Production Practices, Calf Health and Mortality on Six White Veal Farms in Ontario

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ABSTRACT

A group of 4863 white veal calves reared on six commercial white veal farms in Ontario were followed through production to describe calf characteristics and production levels. Patterns of morbidity, mortality, and culling were investigated at the farm, room and individual level. The majority of the calves were male Holsteins, with approximately half originating from Ontario. The mean average daily gain for shipped calves over the entire production period was 1.1 kg/day (SE = 0.002). The overall percentage of calves receiving at least one individual treatment was 59%, with an average number of treatment days per calf of 3.3. The majority of calves receiving one or more treatment days were first treated between the fourth and seventh week of production. The mortality rate was 3.7%, and 5.1% of the calves were culled. Pneumonia was the largest single cause of death. Peak death and cull losses occurred during the seventh and eighth week of production.

RÉSUMÉ

Un total de 4863 veaux de lait élevés dans six fermes commerciales en Ontario ont fait partie d'une étude afin de pouvoir en décrire les paramètres zootechniques. Les patrons de morbidité, mortalité et de réforme ont été étudiés au niveau de la ferme et des chambres ainsi qu'au niveau individuel. La majorité des veaux étaient des mâles Holstein, dont la moitié environ provenaient de l'Ontario. Le gain moyen quotidien des veaux expédiés à l'abattoir pour la période entière de production était de 1.1 kg/jour (ES = 0.002). Le pourcentage de veaux ayant reçu au moins un traitement individuel s'élevait à 59%, avec une moyenne de 3.3 jours de traitement par veau. La majorité des veaux ayant reçu un ou plusieurs jours de traitement ont été traités pour la première fois entre la quatrième et la septième semaine de production. Le taux de mortalité a été de 3.7 % alors que le taux de réforme s'est élevé à 5.1 %. Les pneumonies étaient la seule cause principale de mortalité. Les plus hauts taux de mortalité et de réforme ont été observés durant la septième et huitième semaine de production. (***Traduit par Dr Serge Messier***)

INTRODUCTION

White veal, also referred to as formula-fed veal, involves the rearing of calves on exclusively milk or milk-replacer diets. The calves are primarily the male offspring of dairy animals. In Ontario, white veal calves are assembled at a young age, and spend 16–20 weeks in production (1,2). In 1990, in Ontario, there were 60 white veal farms registered in the Ontario Veal Association, and it is estimated that between 40,000 and 60,000 white veal calves are marketed annually (Ontario Veal Association). Little quantitative information is presently available to describe the industry in Ontario; hence, the objective of this study was to describe production levels and rates of morbidity, mortality, and culling in a sample of Ontario white veal calves. The study provides preliminary data on white veal production in Ontario.

MATERIALS AND METHODS

The study group was comprised of 4863 white veal calves obtained through a convenience sample of six commercial white veal farms in Ontario. Farm selection was based on geographic location relative to the University of Guelph and willingness to institute a written record keeping system. Information was collected on all calves entering five of the farms, and all calves entering one barn on the sixth farm, during the study period.

The calves were housed in rooms ranging in size from 40 to 107 stalls. Data were obtained from 35 rooms housing a total of 76 groups during the study period. The groups were generally managed in an all-in all-out manner, with the calves remaining in the same stall throughout the production period. Calves occasionally were moved early in the production period to replace calves which died or were culled. In these instances, the calf room was recorded as the room in which the calf spent the majority of the production period.

DATA COLLECTION

At the time of entry to the study farms, all of the calves were individually identified by ear tag. The producers recorded the sex, breed, and source of the calves. The exact age of the calves entering the farms was not known and thus not recorded. Breed was classified by the producers as Holstein or non-Holstein based on appearance. The source of the calves was recorded as originating from Ontario or Quebec. Calves denoted as originating from Ontario were purchased either through sales barns in Ontario, through livestock dealers based in Ontario, or from local

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Ontario dairy farms. The exact origin of the calves in most cases was not known, and there may have been some interprovincial movement of calves prior to arrival at sales barn facilities.

All calves were weighed at the time of entry to the farms, and at the time of exit due to death, culling, or shipment to slaughter. The scales were calibrated at 25 kg increments to 225 kg every three months.

Written records were kept by the producers detailing all of the treatments administered during production. Routine group treatments were defined as those treatments given to an aggregate of calves for preventive reasons. Therapeutic group treatments consisted of treatments given to an aggregate of calves for therapeutic reasons, when some proportion of that aggregate became ill.

An individual treatment day was defined as a day on which an individual calf received one or more treatment(s) for therapeutic reasons. The individual treatment days included both antibiotic and nonantibiotic medications, but did not include days spent on group therapeutic treatment. Treatment with a long acting antibiotic was recorded as three treatment days unless another antibiotic was used within the three days. In that instance, the treatment days were recorded as the number of days until, but not including, the day the new antibiotic treatment was instigated. All medications administered to the calves were given based on farm specific criteria for disease identification and treatment. The producers recorded the date of treatment and the drug(s) used, but did not specify the diagnostic reason for treatment.

Calves were lost to production due to death or culling. Calves which died during production had a gross postmortem examination performed. Cause of death was categorized into five morphological diagnoses. Pneumonia, as a cause of death, was defined as sufficient lung pathology to constitute the primary cause of death. Torsion included both abomasal and intestinal torsion. Enteric causes of death were defined as gastrointestinal disorders, other than torsion, and included enteritis, abomasal ulceration/perforation, rumenitis, and bloat. The miscellaneous category contained all other established causes of death. Less than four calves died of each condition included in "miscellaneous". Specific diagnoses in the miscellaneous category included anaphylaxis, copper toxicity, hepatitis, hypoxia, white muscle disease, septicemia, peritonitis not due to abomasal ulceration, nephritis, cellulitis, pharyngeal abscessation, and congenital defects. Calves with an unknown cause of death were those for which no definitive cause of death could be established on gross postmortem examination. Culled calves were defined as calves prematurely removed from white veal production due to illness and/or poor performance.

The written records, kept by the producers, were collected by a member of the study team as each room of calves was marketed. The records were entered into a commercial data base program (Dbase IV, Ashton-Tate Corporation, Torrance, California). All computer entries were checked against the written records and any uncertainties or inconsistencies were identified and discussed with the producers. When inconsistencies could not be resolved, the value was recorded as "missing".

STATISTICAL ANALYSIS

Data analysis was performed at three levels; individual, group, and farm. Individual analysis was at the calf level, uncorrected for farm clustering. A group consisted of an aggregate of calves reared together within one room. Farm level analysis was also performed on aggregated data. Average daily gain at the group and farm level was calculated as the total number of kilograms gained by the marketed calves, divided by the total number of calf-days in production for the marketed calves.

MORBIDITY DURING PRODUCTION

Individual calf treatments — Measures of individual calf treatment frequency and/or intensity were analyzed at the individual, group, and farm level. The frequency of treatment was expressed as a risk rate; specifically, the percentage of calves requiring at least one day of individual treatment and the number of new treatment initiations per calf. A new treatment initiation was defined as a change in the drug used, or the same drug treatment reinstituted following one or more days of no individual drug therapy. The intensity of treatment was indicated by the mean number of treatment days per calf and the mean number of treatment days per treated calf. The number of individual treatment days was further broken down into treatment days containing antibiotics and days containing nonantibiotic drugs.

The risk of first treatment was calculated with the numerator consisting of calves which were treated for the first time during each week of production. The denominator was the number of calves entering the time period, which had not been previously treated, minus one half of the calves censored during the period. Censored calves were all nontreated calves removed from production due to death, culling, or shipment to slaughter. Treatment risk by farm cohort and season of entry cohort were compared using the Wilcoxon statistic (3).

Rolling averages were used for plots of life table results by averaging the risk rates for three consecutive time intervals and assigning the resulting rate to the middle time interval. Rolling averages were calculated for only the first 20 weeks of production due to the variability resulting from the small numbers of calves at risk late in production.

Group treatments — The percentage of the total production days spent on group antibiotic medication was calculated by group, with the denominator being the average number of days in production for shipped calves in that group.

CALF LOSSES DURING PRODUCTION

The reason for exiting the study was recorded as shipped to slaughter, culled, or dying during production. Cause specific mortality rates were calculated for calves which received a postmortem.

Life tables were used to describe the risk of death by week in production. The numerator was comprised of calves which died during the time interval and the denominator was the number of calves entering a time period minus one half of the calves censored (culled or marketed) during that period. The life tables were divided into cohorts by farm and by season of entry. Season of entry was

divided into five time intervals based on when the calves entered production as follows: Spring 1990 (March, April, May); Summer 1990 (June, July, August); Fall 1990 (September, October, November); Winter 1991 (December 1990, January or February 1991); or Spring 1991 (March, April, or May). The statistical significance of differences among farm cohorts and among season of entry cohorts was evaluated using the Wilcoxon statistic (3).

The percentage of calves dying from pneumonia or from causes other than pneumonia was calculated by week of production. Calves on which no postmortem was performed were excluded from this analysis. The risk rates were calculated using the same basis for the denominator as mentioned previously.

TABLE I. Morbidity estimates in white veal calves in Ontario

Percentage of calves treated at least once	59.1%
Group range	29.4–95.3%
Farm range	46.0–78.5%
Mean number of treatment days per calf	3.3 (SE = 0.07)
Individual range	0–50
Group range	1.2–15.7
Farm range	3.1–8.2
Mean number of antibiotic treatment days per calf	3.2 (SE = 0.07)
Individual range	0–50
Group range	1.1–15.1
Farm range	2.5–7.4
Mean number of treatment days which included a nonantibiotic	0.4 (SE = 0.02)
Individual range	0–23
Group range	0–2.1
Farm range	0–1.6
Mean number of treatment days per treated calf	5.6 (SE = 0.10)
Individual range	1–50
Group range	2.4–16.5
Farm range	4.5–10.6
Mean number of treatment initiations	1.5 (SE = 0.03)
Individual range	0–24
Group range	0.4–5.7
Farm range	0.7–3.5

RESULTS

DATA COLLECTION

The study began in March of 1990, with farms entering the study over a three month period. Data collection included calves entering the study farms over a one year period, and continued until October 1991.

The study farms ranged in size from 300 to 6000 calves marketed annually, and in farm type from corporate to part time enterprises. Five of the farms were located within 60 km of the University of Guelph. The sixth was located in eastern Ontario.

All of the farms reared the calves in individual wooden stalls. The stalls ranged in length from 153 to 183 cm and in width from 53 to 71 cm. Calves were fed exclusively milk replacer diets, twice daily, in buckets.

CALF CHARACTERISTICS

The mean weight of 4863 calves at the time of entry to the farms was 45.9 kg (SE = 0.08) with an individual calf range of 26.0 to 90.7 kg. Group level mean entry weights ranged from 38.7 to 58.5 kg. The highest and lowest group level mean entry weights were from two groups reared on the same farm (Farm 3). The mean farm level entry weight was 46.1 kg with farm means ranging from 43.9 to 48.4 kg.

Overall, 97% of the calves were male. The percentage of male calves at the farm level ranged from 92.3% to 100%. The Holstein breed accounted for 94.7% of the calves, with farm level means ranging from 92.7% to 100.0% Holstein. Overall, 53.6% of calves were recorded as originating from Quebec with the remainder purchased in Ontario. Farms ranged from zero to 82.8% of calves purchased in Quebec.

Exit weights were obtained on 4200 of the 4430 calves shipped to market. Calves shipped without recorded market weights originated from four groups of calves on three farms. These calves were shipped while their scales were undergoing repairs or when personnel were unavailable to assist with weighing.

The overall mean weight of calves at the time of marketing was 194.4 kg (SE = 0.33) with individual calf weights ranging from 106.6 to 269.0 kg. Group means ranged from 163.7 to 216.9 kg. The mean farm level market weights ranged from 173.7 to 198.3 kg.

AVERAGE DAILY GAIN

The calves shipped to slaughter averaged 130.7 days in production with a range of 64-189 days.

The overall average daily gain was calculated on 4199 of the 4430 calves shipped to slaughter. Calves missing entry or exit weight information were not included in the analysis. The overall mean average daily gain was 1.1 kg/day with individual marketed calves ranging from 0.5 to 2.0 kg/day over the entire production period. Group level average daily gains ranged from 1.0 to 1.3 kg per day and farm level average daily gains ranged from 1.0 to 1.2 kg per day.

MORBIDITY

Individual calf treatments — The parameters used to estimate morbidity are summarized at the individual, group, and farm level in Table I. There were statistically significant differences between farms and between groups of calves for all of these morbidity parameters.

The majority of calves which required an individual treatment were first treated early in production with a peak between weeks 3 and 6 (Fig. 1). A small proportion of calves, however, continued to receive a first treatment throughout production. The patterns of first treatment rates between farm cohorts and between season of entry cohorts differed statistically with Wilcoxon p-values of <0.001. All of the season cohorts showed a peak in the percent of calves requiring a first treatment between weeks 3 and 6. The magnitude of that peak was lowest for calves entering production during the summer of 1990, and was

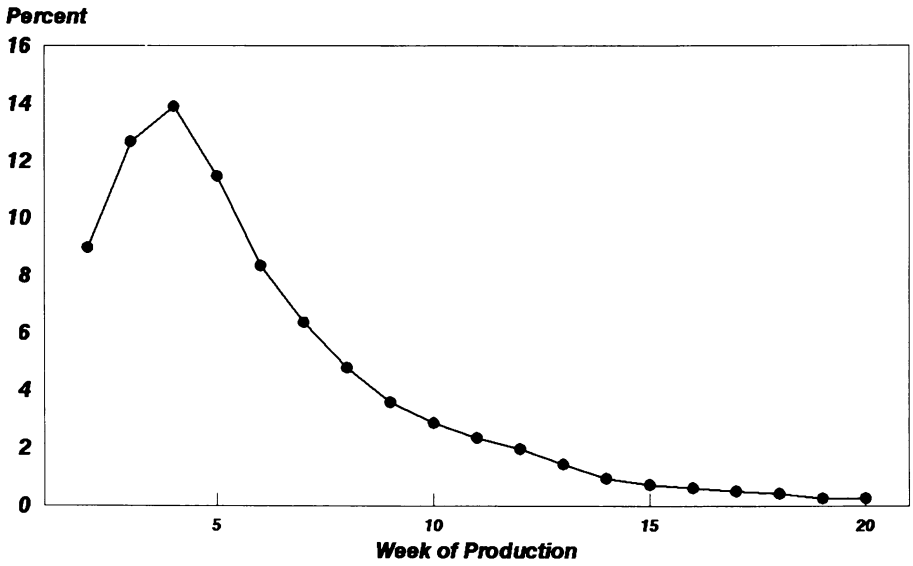

Fig. 1. The percentage of calves receiving a first individual treatment by week of production: Three week rolling average.

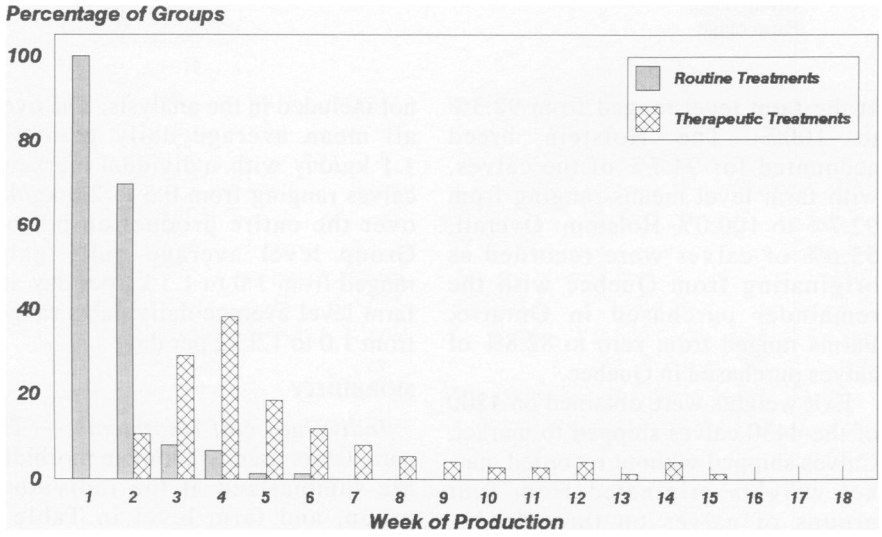

Fig. 2. The percentage of groups receiving group treatment with antibiotics at least one day of the week by week of production.

highest for calves entering production during the winter of 1991.

Group treatments — All of the groups received oral antibiotics during the first week of production. Routine group antibiotic treatments were used solely during the first six weeks of production. Therapeutic group treatments with antibiotics began in the second week and some group treatments were administered up until week 15 (Fig. 2). In each of weeks 13 and 15, the percentage of groups receiving at least one day of antibiotic treatment corresponded to one group of calves. The majority of groups (71/76) spent less than 20% of the production period on group antibiotic medication.

CALF LOSSES DURING PRODUCTION

Overall, 91.1% of the calves were marketed as white veal, 3.7% died during production, 5.1% were culled, and 0.1% did not have an exit reason recorded. Group level losses ranged from 0 to 17.5% dying, 0 to 20.6% culled, and 0 to 26.5% lost to production. Farm level losses ranged from 1.4% to 7.9% dying and from 2.6% to 10.6% culled. Farm level death and cull losses were not significantly correlated. The total percentage of calves lost to production at the farm level ranged from 4.3% to 14.2%.

Postmortem examinations were performed on 136 of the 180 calves which died. All of the postmortems for calves at three of the farms were performed by faculty in the Department of Pathology at the Ontario Veterinary College. One farm had postmortems performed by the local veterinarian and at the Ontario Veterinary College. Gross postmortems were not performed on calves from the two remaining farms (Farms 2 and 4, accounting for 16 of 180 deaths) due to their distant geographic location relative to the University of Guelph.

Table II shows the number and percentage of calves by cause of death on the farms on which at least one postmortem was performed.

Peak death losses occurred early in production (Weeks 2 and 3) and during weeks 7 and 8, with a greater degree of weekly variation late in production (Fig. 3). A Wilcoxon statistic p-value of 0.005 indicated statistically significant differences in calf mortality over the production period between farm cohorts. Differences in mortality across season of entry cohorts were not statistically significant (Wilcoxon p-value of 0.21).

Figure 4 shows a three week rolling average for the percentage of calves which died from pneumonia or from causes other than pneumonia. Although calves died of all causes throughout production, the greater proportion of the deaths early and late in production were due to causes other than pneumonia. Calves dying during weeks 4 to 10 were more likely to die of pneumonia. The distribution of mortality due to pneumonia versus nonpneumonia over the production period was significantly different (Wilcoxon statistic p-value of 0.04).

The percentage of total calf losses due to death or culling by week of production is shown in Fig. 5. Calves tended to be lost at a greater rate between weeks 5–8 and a lesser rate from then on.

DISCUSSION

Choosing the study group by convenience sampling may limit the ability to extrapolate the results to the

general population of white veal calves in Ontario. Although the information may not accurately describe the entire industry in Ontario, the number of calves involved in the study represents approximately 15% of the calves marketed annually and the results may serve as a basis for an initial description of a relatively unknown industry.

All of the calves in this study were raised in individual stalls. This is typical of the veal industry in North America, where it is estimated that 99% of American veal farms utilize crates (4), but is in contrast to the European industry where 13% of calves are reared in group pens in the Netherlands (5). The weight on entry, sex, breed, exit weight, days in production, and average daily gain were typical of the North American industry (4).

The origin of the calves in this study reflected the relative sizes of the dairy industries in Ontario and Quebec. In 1989, there were 798,000 milk cows and dairy heifers in Quebec and 700,000 in Ontario (6). The male offspring of these milking animals constitute the major source of calves available for veal production. Interprovincial movement of calves prior to entering veal production is a common occurrence.

Morbidity estimates were based on farm specific treatment protocols. By choosing to use producer's treatment records without standardizing definitions of "disease" or duration of treatment protocols, the assumption was made that treatment rates accurately reflected illness, and that increased treatment rates indicated a greater degree of morbidity on that farm. Differences between producers in diagnostic acuity, criterion for treatment, and risk aversion may also influence between farm treatment rates. Nonetheless, the calf treatments do reflect calf illness as perceived by the calf rearers.

Various measures of morbidity were evaluated and the interpretation and ramifications of these indices vary. The first treatment rates, or the percentage of calves requiring at least one individual treatment day, measure the crude incidence of disease. The disadvantage of using first treatment rates alone to describe morbidity is that potentially valuable information is lost with respect to the duration of treatment and, by proxy, the severity of illness.

TABLE II. The percent and number of white veal calves dying during production by cause of death, as established by gross postportem examination, during the period of March 1990 to May 1991 in Ontario

Cause of death	Overall	Farm 1	Farm 3	Farm 5	Farm 6
Pneumonia	52.2[a]	12.5	56.1	85.7	0.0
	(71)[b]	(1)	(64)	(6)	(0)
Torsion	8.8	12.5	7.0	0.0	28.3
	(12)	(1)	(8)	(0)	(3)
Enteric	10.4	37.5	8.8	0.0	14.3
	(14)	(3)	(10)	(0)	(1)
Miscellaneous	17.6	37.5	15.8	14.3	28.6
	(24)	(3)	(18)	(1)	(2)
Unknown	11.0	0.0	12.3	0.0	14.3
	(15)	(0)	(14)	(0)	(1)
Total % calves receiving postmortem	75.5 (136)	57.1 (8)	88.4 (114)	58.3 (7)	77.8 (7)
Total number calves dying during production	180[c]	14	129	12	9

[a] Percentage of calves per category with denominator as number of calves receiving a postmortem
[b] Number of calves per category
[c] Overall number of calves dying includes calves from all six farms

The number of individual treatment days per calf provides an indication of the duration of treatment. Differences in the percentage of calves receiving at least one individual treatment day between farms will influence the observed farm differences in the number of treatment days per calf. By itself, the number of treatment days per calf does not differentiate between a small proportion of calves with lengthy treatments as opposed to a large number of calves with short treatment regimes.

Defining morbidity in terms of the number of treatment days per treated calf negates the influence of the percentage of calves receiving a first treatment and as such may more accurately reflect disease severity at the calf level. This parameter is still influenced, however, by variations in the duration of treatment protocols between farms, the diagnostic acuity of the producers, and perhaps by differences in the types of illness predominating on each farm.

Defining morbidity in terms of the number of treatment initiations controls for differences between farms in the duration of treatment protocols.

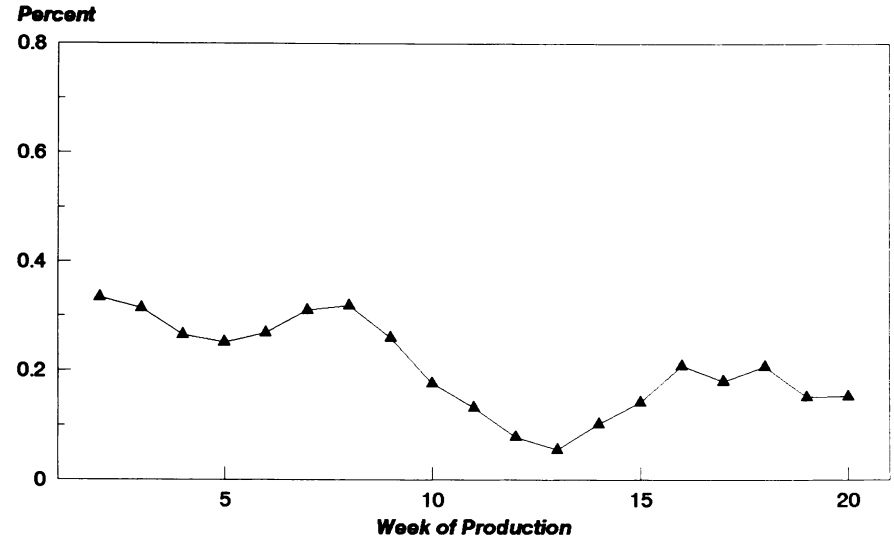

Fig. 3. The percentage of white veal calves dying by week of production: Three week rolling average.

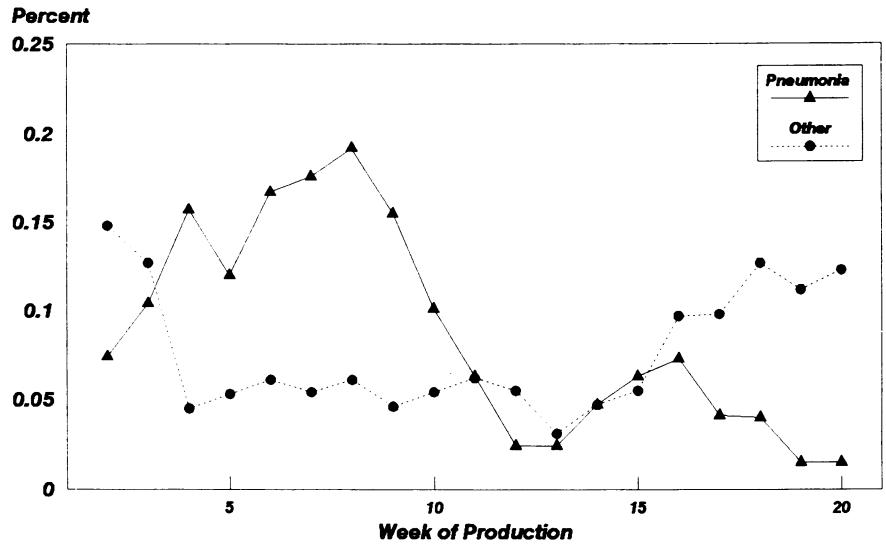

Fig. 4. The percentage of calves dying by week of production and cause of death: Three week rolling average.

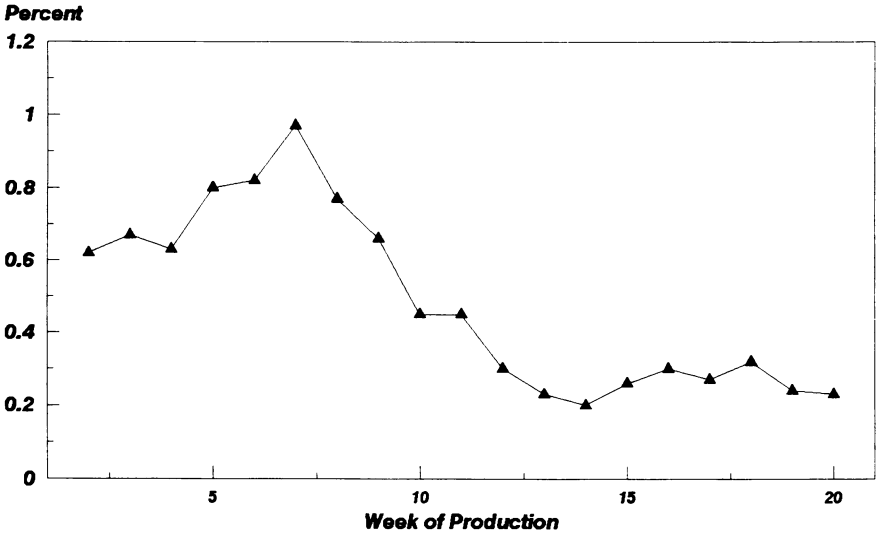

Fig. 5. The percentae of calves dying or culled by week of production: Three week rolling average.

However, the duration of treatment given for a specific disease may influence the recurrence rate which will, in turn, impact on the total number of treatment initiations received. Therefore, overall, it would seem that a combination of first treatment rate and the number of treatment days per treated calf would be an adequate description of the quantitative aspects of morbidity.

The percentage of calves receiving at least one individual treatment day in this study was 59.1%. In a British study, 81% of 836 calves received at least one treatment (7). While the British study considered treatment for respiratory disease only, it was reported that pneumonia was the only significant health problem encountered. In a study of mortality and morbidity in Dutch veal calves, calf morbidity due to pneumonia was approximately 25%, with treatment rates due to diarrhea ranging between 15 and 20% (8).

The comparatively greater risk of receiving a first individual treatment during weeks 4 to 6, observed in our study, was also reported in a study of respiratory disease in British veal calves (7). It is possible that the calves' susceptibility to disease changes at this time due to factors such as declining maternal antibody protection or a build-up of microorganisms. This observation could also be influenced by group treatment protocols on calf entry.

All of the calves in this study received antibiotics in the feed during the first week of production. This is in contrast to the dairy industry in Ontario where it is reported that only about 20% of newborn calves receive prophylactic antimicrobials (9). Veal calves, however, are obtained from multiple sources, transported over varying distances, and mixed into groups, and this may explain the increased real or perceived need for routine antimicrobial drugs.

The mortality rates observed in this study were similar to those reported in a Dutch study at 3.7% for individual and group housed calves (8). The culling rates, at 2.4% and 3.7% respectively for individual and group housed calves in the Netherlands, were somewhat lower than the rates observed in this study (5.1%). On one large veal farm in the United Kingdom, mortality and culling rates were reported as 5.3% and 6.9% respectively (7).

None of the conditions diagnosed in the miscellaneous category accounted for more than four deaths, but together the miscellaneous cases and undiagnosed deaths accounted for over a third of the deaths. Thus, although pneumonia was the leading single cause of death, successful efforts to reduce mortality should not be geared exclusively to factors influencing only respiratory disease. The spectrum of diseases and their relative proportions causing death are not necessarily the same as those causing disease in the calves. Some disease entities may cause morbidity, and thus affect production, while not significantly influencing mortality.

The patterns of calf mortality over the production period indicated that the calves were not at a constant risk of dying over time. Observational studies on calves raised as dairy replacements in Michigan (10), New York State (11), and Ontario (12) indicated that the greatest risk of dying occurred during the first week of life (10,12) or during the third week of life (11). In our study, peaks in the risk of death occurred between

weeks 7–8 and, to a lesser extent, during weeks 2–3 of production. This difference may in part reflect discrepancies in the age of the calves. Weight on entry, which may serve as a proxy for age, was negatively associated with the probability of dying in white veal calves in Ontario (13). Calves entering veal production may be several days to several weeks old, and therefore, they may be past the early high risk period. Another possible explanation for this discrepancy is that the prevalent disease etiologies and/or causes of death are essentially different between dairy and veal calves. The cause of death relative to the stage of production in this study suggests that the risk level is related to the disease entity involved. Calves dying during weeks 6–8 were more likely to die of pneumonia, and the calves which died during the first one to two weeks of production tended to have "other" causes of death. Pneumonia was the largest single cause of death. In a British study of concentrate supplemented veal calves (14), the age and cause of death were related. Calves whose death was associated with gastroenteritis were younger than calves whose death was associated with pneumonia, although the total number of calves dying was small and the difference was not statistically significant.

The differences in mortality rates between farms may be influenced by farm differences in the types of diseases encountered or in the ability of producers to successfully treat disease. In addition, there are a number of unique management features of the white veal industry which may influence morbidity and mortality rates. The calves are assembled at a young age and mixed with other calves prior to, and/or upon entering, veal farms where they are reared "intensively". As previously discussed, many of the calves are transported over considerable distances prior to arrival at the veal farms. All of these factors may predispose to higher death rates (15), and morbidity rates. There is at present no readily available method for producers to ensure that colostral ingestion has taken place prior to purchasing calves.

In summary, this study has described some of the production practices and levels of production as well as characteristics of calves raised as white veal in Ontario. Health parameters for the calves in the study group were described, and the relative merits of each measure of morbidity discussed.

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