Key management factors affecting health and performance of dairy heifers

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Mortality rates of dairy heifers are around 3.5% in each of the periods <1 month, 1-6 months and 6-15 months of age. Some farms manage to achieve almost zero mortality proving that this is possible. On many farms, however, mortality rates are much higher and may become accepted as a normal feature of the rearing process. It is encumbent on dairy producers to provide calves with an enviroment which fulfills the five freedoms required to achive good welfare. These are: freedom from (i) hunger and thirst; (ii) discomfort; (iii) pain, injury and disease; (iv) freedom to express normal behaviour and (v) freedom from fear and distress. With respect to hunger, the amount, frequency and quality of the milk or milk replacer offered to pre-weaned calves is often too low and this is reflected in poor growth rates. When calves are fed ad libitum their milk intake will reach around 12L/day whereas a typical management practice uses restricted milk feeding of around 5 L/day. Furthermore, the lower critical tempertaure for young calves less than 3 weeks of age is 15^{O}C. NRC calculations show that calves need 25% more milk powder (1L more milk, ME 20 MJ/kg mixed at 12.5% solids) to grow at the same rate if the environmental temperature falls from 15 to 0^{O}C. There are advantages and disadvantages to bucket feeding in comparison to using automatic feeders. The latter save labour and offer a more flexible approach but can spread disease between animals in a group and need the farm to be of a sufficent size to generate enough heifers of a similar age to avoid mixing age groups. Concentrate intakes do not start to rise until calves are at least 4 weeks old, and in younger animals the rumen is insufficiently developed to digest concentrate feed. In the UK it is therefore illegal to provide fewer than 2 milk feeds per day until calves are at least 4 weeks of age. Provision of clean drinking water is also essential at all times; failure to do this is a welfare issue which becomes critically important during warm weather or if calves are scouring. Providing an adequate supply of hygienically collected good quality colostrum is important during the first 6 h of life, after which passive transfer declines rapidly. The success of this process can be tested by measuring either IgG or total protein in blood. Although various cut off points have been suggested as a determinant of adequate passive transfer (often 10 mg/ml IgG), our data showed a linear reduction in incidence of respiratory disease as IgG increased from 5 to 35 mg/ml. Good passive transfer does not, however, reduce the risk of scours which is instead influenced by antibodies present in the gut. The most important diseases of calves are scours and bovine respiratory disease (BRD). Both have a very wide range of potential pathogens.

Mixed infection is frequent and involves many opportunistic pathogens. It is, therefore, more useful to consider the epidemiological triad of calf, environment and pathogens rather than any single infectious agent. Using weekly assessments with the Wisconsin scoring system, we established that 48.2% of individual pre-weaned calves monitored on UK 11 farms experienced diarrhoea and 46.5% of individuals had BRD. In 11% and 20% of calves respectively, the episode of diarrhoea or BRD lasted over 2 weeks (1). Although the pre-weaning mortality rate was only 4.5% overall, both diseases were shown to reduce growth rates (2). Calves kept in a stable group, born in warm weather, fed more milk, and with good passive transfer of immunity were at less risk of respiratory disease. The environment and housing system are extremely influential for calf health. Temperature, humidity, ventialtion, bedding and overall hygiene are all important. Penning arrangements also need to be considered. Single pens are popular due to reduced opportunities for disease spread but cattle are social animals and benefit from having at least one companion. Housing calves in pairs also aids thermoregulation and promotes solid feed intake. Successful calf rearing therefore requires a co-ordinated team approach including farm staff, their vet and a nutritionist. It is essential to feed enough milk to maintain good growth rates and to ensure an adequate supply of clean water at all times. Robust policies are required for colostrum feeding and weaning to ensure that these happen at the appropriate time/age for all calves. Disease challenge can be reduce by improved hygiene with optimised housing design to facilitate cleaning, handling, feeding and environmental control. In order to maintain high standards, staff need to be taught why these measures are so important and incentivised to record reliable data on mortality, disease and growth rates for monitoring purposes. A key role for the veterinary surgeon is to identify issues specific to each farm and to work with the farm staff to change their management practices accordingly.

(1) KF Johnson et al. (2017) *Veterinary Record Open* **4:**e000226.
(2) KF Johnson et al. (2017) *Animal* **12:** 1413-1423.