Title:

The improvement of health and performance of dairy-bred calves on a rearing unit through strategic grouping

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Highlights

- Lung ultrasound scanning offers a valuable insight into the respiratory health of calves arriving at a rearing unit from multiple source farms.
- Lung ultrasound scanning showed that a large proportion of calves had sub-clinical respiratory issues.
- Calves whose lung scan score declined across the study period had a lower daily liveweight gain (DLWG; kg/d) compared to those calves with improved lung health and those that remained the same.
- Calves that received treatment had a higher daily liveweight gain (DLWG; kg/d) than those that did not.
- More comprehensive work needs to be done to ascertain a grouping strategy that will enhance the performance of calves on rearing units.

Introduction

In the past decade, there has been an increasing public and media awareness towards the fate of the male dairy calf (Herrler et al., 2023). To most dairy farming operations, the male dairy calf is seen as being of low economic value and 'surplus' to their dairying enterprise where the emphasis is on milk production. The GB Dairy Calf Strategy 2020-2023 states as one of its priorities the encouragement of a responsible breeding strategy. In other words, encouraging dairy farms to produce less of these low economic value male dairy calves. One such method would be through the use of dairy sexed semen (Haskell, 2020). Recent figures released by AHDB (Agricultural and Horticultural Development Board) have shown a year-on-year increase in the sales of dairy sexed semen with quite a dramatic increase from the initial year of the GB Dairy Calf Strategy being implemented (2020) (Figure 1). This recent information on dairy sexed semen sales illustrates that farmers are taking action. Findings from Balzani, et al., (2021) report that 80% of the farmers they surveyed saw the use of sexed semen in dairy herds as a positive influence on herd welfare. Interestingly, a survey conducted by Schulze et al, (2023) found that consumers showed some general resistance towards the use of sexed semen, deeming it as 'unnatural'.

Figure 1. Sales of sexed dairy semen in the UK (Source: (AHDB, 2023).

The increased use of dairy sexed semen means that dairy producers can be selective in terms of which animals they choose to produce dairy replacements from. As not all pregnancies are needed to produce dairy replacements, this provides the opportunity for a calf with some economical value to be produced in the form of a dairy-beef cross calf. AHDB, (2023) reported that sales of beef semen into dairy herds now accounts for 49% of total beef semen sales. Figures from 2021 highlight that of the 1.44M calves registered from dairy dams in the UK, 50% of these were 'non-dairy' calves (i.e. dairy-beef cross calves (AHDB, 2022).

Some of the resultant dairy-beef cross calves will be reared and retained post-weaning on the dairy farm of birth, whilst some dairy farms will sell such calves at the earliest convenient opportunity, more often than not, pre-weaning. Such calves will be traded in various ways, such as through calf collection/assembly centres, live auctions or direct farm to farm sale. Regardless of the way in which these calves are traded, their next destination will be an environment which is unfamiliar to the young animal and one where there is the potential to be mixed with other calves from other source farms. Not only is the mixing process a potential stressor on the calves, but it also allows the exposure to different disease pathogens (Renaud and Pardon, 2022). Therefore, the risk factors for increased disease are quite high on such calf rearing units. One such disease is respiratory disease. Bovine respiratory disease (BRD) is a major source of mortality and morbidity in calves and the resulting lung damage affects productivity and health in later life. Respiratory disease is estimated to cost the UK cattle industry in the region of £50-80million per year through direct costs (such as treatment and mortality) and indirect costs (e.g. loss in growth rates). Bartram et al (2017) states a lifetime cost of £722 per case BRD in dairy cattle and £327 for severe cases in dairy bred beef cattle.

The initial objectives of this study were to:

- assess the respiratory health of dairy-beef calves, sourced from a collection of dairy farms, on arrival at a commercial rearing unit.
- assess the impact of different grouping strategies, based on health assessments or normal farm practice, on calf health and performance outcomes.

However, due to concerns regarding the physical movement between pens, combined with the handling of calves to allow measurements to occur and an extended period of extremely high environmental temperatures for the geographical location, all of which were stressors on the calves, it was decided that the calves would remain in the groups in which they arrived, and any assessment of grouping strategy would be done on reflection but no physical mixing of calves. Any grouping would still be based on the arrival clinical and respiratory health.

Materials and Methods

Calves

The study was conducted on a commercial, family run, calf rearing enterprise based in South-west Scotland (name & location retained) between 29 May and 4 August 2023. The rearing unit directly sources calves from a consortium of dairy farms on a regular basis. Two batches of calves were used for this study and consisted of 138 calves in total. The first batch involved 73 calves which entered the study on 29th May 2023 and the second batch involved 65 calves who commenced the study on 14th July 2023. The first batch of calves were sourced from 12 herds and the second batch from 8 herds. In total, calves used in this study were sourced from 14 separate herds, with 6 farms supplying calves across both batches. Each farm supplied on average 10 calves in total (range: 2-40 calves). Table 1 illustrated the breakdown of the breeds and the sex of the calves used in the study.

Table 1 Breakdown of breed and sex of calves per study batch

	Breed/Sex of Calf					
	AAx		BBx		Dairy Sired	
Study Batch	Female	Male	Female	Male	Female	Male
1	32	39	-	-	-	2
2	26	35	1	1	-	2

AAx = Aberdeen Angus cross; BBx = British Blue cross

Study related measurements, apart from liveweight, were carried out a few days after calves arriving on the rearing unit. These first measurements to be carried out were referred to as “Arrival” measures. The study measurements were repeated on the same calves 20 days later, with the latter measurements referred to as “End”.

Calves at ‘Arrival’ had a mean liveweight of 52.9kg (SD: 8.84; range: 38-90kg) and a mean age of 30 days (SD: 13.62; range: 14-80 days).

On arrival at the rearing unit, calves were penned in groups of either 13 or 15 calves. The pens in this study were 7m by 4m in size (length x width) with straw used as the bedding material. Calves were fed twice daily with reconstituted milk replacer via teat milk feeders and had ad-lib access to starter pellets from troughs, fresh water from a water drinking bowl and straw from racks.

(i) (ii)

Figure 2. Example of calf housing and penning used in the study. (i) Housing for batch 1 (ii) Housing for batch 2.

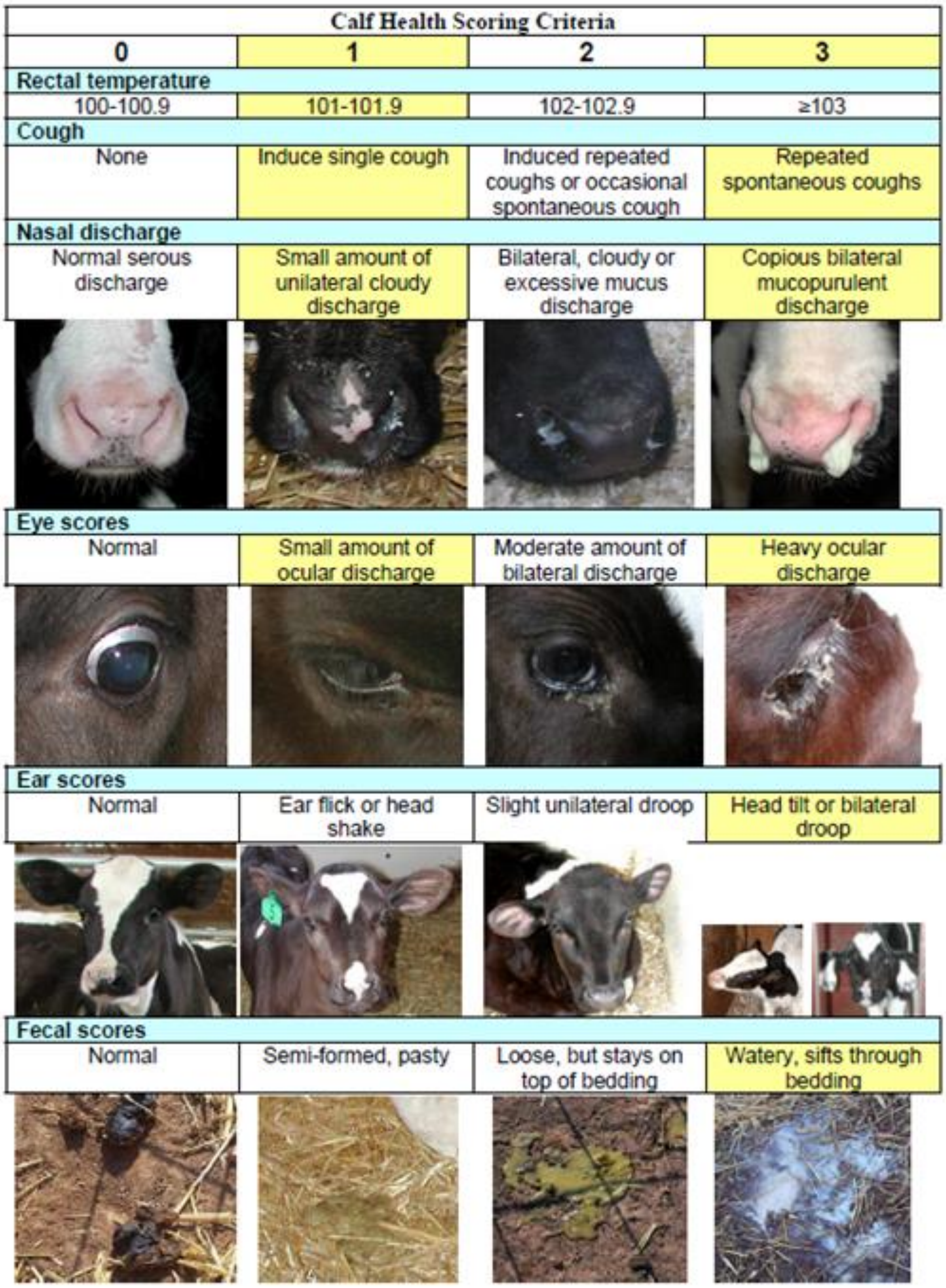
Measurements

All calves used for this study were lung ultrasound scanned (TUS) and allocated a score from 0 to 5 (Table 2). All the scanning was carried out by a veterinarian who was experienced and trained in carrying out such a procedure. An Easi-Scan Go Scanner with a linear probe (IMV Imaging UK Ltd) was used. This procedure involved creating a small holding area within each pen where all calves were held prior to being ultrasound scanned. Each calf was then handled and gently restrained by an experienced member of the technical staff to allow the scanning to take place. A liberal amount of Isopropanol solution was applied to both sides of the thoracic area of the calf to ensure a suitable contact between the coat of the calf and the ultrasound probe. The thoracic area of the calves was not clipped for the procedure to be carried out.

Table 2 Lung ultrasound scanning scores (TUS) (Source: Ollivett and Buczinski, 2016)

TUS	Description
0	Normal aerated lung with no consolidation
1	Diffuse comet-tail artifacts without consolidation
2	Small lobular lesions
3	Lobar pneumonia affecting only 1 lobe
4	Lobar pneumonia affecting 2 lobes
5	Lobar pneumonia affecting 3 or more lobes

After each calf had been lung ultrasound scanned, it was passed to another 2 members of the study team. The calves were then visually assessed for clinical signs of disease using the Wisconsin clinical calf health scoring system. This procedure involved taking a rectal temperature and assessing nasal and ocular discharge, head/ear positioning and cough and allocating each parameter a score from 0 to 3 based on severity (Figure 3). The calf was then released back into the larger pen. The same process was carried out at both measurement sessions for each batch of calves.



Calf Health Scoring Criteria			
0	1	2	3
Rectal temperature			
100-100.9	101-101.9	102-102.9	≥103
Cough			
None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
Nasal discharge			
Normal serous discharge	Small amount of unilateral cloudy discharge	Bilateral, cloudy or excessive mucus discharge	Copious bilateral mucopurulent discharge
Eye scores			
Normal	Small amount of ocular discharge	Moderate amount of bilateral discharge	Heavy ocular discharge
Ear scores			
Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop
Fecal scores			
Normal	Semi-formed, pasty	Loose, but stays on top of bedding	Watery, sifts through bedding

Figure 3. Wisconsin calf health scoring system (Source University of Wisconsin; https://fyi.extension.wisc.edu/heifermgmt/files/2015/02/calf_health_scoring_chart.pdf)

Liveweight (Kg) was recorded by the rearing unit on two occasions during the study period for each batch of calves. The first liveweight (Arrival) was taken in the days following the calves arriving at the rearing unit and the second liveweight (End) was taken the day preceding the last of the study measurements.

Data analysis

All collected data was collated in Microsoft Excel with data manipulation, statistical tests and data visualisations carried out in R Studio, version 4.3.1 (R Core Team, 2023). The 'ggplot2' package (Wickham, 2016) was used for data visualisation.

Lung ultrasound scanning scores

The lung ultrasound scanning scores (TUS-Arrive; TUS-End) were used in a number of the analyses in a few various ways. Firstly, they were used as their separate TUS scores (i.e. 0-5) to illustrate the effects of each TUS score on other parameters. They were also used to characterise the status of the calf in terms of respiratory health. TUS scores 0 to 2 were classed as respiratory negative (TUS-) and TUS scores 3 and above were classed as respiratory positive (TUS+). Finally, a change in lung health was calculated by subtracting the TUS-End score from the TUS-Arrival score. As a result, any calf that had an increase in TUS was regarded as having a decline in lung health (Decline). Any calf that had the same TUS for both TUS-Arrival and TUS-End was regarded as 'No change' and any calf that had a decrease in TUS was regarded as having an improvement in lung health (Improve). These changes are referred to as 'TUS Change'. The direction of change in TUS was also used for some analyses. Calves that were regarded as being TUS+ at TUS-Arrive but by TUS-End were regarded as TUS- were classed as 'POS to NEG'. The calves that were regarded as being TUS- at TUS-Arrive but by TUS-End were regarded as TUS+ were classed as 'NEG to POS'. 'No Change-NEG' and 'No Change-POS' was used to class calves with the same TUS at TUS-Arrive and TUS-End (e.g., TUS + at TUS-Arrive and still TUS+ by TUS-End). These changes of direction of TUS scores are referred to as 'TUSChangeMove'.

Wisconsin clinical health scores

After the clinical health of the calves was visually assessed, a respiratory score (CRS-Score) was calculated following the method of McGuirk (2008). Calves were considered to be clinically positive (CRS+) if they had a CRS-Score ≥5 or two or more of the individual scores were ≥2 (Donlon et al., 2023). All calves that did not meet these criteria were considered to be clinically negative (CRS-). Due to the calves having been vaccinated the day prior to the END measurements, the END Wisconsin clinical health scores were not used in the analysis due to the uncertainty of whether or not a raised rectal temperature was due to illness or administration of the vaccine.

Liveweights and farm recorded treatments

The liveweights recorded by the farm were used to calculate the daily liveweight gain (DLWG; Kg/d) by subtracting the 'end' weight from the 'arrival' weight and dividing by the number of days between each weighing. Farm recorded treatments for respiratory related diseases were collected and collated for each calf. These were then transformed into a binary character (No/Yes) for whether or not the calf had received treatment within the duration of the study period.

Arrival age of calves

The age of the calves when the first series of measurements was taken was referred to as the 'Arrival age' (d). To categorise the arrival age of the calves, the data was divided into quartiles.

Reflective grouping of calves

As previously stated, there was no physical movement of calves between pens to create groups of calves based on source farm and/or arrival health measurements (Wisconsin clinical health scores; thoracic ultrasound scan scores). To create a 'group' the TUS and CRS were combined to categorise calves into 'TUS+, CRS+', 'TUS+, CRS-', 'TUS-, CRS-' and 'TUS-, CRS+'. The proportion of calves that were in the category of 'TUS+, CRS+' within each pen was calculated. The result of this calculation was then used to characterise the pens into the following groups: 'Less10TC' (pens with less than 10% of the calves categorised as TUS+, CRS+) and 'More10TC' (pens with more than 10% of calves categorised as TUS+, CRS+).

Statistical analysis

All data was checked for normality by carrying out Shapiro-Wilk tests. One-way ANOVAs were conducted to compare assess the relationship between the DLWG of TUS Change and the DLWG of TUSClassMove. A two-way ANOVA was carried out on TUS by age of calf at Arrival and TUS session (Arrive; End). Two-way ANOVAs were also carried out on DLWG by TUS Change and whether or not calves had been treated or not treated by the farm for respiratory disease and DLWG by grouping and whether or not calves had been treated or not by the farm for respiratory disease.

Results

Arrival health information

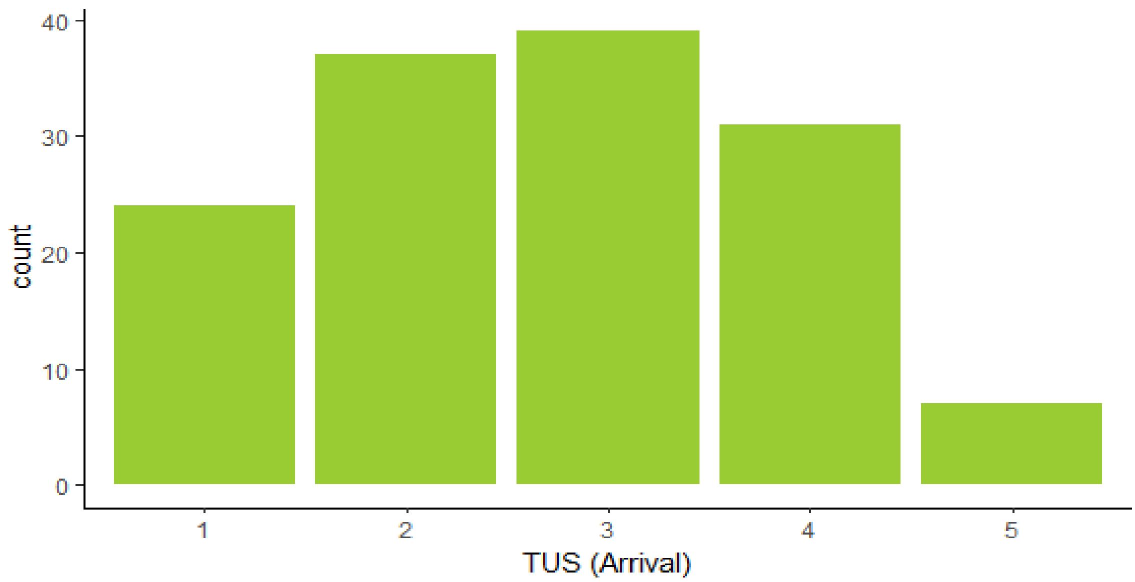


Figure 4. Number of calves per lung ultrasound scanning score (TUS) on arrival at the rearing unit

Based on the TUS on arrival at the rearing unit, no calves arrived with normal aerated lungs (TUS = 0). A total of 77 calves (55.8%) arrived at the rearing unit with positive TUS (TUS+) (TUS ≥3) for respiratory disease (Figure 4).

On the same day as the arrival lung scanning (TUS) was carried out, 24.6% of the calves (34/138) were regarded as clinically positive for respiratory disease (CRS+) based on the Wisconsin clinical health scores. Based on CRS and TUS information, 17.4% (24/138) of the calves in this study were both TUS and CRS positive on the day of arrival data collection (Table 3).

Table 3. Summary of BRD subtypes observed for calves on arrival at the rearing unit

TUS status (Arrival)	CRS status (Arrival)	No. Calves	Percentage of total number of calves
TUS-	CRS-	51	37.0
TUS-	CRS+	10	7.2
TUS+	CRS-	53	38.4
TUS+	CRS+	24	17.4

Herds by TUS (Arrival)

Table 4. Number of calves per Herd by Arrival TUS status and as proportion per herd

		Count of calves per Herd		Percentage (%) of calves per Herd	
Herd	**Total No calves per Herd**	**TUS-**	**TUS+**	**TUS-**	**TUS+**
A	9	6	3	66.7	33.3
B	9	3	6	33.3	66.7
C	8	2	6	25.0	75.0
D	6	0	6	0.0	100.0
E	3	1	2	33.3	66.7
F	7	4	3	57.1	42.9
G	6	2	4	33.3	66.7
H	40	21	19	52.5	47.5
I	9	4	5	44.4	55.6
J	4	3	1	75.0	25.0
K	2	2	0	100.0	0.0
L	10	4	6	40.0	60.0
M	16	7	9	43.8	56.3
N	9	2	7	22.2	77.8

Thirteen of the fourteen herds from which the calves for this study were sourced from, supplied calves that were classed as TUS+ (Table 4). Nine of those thirteen herds had 50% or more of their calves arriving at rearing unit as TUS+.

TUS by Arrival age (categorised)

There was no clear effect of arrival age of the calves on the TUS status (positive (TUS+); negative (TUS-)) (Table 5).

Table 3. Number of calves by Arrival Age quartiles and TUS status (Arrival)

Arrival Age (d)	No. Calves	TUS-	TUS+	Percentage TUS-	Percentage TUS+
≤24	42	17	25	40.4	59.6
25-30	30	15	15	50.0	50.0
31-41	31	12	19	38.7	61.3
≥42	35	17	18	48.6	51.4

End health information

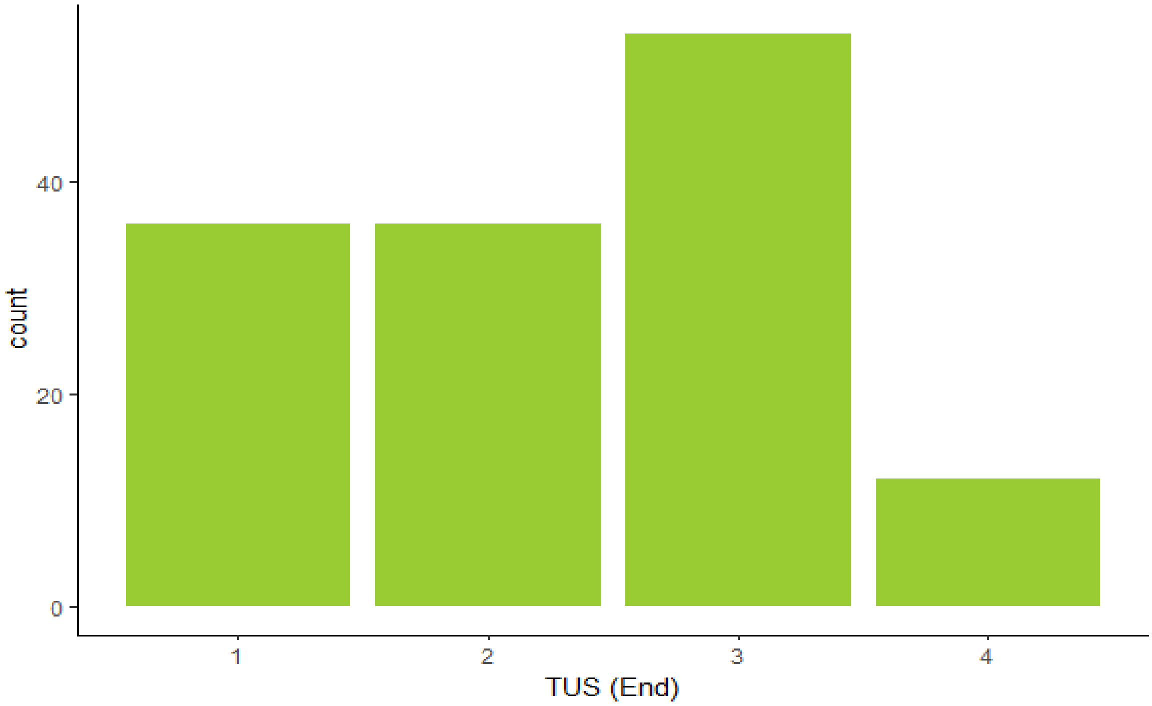


Figure 5. Number of calves per lung ultrasound scanning score (TUS) at the end of the study period (End)

At the second occasion of lung ultrasound scanning (TUS-End), there were no calves with a TUS of 0 and no calves with a TUS of 5 (Figure 5). Out of the 138 calves, 66 (47.8%) were regarded as respiratory positive (TUS+) at TUS-End.

TUS score declined (Decline) in 23.9% of the calves (33/138), stayed the same (No Change) in 29.7% (41/138) and improved (Improve) in 46.4% (64/138).

All categories of Arrival age showed an improvement in TUS-End compared to TUS-Arrive (Figure 6). However, there was no statistically significant interaction between TUS Session (TUS-Arrive, TUS-End) and Arrival age on TUS ($F(3,268) = 0.194$, $p = 0.900$).

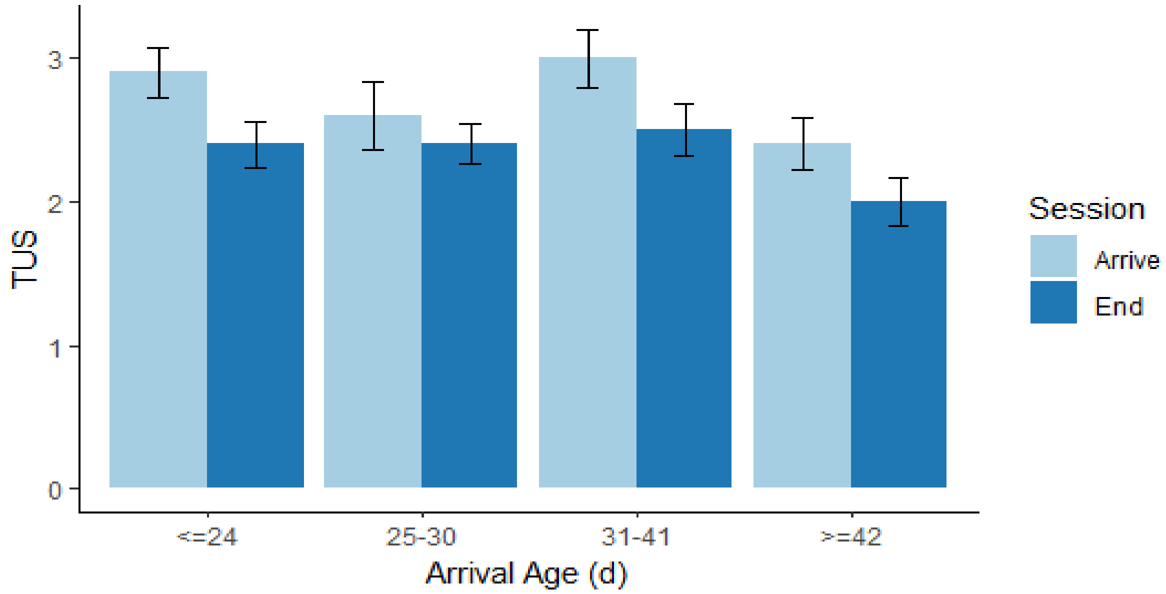


Figure 6. Initial and last (Arrive; End) lung ultrasound scanning score (TUS) by Arrival age (days; d) of the calves (mean±SE).

Farm recorded treatments

Of the 138 calves monitored in this study, 49.3% (68) were recorded as having been treated by the farm for respiratory disease. There were signs of a trend indicating that higher TUS (Arrival) led to more farm treatments for respiratory disease (Table 6).

Table 6. Number of calves treated by the farm for respiratory disease (No; Yes) by initial lung ultrasound scanning score (TUS-Arrival) as a count and as percentage.

TUS (Arrival)	No. Calves	Farm Treated for Respiratory disease			
		No	Yes	% No	%Yes
1	24	15	9	62.5	37.5
2	37	25	12	67.6	32.4
3	39	20	19	51.3	48.7
4	31	8	23	25.8	74.2
5	7	2	5	28.6	71.4

This trend becomes clearer when classifying calves as either respiratory negative (TUS-) or respiratory positive (TUS+) on arrival (Table 7).

Table 7. Number of calves treated by the farm for respiratory disease (No; Yes) by respiratory status on initial lung ultrasound scanning score (TUS status (Arrival); TUS-; TUS+)).

TUS status (Arrival)	No. Calves	Farm treated for respiratory disease			
		No	Yes	% No	%Yes
TUS-	61	40	21	65.6	34.4
TUS+	77	30	47	39.0	61.0

When examining the farm treatments for respiratory disease further, all source farms supplied calves that required treatment. The percentage of calves that they supplied that required treatment ranged from 11.1% to 100%.

TUS information and DLWG

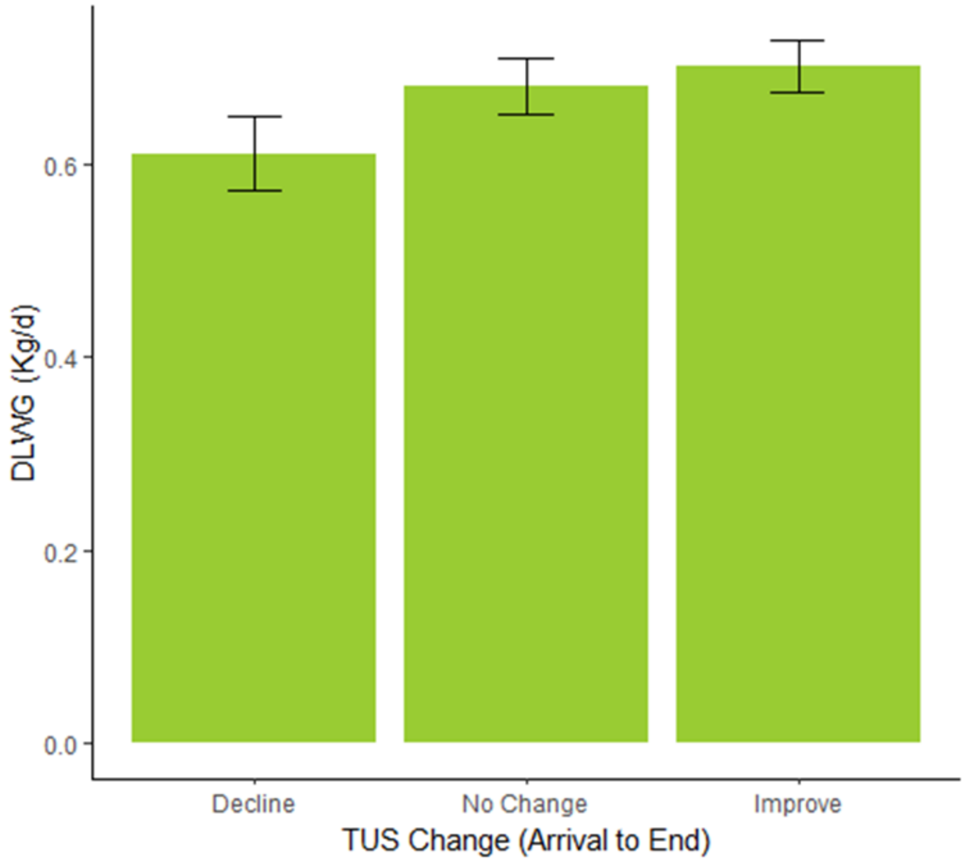


Figure 7. Daily liveweight gain (DLWG; Kg/d) by change in TUS from Arrival at the rearing unit to End of study period (mean±SE).

The calves that had a worse TUS at the end of the study period (TUS-End) than at the beginning (TUS-Arrive) (Decline) had the lowest daily liveweight gain compared to the calves that had the same TUS (No change) or had a lower TUS at the end of the study compared to the beginning (Improve) (Figure 7). Despite this numerical difference, there was no significant difference in mean DLWG ($F(2,135)=1.904$, $p = 0.153$) between TUS Change (Decline: 0.61kg/d ± 0.038; No Change: 0.68kg/d ±0.030; Improve: 0.70kg/d ± 0.027 (Mean ± SE).

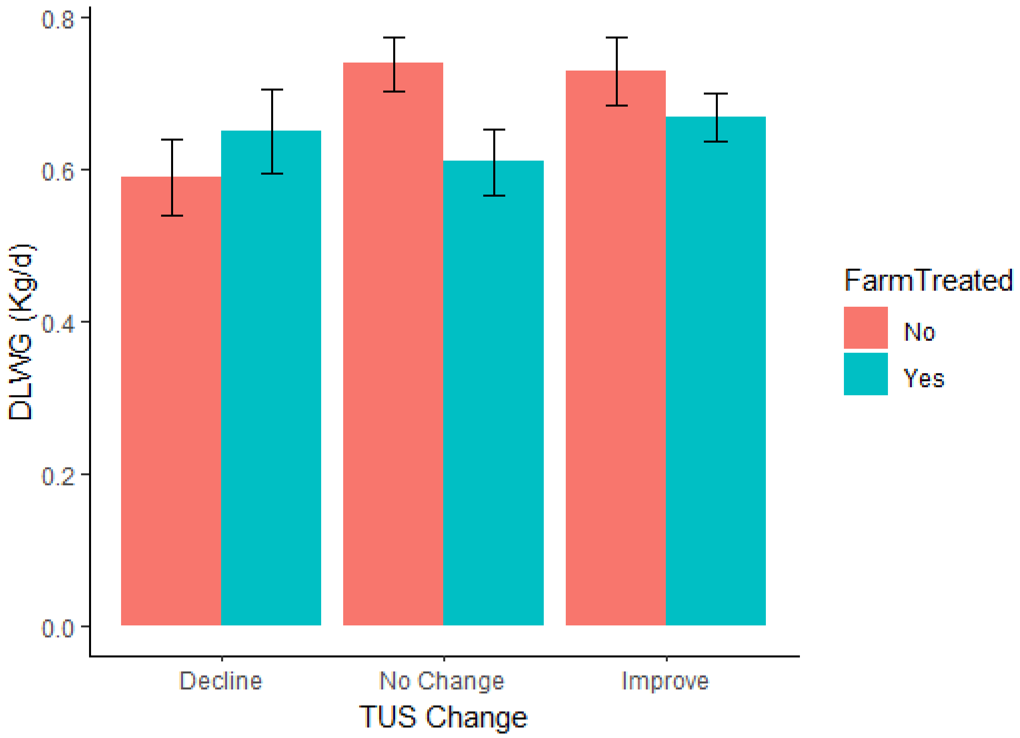


Figure 8. Daily liveweight gain (DLWG; Kg/d) by change in lung ultrasound scanning score (TUS change) between initial and last scanning and treatment by the farm for respiratory disease (No; Yes) (mean±SE).

Calves that had a Decline in TUS for the study period and were treated by the farm for respiratory disease, had a higher daily liveweight gain (DLWG; kg/d) compared to those calves that had not received treatment (Figure 8). There was no statistical significant interaction between TUS Change (Decline, No Change, Improve) and Farm treated (No, Yes) on daily liveweight gain (DLWG) ($F(2,132)=1.685$, $p=0.189$).

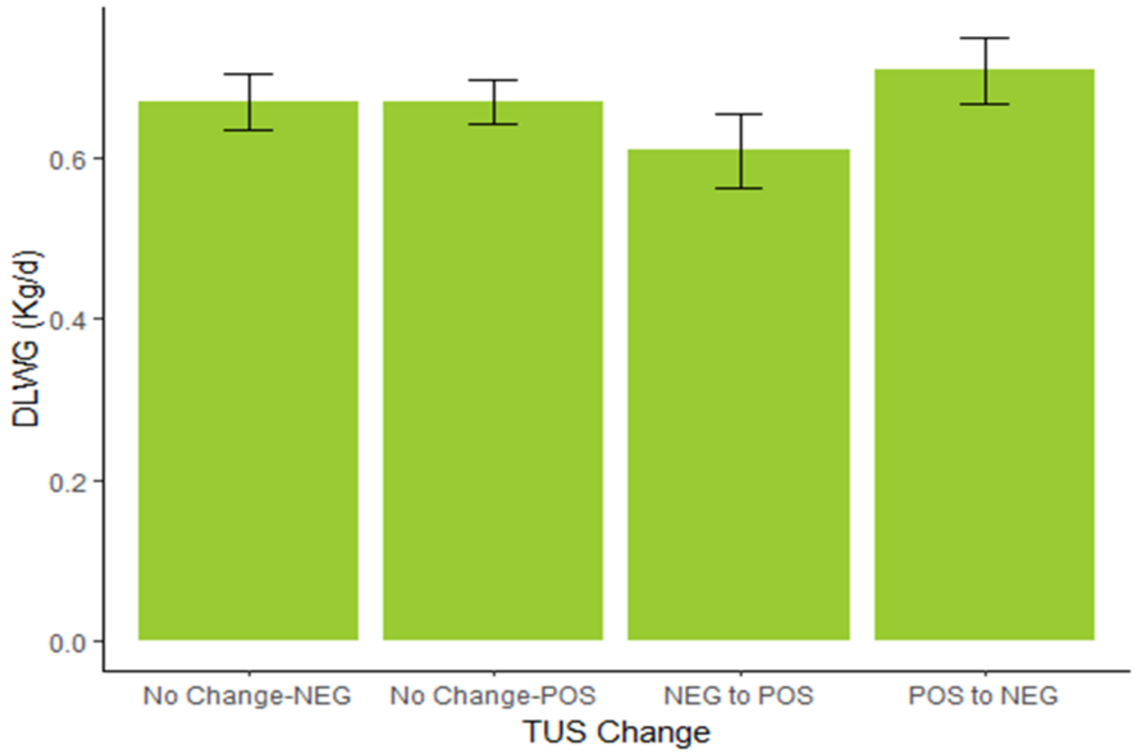


Figure 9. DLWG (kg/d) by the direction of change in TUS status (TUS+, TUS-) from arriving and end of study period (mean±SE).

The calves that went from being respiratory negative (TUS-) on Arrival to respiratory positive (TUS+) at the End, had the lowest daily liveweight gain (DLWG, Kg/d) compared to the calves that went from being respiratory positive to respiratory negative or did not change (No Change-NEG, No Change-YES) (Figure 9). However, there was no significant difference in mean DLWG ($F(3,134)=1.018$, $p = 0.387$) between the change in respiratory classification (No Change-NEG: .0.67Kg/d ± 0.035 (Mean±SE); No Change-POS: 0.67Kg/d ± 0.027; NEG to POS: 0.61Kg/d ± 0.046; POS to NEG: 0.71Kg/d ± 0.041).

Table 8. Change in respiratory status from Arrival to End (TUSClassMove) and calves recorded by the farm as receiving treatment for respiratory diseases as a count and as a percentage.

TUSClassMove	Total No. calves	Farm treated			
		No	Yes	% No	%Yes
No change – Negative	40	26	14	65.0	35.0
No change – Positive	45	15	30	33.3	66.7
Negative to Positive	21	14	7	66.7	33.3
Positive to Negative	32	15	17	46.9	53.1

Two-thirds of the calves that went from being respiratory negative (TUS-) on Arrival to respiratory positive (TUS+) at the End received treatment for respiratory disease (Table 8) which is a similar trend to those calves that Arrived respiratory negative (TUS-) and stayed respiratory negative. Two-thirds of calves that stayed respiratory positive (TUS+) from Arrival to End received treatment for respiratory disease.

Reflective grouping

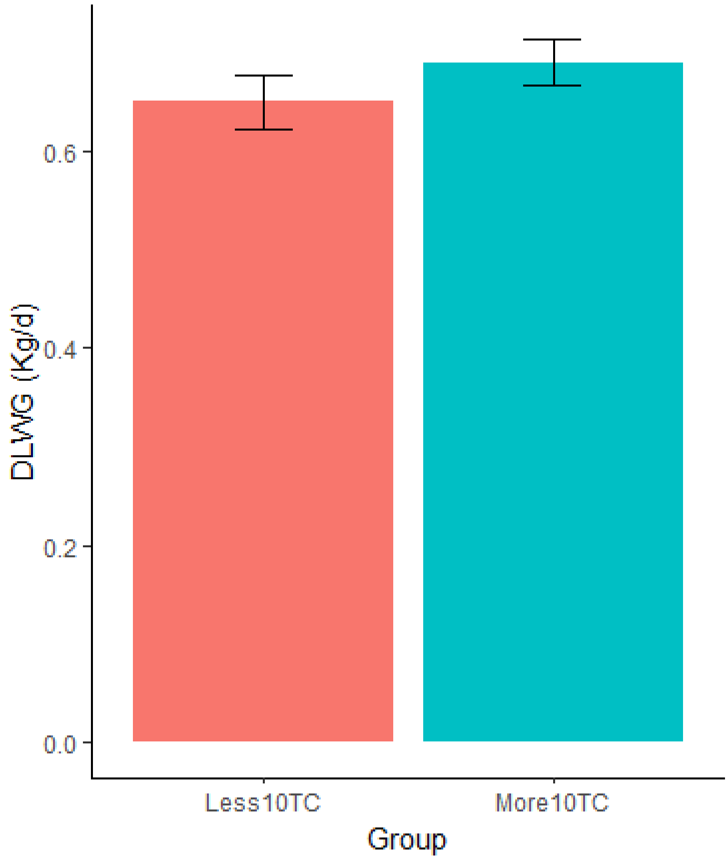


Figure 10. Daily liveweight gain (DLWG; kg/d) by Grouping of calves (Less10TC, More10TC) (mean±SE)

Although there was a numerical difference in the daily liveweight gain (DLWG; Kg/d) between the 2 groups (More10TC; Less10TC) (More10TC: 0.69Kg/d ± 0.023 (Mean±SE); Less10TC: 0.65Kg/d ±0.028) (Figure 10), there was no statistically significant difference in the daily liveweight gain (DLWG, Kg/d) between the 2 groups (More10TC; Less10TC) (p=0.272).

Table 9. Calves treated during study period by farm by Group (Less10TC; More10TC) as a count and as a percentage.

Group	Total	No. calves farm treated		Percentage of calves farm treated	
		Not treated	Treated	Not treated	Treated
Less10TC	60	33	27	55	45
More10TC	78	37	41	47.4	52.6

Within the Less10TC group, there was a larger percentage of calves that had not received treatment by the farm for respiratory disease than those that had received treatment (Table 9). Within the More10TC group, the opposite was observed in that there was a larger percentage of calves that had received treatment for respiratory disease than those that had not received treatment.

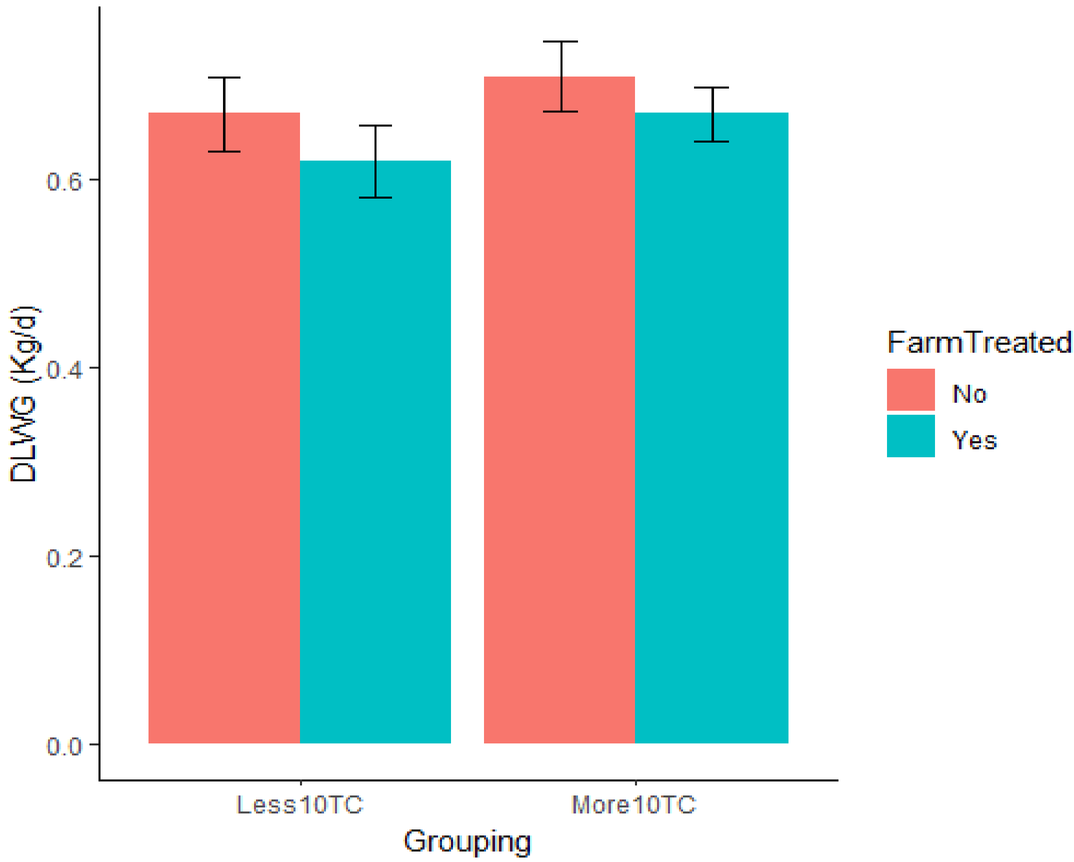


Figure 11 Daily liveweight gain (DLWG; Kg/d) by Grouping (Less10TC; More10TC) and treatment by the farm for respiratory disease (No; Yes) (mean±SE).

There was no statistically significant interaction between the effects of Grouping and Farm treated (No, Yes) on DLWG ($F(1,134)=0.111$, $p=0.740$). Within each of the 2 groupings, calves that had received treatment for respiratory disease had a lower DLWG compared to those that had not received treatment (Less10TC: Farm treated-No 0.67kg/d±0.039 (Mean±SE), Farm treated- Yes 0.62kg/d ±0.039; More10TC: Farm treated-No 0.71kg/d ±0.037, Farm treated-Yes 0.67kg/d ±0.029) (Figure 11).

Discussion

The objectives of this study were to explore the health of dairy-beef calves as well as to try and employ a strategy for grouping calves when they arrive on a commercial rearing unit.

Arrival information

In this study, on arrival at the rearing unit, 55.8% of the calves were regarded as respiratory positive (TUS+) based on having a thoracic ultrasound scan score of 3 or above. This figure is slightly lower than that from a previous unpublished SRUC-conducted study. In that particular study which was conducted at a time of the year which is normally associated with respiratory disease (Winter/early Spring), the health of 140 calves arriving at a rearing unit was examined and it was found that 62.1% of the calves arrived respiratory positive. In the current study, nearly every source dairy farm (13 out of 14) supplied calves that were TUS+ and a large proportion of those farms (9 out of 13) had more than 50% of their calf consignment that were classed as TUS+. Once again, these figures follow a similar trend to those found in the previously mentioned SRUC-conducted study. However, some of the figures from particular source herds should be interpreted with a note of caution due to the small number of calves included within their calf consignment. None of those farms would potentially have known about the lung health of the calves they consigned, and neither would the rearing unit have selected those calves if they deemed them to have respiratory disease. Despite both studies being conducted at different times of the year and with different source dairy farms, such figures start to raise concerns about the management of these calves on the source dairy farms. It also brings into question the respiratory health of the dairy replacement calves that remain on those farms. It would be of interest to know if the proportion of dairy replacement calves that were respiratory positive was similar to the dairy-beef calves that are leaving the source farm. It would have been interesting to have collected information about the colostrum management for these dairy-beef calves and passive immunity status of each calf.

In relation to other known studies, the prevalence level of respiratory positive calves in this study is extremely high. In a study conducted by Jourquin et al. (2023) they found 17.6% of calves (52/295) had signs of consolidation ≥3cm which would be the equivalent of a score 3 or above on the scale used in this study.

In this study, there was a range in the liveweight of calves on arrival at the rearing unit. The mean liveweight of those calves was 52.9kg. A review by Renaud and Pardon (2022) highlighted that a liveweight greater than 50kg seemed to reduce the risk of morbidity and mortality due to respiratory disease in the first twenty-one days of arriving at the rearing unit. Therefore, attempts to maximise the liveweight of the calves on the source dairy farm should be encouraged. However, this then leads back to the debate as mentioned in the introduction to this report in that these calves are non-replacements for the dairy herd and there is potentially the thought of spending as little as possible on such calves.

Study period – TUS change and daily liveweight gain

A large number of the calves in this study (46.4%) showed signs of improvements (IMPROVE) in lung health as indicated by the use of thoracic ultrasound scanning (TUS). When examining the change in lung health in slightly more detail, 21 of the 138 calves went from being respiratory negative (TUS-) (i.e. TUS ≤2) to respiratory positive (TUS+) (i.e.TUS≥3). Two thirds of these particular calves did not receive treatment for respiratory disease from the farm. This is in no way a reflection of the level of disease detection carried out by the farm but highlights the difficulty in detecting respiratory disease and often, extremely subtle symptoms will be expressed by the calves in the early stages of the disease process.

Biologically, calves that went from TUS+ (TUS≥3) to TUS- (TUS≤2) (POS to NEG) would have a reduction in the number of lung lobes displaying signs of consolidation. Calves that went from being TUS- to TUS+ (NEG to POS) would have an increase in the number of lung lobes displaying signs of consolidation. Over 50% of the calves that were POS to NEG had received treatment by the farm for respiratory disease. This may go some way to explain why this group had the highest DLWG. The calves received adequate treatment that would aid their recovery and allow them to partition more energy into growth rather than using this energy into fighting disease.

Calves that showed signs of improvements in lung health had a higher daily liveweight gain (DLWG) compared to those calves on the study that showed a decline or no change in lung health. This may be a result of effective treatment of such calves. Cuevas-Gómez et al. (2021) reported that the presence of lung lesions was associated with reduced growth rates in pre-weaned calves. The findings from the study are also possibly a testament to the dedication of the calf rearers and management of the calves on this particular rearing unit.

The housing and management of the calves may have been enough to effectively aid the improvement in the lung health of the calves used in this particular study.

Grouping of calves

Although testing of grouping strategies on arrival to the study farm was not able to be carried out on this particular occasion, the strategy used was reflective of the health status of the calves as grouped by the rearing unit on their arrival on this occasion. The strategy 'implemented' was that of groups with less than or more than 10% of calves within the group being clinically and respiratory positive (CRS+, TUS+) on arrival. There was no statistical significance of this grouping strategy on daily liveweight gain (DLWG) or on the interaction between the effect of this grouping strategy and whether or not the calf was treated by the farm for respiratory disease or not on DLWG. A possible explanation could be that those calves that were initially clinically and respiratory positive were not of a 'severe enough' disease level to have any influence on the overall health of the other calves within the group. Also, the threshold set of 10% may be considered as extremely low, given the number of calves per pen.

As far as the authors of this report are aware, there has been no research into appropriate grouping practices for calves from multiple sources when they arrive at rearing units. Most calf rearing units prefer to keep calves from the same source dairy farms together as and when possible (personal communication) with the philosophy behind this being that these calves will have had been subjected to the same management regime on the source dairy farm and will have been 'exposed' to the same 'pathogenic environment' as each other. However, on some occasions this is not always possible and these calves have to be mixed with calves from other source dairy farms.

Conclusions

In summary, this study highlights the use of lung ultrasound scanning to detect respiratory health in calves that may otherwise have gone undetected. There are also a considerable number of calves arriving at a rearing unit with sub-clinical respiratory disease. Further follow up work should be conducted to explore the grouping of calves at a rearing unit to try and improve their health and future performance as well as investigating potential explanatory factors on source dairy farms into the lung health of the non-replacement calves.

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