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Denormalizing poor dairy youngstock management: dealing with "farm-blindness"

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Introduction

This review consists of three interrelated sections. Firstly, the phenomenon of farm blindness is defined and described using examples from poor young stock management. Secondly, the extent of poor youngstock management internationally is quantified using data on management practices and calf morbidity and mortality rates. Finally, these two sections are linked together in addressing how to denormalize poor youngstock management by dealing with farm blindness.

Farm-blindness

At its simplest, farm-blindness/herd blindness ("barn blindness" in the United States) may be defined as "a misperception by farmers that what they see every day on their own farm is normal, and like on every other farm, particularly when it is not; a new normal"; farming without self-awareness (tunnel vision/"owneritis"). This syndrome ["farmblindness", shifting baseline syndrome (SBS)] has been recognized in all professional groups for at least 60 yr (Westermarck, 1961). In relation to calves, the issue has been highlighted in both perinatal losses (Mee, 2013a) and youngstock losses (Boersma et al., 2008). Other examples of farm-blindness cited in the cattle health literature include lameness (Bruijnis et al., 2013), nematode control practices (Vande Velde et al., 2018), biosecurity (Sayer et al., 2013), and cow welfare (Mee et al., 2019). Concomitants of farm-blindness have been recognized across most farming systems, e.g., cattle, pigs, poultry, sheep, fur farming, vegetable farming, and organic farming.

There are variations within the concept of "blindness" as applied at farm-level. Distinctions include "defensive blindness" whereby we may block out anything deemed too alarming as part of our innate defence mechanisms for dealing with problems (Strijack, 2018). Another variation on farm blindness is "willed/wilful blindness" where we exhibit a lack of reaction to the effects of our actions which cannot be explained by lack of knowledge or scientific uncertainty, rather it reflects our moral shortcomings (Gjerris, 2015). "Production/organizational blindness" is an adjacent type of farm blindness whereby farmers continue to produce at a rate asymmetric with the supply–demand dyad (Wang et al., 2018).

The syndrome of farm blindness may be caused by two management deficits; not recognizing the problem or recognizing the problem but being blind to it.

Failure to Recognize the Problem

Failure to recognize the problem may be due to (1) not recording the problem and (2) underestimating the extent of the problem whether recorded or not.

Problem is not recorded

Farm blindness is a particular problem with perinatal calf mortality. If the calf dies before the legally required age to tag the calf its birth/death may go unrecorded (not written down or entered into a database) and so unnoticed, i.e., the farmer is "blind" to the loss. In dairy herds where the cow is likely to lactate independent of the calf death, the loss may be perceived as secondary to the onset of lactation and so the farmer may be blind to its occurrence/importance. Concern about this specific issue has been documented. For example, recording of "stillbirth," which may be defined by farmers as death up to 2 d after birth, is exclusively on a voluntary basis in the United States and Canada resulting in highly variable recording from farm to farm (Henderson et al., 2011). In Ireland, it is estimated that more than 90% of cattle abortions are not reported to the national diagnostic laboratories. Similarly, in France, 60%–80% of beef and dairy farmers, respectively, who detected an abortion, did not report it (Bronner et al., 2013). A Norwegian study found a high level (40%)

Abbreviations

FPT	failure of passive transfer
ICBF	Irish Cattle Breeding Federation
Ig	immunoglobulin
KPI	key performance indicator
Max.	maximum
Min.	minimum
NR	not recorded
STP	serum total protein

of underreporting of calf diarrhea and respiratory disease on dairy farms (Gulliksen et al., 2009). If a problem is not recorded, it may not be visible and hence the farmer is blind to its existence (unconscious bias) (Newell and Shanks, 2014).

Problem is not recognized as a problem

Farmers may not recognize that there is a "real" problem if they underestimate the true extent of the problem. So, a farmer may be cognizant that some calves die on their farm but because they underestimate the extent of this loss they are "blind" to it as a problem. There is evidence of this occurring, for example, a Canadian study found that calf mortality was underestimated by 20%–50% by dairy farmers (Vasseur et al., 2010). This may be a form of spatial blindness where a farmer fails to grasp the "big picture" of, for example, high mortality, if they underestimate loss rates. In that same Canadian study (Vasseur et al., 2010), 94% of farmers did not perceive calf mortality as a problem even though the perinatal mortality rate was 8.8%. Similarly, in a sociological study of Dutch farmers with high (>10%) calf mortality, 57% of farmers were not aware of the fact that the calf mortality rates in their herds was unusually high (Santman-Berends et al., 2014). Thus farmers may have a genuine problem but not "see" (perceive) it as a problem.

In order to understand this issue, veterinary practitioners need to recognize that the farmer's perception of animal health problems does not always align with theirs, a fact they may not be aware of (Derks et al., 2013). For example, a Dutch study showed that the hazard rankings of vets and farmers differed (in some cases significantly) throughout the rearing period of heifers (birth to insemination) (Boersma et al., 2013). Similarly, a Delphi study of Irish stakeholders' perceptions about animal health disorders showed that experts disagreed with both dairy and beef farmers on the ranking of diseases of young calves (More et al., 2010). Additionally, amongst dairy farmers, attitudes and perceptions to calf management differ between those with high vs. no calf mortality (Vaartst and Sorensen, 2009). Given these disparities, it is perhaps not surprising that some farmers may be blind to youngstock health problems as they may not perceive them as as important as other farmers do or as their veterinarians do (aberrant hazard perception) (Boersema et al., 2013). Thus, as the definition of which calf health problems are important differs between vets and farmers and between different farmers, it is perhaps not surprising that some farmers are "blind" to the importance of some calf health problems. They simply do not see them as a problem to the same extent as their veterinarian (asymmetric awareness).

Recognizing the Problem but Being Blind to It

Blindness, despite recognition, of the problem may be due to (1) desensitization, (2) change-blindness, and (3) pluralistic ignorance.

Desensitization

At the core of farm-blindness is desensitization resulting from the experience of the everyday (repetition/observational blindness). We see the problem so often that we do not notice it anymore; we are immune to the problem. We work unthinkingly, we do things in the traditional way, we get used to our own shortcomings so that we fail to regard them as weaknesses—complacency blind spots; we get "stuck in a rut." Farmers may suffer from "routine inertia" where they do not deviate from established routines in management practices until dealing with a problem becomes unavoidable. We can become inured to the abnormal by the anesthetic of the familiar. For example, the epithet "where there are livestock, there are deadstock" indicating fatalism as a default response to a problem. This state conforms to the inattentional blindness paradigm, i.e., the problem stimulus is "visible," e.g., diarrheic calves (so this differs from the perception issue outlined above), ensuring that the unawareness is due to lack of attention directed at the stimulus, rather than induced by insufficient sensory input. Inattentional blindness occurs when the observer's attention set does not adequately adjust itself according to the evidence (Netherland, 2017). Our limited attentional capacity may feed into this paradigm, particularly at busy times of the year or of the day. This paradigm may have a cognitive component of affected ignorance, i.e., choosing not to be informed of what we can and should know, particularly when this does not accord with how we see the world, in effect making us blind to counter-examples—self-deception.

Change-blindness

Slowing changing, gradual (unrecorded) subtle trends may go unrecognized; "bad, slowly, becomes normal." For example, vaccination administration dates may drift across years (often due to delayed availability of vaccines) to the point that they are no longer congruent with the period of risk/prevention. If calves are seen every day, it can be difficult to notice that they are not growing optimally over time. While we all have a certain frame of reference of what is normal, over time abnormal may become normal; the "change-blindness" phenomenon. This occurs where our original frame of reference, e.g., "we always vaccinate in mid-March," gradually changes over time without noticing that this has happened so that, for example, a decade later "we are now vaccinating in mid-June," without noticing the change—we are blind to the change.

Pluralistic ignorance

Pluralistic ignorance may play a role in farm blindness whereby the farmer is ignorant of what other farmers are doing in calf management and how their calves are performing (information asymmetry). The two actors in this example are two farmers who work independently and do not know what each other does with regard to calf management (this differs from cogitative dissonance whereby a single farmer holds two conflicting perceptions concurrently). This is a natural product of an industry where farmers often work largely in isolation from their peers. It has been stated that farm-blindness is more likely to be a feature on traditional, small dairy farms rather than on modern, large entrepreneurial dairy farms (Noordhuizen et al., 2008). The latter group of farmers are more likely to engage in knowledge dissemination, for example, farming discussion groups (Hennessy and Heanue, 2012). Farm blindness is particularly associated with farmers who grow up and work only on the same farm; in such cases, some conditions are considered as fixed and unalterable

(Westermarck, 1961) and pluralistic ignorance may be more prevalent. Farm blindness has also been associated particularly with new entrants to farming who may be ignorant of peer performance.

Poor Youngstock Management

Youngstock are the future of the farm. The multiple impacts of youngstock management during the preweaning period on subsequent performance in later life are well documented (Moallem et al., 2010). Yet poor management of youngstock is evident in the day-to-day procedures implemented (or not implemented) by farmers and in the outcomes they achieve (or do not achieve) in calf health, welfare, and growth. To highlight details of poor management, the latest studies characterizing youngstock management practices and output variables on dairy farms internationally are reviewed here.

Youngstock Management Practices

Numerous surveys have been conducted in recent decades which highlight areas where improvements in poor dairy youngstock management can be made. Poor management practices are risk factors for calf morbidity and mortality. Tables 1–7 show results from these surveys on selected topics; calving unit management, umbilical care, and colostrum management.

Calving pen used for sick cows

To avoid contamination of the calving pen environment for the newborn calf, it should not be used for sick animal, only for calving, as this can significantly increase the risk of both calf diarrhea and respiratory disease (Medrano-Galarza et al., 2018). Recent studies suggest that keeping the calving pen only for calving cows is not the case on many dairy farms, e.g., on 62% of both Austrian (Klein-Jobstl et al., 2014) and Swedish (Torsein et al., 2011) farms, on 58% of Irish dairy farms (Kennedy et al., 2014), and on 41% of U.S. dairy farms (U.S. Department of Agriculture [USDA], 2016) used calving boxes for sick cows.

Poor calving pen hygiene

Ideally, calving pens should be cleaned out after each calving and new bedding put down. However, the frequency of cleaning out these pens is highly variable and, in many dairy farms, cleaning happens after more than one calving, e.g., 83% of farms in the United States (Caraviello et al., 2006), 70% in Ireland (Kennedy et al., 2014), and 42% in Austria (Klein-Jobstl et al., 2014).

Delayed cow–calf separation

In the majority of studies internationally, calves are not immediately (<30 min) separated from their dam ("snatch calving") (Table 1). Traditionally, leaving the calf with the dam has been associated with aggravation of the acute separation distress response, increased risk of paratuberculosis and, if supplementary colostrum is not fed, failure of passive transfer (FPT), (Vasseur et al., 2010). However, a recent review has concluded that the evidence is not consistent on this practice (Beaver et al., 2019). This is an example where, in the absence of evidence (not synonymous with evidence of absence), the precautionary principle of removing the calf from a potentially contaminated calving environment is currently considered best practice for management of paratuberculosis internationally (Anon, 2015, 2020; McAloon et al., 2017; Collins, 2019).

No umbilical antisepsis

It is generally recommended that navel care should be carried out in newborn calves (European Food Safety Authority, 2012). However, the implementation of this practice is highly variable across countries with between 12% and 90% of surveyed farmers not adopting this practice (Table 2).

Delayed colostrum collection

The earlier after calving that colostrum is collected from cows the higher the Ig content of the colostrum and delay in collection is a risk factor for FPT. Few studies have examined this practice at farm level, but in those that did, a large percentage of farmers did not milk cows out immediately after calving, e.g., 92% of United Kingdom farmers collected the colostrum in the milking parlor more than 3 h after calving (Aitkinson 2015); 61% of Irish farmers collected colostrum more than 5 h after calving (Cummins et al., 2016), and 36% of Canadian farmers collected colostrum more than 4 h after calving (Renaud et al., 2018).

No measurement of colostrum quality

In order to decide which colostrum to feed to newborn calves, in particular for the first feed to replacement heifer calves, measurement of colostrum quality is recommended (e.g., using a Brix refractometer or colostrometer). The data in Table 3 clearly show that this is not a common practice in the majority (56%–89%) of dairy herds internationally.

Delayed feeding of first colostrum

Ideally, calves should be fed colostrum immediately after birth and the longer the interval between birth and feeding, the lower the absorption of immunoglobulins (FPT). The timing of

Table 1. Timing of cow–calf separation in dairy herds internationally from recent surveys (2005–2018)

Country	Herds (%)	Definition	Herds (No.)	Reference
Australia	68	>12 h	54	Ridge et al. (2005)
Austria	59	Not immediate	1,287	Klein-Jobstl et al. (2015)
Brazil	60	≥8 h	179	Santos et al. (2015)
Canada	77	>30 min	1,076	Winder et al. (2018)
Czech Republic	15	>12 h	136	Stanek et al. (2014)
Finland	–	0.6 d[1]	82	Seppa-Lassila et al. (2016)
Ireland	83	>6 h	306	Kennedy et al. (2014)
Norway	30	>30 min	125	Gulliksen et al. (2009)
United States	95	>30 min	1,262	USDA (2016)

[1]Mean time of cow–calf separation.

Table 2. Absence of umbilical antisepsis in dairy herds internationally from recent surveys (2008–2018)

Country	Herds (%)	Definition	Herds (No.)	Reference
Austria	27	No navel disinfection	1,287	Klein-Jobstl et al. (2015)
Brazil	52	No navel iodine dip	179	Santos et al. (2015)
Canada	51	Did not navel dip	52	Renaud et al. (2018)
Czech Republic	12	No navel disinfection	136	Stanek et al. (2014)
India	90	No application of iodine	50	Manivannan et al. (2009)
Ireland	19	No navel disinfection	132	Anon. (2010)
New Zealand	19	Did not routinely spray	23	Bryan et al. (2018)
Pakistan	69	Did not navel dip	120	Bilal et al. (2008)
United Kingdom	25	No routine disinfection	75	Atkinson (2015)
United States	23	No navel disinfection	104	Urie et al. (2018)

Table 3. Absence of measurement of colostrum quality in dairy herds internationally from recent surveys (2014–2019)

Country	Herds (%)	Herds (No.)	Reference
Austria	79	1,287	Klein-Jobstl et al. (2015)
Brazil	89	179	Santos et al. (2015)
Canada	82	52	Renaud et al. (2018)
Czech Republic	56	136	Stanek et al. (2014)
Ireland	87	47	Barry et al. (2019)
United Kingdom	80	75	Atkinson (2015)
United States	84	1,261	USDA (2016)

colostrum feeding internationally is highly variable indicating potential risk for FPT (Table 4). For example, in two recent (Santos et al., 2015) surveys, twice as many farmers in Brazil (29%) offered the first feed of colostrum more than 4 h after birth compared with that in Austria (15%) Klein-Jobstl et al., 2015; (Table 4). Given that the risk of FPT is directly correlated with timing of first colostrum feeding, this variability is a risk for FPT.

Inadequate volume of first colostrum feed

Research indicates that calves should be fed approximately 10% of their bodyweight in their first colostrum feed (Urie et al., 2018). However, calves are generally not weighed at birth hence a standard volume of at least 4 liters has been recommended for Holstein calves (assuming an average birth weight of 40 kg), (Shivley et al., 2018). As the data in Table 5 show, a substantial proportion of surveyed farmers do not feed this minimum volume.

Feeding of pooled colostrum

Pooled colostrum is a potential route of transmission of pathogenic bacteria present in mammary secretions (e.g., *Mycobacterium avium* subspecies *paratuberculosis* and *Mycoplasma bovis*). However, feeding of pooled colostrum is common practice internationally in dairy herds (20%–82%) (Table 6).

No measurement of FPT

In order to assess the effectiveness of colostrum management, measurement of FPT is a recommended herd health practice. Though very few studies have monitored this, the vast majority of farmers do not carry out this procedure; 98% in Brazil (Santos et al., 2015), 97% in the United Kingdom (Atkinson 2015), 94% in the United States (USDA, 2016), and 86% in Canada (Renaud et al., 2018).

While surveys of youngstock management practices measure throughput variables, three important inter-related output variables are: success of colostrum management, calf health and survival, and their obverse: FPT and calf morbidity and mortality. Additionally, growth rate metrics provide important indicators of performance, e.g., the proportion of calves born on the dairy farm which achieve a weight of 70 kg within the first 42 d of life.

Failure of Passive Transfer

While the importance of good colostrum management has been accepted for decades, the data in Table 7 show that a substantial minority of calves (12%–46%) still do not receive adequate colostrum. These average figures obscure the wide variation between herds. For example, an Italian study showed that 5%–70% of herds had calves with FPT (Lora et al., 2018) and an American study reported that 76% of farms had at least one calf with FPT (Urie et al., 2018).

Calf Morbidity

Despite recent advances in agri-technology (e.g., wearable bio-sensors—"fever tags"), immunology (e.g., vaccinology), and pharmacology (e.g., anti-parasiticides), dairy farmers perennially experience problems with the common calf diseases, i.e., diarrhea, respiratory disease, and navel ill. It is of course recognized that the case definitions of calf diseases vary widely between farmers and as such comparisons of calf morbidity prevalence data are fraught with difficulty. A recent Irish study of morbidity in calves less than 3 mo of age showed that at a herd-level, using Wisconsin health scoring case definitions, diarrhea, elevated rectal temperature (≥39.5°C), and enlarged navels were present on the majority (>50%) of farms (Table 8). Much less prevalent was respiratory disease, pyrexia (≥40°C) and other calf health issues. The same trends were detected at an animal level, but at much lower prevalence (generally <10% of calves).

Calf Mortality

Young calf mortality rates in both dairy and beef studies internationally are listed in Table 9 and 10. These vary between ~1% and 20% across studies, with differing definitions of the risk periods. This wide variation shows the potential for improvement in some countries, but may also reflect variation in the accuracy and methodology of data recording.

Table 4. Timing of first colostrum feed in dairy herds internationally from recent surveys (2009–2018)

Country	Herds (%)	Definition (h)	Herds (No.)	Reference
Austria	15	>4	1,287	Klein-Jobstl et al. (2015)
Brazil	29	>4	179	Santos et al. (2015)
Canada	62	>2	52	Renaud et al. (2018)
Ireland	64	>1	262	Cummins et al. (2016)
Norway	30	>2	125	Gulliksen et al. (2009)
United States	–	3.6[1]	1,261	USDA (2016)

[1]Mean time of first colostrum feeding.

Table 5. Volume of first colostrum feed in dairy herds internationally from recent surveys (2005–2018)

Country	Herds (%)	Definition (liters)	Herds (No.)	Reference
Austria	13	<2	1,287	Klein-Jobstl et al. (2015)
Brazil	20	<3	179	Santos et al. (2015)
Canada	26	<3	52	Renaud et al. (2018)
Finland	–	2.7*	82	Seppa-Lassila et al. (2016)
Ireland	80	≤3	262	Cummins et al. (2016)
Norway	82	<2	125	Gulliksen et al. (2009)
Sweden	30	≤4	122	Lundborg et al. (2005)
United States	65	<3	1,261	USDA (2016)

Table 6. Feeding of pooled colostrum in dairy herds internationally from recent surveys (2009–2016)

Country	Herds (%)	Herds (No.)	Reference
Australia	67	100	Vogels et al. (2013)
Czech Republic	20	136	Stanek et al. (2014)
Ireland	74	306	Kennedy et al. (2014)
Norway	82	125	Gulliksen et al. (2009)
United Kingdom	63	75	Atkinson (2015)
United States	20	1,261	USDA (2016)

Denormalizing Poor Youngstock Management

A blended response to denormalising poor youngstock management and addressing farm blindness is outlined hereunder. In attempting to denormalize poor youngstock management, veterinary practitioners or agricultural advisers may be confronted by client cognitive dissonance defined as the discomfort felt by a person who holds conflicting ideas, beliefs, or values at the same time (Becker et al., 2018). In the example of youngstock management, this is the discomfort experienced by someone challenged by new information (e.g., veterinarian advising that the calf loss rate is "too high") which is in conflict with existing beliefs (e.g., calf loss rate is normal "for my farm"). Dissonance reduction is a prerequisite for behavior change.

Create awareness

In order to "breakthrough" farm blindness, conditions must be created which capture exogenous attention/awareness. The first step in denormalizing *poor* management is to create awareness of *good* management (Mee, 2013b). An external fresh pair of eyes is required to assess the farm performance as the farmer is essentially an integral part of the farm superorganism and so can lack perspective. Another farmer, agricultural advisor, or veterinarian can perform this role. Farmers view participation in a herd health management plan as a means of preventing their farm blindness but worry that using the same advisor continuously may contribute to farm blindness on behalf of their advisor, i.e., the fact that the same advisor visits the same farm repeatedly, farmers worry that the advisor may become blind to its problems (Van Bijnen, 2015). In addition to external observations, an audit of performance may include health, locomotion or body condition scoring, or weighing/weigh-banding of a sample of youngstock. Awareness creation should also be done at a national or regional level as this enables awareness to filter down from domain experts based on consensus-led, evidence-based knowledge (Lorenz et al., 2011) via a dissemination infrastructure (national organization, social media, newsletters, website, videos, meetings, demonstrations, etc.) to the end users. Numerous exemplars of this awareness model are in action internationally, e.g., CalfCare (Ireland), KalfOK (The Netherlands; Santman-Berends et al., 2018), Calf Health Service (Switzerland), Stop the Loss (the United Kingdom), and InCalf (Australia and New Zealand). The objective of such campaigns was to alert farmers how important good management is to a successful farm and to highlight how they can assess their own management (directly addressing the issue of farm blindness) and improve it where necessary. Such animal health organizations increasingly employ social science at a national level to "nudge" farmer adoption of best practices in calf health by acting as "choice architects" formulating the context in which farmers make management decisions. In addition to public good organizations, other private good actors such as retail oligopolies can increase awareness of farmers through their farm quality assurance scheme standards in youngstock management (Sibley and Orpin, 2014). Similarly, pharmaceutical companies raise awareness of calf morbidity through commercial campaigns (e.g., Calfmatters, CalfTracker, Calf Resilience, Healthycalves, SureCalf) and by provision of subsidized diagnostics, for example, for diarrhea pathogens or respiratory disease antibodies.

Table 7. Incidence of FPT of colostral immunoglobulins to dairy calves internationally (2007–2019)

Country	FPT (% calves)	Definition	Calves[1] (No.)	Herds (No.)	Reference
Australia	41.9	IgG <10 g/liter	253	23	Abuelo et al. (2019)
Canada	46.5	IgG <10 g/liter	217	30	Elsohaby et al. (2019)
Czech Republic	34.6	IgG <10 g/liter	1,175	33	Stanek et al. (2019)
Germany	32.1	IgG <10 g/liter	262	15	Ebert et al. (2007)
Ireland	39	STP <5.7 g/dL	2,090	84	Todd et al. (2018)
Italy	41	IgG <10 g/liter	244	21	Lora et al. (2018)
New Zealand	32.3	STP <52 g/liter	1,921	34	Cuttance et al. (2019)
United Kingdom	26	STP <5.7 g/dL	444	7	MacFarlane et al. (2015)
United States	12.1	IgG <10 g/liter	1,623	104	Shivley et al., (2018)

[1]1–21 d old.

Table 8. Morbidity (Wisconsin health scoring point prevalence) in dairy calves (n = 6,850), 3 d to 3 mo of age, on 120 Irish dairy farms

Level	%	Diarrhea	Respiratory disease	Pyrexia (≥40°C)	High temperature (≥39.5°C)	Enlarged navel	Navel ill
Herd	Min.	0	0	0	0	4	0
	Max.	12	27	4	20	27	6
	≥1 calf	89	42	37	95	100	53
Calf	%	7	2	<1	6	14	2

Table 9. Incidence of dairy calf mortality (<6 mo old) internationally over the last decade (2011–2019)

Country	Calf mortality (%)	Definition	Calves (No.)	Herds (No.)	Reference
Australia	5.6	Prewean	NR	106	Abuelo et al. (2019)
Brazil	6.9	1 d—wean	10,721	1,460	Fruscalso et al. (2017)
Canada	6.4	2 d—wean	NR	578	Winder et al. (2018)
Denmark	10	0–180 d	752	30	Reiten et al., (2018)
Finland	6	7–180 d	13,583	82	Seppa-Lassila et al. (2016)
Germany	5	1–6 mo	NR	50	Tauthenhahn et al. (2016)
Iran	6.5	1–90 d	4,097	10	Azizzadeh et al. (2012)
Ireland	6.3	3 d–6 mo	NR	4,110	Lane (2018)
Norway	2.3	<6 mo	NR	470	Johnsen et al. (2019)
Portugal	20.8	<6 mo	NR	6,605	Krug et al. (2015)
Switzerland	3	2–120 d	216,287	NR	Bleul (2011)[1]
United Kingdom	4.5	2 d—wean	492	11	Johnson et al. (2017)
United States	5	2 d—wean	2,545	104	Urie et al. (2018)

[1]Holsteins.

Table 10 Incidence of pre-weaning beef calf mortality internationally over the last decade (2009–2018)

Country	Pre-weaning mortality (%)	Definition	Calves (No.)	Herds (No.)	Reference
Austria	3.24	2 d–6 mo	86,249	NR[1]	Fuerst-Waltl and Fuerst (2010)
Canada	3.8	1 h—wean	23,409	174	Elghafghuf et al. (2014)
Estonia	2.7	2 d–5 mo	21,075	NR	Motus et al. (2017)
France	6.53	7 d–6 mo	~75m	NR	Perrin et al. (2011)
Ireland	6.7	3 d–6 mo	NR	7,790	Lane (2018)
Mexico	9.7	2 d—wean	2,438	1[1]	Segura-Correa et al. (2018)
Scotland	3.2	2 d—wean	1,496	15	Geraghty (2018)
Slovenia	2.15	2–30 d	1,333,765	NR	Voljc et al. (2017)
Spain	9.58	Pre-wean	35,995	NR	Cervantes et al. (2010)
Switzerland	1.4	2 d–4 mo	65,063[2]	NR	Bleul (2011)

[1]9 herd-years.
[2]Simmentals.

Provide benchmarks

The second step is to provide farmers with credible peer benchmarks (KPIs—key performance indicators) against which they can compare their performance in youngstock management, e.g., for FPT (Chuck et al., 2014; Atkinson 2017), ADG (the proportion of calves reaching a specific body weight within a defined period of early life), or morbidity and mortality (Santman-Berends et al., 2018). "*Iceberg indicators*" can be used to highlight the fact that while these KPIs only document clinical disease, e.g., number of calves treated for respiratory disease, there is likely to be more nondiagnosed subclinical cases possibly detectable with screening diagnostics, e.g., pulmonary ultrasonography. If a farmer does not know what "normal" is, they cannot recognize "abnormal" on their own farm. The use of nationally generated statistics, disaggregated to a regional level (e.g., milk processing company clients, veterinary practice clients or farmer discussion groups), provide both robust power but also intrinsic validity for a particular country, rather than using generic textbook values. For example, in Ireland, the national breeding organization, Irish Cattle Breeding Federation (ICBF), provides all farmer members with regular reports on their animal performance and includes benchmark data from the top and bottom 5th percentiles (norm-referenced criteria). The KalfOK programme in the Netherlands scores calf management and compares farm scores with national benchmark metrics (Santman-Berends et al., 2018). In Canada, benchmarking was shown to significantly alter farmer youngstock management and improve outcomes (Atkinson et al., 2017; Sumner et al., 2018). However, in some cases, veterinarians may be reluctant to set farm-specific targets as they feel they will be judged negatively if those goals are not met (Derks et al., 2013).

Use agri-technology alerts

Decision making on farms can, in some cases, be aided with tools from precision livestock management as herd sizes expand; these aids can complement good stockmanship, but not replace it. Greater adoption of wearable wellness sensors (e.g., ear fever tags, accelerometers, calving sensors) combined with 24/7 data collection on calf behavior, welfare, feeding, and intake via automatic feeders is predicted (Mee, 2018). This technological evolution will facilitate preclinical diagnosis (with smart phone alerts) of individual calf and group deviations from expected norms of health and performance (farm-level "big data"). For example, automated cough detection may alert the farmer to an incipient calf respiratory disease outbreak (Carpentier et al., 2018). Given the automated nature of these alerts they do not rely solely on the (possibly blinded) observations of the farmer to detect impending problems thus circumventing farm blindness. However, there is a "catch-22" paradox here whereby the very farmer that might benefit from agro-technologies (she/he who suffers from farm blindness) may be the very farmer who would not think of investing in such remedial measures as they do not believe that they need them!

Communicate best-practice

Once poor youngstock management is denormalized through of recognition of the existence of the problem (awareness campaigns) and the extent of the problem (benchmarking), dealing with management deficiencies should be addressed, ideally as part of a herd health and productivity management programme (Boersma et al., 2010). In fact, farmers expect trusted consultants to identify animal care issues, inform farmers about the issue (to prevent farm-blindness), and provide practical steps to remediate these issues (Croyle et al., 2019). A critical concept veterinarians need to grasp is the principle that with individual animal cases the treatment protocol is under the control of the vet. However, with herd problems, the resolution of the issue resides with the farmer (More et al., 2017). Hence, effective communication of prioritized, best-practice recommendations (in particular what good farmers are doing—use of social contagion herd effect nudges) is critical to enable most farmers to realign their management with current norms. Veterinary trouble-shooting of problem animals and herds will still be required but the central role of the farmer needs to be recognized both by the vet and by the farmer. Realignment needs to address both activity (processes) and performance (output). Veterinarians and specialized advisory staff have a critical role in extending calf rearing messages to farmers (Svensson et al., 2008) but must be cognizant of the limitations of one-step thinking which may miss the more subtle web of causality. Thinking in knowledge transfer is changing significantly from the former linear, top-down approach to a more sharing, bottom-up, design solutions approach (Hennessy and Heanue, 2012). Peer-to-peer learning is particularly effective in this regard via farmer action or discussion groups (Hennessy and Heanue, 2012; Morgans et al., 2018). As farms get larger and evolve from an owner–operator model to a distributed model, staff numbers/job titles increase. Inter-staff communication becomes more complex as the goals of care staff may be process orientated (e.g., calf hutch hygiene) while those of managers are outcome orientated (e.g., calf mortality rate) (Pereira et al., 2014). Also, educational, generational, and language barriers may need to be overcome (Sischo et al., 2019). Effective communication results in better stockmanship and good calf management stockmanship knowledge, attitudes, and perceptions are positively associated with better calf health outcomes (Vaarst and Sorensen, 2009; Adler et al., 2019). Novel models of farming may also contribute to better youngstock management best practice where calves are sent to specialized/custom contract rearers until the point of calving (Mee et al., 2018). In addition to addressing issues of poor youngstock management, education, and public engagement on best practice in youngstock management will be a pillar of sustainable agricultural systems ("social license to farm") in the future to avoid reputational risk to the dairy industry.

Conflict of interest statement

None declared.

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