth should be thoroughly cleaned and disinfected after each use. If straps are being used rather than chains, extra attention should be given to making sure that the strap is clean and dry before storing. Chains should be allowed to dry completely before storing to prevent rusting.

One of the most consistent, positive returns on investment procedures in the cattle industry is the use of growth-promoting implants. For this practice to be effective, care must be taken to ensure that it is performed properly. Implant guns should be thoroughly washed with detergent and hot water after each use and allowed to dry. It is essential that the needles on these guns are sharp. If needles become dull or burred, they should be discarded rather than attempting to sharpen them. The ear should be free of feces and other gross contamination. If not, the ear should be cleaned with a disinfectant solution before placing the implant. A sponge or paint roller in a disinfectant solution should be available to clean the implant needle after each animal is implanted. If the needle skips off the ear, the needle should be disinfected before another attempt to implant is made.

### CARE AND CLEANING OF VETERINARY VACCINE SYRINGES

Inadequate care and cleaning of syringes used for routine vaccination of livestock can be associated with localized swelling and infection after vaccination. Swellings involving the injection site are common, particularly when vaccines such as clostridial vaccines are given subcutaneously. The subcutaneous use of oil-adjuvanted vaccines also results in swelling of the injection site. If these swellings do not subside in a short period, if they become larger than a small hen’s egg, or if they become fluid filled, they may be infected and should be examined.

<table>
<thead>
<tr>
<th>Virus</th>
<th>Envelope</th>
<th>Virus</th>
<th>Envelope</th>
<th>Virus</th>
<th>Envelope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluetongue</td>
<td>No</td>
<td>Malignant catarrhal fever</td>
<td>Yes</td>
<td>PI3</td>
<td>Yes</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>No</td>
<td>Enteric coronavirus</td>
<td>Yes</td>
<td>Rabies</td>
<td>Yes</td>
</tr>
<tr>
<td>Papillomatosis</td>
<td>No</td>
<td>Respiratory coronavirus</td>
<td>Yes</td>
<td>Herpes mammillitis</td>
<td>Yes</td>
</tr>
<tr>
<td>Foot-and-mouth disease</td>
<td>No</td>
<td>Bovine virus diarrhea</td>
<td>Yes</td>
<td>Cowpox</td>
<td>Yes</td>
</tr>
<tr>
<td>Leukemia</td>
<td>Yes</td>
<td>Bovine respiratory syncytial virus</td>
<td>Yes</td>
<td>Pseudocowpox</td>
<td>Yes</td>
</tr>
<tr>
<td>Papular stomatitis</td>
<td>Yes</td>
<td>Infectious bovine rhinotracheitis/ infectious pustular vulvovaginitis</td>
<td>Yes</td>
<td>Lumpy skin disease</td>
<td>Yes</td>
</tr>
<tr>
<td>Vesicular stomatitis</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Proper cleaning of syringes begins with using hot water, soap, and a brush to clean the external surface and working mechanism of the syringe. Care should be taken to keep soap away from the luer tip of the syringe. After cleaning the external components, rinse the internal components with distilled or deionized water that is warmer than 82.2°C (180°F) by drawing the water into the syringe and squirting it out several times. All syringes, whether pistol grip repeaters or continuous feed syringes with vinyl tubing and vent spikes, can be cleaned in this manner. Soap and disinfectant should not be used on the internal components of syringes. Remove as much water as possible from the syringe and allow it to cool before use, because heat inactivates modified live viral vaccines. Some syringes may need to be disassembled to adequately clean them. Disassembly should be performed on a clean work surface followed by cleaning the components with hot tap water, avoiding the use of soap or disinfectant. If syringes are physically contaminated enough to require disassembly for cleaning, they should be boiled for 5 minutes in deionized or distilled water. Plastic, continuous feed syringes can be sanitized after cleaning, if necessary. The syringe and tubing should be filled with distilled water and wrapped in multiple layers of paper towels. After soaking the paper towels in water, the syringe is placed in an unclosed zip-lock bag. This bag is placed in a microwave oven for 5 minutes using the high setting. Care should be taken that the paper towels do not dry out during this process. Syringes should be individually microwaved when using this method. After the syringes are removed from the microwave, any water remaining in them should be squirited out and the syringe allowed to cool before using.

Syringes should be reassembled while hot, using lubricant such as vegetable oil spray on the rubber plunger. Others recommend using the first draw of vaccine as the lubricant, thus avoiding silicone, mineral oil, or Vaseline. There does not seem to be a consensus as to what is acceptable (nonviricidal) in regard to syringe lubricant, because still others recommend the use of silicone or Vaseline. This is an area that warrants further investigation.

Once assembled, the syringe should be rinsed several times with water warmer than 180°F. After cooling, the syringes should be stored in a clean, dry environment, such as a new zip-lock bag that is placed in a freezer. Syringes should be allowed to warm to room temperature before filling with vaccine. Warming the syringes by artificial means may result in hot spots in the syringes, which have the potential to damage the vaccine.

Syringes should be labeled to ensure that the same product goes in each syringe every time cattle are worked. This strategy eliminates the possibility of trace amounts of a vaccine or pharmaceutical remaining in a syringe and having a detrimental effect on the next product in the syringe. It also ensures that syringes are not filled with the wrong product during processing.

TRANSFER NEEDLE MANAGEMENT

Transfer needles should be cleaned in a manner similar to syringes, after using a stylet to remove rubber plugs from the needle, using hot water without soap or disinfectant. Once cleaned, there are several methods that can be used to ensure that the needles are sterile. These methods include:

1. Boiling in distilled water for 5 minutes. After cooling, the needles should be stored in a clean, dust-free container.
2. Microwaving the needles in a cup filled with distilled water. Use the high setting to bring the water to a boil. Once the water boils, continue for 1 minute. Be sure the needles are completely covered with water during the entire process. Once again, the needles should be stored in a clean, dust-free container after cooling.
3. Wrap the needles in several layers of paper towels. Soak the paper towels in water and place in a zip-lock bag. Place the unclosed zip-lock bag in a microwave for 2 minutes using the high setting. The paper towels should remain wet during the process. Store appropriately when cool.

4. Autoclaving works well if such equipment is available. The clean needles are placed in a 12-mL disposable syringe case or multiple needles in a 20-mL syringe case. The cap is held in place with autoclave tape. After autoclaving, the syringe cases work well for clean, dust-free storage.

**NEEDLE SELECTION AND MANAGEMENT**

The size of needles used for processing and treatment of cattle should be adjusted according to cattle size, viscosity of product injected, route of administration, and type of restraint to be used (**Table 3**). Use the smallest needle possible to easily administer the product, yet large enough to prevent the needle from bending or breaking off in the animal. The use of disposable needles is recommended, because they are sterile and are sharp. Using steel needles that are reusable is discouraged, because they are difficult to sterilize and keep sharp. Improper needle management results in injection site lesions that requires trimming during harvest or fabrication.

Needles should be changed before they become dull, preferably every 10 to 15 head. In addition, they should be changed immediately if the needle bends, becomes contaminated with feces, dirt, or chemicals, or if the needle point is damaged. In herds that are known to be infected with pathogens that are blood borne, consideration should be given to changing needles after each animal. Never use a needle that is bent, because this increases the likelihood that the needle will break off in the animal being injected. It is considered an emergency situation when a needle breaks off in an animal. If this occurs, great effort should be made to find the needle immediately. If the needle cannot be found, the animal should be identified to be checked later. An animal that is known to have a broken needle in it should not be marketed for human consumption.

The best method for disposal of used needles is the collection of needles in a biohazard sharps container, which should be disposed of by a biomedical disposal company. An alternative disposal method is collecting the needles in a plastic jug or bucket and filling the bucket with cement powder and water before sealing it and disposing of it in a landfill. Used needles should never be disposed of individually in

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Needle selection guide</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route of Administration</strong></td>
<td><strong>Injectable viscosity</strong>&lt;br&gt;<strong>Cattle Weight</strong>&lt;br&gt;SQ (0.5–0.75 inch Needle)</td>
</tr>
<tr>
<td>Thin (gauge)</td>
<td>18</td>
</tr>
<tr>
<td>Example: Saline</td>
<td>18–16</td>
</tr>
<tr>
<td>Thick (gauge)</td>
<td>18–16</td>
</tr>
<tr>
<td>Example: Oxytetracycline</td>
<td>18–16</td>
</tr>
</tbody>
</table>

Select the needle to fit the cattle size (the smallest practical size without bending).

the daily trash. State law should be checked if one is unsure of the legalities of needle disposal in one’s local area.

VACCINE STORAGE AND HANDLING

For vaccines to induce adequate immunity, they must be shipped, stored, and handled in a proper manner, including the handling that occurs during administration. Although this factor is especially important for modified live vaccines, it applies to all vaccines whether modified live virus, killed virus, or a bacterin toxoid.

Refrigerators used to store animal health products come in all shapes and sizes, ranging from minirefrigerators to household-type refrigerators to glass-front display coolers. Many of the household-type refrigerators are used refrigerators purchased for the sole purpose of storage of animal health products. These refrigerators are found in a variety of places from the barn, to the shop, to the mudroom, or even the kitchen. Retailers such as feed stores and veterinary clinics are another common location for refrigerators used to store animal health products.

Two studies funded by state Beef Quality Assurance programs have evaluated how well these refrigerators cool. The first study evaluated 191 refrigerators. Of these refrigerators, only 51 (26.7%) operated within the desired temperature range greater than 95% of the time over the 48-hour test period. Thirty-eight (19.9%) operated at the correct temperature 66% to 95% of the time, whereas 34 (17.8%) operated properly 36% to 65% of the time and 23 (12.0%) were in the correct range 5% to 35% of the time. The remaining 45 refrigerators (23.6%) operated at the desired temperature less than 5% of the time. Nearly 43% of these 191 refrigerators were greater than 10 years old. The second study evaluated 176 refrigerators. Producer refrigerators accounted for 129 of the 176, whereas 47 were feedstore or veterinary clinic refrigerators. Forty (31%) of the 129 refrigerators operated at the correct temperature greater than 95% of the time, with another 19 (14.5%), operating properly 66% to 95% of the time. Forty-three (33.3%) were at the correct temperature less than 5% of the time. The retail coolers were similar, in that 16 (34%) were at the correct temperature greater than 95% of the time. Seven (14.9%) operated properly 66% to 95% of the time and 10 (21.3%), were at the correct temperature 36% to 65% of the time. Eight (17%) were found to be at the proper temperature less than 5% of the time.

The desired temperature range as defined for these studies was 2°C to 7°C (35°F–45°F), which is the temperature range commonly recommended by the pharmaceutical industry. Temperatures lower than 2°C (35°F) can be more detrimental than temperatures higher than 7°C (45°F) because of antigen–adjuvant separation. Temperatures higher than 7°C (45°F) are particularly detrimental to modified live vaccines.

Location of the refrigerators in this study seemed to account for a portion of the fluctuation of the temperature. Those refrigerators that were in a controlled environment maintained proper temperature in a more acceptable manner than did those that were located in an uninsulated building.

An interesting observation in these studies was the number of outdated products and open bottles of product, including modified live viral vaccine, that were found in the refrigerators evaluated. Of the 1800 products found in producer refrigerators in the first survey, 11.8% were outdated and 29.3% were open. The second survey found nearly 2260 products in the refrigerators, of which 20.5% were expired and 27.2% were open.

A summary of these 2 refrigerator studies includes the following:

1. Keep a thermometer in the refrigerator so that temperature can be monitored.
2. Do not use minirefrigerators for long-term storage.
3. Keep the refrigerator in a controlled environment.
4. Regular cleaning of the coil and compressor are essential, particularly if the refrigerator is located in a barn or processing shed.
5. Refrigerators that do not maintain temperature between 2°C and 7°C (35°F – 45°F) should be replaced.

When vaccine is taken from the refrigerator to chute-side, it should be stored in a cooler box with freezer packs. This strategy not only keeps the vaccine cool but provides for storage of the vaccine out of direct sunlight once it has been mixed. No more modified live viral vaccine should be mixed than is anticipated will be used in 1 hour. Open vaccine, whether modified live or killed, should be stored in the cooler box unless syringes are being filled. Modified live vaccine that has been mixed should be discarded when the cattle have been processed, because of the short life of the vaccine (≤1 hour).

Care should be taken to ensure that a used needle never enters a bottle of vaccine. A used needle can contaminate the remainder of the vaccine, resulting in injection site blemishes. The importance of cleanliness during processing is shown by the fact that dried nasal secretions from a calf persistently infected with bovine virus diarrhea (BVD) virus on the rubber stopper of a vaccine bottle transmitted BVD virus to a seronegative calf.1

The storage environment of nonrefrigerated pharmaceutical products such as antibiotics, anthelmintics, and topical insecticides should be considered. These products should be protected from freezing and heat, because either can cause damage to the product. If the rubber stoppers on stored bottles of product are damaged enough to not seal the bottle, the product may deteriorate because of exposure to air. These bottles should be capped in some manner, such as a roll-on rubber stopper, to prevent exposure of the product to air.

HYDRAULIC CHUTE MANAGEMENT

The operating pressure and thus the operating speed of a hydraulic chute are set by the manufacturer and should not be changed. Although this pressure setting varies between manufacturers, the basic guideline is 272 kg (600 lb) of squeeze pressure measured at the bottom of the squeeze panel drop gates using a pressure bar between the 2 squeeze panels (D.D. Griffin, personal communication, 2015). For this pressure to be accurate, the distance between the bottom of the squeeze panels should be slightly narrower than the distance between the squeeze panels at the bottom of the drop gates (simulate shoulder width vs stance width).

The chute operator should always use 2 hands on the controls. This technique allows for smoother handling of the cattle and reduces the bruising that can be associated with processing. Before cattle enter the chute, the distance between the bottoms of the squeeze panels should be observed. This distance should be approximately the stance width for the class of cattle being processed. If this distance is too narrow, excessive pressure will be applied to the animal when the squeeze is applied. As the operator prepares to let cattle enter the chute, the tailgate is opened with the squeeze slightly closed and the headgate open no wider than the animal’s shoulders.

As the animal proceeds into the chute, it is slowed with the squeeze panels to prevent it from slamming into the headgate. The headgate is closed, the tailgate closed and then, if necessary the squeeze panels. When releasing the animal, the headgate should be opened first, then the squeeze released. When this sequence is followed, the cattle tend to move forward, without the use of an electrical prod. If the squeeze is released before opening the headgate, the cattle tend to back up, necessitating prod use in many instances. The use of low-stress handling practices before the animal enters the chute can reduce the risk of injury and problems associated with hydraulic chute use.
SUMMARY

Proper health equipment management requires significant attention to detail. Establishing and following protocols during processing (eg, cleaning and disinfecting equipment at the end of the work day) is required to ensure a safe product that is free of defects and residues. In this age of increasing production transparency, overall cleanliness of equipment and facilities is important not only from a food safety standpoint but many view these as an overall indicator of attention to detail in the entire production system. Therefore, ensuring that needles are changed, implant guns are managed properly, vaccine is handled in an acceptable manner, and proper chute operation occurs is essential.

REFERENCES