Knowledge Transfer – do the numbers reflect fertility?

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The Department of Agriculture, Food and the Marine (DAFM) aims to lead the development of a competitive, sustainable and consumer-focused agri-food sector and a vibrant rural economy and society. The National Farmed Animal Health Strategy is an integral part of this mission with the objective to optimise animal health to ensure profitability and sustainability of our farming and processing industries.[1] The strategy is guided by two main principles;: to work in partnership to improve animal health standards with clear roles and responsibilities for all stakeholders; and to apply the principle of "prevention is better than cure" through sustainably and appropriately-funded animal-health programmes. The knowledge transfer (KT) programme plays an important role in this strategy.

The KT programme is part of the Rural Development Programme (RDP), which is part-funded by the EU and the Irish exchequer. The programme extends over six sectors, with veterinary input into five, namely: dairy, beef, sheep, equine and poultry. The programme operates on a dicussion-group model delivered by network of approved facilitators. It comprises of a number of strands, including animal health and management, profitability and financial management, grassland management, sustainability, farm health and safety, farm progression and a breeding plan.

The animal-health component of the KT programme forms part of a compulsory Farm Improvement Plan (FIP) and were developed in collaboration with veterinary staff from DAFM, Animal Health Ireland (AHI), Teagasc, the Herd Health Group in University College Dublin (UCD) and private veterinary practitioners with the support of Veterinary Ireland (VI). This component is completed in year one by the participants' veterinary practitioner and will be updated in years two and three. Calf health, biosecurity, fertility, parasite control, and lameness (dairy participants only) are included in the selected measures for cattle.

Additionally, completing the Irish Cattle Breeding Federation (ICBF) Breeding Plan is mandatory for all cattle herds, while, participation in an AHI CellCheck Farmer Workshop is a condition for all dairy herds.

FERTILITY IN THE IRISH DAIRY HERD

Fertility performance in dairy herds is the good news story.[2] Following years of reports describing a downward spiral in fertility worldwide;[3,4] studies are reporting maintained[5,6] or improved[7,8] reproductive performance. There is clear evidence that dairy cow fertility can be improved through genetic selection in the Irish context;[9,10] and work conducted by ICBF demonstrates improved six-week pregnancy rates and calving intervals.[8] Ireland, however, is heavily reliant on grass-based management systems and the challenge of attaining a 365-day calving interval is evident. Previous work conducted from our group suggests that next year's calving

Variable	Mean	SEM	Range		N
Herd size (eligible cows)	114	2.2	26	541	818
Smallest herd category	53	*0.8*	26	66	148
Moderate size herd category	84	*0.7*	67	104	277
Largest herd category	159	*26.2*	105	541	392
Length of breeding season (days)	94	0.9	42	181	840
0; normal breeding season	71	*0.6*	42	84	318
1; long breeding season	108	*0.9*	85	181	522
Herd-efficient oestrous detection (target >60% repeat interval a normal return – reported number is the proportion of repeat intervals classified as a normal return)	49.9	0.64	0	100	796
0; Efficient oestrous detection	67.4	*0.46*	60	100	258
1; Inefficient oestrous detection	41.5	*0.67*	0	59	538
Oestrous detection accuracy (target <40% repeat interval categorised an abnormal return	49.6	0.62	0	100	796
0; Accurate oestrous detection	32.6	*0.46*	0	40	266
1; Inaccurate oestrous detection	58.2	*0.65*	41	100	530
No of services per cow	1.65	0.01	1	5.5	840
0; within target 1.4	1.23	*0.009*	1	1.4	239
1; exceeding target	1.81	*0.01*	1.4	5.5	601

Table 1: The categorisation of continuous variables for mean herd size, length of breeding season, an estimation of herd oestrous-detection efficiency and accuracy, and number of serves per cow for 840 dairy herds enrolled in the KT programme with breeding records available from HerdPlus.

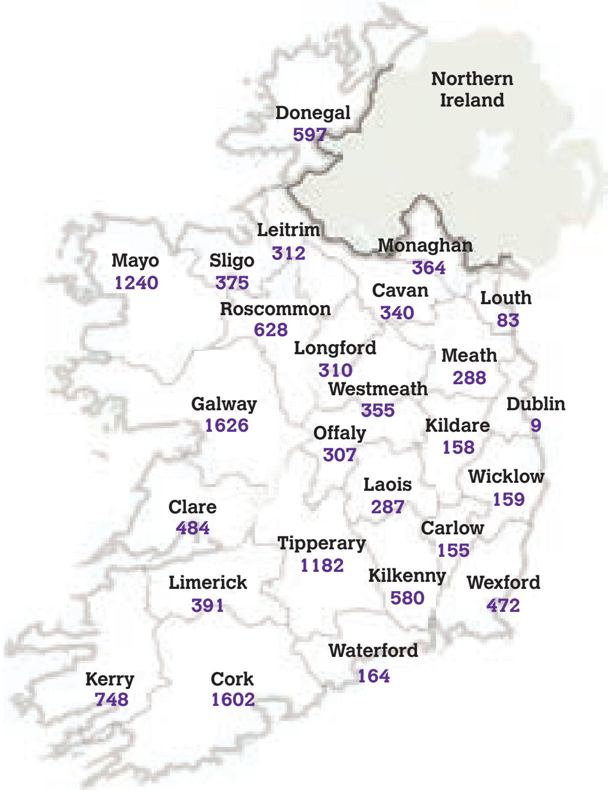

Figure 1: The distribution of KT dairy and beef participants, enrolled at the start of the programme, in each county.

patterns is essentially determined by the existing calving pattern.[11,12] One method employed to maintain a high six-week pregnancy rate is to cull cows not achieving targets. Culling patterns in HerdPlus herds in the past number of years is concerning, with culling rates of approximately 30% recorded annually.[8] Data collected as part of the KT programme will provide valuable asset to quantify the extent of the problem and will allow for robust analysis.

FARM-SPECIFIC DATA USED FOR THE ANIMAL HEALTH MEASURES

SOURCES OF DATA FOR THE KT PROGRAMME

ICBF HerdPlus database collected information on brre breeding records, including herd identifier; counts of eligible cows; length of breeding season; start of calving season; median calving date; reproductive indices, including pregnancy rate to first service; subsequent service; serves per conception; six-week pregnancy rate; overall pregnancy rate; short, normal and long-repeat intervals; not in-calf rate for cows and heifers. Additionally, herd-level data pertaining to herd size, biosecurity, calf mortality and animal registrations were sourced from the DAFMs Animal Information Movement System (AIMS) database for herds enrolled in the KT programme.

DATA MANAGEMENT AND STATISTICAL ANALYSIS

Categorisations used for all independent variables are presented in Table 1. Herds were assigned a low-normal return rate if less than 60% of repeat intervals recorded were within the normal return range, indicative of inefficient oestrous detection. Herds were assigned a high-abnormal return rate if in excess of 40% of repeat intervals were classified as an abnormal return, indicative of inacurate oestrous detection. Herd-reproductive performance was described in terms of a single-binary outcome variable: achieving (or not) the target (70%) six-week pregnancy rate. A multivariable logistic-regression analysis was utilised to determine the effect of herd-level factors on the outcome variable, a high six-week pregnancy rate.

THE HERDS

A total of 9,876 beef and 4,268 dairy participants enrolled in the KT programme in 2016 (see Figure 1). Baseline data were available for 9,494 beef participants and 4,166 dairy participants from the AIMS database. However, only 6% (n = 853; see Table 2) of cattle herds (19% of dairy herds) had usable data for the purposes of this study. A further 13 herds were then excluded (fertility recorded beef and dual herds) due to the small numbers of each.

County	No of participants	County	No of participants
Carlow	12	Longford	9
Cavan	26	Louth	15
Clare	11	Mayo	13
Cork	193	Meath	33
Donegal	10	Monaghan	23
Dublin	0	Offaly	37
Galway	27	Roscommon	7
Kerry	56	Sligo	3
Kildare	17	Tipperary	121
Kilkenny	65	Waterford	9
Laois	27	Westmeath	13
Leitrim	0	Wexford	43
Limerick	72	Wicklow	11
		Total	853

Table 2: The number of participants, for whom breeding data was available from ICBF's HerdPlus database, in the cattle sector of the KT programme in each county.

REPRODUCTIVE PERFORMANCE OF THE KT HERDS

Mean (± SEM) herd size was 115 (± 2.1) cows in the 840 herds. The mean (± SEM) three-week and six-week submission rates were 65 (± 0.8), and 82 (± 0.6)%, respectively. The breeding season was a mean of 94 (± 0.9) days in length. The six-week and overall pregnancy rate were 67 (± 0.6), and 91 (± 0.3)%, respectively. The six-week pregnancy rate, ranged from 5-100% for the all farms, indicating the expected spread in the pattern of calving predicted for the following year. Reproductive indices, represented by box and whisker plots, for farms achieving (or not) the target six-week pregnancy rate (six-week PR > 70%) are presented in Figure 2.

The cow not-in-calf rate was highly variable among participant herds, and ranged from 0 to 80% for individual herds. The mean not-in-calf rate was 9.0 ± 0.25% for all herds with herds classified as achieving the target pregnancy rate recording a not-in-calf rate of 6.9 ± 0.22% compared with 11.2 ± 0.43% for herds not achieving the target pregnancy rate.

EVALUATION OF FERTILITY IN KT HERDS CONDUCTED AS PART OF THE KT PROGRAMME

A multivariable logistic regression model was developed to assess the risk of herd being classified as achieving target pregnancy rate (>70% six-week pregnancy rate) or not (see Table 3).

Herds classified as having a long breeding season (62%) or calving season (11 %) were 0.23 (confidence interval; CI; 0.16 to 0.33) and 0.10 (CI; 0.05 to 0.23) times as likely (p = 0.001) to achieve the target six-week pregnancy rate (> 70%) compared with herds classified as having a normal length of breeding or calving season.

Large herds were 2.6 times (CI 1.61 to 4.23) more likely to achieve the target pregnancy rate. While herds with lowered oestrous detection efficiency were 0.5 (CI 0.35 to 0.72) times as likely to achieve the target pregnancy rate compared with herds cateogrised as having good oestrous detection efficiency.

Higher number of recorded services per cow was, not unsurprisingly, associated with lowered risk of achieving the target pregnancy rate. Inaccurate oestrous detection, region, late calf registration, herd calf mortality rate, and an estimate of herds biosecurity were not associated with the risk of a herd achieving a target pregnancy rate or not.

DISCUSSION

The most surprising finding of this work was the lack of data recorded on national databases. Merely 6% of all herds, and 19% of dairy herds, had usable fertility records on a national database. This underlines the importance of data capture on farm and the need to improve data collection to enable good on-farm decision-making. It is envisaged that placing a spotlight on fertility and milk recording through the participation in the CellCheck Farmer Workshops and ICBF's HerdPlus programme should improve the data capture in future years.

Only half of the herds are achieving the six-week pregnancy rates target set by ICBF for seasonal calving dairy herds. The mean six-week pregnancy rate of 67% was recorded for all herds. These pregnancy rates are similar to those reported in seasonal calving dairy herds in Australia (63%)[13] and New Zealand (70%),[14] (66%).[7]

However, it is worth noting that the pregnancy rates reported in this study are based on pregnancy diagnosis and not corrected for estimated date of calving based on veterinary examination. Many individual cows will calve down later than expected and pregnancy losses, subsequent to pregnancy diagnosis, will lower the rate reported.

Similar to elsewhere, large variation between herds has been reported in grass-based seasonal herds.[7,13] However, the use of large databases precludes an understanding of each

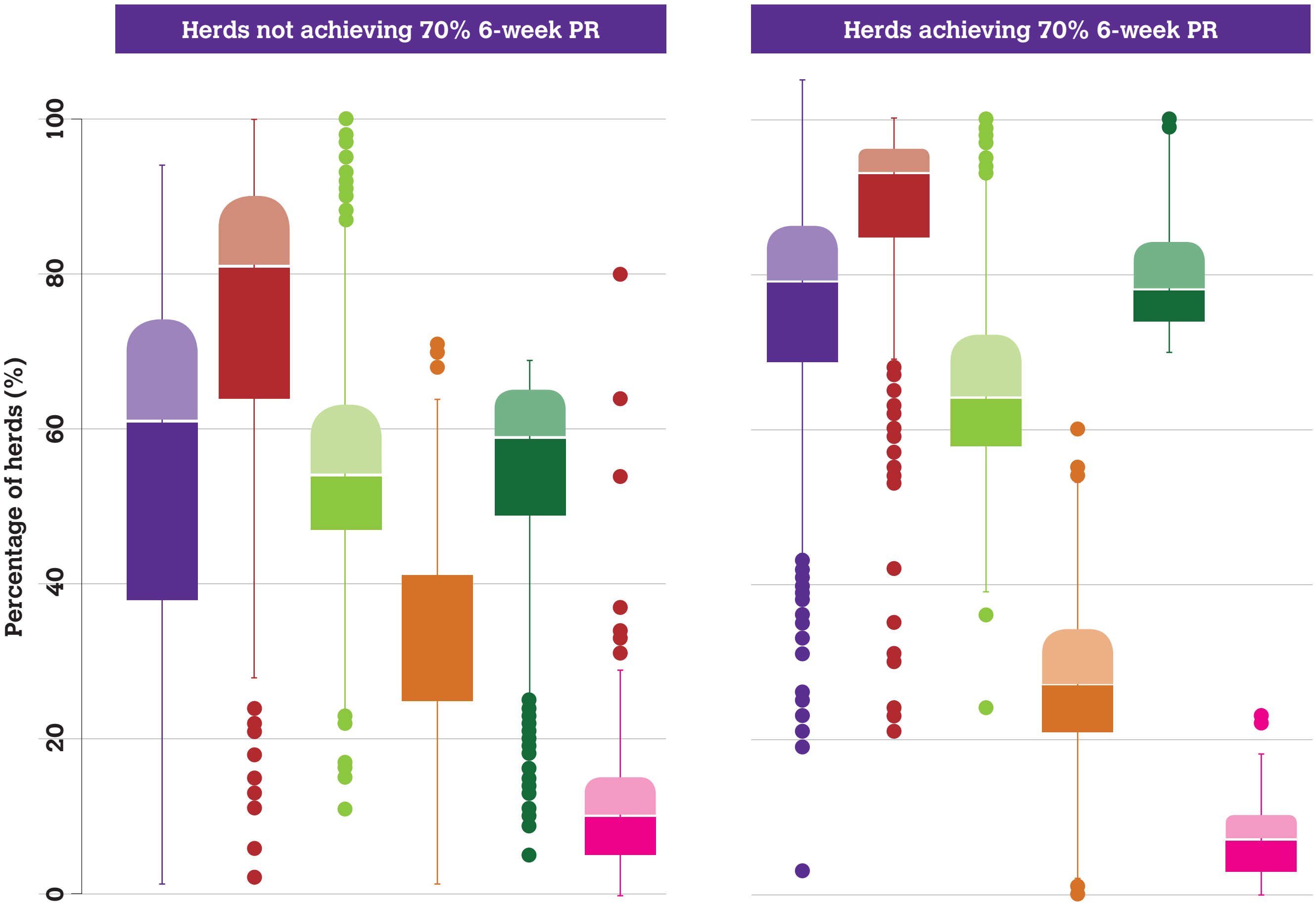

Figure 2: The herd-submission rate at three weeks (purple), at six weeks (red), pregnancy rate to first service (green), subsequent service (orange), six-week pregnancy rate (dark green) and not in calf percentage (pink) for herds achieving a 70%, six-week pregnancy rate or not.

individual herds aims.

Despite this, the vast majority of Irish herds are seasonal calving herds, and there is no reason to believe that this subgroup of herds differ markedly from typical herds nationally.

Substantial variation was reported in cow not-in-calf rates (0 to 80% for individual farms), although the overall means of 9% not-in-calf rate is reasonable. This is likely underestimated, as some animals will be reported as pregnant based on an assumption rather than pregnancy diagnosis.

Of more concern, perhaps, is the national picture and the high rate of culling reported by ICBF for all HerdPlus recording herds.[8] An average culling rate of 30% has been reported by ICBF for the past six-year period. Over the same period, improvements in calving intervals and six-week pregnancy rates are evident. However, the high rate of culling is essentially one of the key contributors for the improvement observed in the reproductive indices; thus, part of the overall improvement reported in fertility in the Irish dairy herds is resulting from a high-culling rate. This high level of culling is not sustainable in the long-term. The high-culling rates mean we lessen the options to choose replacements heifers and instead we are forced to retain all available heifers as replacements, especially significant in expanding herds that are seeking to avoid purchasing stock.

We should aim to understand the key drivers of culling. There is a need to examine the management of heifers destined to join the breeding herd. While thought is given to the percentage of heifers calving down between 22 and 26 months (average of 58% over the past six-year period),[8] in fact, we also need to consider the interaction between age at first calving and time relative to the start of the calving season. Late calving animals are at high risk of culling, and previous work has shown that increasing the proportion of late calvers within the herd essentially precludes the herd from achieving target pregnancy rates.[12]

A focus on nutrition is crucial to ensure adequate growth such that heifers are prepared for breeding by 14-15 months of age. It is essential that we aim to reduce disease incidence as calves and weanlings to optimise growth rates. We must aim to select only early-born heifers as potential replacements, and consideration given to using sexed semen to increase the number of heifers born early in the calving season. Therefore, it is critical to set up replacements to succeed within the herd rather than being destined for failure from the start of their careers.

Clearly management does not end with replacements; strategies are needed to ensure that early calving cows are kept on track, while later calving cows are managed to increase their likelihood of being retained within the herd unless selected for culling for reasons other than fertility.

	Odds Ratio	Std. Err.	P-value	Confidence Interval	
Length breeding season:	Referent				
Long-breeding season (> 12 weeks)	0.23	0.05	0.001	0.16	0.33
Length calving season:	Referent				
Long calving season (> six weeks to median)	0.10	0.04	0.001	0.05	0.23
Proxy herd size: Smallest herds	Referent				
Medium herds	1.79	0.46	0.024	1.08	2.96
Largest herds	2.62	0.65	0.001	1.61	4.23
No of services per cow:	Referent				
High no. services (> 1.4 per cow)	0.17	0.04	0.001	0.11	0.27
Heat detection efficiency	Referent				
Low normal returns (< 60%)	0.51	0.09	0.001	0.35	0.72

Table 3. Multivariable logistic-regression model for the association between selected potential risk factors, and the proportion of herds that that achieved a high six-week pregnancy rate (six-week PR > 70%). The odds ratios (OR), Standard error (Std. Err.) the p-value and the 95% confidence intervals are presented. Variables for region, an estimation of oestrous detection accuracy, a record of late registrations and herd-calf mortality were removed from the model as non-significant.

Expanding herds place greater demands on management, these herds face unique challenges to ensure that housing, roadways, nutrition and disease management, uterine health, and oestrous-detection regimens keep pace with the extra demands placed on herd managers due to herd expansion.

CHALLENGES FACED BY THE KT PROGRAMME

It must be acknowledged that the KT programme has faced challenges. The IT support failed to deliver the programme on time and resulted in much negative commentary, which perhaps, has taken from the overall positive aspects of the programme.

The regulation underpinning the programme does not allow for direct payment to the provider of the animal health advice to individual farms; effectively it is regarded as private transaction between the KT participant and the veterinary practitioner.

The time and resources given to the veterinary aspect within the overall programme is limited. We see this iteration of the programme as a first step in the delivery of herd health plan. It is also important to note that the data presented in this review was based on year of entry to the programme and limited to one year's reproductive data and, as a consequence, the estimate of herd reproductive performance may be somewhat imprecise.

Future work will extend to a larger-scale study incorporating data collected from all participating herds, over a number of years, and will allow for a greater understanding of the trends in reproductive performance nationally.

CONCLUSIONS

Considerable variation in reproductive performance has been demonstrated in this study. The six-week pregnancy rate varied between 5% and 100% on individual farms. Reported not-in-calf rates varied from 0% to 80%. Clearly, some farms are confronting serious fertility challenges. Overall, the existing calving pattern and oestrous-detection efficiency were the greatest determinants of fertility in these herds. Management strategies aimed at improving oestrous detection and the calving pattern are essential and strategies must be employed to deal with late calving cows. Management of replacements to ensure early calving is key. The aim is to calve replacement heifers down early such that they have longer period available for rebreeding in their first lactation. However, the selection of suitable replacement heifers is challenging; expanding herds may struggle to procure enough early0born replacements to enter the herd, especially in light of the high culling rates practiced by so many herds.

Year one of the KT programme is the first step in the development of an individualised herd health for cattle herds. The programme aims to make farm-specific data available to the attending veterinary practitioner, to facililate good decision making, in light of discussions with the herdowner on their outlook for the future of their farming enterprise. The limited data available to herds underlines the difficulty many herd advisers face with inadequate data to support effective decision-making. However, mandatory particpation in ICBF's HerdPlus and in a CellCheck Farmer Workshop should stimulate an increase in milk and fertility recording. With regards to programme delivery, the delay in the provision of the IT support to the programme was unsatisfactory and must be avoided in future. The intention is to deliver improved farm indices each year, to support effective assessment and decision-making, with the ultimate aim of a herd-health plan.

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CONFLICT OF INTEREST STATEMENT

The author of this paper does not have a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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