Medical Design for a Total Animal Health Care System

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Veterinarians have diagnosed enteric and pneumonic diseases of cattle for many years. Isolations of numerous causative organisms have been made. Vaccines have been produced against some of these organisms. New methods of vaccine and monoclonal antibody production are now being offered via genetic engineering. Regimes for treatment have been offered, however diseases often continue practically unabated. Evidence for this conclusion is drawn from the yearly mortality rate of 7-20% in dairy calves in the United States (Jenny et al. 1983).

The role of environment in disease states must be addressed because sufficient numbers of disease organisms can, in fact, overwhelm an animal's immune mechanism. One of the major factors contributing to animal susceptibility to disease is size of inoculum (numbers of organisms involved in the exposure process). A second factor which influences the ability of a disease to establish itself is virulence of the organism. An increase in virulence by an organism is achieved via its serial passage through susceptible individuals.

An animal's total defense mechanism consists of a number of parts. If moderate to high numbers of organisms with sufficient virulence enter an animal's body, one or several of these defense mechanisms may be overwhelmed and disease can result. Further, an improper environment serves as a stressor and provides a means whereby diseases are unintentionally perpetuated. Ongoing experimental and clinical research programs have indicated that environment does in fact play a major role in exposure, infection and perpetuation of disease (Anderson and Bates, 1979; Bates and Anderson, 1979; Anderson, Bates and Jordon, 1978).

As a result of environmental stress, there is an elevation of an animal's corticosteroid levels and the animal's body defense mechanisms are thereby depressed. In addition, if rations are formulated with higher levels of iodine than is required for proper thyroid function, the animal's defense mechanisms may be further suppressed, often with disasterous results (Anderson, 1980; Olson et al. 1980; Haggard et al., 1980).

Calves which recover from severe enteric or respiratory diseases depending on the causative organism, seldom achieve optimum growth rates (Anderson, 1976; Bates, 1976; Anderson and Bates, 1979). Many of these animals are stunted and are often inapparent carriers of disease. They exhibit no outward clinical signs and continue to serve as reservoirs disseminating disease organisms to non-immune animals which they contact.

Potential exposure of calves to older animals carrying disease on many livestock operations is often disregarded in the interest of economics of construction (Bates and Anderson, 1979). Epidemiological and environmental evaluation indicate that the proper individual animal movement within the total confines of a dairy should be in the following manner (Anderson and Bates, 1983):

1. A clean, pre-partum cow enters a clean, separate disinfected maternity facility (Anderson and Bates, 1983).
2. Immediately following birth, the calf has:
   a) A plastic navel clip applied.
   b) Necessary injections administered.
   c) Two feedings of colostrum within 6 hours (at least 1 quart per feeding).
   d) Its haircoat thoroughly dried.
   e) Immediate transportation to a clean calf hutch (except in extremely cold weather when the acclimation process should be applied).
3. The calf is weaned at the age of 6 weeks or whenever the animal is physically ready to be weaned and is consuming an adequate level of dry feed.
4. Two weeks following weaning, a calf is grouped with no more than 7 other calves in a "super-hutch."
5. At 4-5 months of age this group of 8 calves is moved to a more labor efficient building. They are separated from their older counterparts by a barrier wall. In addition, they have their own feed and water facilities.

Design errors which encourage disease are often made because friends or neigbhors are regarded as environmental experts and their advice is followed. Buildings are often built

with information provided by these well-intended but misinformed individuals. Livestock producers, builders and some design engineers often do not understand the construction principles which should be utilized to prevent disease rather than encourage its spread within a livestock operation.

This, in brief, explains the process whereby clinical and/or subclinical diseases become perpetuated in improperly designed confinement units for any species of animals. It is extremely important that professionals involved with buildings and ventilation design be aware of disease prevention through proper design, construction, operation and maintenance of confinement units.

It should be emphasized that any total animal health care program should be designed to fit the specific herd. No attempt should be made to make the herd fit a specific program.

Calf Hutch

The calf hutch provides semi-isolation thereby reducing exposure to infectious agents. The animal is housed outside and as a result it must be fed properly to cope with outside environmental temperatures. The ration may consist of whole milk, a high quality milk replacer, fermented colostrum or milk which is not grossly abnormal from cows which have been treated for mastitis. The usual whole milk ration is 10% of the calf's body weight; fed ½ in the morning and ½ in the evening. During extremely cold weather periods of any duration, however, this ration needs to be gradually increased to a level possibly as high as 20% of the calf's body weight per day. At these higher levels, however, the total daily intake of milk should be divided among three feedings. The best indicator of need for increased ration is the calf itself. A caretaker should always place a hand on the calf's loin or rib cage daily to ascertain weight loss. Due to cold weather, the small muscles attached to the individual hair shafts of the hair coat brings the hair erect to improve the insulating quality of the hair coat. This makes the calf appear larger and it would also appear as though the calf was gaining weight. This is deceiving, visually because the calf may actually be starving. It is therefore necessary to handle and examine the younger calves of the group daily. A good quality calf starter should be offered when the calf is approximately 1 week of age. Neither milk replacer if it is fed nor calf starter should contain iodine at a combined level greater than 1-2 mg/head/day. This amount is needed only for proper thyroid function. In addition, neither the calf milk replacer nor the calf starter should contain antibiotics.

In extremely cold weather (0°F and below), acclimation of the newborn calf to cold outside hutch temperatures may be necessary. This is best accomplished by placing the dry calf in a hutch which is housed inside of a larger building. This hutch should be used only during extremely cold weather. The larger structure housing the calf hutch should preferably be a shed which houses no older animals. The reason for this acclimation process is to prevent the calf from becoming hypothermic and hypoglycemic. Bedding within the hutch should be very heavy. The calf is then placed into an outside hutch when weather moderates. The bedding should be removed from this acclimation hutch before another calf is placed into the unit. The acclimation hutch is then disinfected (weather permitting) and re-bedded in order to reduce bacterial contamination. **Never place more than one calf in any calf hutch.**

At the age of six weeks the calf is weaned. The weaning process from either whole milk, milk replacer, fermented colostrum or normal appearing mastitis treatment discard milk is best achieved by feeding milk once a day, either in the morning or in the evening, for one week. The other daily feeding should consist of warm water which is placed in the milk pail to allow free access by the calf. In addition, during cold weather there are periods of time when oral electrolytes are indicated. These are added to this warm water. During the course of the weaning period close attention should be paid to the total daily feed consumption to be certain that adequate levels of grain and hay rations are being consumed before the calf is taken off milk completely. Growth rates while the calf is housed in the calf hutch should be at least 1 pound per head per day or greater.

Super Calf Hutch

Raising healthy dairy calves in individual calf hutches has become a common practice. Calf growth rate in these units is excellent with proper nutrition and management. At about 8 weeks of age, however, calves outgrow hutches and alternative housing is required. Difficulty may then be encountered on most farms because there is a general lack of suitable housing for calves of this age. They are often moved to an "old chicken house" to a lean-to along the side of the barn or to a pole building housing older animals. Competition for feed and group status results in stress. Exposure to infections from larger animals during this time often precipitates disease. Healthy calves introduced into undesirable conditions after being raised in the semi-isolation of a calf hutch may contract pneumonia and some may die. Surviving calves often do not do well. However, the greatest loss is that the animals never will produce up to their genetic capability. Chronic disease can severely limit genetic potential (Anderson and Bates, 1982).

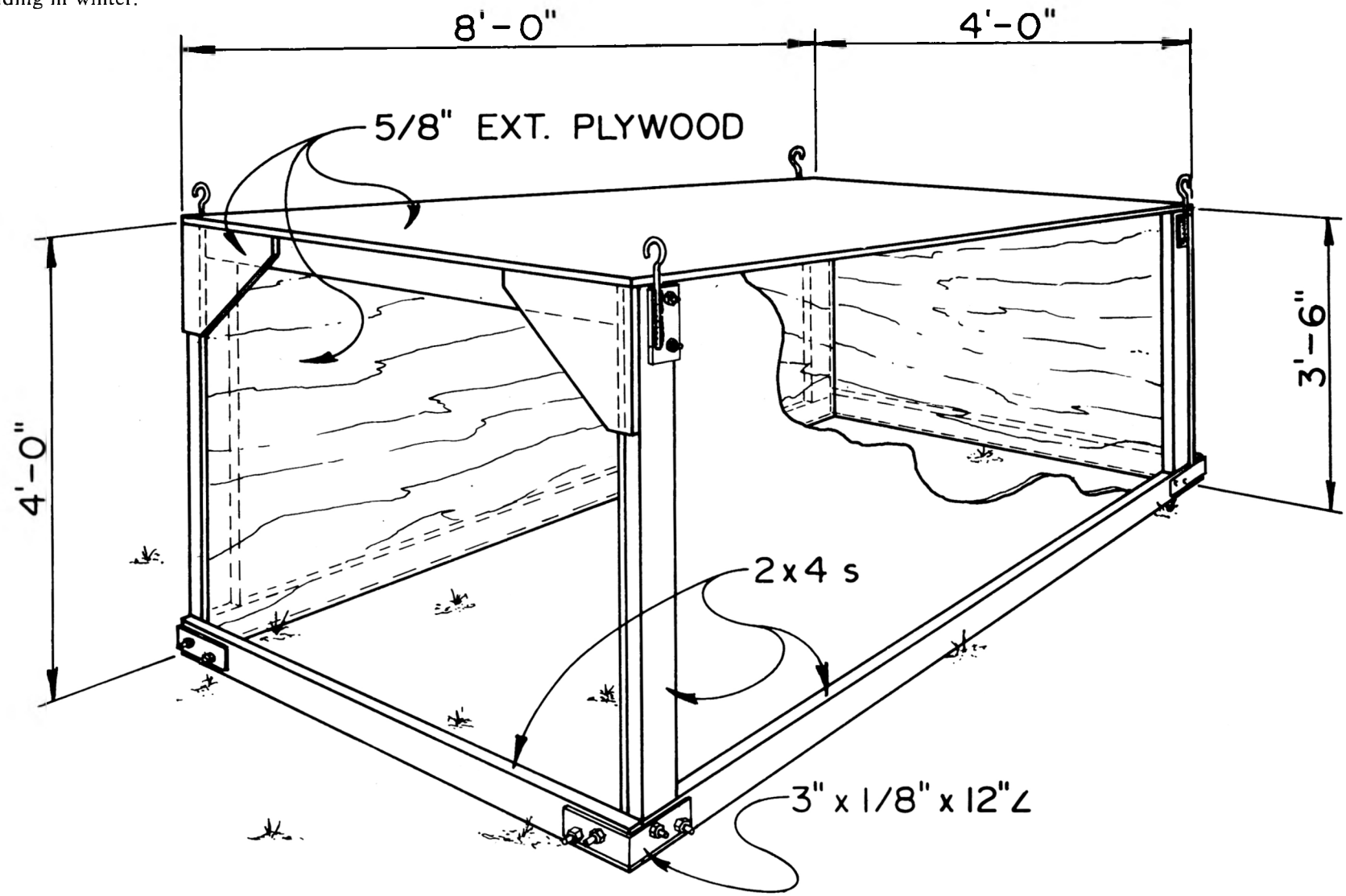
Movable for Cleaning

The super calf hutch is a 12 x 19' semi-portable unit built on skids. It is a frame construction covered with plywood and has a shed roof. Straw or other suitable material is used for bedding as in the calf hutch.

Hinged doors are located at the base of the end walls running the full width of the unit. The sills of the end walls are raised to accommodate these end openings which are unobstructed when either door is opened. These doors are

Figure 1: *The Calf Hutch*

The drawing above shows construction details for an open front plywood calf hutch. A 2 x 6 can be used across the base of the open front if desired as a further aid in retaining deep bedding in winter.



OPEN FRONT PLYWOOD CALF HUTCH

Figure 1 (Continued): *The Calf Hutch*

In the photo above, note the grain box on the interior wall which is hinged to open to the outside. In fair weather, the calf spends much time outside of this structure.

intended for use only when the unit is moved prior to cleaning. One end door is fastened open and the super hutch is pulled in the opposite direction with a tractor—a procedure prohibited only when the super hutch is frozen in place during winter. The manure is left in a pile for easy removal with a loader.

Because the super hutch is intended for year round use, its design must allow for maintenance of proper environmental conditions during sub-zero temperatures on a windy day as well as the hot summer day when there is little, if any, air movement. To accomplish this, adjustable openings are provided in both the front and back walls (Bates and Anderson, 1983).

Calf Restraint

An important feature of the super calf hutch is the restraint unit. This provides safety for the animal and safety and convenience for the caretaker during processing procedures. A small wooden stanchion built into the left front of the building is uncovered when the horizontally hinged front panel is lifted. It is always exposed in summer because the front doors of the building are then fully open.

A swinging plywood panel is attached to a front post. This is hinged vertically to form a chute which directs the calf into the wooden stanchion. The calf being processed is then firmly restrained between this panel and the outside wall. This arrangement provides safety for the caretaker who stands outside of this panel.

From the veterinarian's standpoint, this restraint permits safe, easy efficient handling of animals. The procedure being performed then becomes the main focus of attention rather than the safety issue.

Feeding is accomplished outside of the super hutch in a small yard. This area is formed using movable steel gates or other portable fencing material. The feed bunk and water supply are accessible to the calf through the gate panels opposite the building.

The super hutch (12 x 19') and the outside feedlot (16 x 19') should be located on a concrete slab (30 x 42') more than twice the length and width of the building and feedlot. The slab should be crowned at the center with respect to its length to allow rain and snow melt to drain to either end.

Careful thought must be given to the winter water supply. A good approach for a permanent water installation is to provide a single compartment frost-free waterer placed to serve one super hutch. The water supply should be located in the center of the slab to accommodate each move of the building.

Super calf hutches perform well in winter. They have been tested under severe weather conditions with temperatures ranging as low as -20° F with a wind chill of -90° F. Calves in the three experimental units remained in excellent health and good physical condition.

The Heifer/Dry Cow Facility

Calves at 4 to 5 months of age are moved to a more labor efficient building which houses older animals. Newly introduced individuals should be separated from their older counterparts in this structure by a 7 foot high barrier wall (usually constructed of 1 x 6" oak or elm boards). The reason for the placement of this barrier wall is to minimize the size of inoculum (numbers of organisms) transmitted from the older animals to the younger recently introduced animals (Bates and Anderson, 1979). Prior to the movement of these calves into the building, they are vaccinated with an intranasal infectious bovine rhinotracheitis (IBR) and parainfluenza-3 (PI_3) vaccine. This vaccine is used because of its characteristic of initiating production of interferon and IGA antibody. It has been shown that interferon prevents viral entrance into cells. IGA antibody is produced locally (upper respiratory) in response to the antigen which also helps to protect the animal.

Naturally ventilated buildings having a continuous open ridge have been found to work well for housing dairy herd replacements. These buildings may have one side open and a continuous row of ventilation doors in the opposite wall or they may have both sides closed with a continous row of ventilation doors around the entire periphery of the building. The bottom of the ventilation doors should be about 4 feet above the floor and the doors should be at least 3 feet in height. Space does not permit a detailed discussed of natural ventilation design. Exhaust air is conducted through an unobstructed open ridge in the "stack effect" (Heinrichs, 1962). This system reduces aerosol transmission between pens because of the upward air movement as well as the large volume of air removed from the naturally ventilated building. Dilution of infectious aerosols plays a role in disease control.

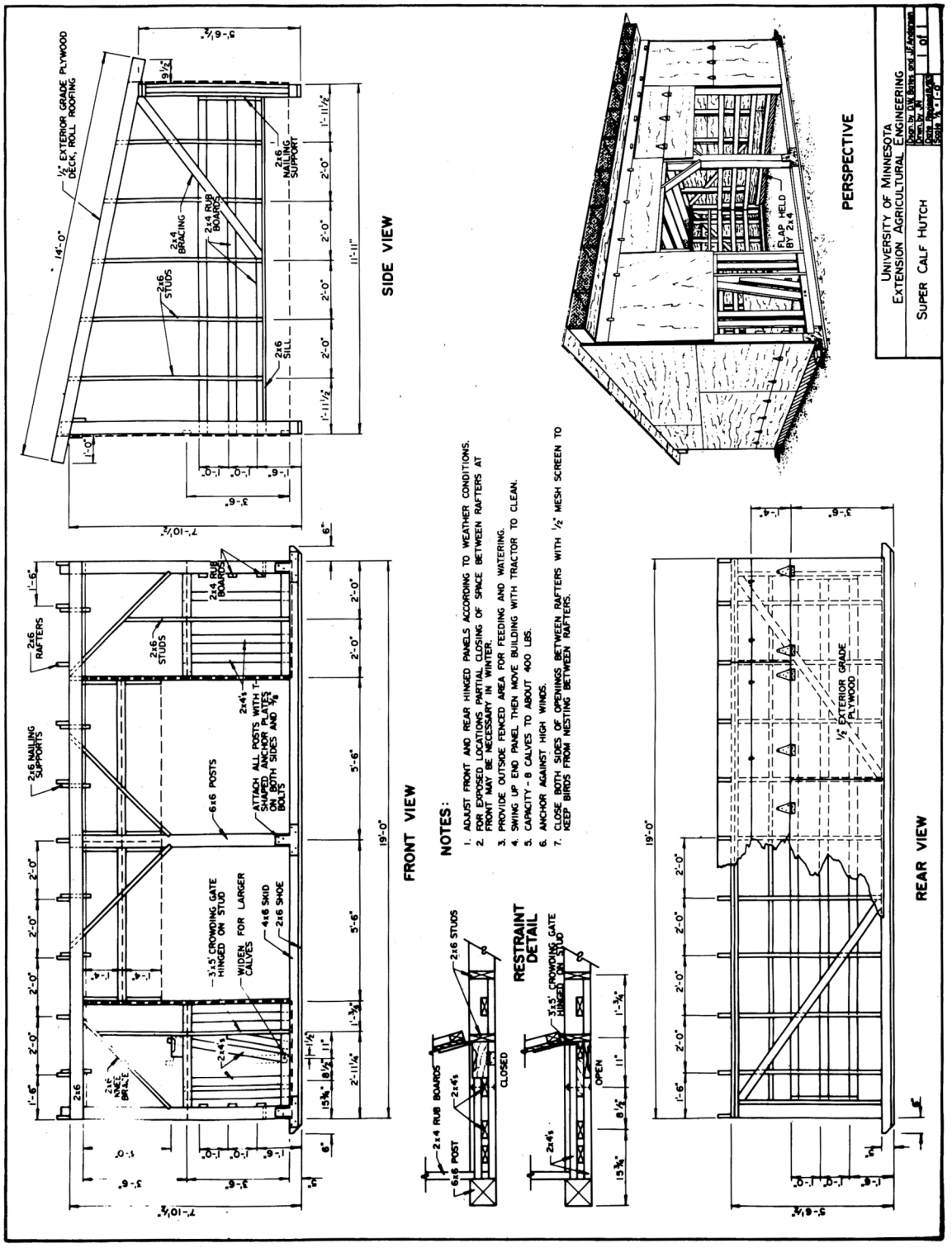


Figure 2: *The Super Calf Hutch*

The super calf hutch (Figure 2) has been developed at the University of Minnesota specifically to provide housing for the calf after 8 weeks of age. It also prevents exposure to more mature animals maintained under a variety of conditions. A working drawing is available from the Department of Agricultural Engineering, University of Minnesota.

The capacity of this unit is 8 calves until they weigh approximately 400 pounds (180 kg). In this structure, the animals are thus exposed only to each other. It allows a small number of calves to be acclimated to group housing and they experience less stress as a result.

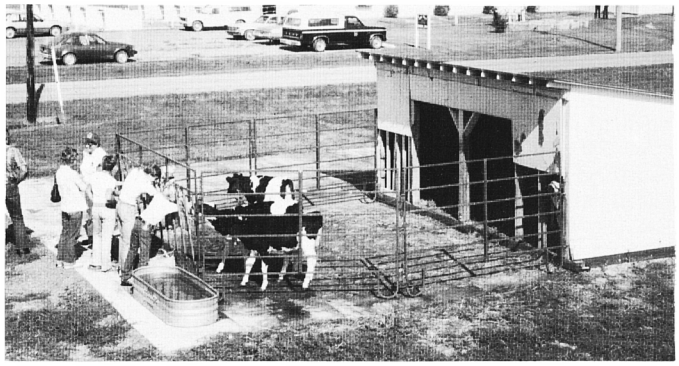


Figure 3: *The Super Calf Hutch*

When cleaning the super calf hutch, the end panel at the lower right hand side of this photo hinged on an elevated sill is swung upward and the building is pulled in the opposite direction with a tractor. Exposed manure is then easily removed with a front end loader. Coarse screen may be required on both sides of the opening between the rafters to prevent birds from nesting. The water tank at the lower left has an electric heater and is covered approximately ¾ of the top distance with a sheet of plywood.

Routine animal examination and laboratory analysis of fecal material are utilized to ascertain disease and parasite levels in this larger building. Treatment, if necessary, is based on observation and laboratory findings. Routine recordkeeping is essential; recording laboratory information, treatments and vaccination dates.

Revaccination for IBR and vaccination for BVD are performed after the animal reaches 6 and 8 months of age respectively with modified live virus vaccines. Subsequent yearly vaccinations for IBR and BVD are performed with killed vaccines. Records are the key to being certain that vaccinations are performed at the proper ages.

Coccidiosis, which is present in most dairy operations, is controlled by the use of inophores such as monensin or lasalisid. These are fed only under veterinary prescription and supervision at lower than label dosage to allow the animal to develop clinical immunity to coccidia. These products also reduce total feed consumption. **These products should never be fed to dry or lactating dairy cows because they limit feed intake and markedly reduce butterfat production.**

Fertility examinations are performed before breeding at 750 pounds body weight in the heifers. These examinations consist of rectal palpation of the heifers' reproductive tracts. The animals are restrained, preferably in a row of lock-up stanchions, in slat or solid floor barns or in the outside walk alley behind a blocker gate in slat floored facilities. In the wall alley, each heifer must be guided into and out of this restraint individually. It is found that the heifers reared in larger slat floor units are docile and easily handled. Fertility rates have been excellent. All heifers to be bred should be maintained in one pen designated as the breeding pen since this arrangement facilitates heat detection.

When these naturally ventilated buildings have slatted floors, it is best to extend the pit 6 feet beyond one outside wall of the building. This wall is supported by posts and girders beneath the slatted surface. Agitation and pumping of the manure are more easily accomplished when the tractor and pump can be located outside of the building. Regardless of whether slats or solid flooring are used, a surface providing good footing is absolutely essential.

Buildings with "manure packs" also work well for heifer housing. These cold naturally ventilated buildings should also have open ridges, continuous tip out doors and barrier walls. In either building type, self-feeders are strongly discouraged. Laminitis is an ever present problem associated with self-feeders. In addition, heifers on self-feeders have a tendency of becoming too fat, another undesirable characteristic.

Prevailing winds, access to aerosols from older animals and exhaust fans from other buildings must be considered when locating these structures.

This animal movement pattern was first initiated in 1963 and has been refined and modified since. Data collected from DHIA records of herds on clinical research programs illustrate the following results.

1. Death loss have consistently been reduced from 30 and 40% to less than 1%.
2. Heifer replacement with good genetic capability reared before these changes produced milk at the rate of 40-50 pounds per head per day. On auscultation with a stethoscope these same animals often exhibited signs of chronic lung disease. Heifer replacements with similar genetic capability reared after these changes now routinely produce 70-90 pounds of milk per head per day (Anderson, 1982).
3. Heifer replacements reared under this new system are now giving birth to their first calves at 21-24 months of age (Anderson, 1982). Minnesota DHIA records indicate average heifer replacements to be 29 months of age at their first calving. A dairy producer sustains about $70 to $120 per month loss per head for every month past 24 months on the first calving date.
4. Steer calves reared under this new method of management can routinely be finished for slaughter at 1,050 to 1,150 pounds at 55-56 weeks. Increases in cash flow with more than adequate numbers of replacement animals is a distinct advantage.

The institution of a "closed herd concept" with no new animals being introduced by purchase also results concurrently in no new pathogens being introduced. This is a distinct advantage of this program. Because of the reduction in death losses which results in adequate numbers of replacement animals, producers quickly realize the need for hygiene and sanitation after observing the beneficial results.

Prevention of exposure of the young non-immune calf to older recovered carrier animals is necessary to allow

expression of genetic potential. Concurrently, the individual animal's immune mechanism and immune status matures with age. As a result, the vaccination program also becomes more effective under this new regime. Products which are used to immunize animals are designed for use in normal healthy animals which are capable of producing an immune response. These animals must be housed in a properly designed and maintained environment for optimal performance of all body functions.

Bird control is essential for disease prevention. Starlings especially, prefer both hutches and superhutches because of the readily available water and feed supply. Spilled feed should be removed to prevent bird congregation.

Through application of these basic disease control techniques in properly designed and managed animal shelters, healthy dairy replacements can be raised to calve at 21-24 months of age.

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