*Medical Factors Relating to Calf Health as Influenced by the Environment

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For many years infectious diseases and nutrition have held the spotlight in discussions of animal health. It is becoming increasingly apparent, however, that epidemiological studies now often point to failures in building design as contributing factors when disease problems arise. In order to illustrate the sound contributions of Professor Donald W. Bates, a highly qualified agricultural engineer, three herd situations will be presented. Professor Bates has contributed greatly to our teaching and continuing education programs in preventive medicine at the University of Minnesota, College of Veterinary Medicine.

This discussion will include only those portions of the total preventive veterinary medical program which relate directly to ventilation and its various ramifications. Epidemiology will be discussed briefly where applicable to emphasize disease patterns within these units. All other aspects of our program have been deleted for brevity as well as clarity.

The first farm to be discussed is one which raises dairy calves for beef. The calves are purchased at two weeks of age from a central gathering point. The owner's reason for requesting a total preventive veterinary medical program was that a 50% to an 80% death loss was occurring in recently purchased calves.

Pasteurella pneumonia in the calves was the primary disease problem. This was precipitated by a grossly misdesigned ventilation system which allowed for no pit ventilation in the first calf rearing barn. The ventilation was designed to be a positive type; however, no exhaust ports were installed in the pits. The inside air in the building consisted of thoroughly mixed pit gas. In an attempt to decrease death losses, the owner was advised by some "ventilation expert" to increase the temperature in the building. This served to increase the gas produced by bacterial action in the manure pit. As a result, the number of pneumonia cases increased.

The initial visit to this farm was quite striking in that the pile of dead calves completely obscured the entry door. Ambient air temperature was -20°F and the frozen calves were stacked like cordwood awaiting the arrival of the rendering truck. Necropsy examination of the unfrozen calves revealed gross lesions consistent with pasteurella pneumonia. *Pasteurella hemolytica* isolated in almost pure culture confirmed the diagnosis. Although this organism is regarded as a normal inhabitant of the bovine respiratory tract, it can become pathogenic when pulmonary tissue is stressed.

Upon entering the barn, the odor of pit gasses was almost overwhelming. Within five minutes, tearing from my own eyes was marked. It was evident that the pit gas was serving as the primary insult allowing proliferation of bacteria in the calves' lung tissue. In order to illustrate the virulence of these pasteurella organisms, the time lapse between stress and clinical disease was 12 to 72 hours.

It should be emphasized that concentrations of pit gas which irritate the lining of a calf's lung can increase in concentration and become toxic to owners and operators. Instances of human gas intoxication have occurred during the agitation of manure pits prior to pumping. It is quite likely that tolerance to pit gasses will vary between individual animals and humans as well. However, in the case of the animal lung, if potential pathogens are present, pit gasses in the environment are especially detrimental. Pit ventilation was subsequently installed and the positive pressure ventilation system directs the air flow down into the pit. The air is exhausted via three 20" cement tile ducts.

This total feeder unit consists of seven pens. Barn number one is a one room building which houses forty calves in raised stalls above a manure pit. After weaning, the calves are moved to barn number two which is a total slat building as well. The third barn consists of a large unit with five pens graduated in size to accommodate forty calves per pen. The calves spend seven weeks in the first barn and eight weeks in each additional pen thereafter. The large feeder barn has recently been changed from a warm to a cold slat unit. The reason for this change was an existing ventilation problem. Air flow in the negatively ventilated building was **from the older cattle toward the younger more susceptible animals.** (Air flow should always be from the younger **toward** the older animals in the unit.) With the introduction of each group of calves into the larger barn from number two barn, pneumonia invariably occurred. Since the change in temperature in the large barn and with the addition of an open ridge and tip out side doors, five cycles of calves have been introduced **without** the usual

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pneumonia break. Disease producing organisms are usually spread by chronic recovered carriers because aerosol droplets laden with disease organisms are dispersed in the air. Transmission by the ventilation system is therefore inevitable if it is improperly designed or improperly installed.

A number of other management changes have been installed on this farm. Death loss in calves as a result of these management changes have been reduced from approximately 50 to 80% to 1%. The reduction in death loss plus better quality cattle at finishing, have been the two economic factors which kept this feeder in business. Due to the fact that healthy cattle are now being fed, feed conversion ratios are excellent. The clinical lesion associated with chronic bacterial pneumonia in the bovine species consists of abscessation and fibrosis of the dependent portion of the lung. The animal growth is impaired by inadequate lung capacity and endogenous toxic products from chronic abscessation. As a result, less beef is produced than would have been if the animal were healthy. In addition, the same holds true for the dairy cow, less milk is produced in an animal with diseased lungs.

Farm number two consists of a rather sizeable livestock operation. Ninety-six cows are in the milk line, two to three hundred steers are fed yearly and two thousand hogs are finished annually. This operation, at the inception of the preventive veterinary medical program, had a calf death loss of 18% to 22% yearly. The present death loss is 1.0% to 2.0%.

The calf housing was inadequate at the time that the preventive veterinary medical program was begun. It consisted of a two story block wall basement barn which was a converted poultry barn. This building was without ventilation and was extremely cold and damp. No supplemental heat was provided and the walls were not insulated. The calves which did survive the pasteurella pneumonia onslaughts were usually chronic poor doing animals with partially destroyed lung tissue.

The first attempt to alleviate the high death loss and chronic lung conditions was made through the acquisition of second hand portable hog range shelters. These buildings were 8' wide, 8' long and 5' high. Each shelter was modified to accommodate three pens with one calf per pen. The partitions were high enough to prevent "sucking" following the feeding of milk. During extremely cold weather straw bales were used to "bank" the buildings to decrease drafts and provide some insulation. Newborn calves were placed in these shelters after they were dry and had received an adequate feeding of colostrum within six hours after birth. The institution of this type of housing was quite dramatic because the death loss dropped to 2.0 to 3.0%. The primary problem with this type of housing was the labor required to maintain it and the unpleasantness of feeding calves in inclement weather.

The next building change which occurred on this farm was the construction of a cold slatted floor barn for heifers and dry cows. At the same time an older two story cow barn was modified by the installation of two partial four foot pits to accommodate the waste from the younger calves. In the modification of this latter structure, the pits had to be installed four feet from the existing walls to prevent a wall cave-in from occurring during excavation. In order to achieve adequate manure storage space with pits of this small size, a larger 10 foot deep storage pit was installed at the end of the two four foot runs. To allow for complete emptying, a gate was installed at the end of each shallow pit. When these pits are full, the gates are released and the manure very quickly flows into the deeper storage pit. The gates are again locked and when the pits are filled the second time, they are pumped.

The greatest problem encountered in this barn was the installation of adequate ventilation. Part of this problem was that the contractor established the wrong grade. As a result, the ceiling was six feet, three inches from the floor. (Any calf barn should allow 250 cubic feet of air volume per calf housed.) In this existing space, pit gas dilution in the available air was negligible. Air distribution was a problem as well. A positive pressure ventilation and heating unit was installed but was inadequate. A second positive pressure unit of equal size was installed with a duct which more adequately distributed the air. Older buildings are not easy facilities to ventilate, especially with positive pressure units. This is due to the cracks and seams in the old walls which interfere with any planned air flow patterns.

Data collected on air exchange and disease should be discussed. Prior to the installation of an air outlet on the opposite side of the building from the pit exhaust fan, it was noted that the slats were invariably wet in the pen on one side of the building and pneumonia was diagnosed on four separate occasions in one group of calves. In the pen on the side with the pit pump out station where the air was exhausted, the slats were always dry and pneumonia was not diagnosed during the same period of time. The calves in these two pens were the same size when they were placed in these pens. When they were removed from the pens, the calves which were on the wet slats were 50 to 100 lbs. **lighter** than the calves from the dry side. Disease decreases feed efficiency and subsequently, profits. Air exhaust ports were subsequently installed on the side with no ports and there is presently no observable difference in the two pens, either in environment or efficiency. Emphasis should be placed on new construction for calf facilities rather than make-do projects.

The slatted floor in this unit was installed as 6" "gang" slats. When this type of wide slat is installed in buildings housing small calves, manure build-up in a dry building is a problem. Scraping the slats and the adjacent areas next to the walls is a laborious job. In spite of its problems, the death losses in this building have been held at 1.0 to 2.0% with high medication levels. It is apparent that labor is less in a

unit of this type than with the individual portable houses. It is also more comfortable for the operator to feed calves without wearing heavy clothing. It should be emphasized that a continuous ventilation system is **absolutely necessary** with a minimum of four air changes per hour. In winter, supplemental heat must be added to increase the water holding capacity of incoming air. In addition, only tempered fresh air should be used – **no air recirculated** from within the building. Another point which should be reemphasized is that air flow should be **from the younger calves toward the older calves.** This is the case in this modified building where the elevated calf stalls are closest to the two positive pressure units. The older calves, up to five months of age, are farthest from the heating units.

The recently constructed, larger, total slat heifer replacement barn has been an excellent addition to this livestock enterprise. It houses not only the cattle that leave the calf unit, but also houses the dry cows as well. It is a total slat, cold building with an open ridge. On the north end of this building a solid floor was installed adjacent to the slatted floor which provides an area for two hospital pens. In addition, a restraint facility was installed in this same area which consists of a chute and headgate. This restraint facility serves the beef area, the dairy replacement building and the dairy cow facility as well.

Evaluation of this structure is best accomplished through assessment of disease incidence and feed efficiency. Only one disease outbreak has occurred in this building since its construction 3 years ago. That outbreak occurred four days after an abrupt feed change from corn silage, which was depleted, to lush green chopped alfalfa. It is suggested, because of the temporal relationship between the disease outbreak and change of feed, that the sudden feed change precipitated the outbreak of disease. Possible factors involved in this include the stress associated with sudden feed changes and/or breakdown products in the rumen which may serve to irritate the epithelium of the respiratory tract. Recent work reported from Washington State by Carlson would support this theory. He reported that 3-methylindole, a breakdown product of tryptophane, can cause an irritating effect on respiratory epithelium and is associated with acute bovine pulmonary emphysema.

Feed efficiency is excellent. Heifers are bred at 750 lbs. body weight and calve at 24 months of age. The rate of gain on these animals is as economical as the owner has ever experienced. In addition, his herd replacements are entering the herd as healthier animals.

Farm number three is a dairy farm which milks 40 cows, feeds 100 steers and 200 hogs per year. The owner's request for a preventive veterinary medical program was prompted by inefficiency in his calf rearing program. The building which housed his calf replacements was a converted two story poultry house. The second floor was not used and pens had been constructed for the calves on the first floor. Ventilation was supplied by an exhaust fan switched on by a time clock. The manure handling system was a group of five tine manure forks operated by the owner's protesting sons. Problems identified in this operation were previously in the calf rearing unit and the owner complained that calves were not doing as well as expected but the death loss was not excessive.

It was suggested that the ventilation changes include the installation of a second exhaust fan wired to **operate continuously** which would have a duct built to within 18" of the floor. In addition, a duct system for incoming air was proposed to bring fresh air into the unit. This opening was located in the center of the ceiling and a duct extended the full length of the building with a 1" slot on each side. The ventilation system was designed to provide for four air changes in the unit per hour in winter and 30 air changes per hour in the summer. Supplemental heat is added at the end of the building opposite the exhaust fans and the temperature is maintained at 50°F.

The newborn calves are placed in elevated wooden calf stalls after they are dry and have had an adequate feeding of colostrum. Their milk ration consists of soured colostrum. They remain in these stalls until they weigh approximately 125 lbs. At this time they are transferred across the aisle to individual calf pens. The calves remain in these pens until they weigh 200-250 lbs. at which time they are removed from the building.

The manure disposal system consists of a gutter cleaner which runs in a 2' deep gutter beneath the elevated stalls and beneath wooden (oak) slats under the individual pens. This system serves as a "micro pit." With the collection of urine and feces (with no "pit" ventilation), the system allows for a higher concentration of "pit gas" within the building than is present in other calf barns in which I work.

This building is vacated for one month during the summer. The calves are housed in temporary calf hutches constructed with steel posts, exterior grade plywood, and rod hog panels. During this time the main unit is cleaned, washed and thoroughly disinfected.

The death losses in this calf unit consist of three calves in the past two years. One animal at necropsy was found to have a congenital septal defect in the heart. One died as a result of septicemia and one succumbed to BVD. There was been an improvement in the rate of gain in the calves and it was suggested that improved ventilation was a factor in the improved health. The manure disposal system change has helped to reduce the labor requirements.

The need for veterinarians who understand basic housing and ventilation principles is becoming increasingly apparent in modern confinement units. Predisposition to disease and occasional deaths in animals may stem from improper building design or management error. As diagnosticians, we must be aware of potential contributing factors to disease processes which we are attempting to prevent.