Key Performance Indicators for the UK national dairy herd

A study of herd performance in 500 Holstein/Friesian herds for the year ending 30th September 2011

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Section 1: Key Performance Indicators for the year ending 30/09/2011

Introduction

This study describes the performance achieved by a large representative sample of 500 commercial black and white dairy herds in the United Kingdom for the year ending 30th September 2011. The study presents 27 parameters that cover key aspects of herd production, fertility and health. The source of data is the monthly milk records obtained from National Milk Records (NMR).

This study is a repeat of a similar exercise a year earlier where the principal objective was to provide farmers and technical advisers with indications of good, bad and indifferent performance. While calculating production parameters for an individual herd is relatively straightforward, it can be more difficult to answer the fundamental questions of "*Is that a good or acceptable level of performance?*" and *"Should this herd be doing better than it is?"* These studies provide answers to these questions and help to focus attention on the causes of and possible solutions to poor performance.

For each parameter the performance levels of all 500 herds are presented as a bar chart. A median (middle) value and inter-quartile range (the level achieved by the middle 50% of herds) are also derived. A **target** value is proposed for each parameter based on the level achieved by the **"best" 25%** of the herds for that parameter. Consequently, the target is set at a level achieved (or exceeded) by one in four dairy herds over the last year.

The study demonstrates clearly the wide differences that exist in commercial dairy herds between "best" and "worst" levels of performance. The findings provide a simple means to quantify the relative strengths and weaknesses of any dairy herd as a first step towards discussing causes and potential solutions. Through repeating the study for 2011 this also provides an indication of the direction of any movement for each parameter.

Following the analysis there is a section on the practical use of these parameters, using the InterHerd+ program, to facilitate the analysis of herd performance.

The sample

The 500 herds used in the study all fully milk record on a monthly assisted basis with NMR. The herds are all predominantly comprised of black and white breeds and have recorded for a minimum of two years. The original selection of herds in 2010 used random numbers of all such herds with NMR. Where possible these same herds were maintained for the 2011 sample. Herds with poor fertility data (inadequate services and pregnancy diagnoses), as well as herds no longer recording, were replaced with herds selected using random numbers. In total 359 herds were in both studies with 141 joining in 2011.

The parameters

To minimize the impact of short term seasonal changes, the analyses are based on 12 month rolling averages for each parameter. In other words, they represent the performance levels achieved by each herd for the 12 month period from 1st October 2010 to 30th September 2011.

The results of the study are summarized in Table 1. For each parameter there are 4 values:

1. The **median**: The middle value. If the performance levels of all herds are arranged in ascending order, the median is the performance of the middle herd. In essence, half the herds do better

and half do worse than the median value. For example, if the conception rates of 5 herds were arranged in ascending order, the median value would be the conception rate of the third herd, leaving 2 herds with better and two herds with worse performance.

2. The **first quartile (25% value) and third quartile (75% value)** describe the lower and upper limits of performance achieved by the middle 50% of herds. 25% achieve "better" and 25% achieve "worse" than the limits for that parameter.

3. The **target** value is the level achieved or bettered by 25% of the herds in the study. This value is the "better" of the **first quartile (25%) and third quartile (75%) values.** For parameters like somatic cell count, culling % and calving interval the target will be the 25% (lower) value, while for others (conception %, protein %, dry period cure %) it will be the 75% (higher) value.

4. The **inter-quartile range** is the difference between the performance of the best and worst 25% of herds (i.e. the difference between the **first quartile (25% value) and third quartile (75% value)**).

The origin of these values is shown in Figure 1. Throughout this document the parameter value is displayed on the vertical Y axis with one bar for each of the study herds arranged along the horizontal X axis. The bars are either in ascending or descending order of the parameter value, arranged so that the "best" quartile, or "target" value, appears closest to the Y axis. The parameter in Figure 1 is the culling % so the target value is at the lower end of the inter-quartile range (a low culling % is preferable to a high culling %).

Figure 1. A description of the median, inter-quartile range and target values generated for each parameter
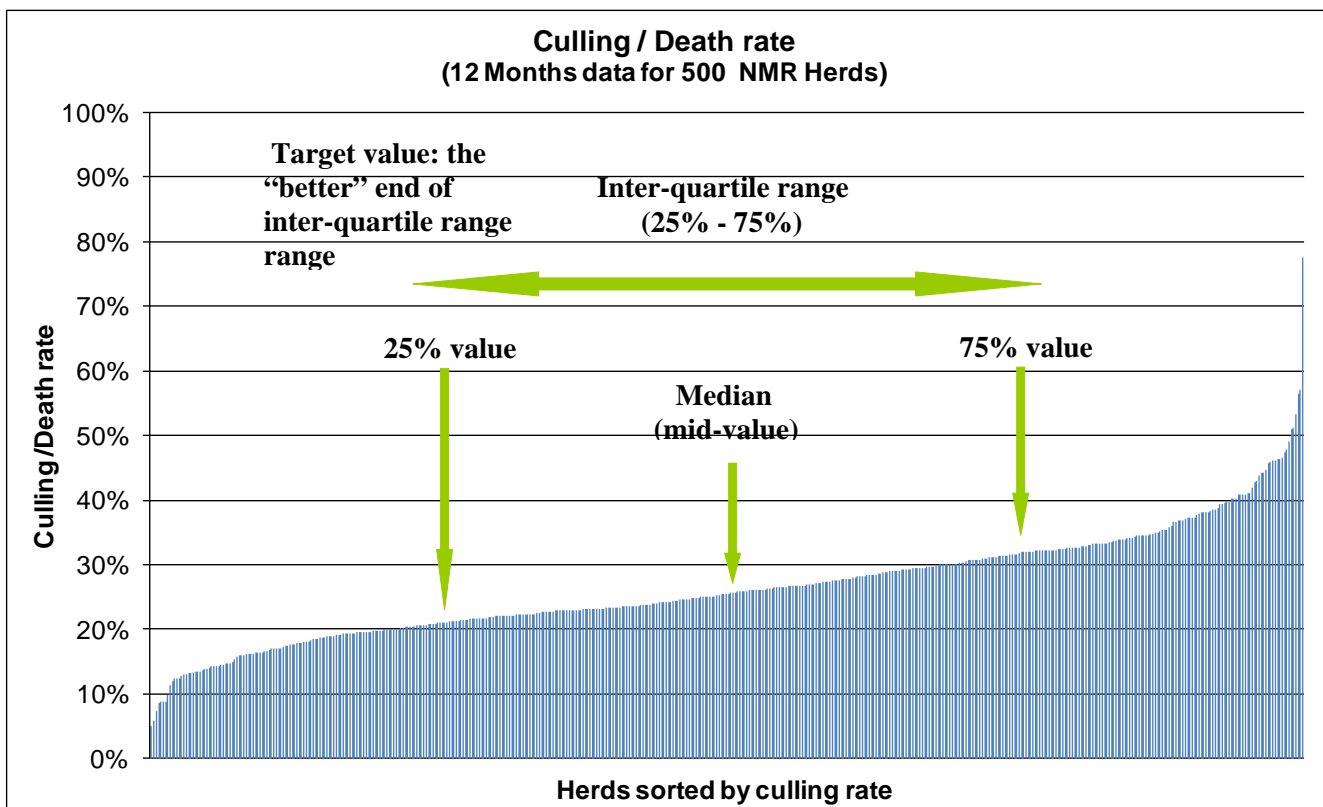
The definitions of each parameter are detailed in Appendix 1.

Acknowledgements

Table 1. Summary of Key Performance Indicators derived from analysis of 500 NMR milk recording herds for the year ending 30th September 2011

Parameter	Median (1)	1st – 3rd quartile (25% - 75%) (2)	Target (3)	Inter-quartile range (4)
A. Culling rate	26%	21% - 32%	**21%**	11%
B. Culling / death rate in first 100 days of lactation	5%	3% - 8%	**3%**	5%
C. Age at exit (years)	6.6	5.9 - 7.5	**7.5**	1.6
D. Age at exit by lactations	3.9	3.3 - 4.5	**4.5**	1.2
E. Percentage Served by day 80	47%	33% - 59%	**59%**	26%
F. Percentage conceived 100 days after calving	25%	16% - 33%	**33%**	17%
G. Calving to 1st service interval (days)	98	82 - 119	**82**	37
H. Calving interval (days)	421	408 - 436	**408**	28
I. Age at 1st calving (years)	2.4	2.2 - 2.7	**2.2**	0.5
J. Conception rate	31%	24% - 37%	**37%**	13%
K. Percentage service intervals at 18-24 days	30%	23% - 38%	**38%**	15%
L. Percentage service intervals >50 days	29%	20% - 40%	**20%**	20%
M. Percentage eligible for service that served	29%	20% - 40%	**40%**	20%
N. Percentage eligible for service that conceived	9%	5% - 13%	**13%**	8%
O. Lifetime milk / cow / day (kg)	12	10 - 13	**13**	3
P. Milk / cow / year (kg)	8,200	7,170 - 8,953	**8,953**	1,783
Q. Average protein%	3.27%	3.20 - 3.33%	**3.33%**	0.13%
R. Average fat%	3.98%	3.84% - 4.12%	**4.12%**	0.28%
S. 305 day yield (kg)	7,768	6,960 - 8,515	**8,515**	1,555
T. Average SCC ('000 cells/ml)	203	158 - 249	**158**	91
U. Percentage SCC >=200,000 cells/ml	23%	18% - 29%	**18%**	11%
V. Percentage SCC >500,000 cells/ml	9%	6% - 12%	**6%**	6%
W. Percentage 1st recording SCC >=200,000 cells/ml	19%	15% - 24%	**15%**	9%
X. Percentage chronic SCC >=200,000 cells/ml	13%	9% - 17%	**9%**	8%
Y. Percentage Dry period cure (High:Low)	73%	66% - 80%	**80%**	14%
Z. Percentage Dry period protection (Low:Low)	84%	80% - 90%	**90%**	10%
ZA. Percentage Low at end of previous lactation (SCC<200,000 cells/ml)	63%	52% - 72%	**72%**	20%

(1) The median is the middle value achieved for the parameter across all 500 herds (so 250 herds were better and 250 were worse than this value).

(2) The **first quartile (25% value) and third quartile (75% value)** describe the lower and upper limits of performance achieved by the middle 50% of herds. 25%, or one in four, herds achieve "better" and 25% "worse" than the limits for that parameter.

(3) The Target is set at the level achieved by the "best" 25% of herds. So, depending on the variable, it is either the **first quartile (25% value) or third quartile (75% value)**.

(4) The inter-quartile range is the difference between the **first quartile (25% value) and third quartile (75% value)**.
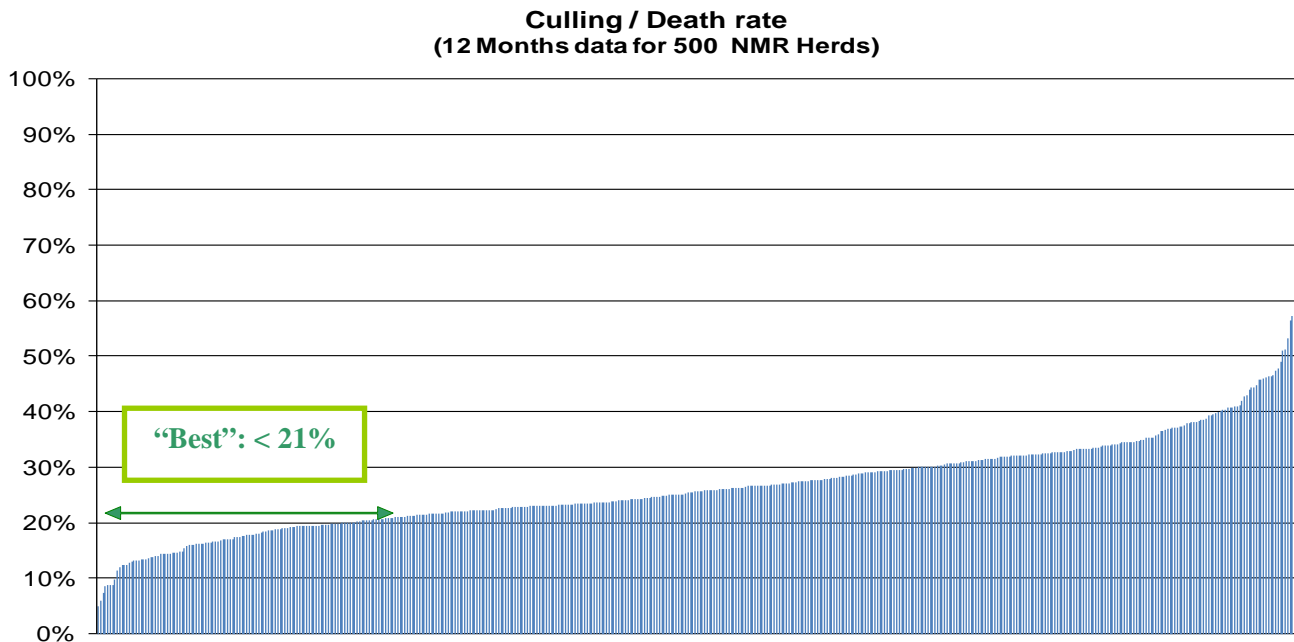
A. Culling/death rate: What percentage of all the cows were culled or died in the last 12 months.
Target (level achieved or surpassed by 25% of herds): 21%
Median (level achieved by the middle herd): 26%
75% level (level achieved or surpassed by 75% of herds): 32%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 11%

Culling / Death rate
(12 Months data for 500 NMR Herds)

"Best": < 21%

B. Culling / deaths in first 100 days of lactation: What was the culling % during the first 100 days of lactations during the last 12 months. Indicates the level of "involuntary culls" as cows should be at their most productive/profitable periods.
Target (level achieved or surpassed by 25% of herds): 3%
Median (level achieved by the middle herd): 5%
75% level (level achieved or surpassed by 75% of herds): 8%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 5%

Culling / Death rate within 100 days of Calving
**(12 Months data for 500 NMR Herds)**

"Best": < 3%
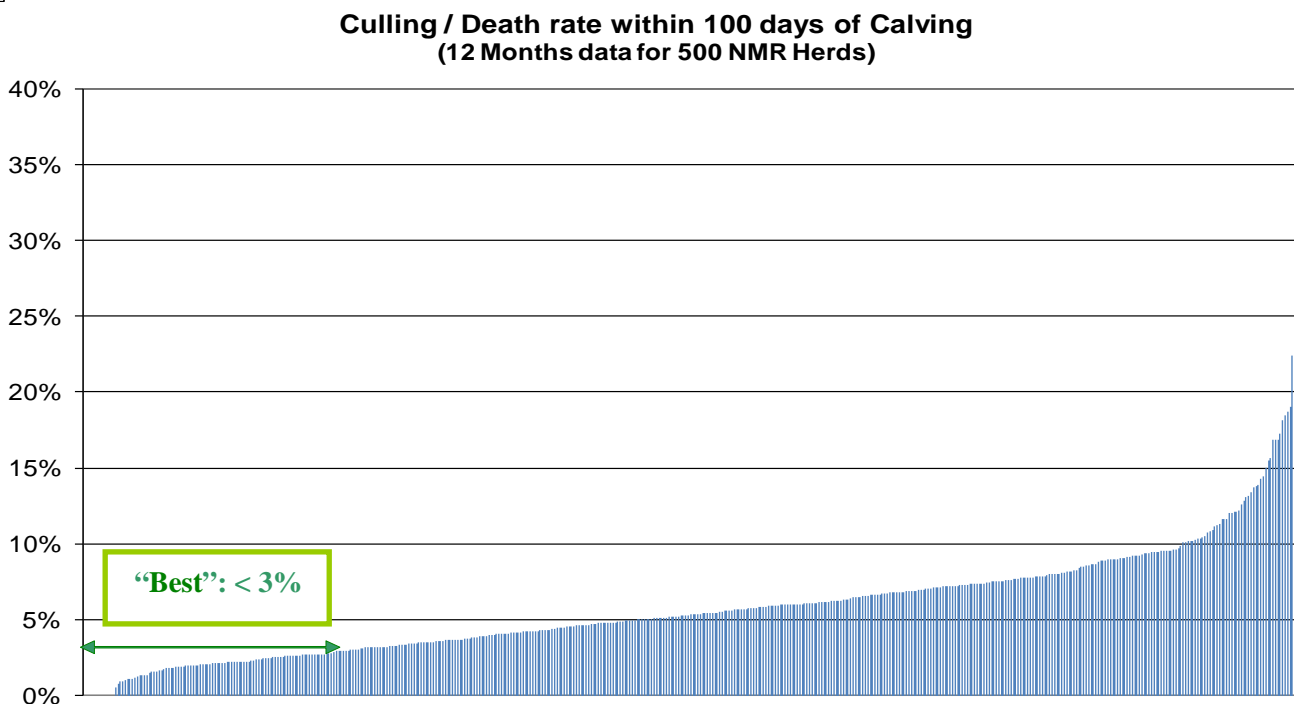
C. Average Age (in years) at exit: What was the average age of cows leaving the herd in the last 12 month at the time of exit. A measure of longevity.

Target (level achieved or surpassed by 25% of herds): 7.5 years

   Median (level achieved by the middle herd): 6.6 years
   75% level (level achieved or surpassed by 75% of herds): 5.9 years
   Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1.6 years

Average Age at Exit (years)
**(12 Months data for 500 NMR Herds)**

"Best": >7.5 years
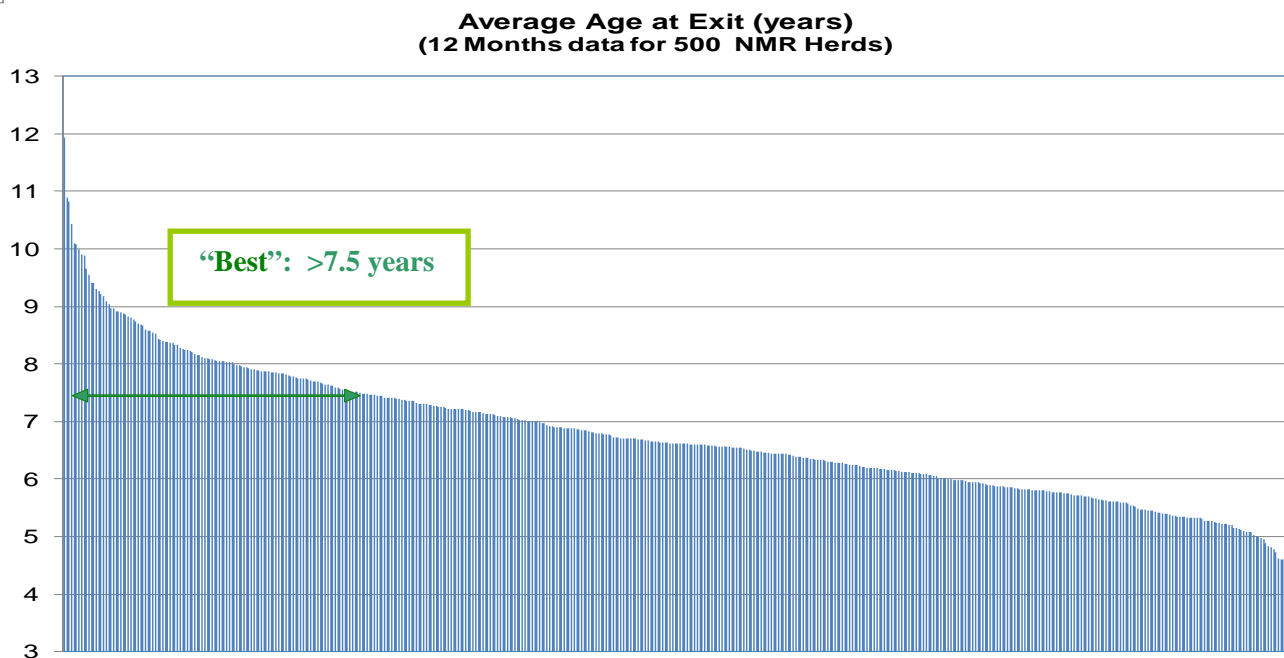
D. Average Age at exit by lactations: What was the average lactation number of cows leaving the herd in the last 12 months. A measure of longevity.

Target (level achieved or surpassed by 25% of herds): 4.5

   Median (level achieved by the middle herd): 3.9
   75% level (level achieved or surpassed by 75% of herds): 3.3
   Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1.2

Average Age by Lactation No. at Exit
(12 Months data for 500 NMR Herds)

"Best": > 4.5 Lactations
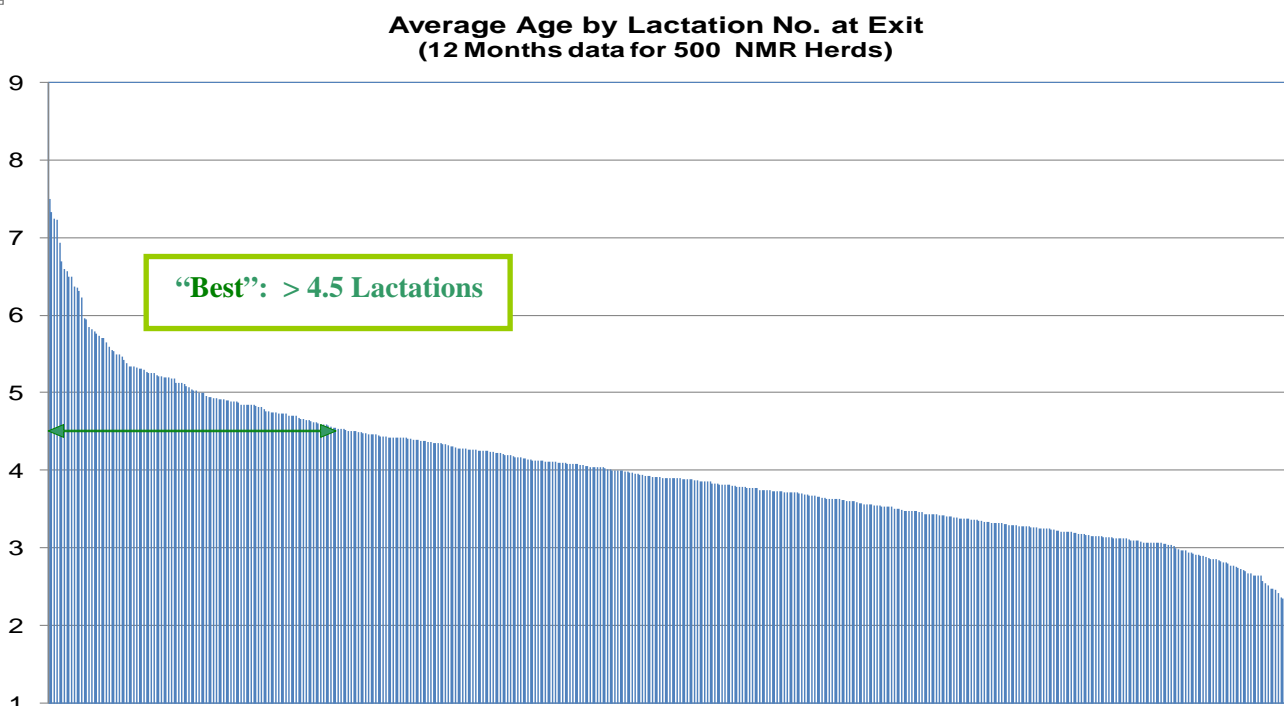
E. Served by day 80: What percentage of calving cows had been served at least once within 80 days of calving.
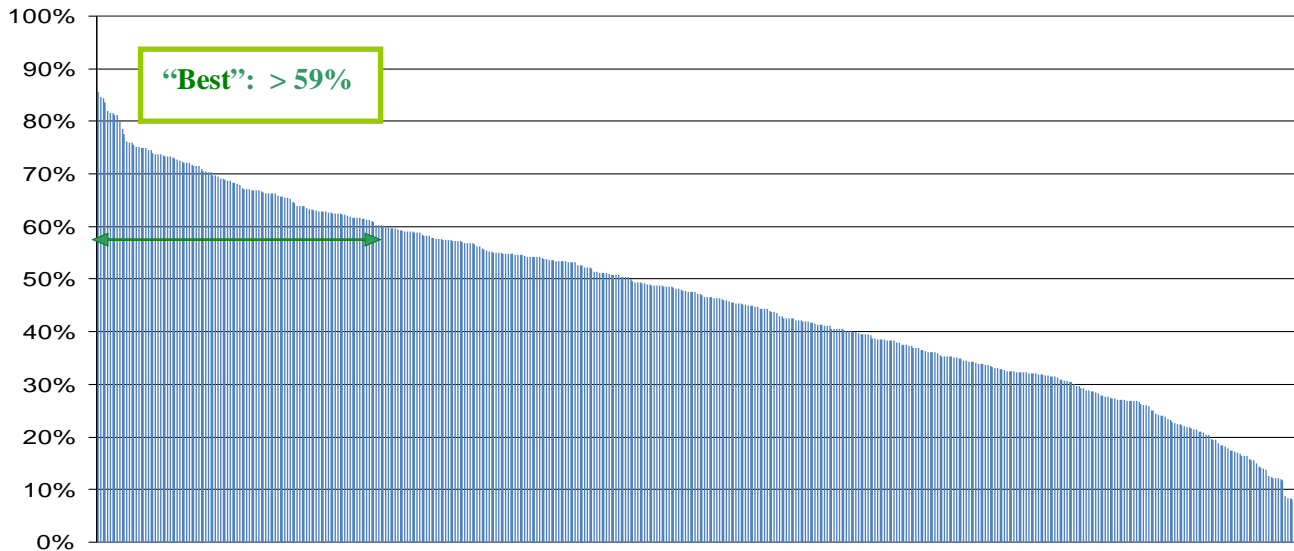
Target (level achieved or surpassed by 25% of herds): 59%
Median (level achieved by the middle herd): 47%
75% level (level achieved or surpassed by 75% of herds): 33%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 26%

% Cows Served by Day 80 After Calving
(12 Months data for 500 NMR Herds)

"Best": > 59%

F. Percentage conceived 100 days after calving: What percentage of calving cows had conceived within 100 days of calving.
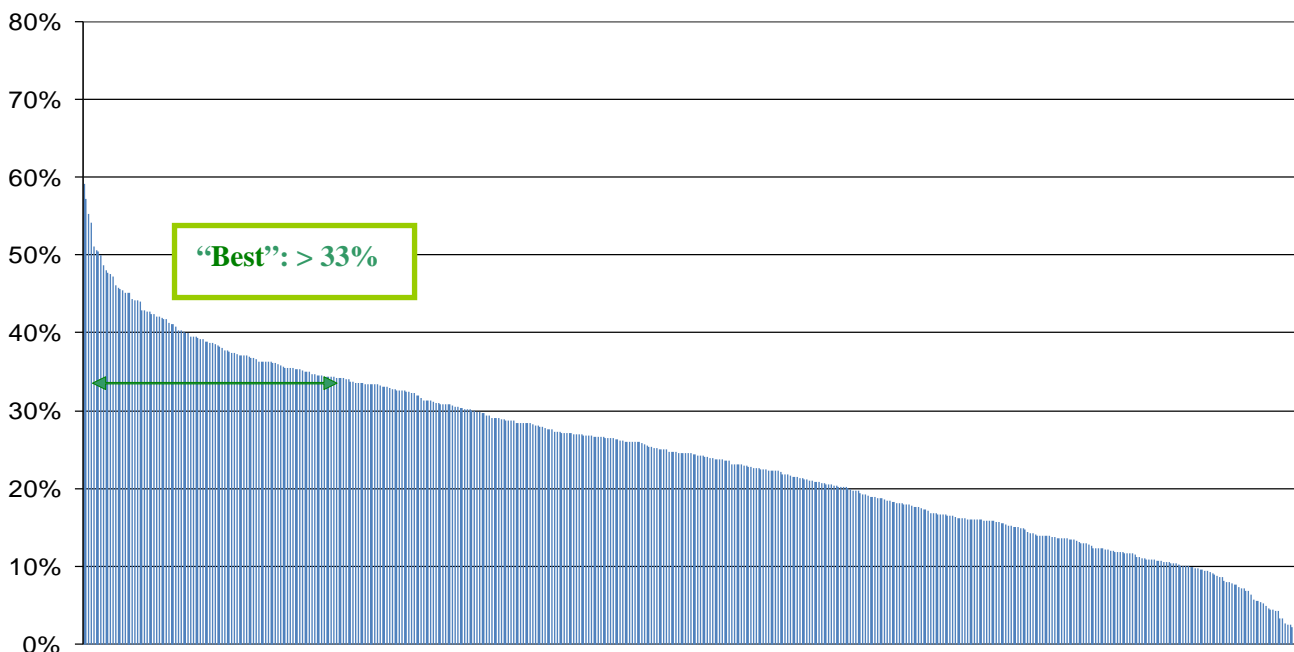
Target (level achieved or surpassed by 25% of herds): 33%
Median (level achieved by the middle herd): 25%
75% level (level achieved or surpassed by 75% of herds): 16%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 17%

% Cows Pregnant by Day 100 After Calving
(12 Months data for 500 NMR Herds)

"Best": > 33%

G. Calving to 1ˢᵗ service interval: What was the average interval between calving and 1ˢᵗ service (in days).
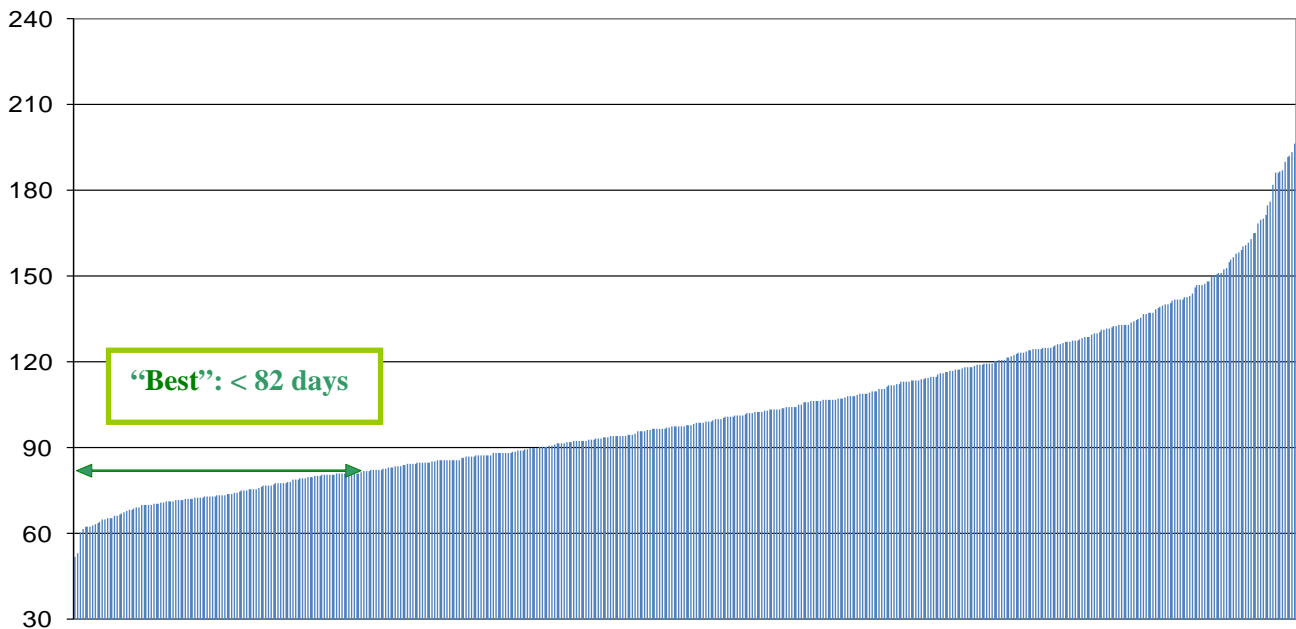
Target (level achieved or surpassed by 25% of herds): 82 days
Median (level achieved by the middle herd): 98 days
75% level (level achieved or surpassed by 75% of herds): 119 days
Inter-quartile range (difference between 1ˢᵗ (25%) and 3ʳᵈ (75%) quartile herds): 37 days

Calving to First Service Interval (days)
(12 Months data for 500 NMR Herds)

"Best": < 82 days

H. Calving interval: What was the average interval between consecutive calvings (in days).
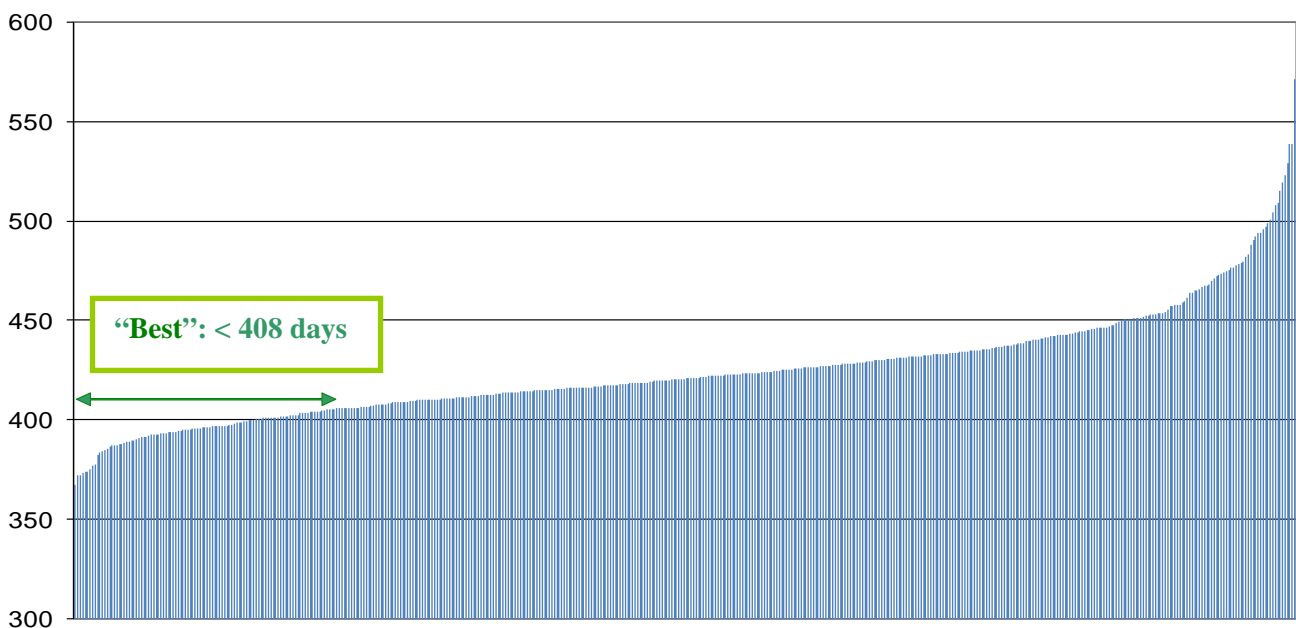
Target (level achieved or surpassed by 25% of herds): 408 days
Median (level achieved by the middle herd): 421 days
75% level (level achieved or surpassed by 75% of herds): 436 days
Inter-quartile range (difference between 1ˢᵗ (25%) and 3ʳᵈ (75%) quartile herds): 28 days

Calving Interval (days)
(12 Months data for 500 NMR Herds)

"Best": < 408 days

I. Age at 1st calving: What was the average age of heifers calving down (in years) over the last year.
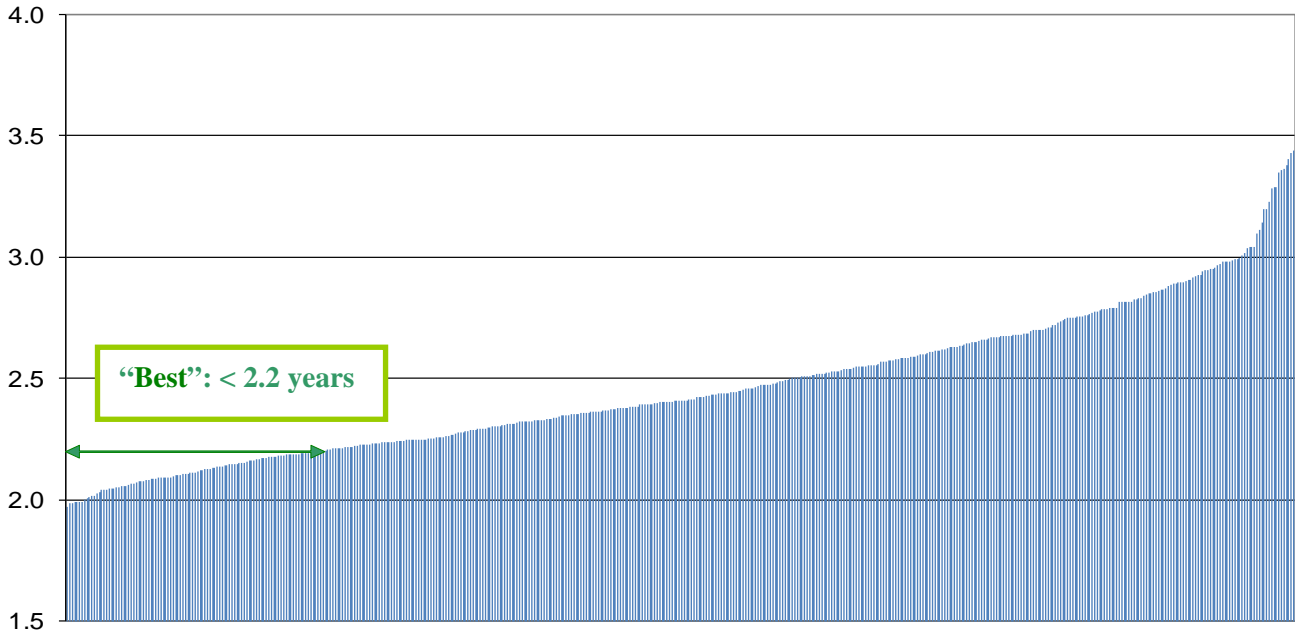
    Target (level achieved or surpassed by 25% of herds): 2.2 years
    Median (level achieved by the middle herd): 2.4 years
    75% level (level achieved or surpassed by 75% of herds): 2.7 years
    Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 0.5 years

Age at First Calving (years)
(12 Months data for 500 NMR Herds)

"Best": < 2.2 years

J. Conception rate: What was the average conception rate for services in the last 12 months.
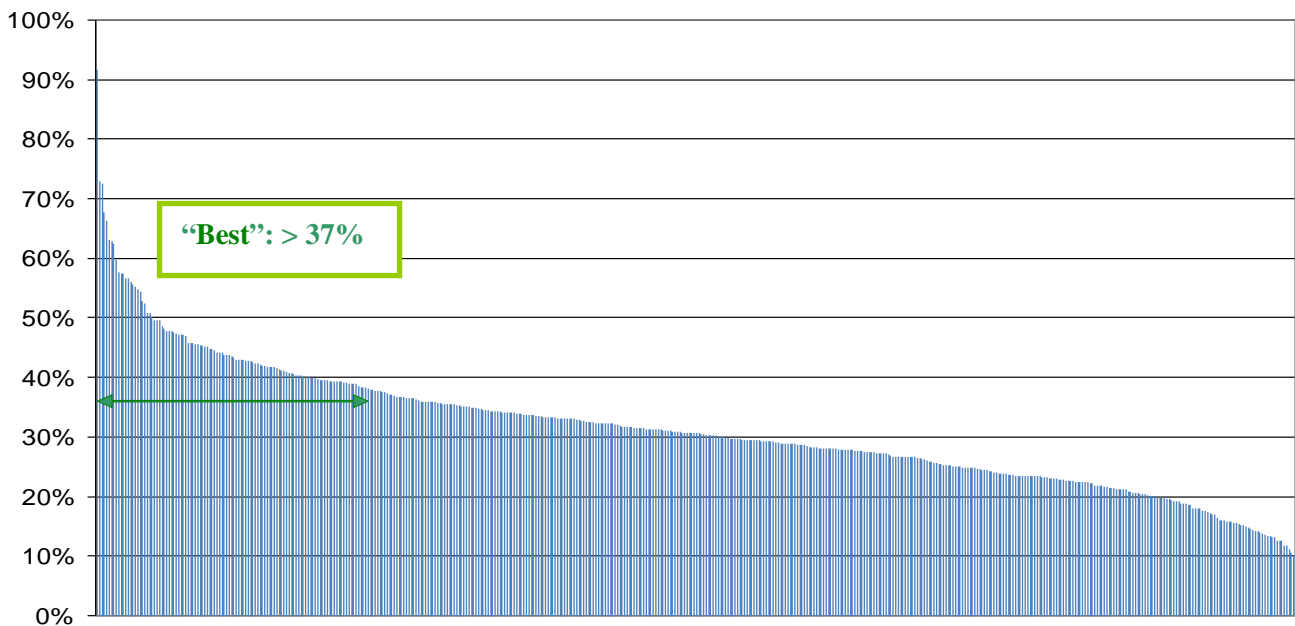
    Target (level achieved or surpassed by 25% of herds): 37%
    Median (level achieved by the middle herd): 31%
    75% level (level achieved or surpassed by 75% of herds): 24%
    Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 13%

Conception rate (%)
(12 Months data for 500 NMR Herds)

"Best": > 37%

9

K. Percentage service intervals at 18-24 days: When cows were "re-served", what % of those repeat services happened 18-24 days (one oestrus cycle) after the previous service.
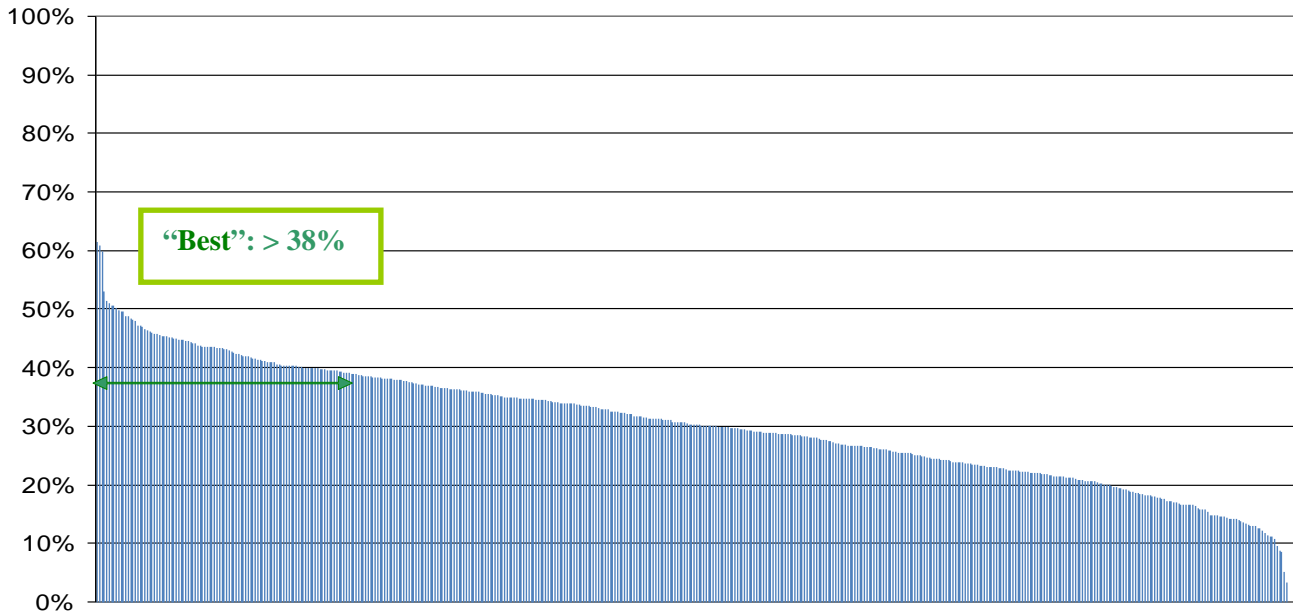
    Target (level achieved or surpassed by 25% of herds): 38%
    Median (level achieved by the middle herd): 30%
    75% level (level achieved or surpassed by 75% of herds): 23%
    Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 15%

% Service Returns between 18 and 24 Days
(12 Months data for 500 NMR Herds)

L. Percentage service intervals >50 days: When cows were "re-served", what % of those repeat services happened more than 50 days after the previous service.
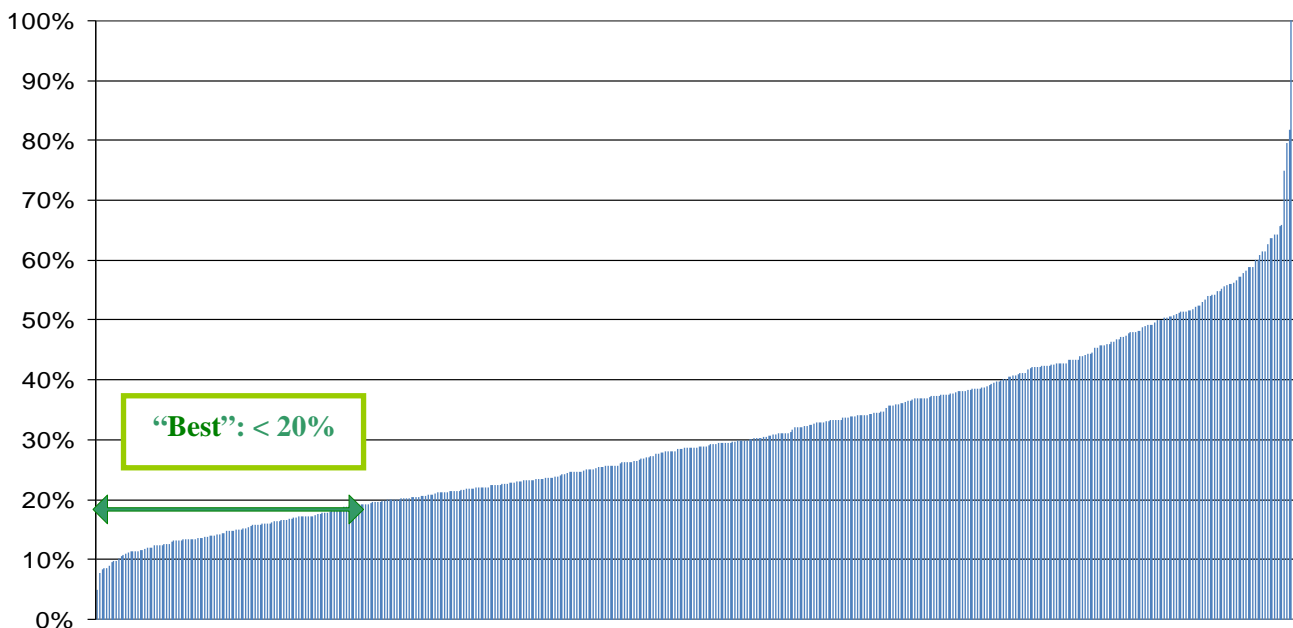
    Target (level achieved or surpassed by 25% of herds): 20%
    Median (level achieved by the middle herd): 29%
    75% level (level achieved or surpassed by 75% of herds): 40%
    Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 20%

% Service Returns at >50 Days
(12 Months data for 500 NMR Herds)

M. Percentage of cows eligible for service were served: What is the percentage of cows that were eligible for service were served.
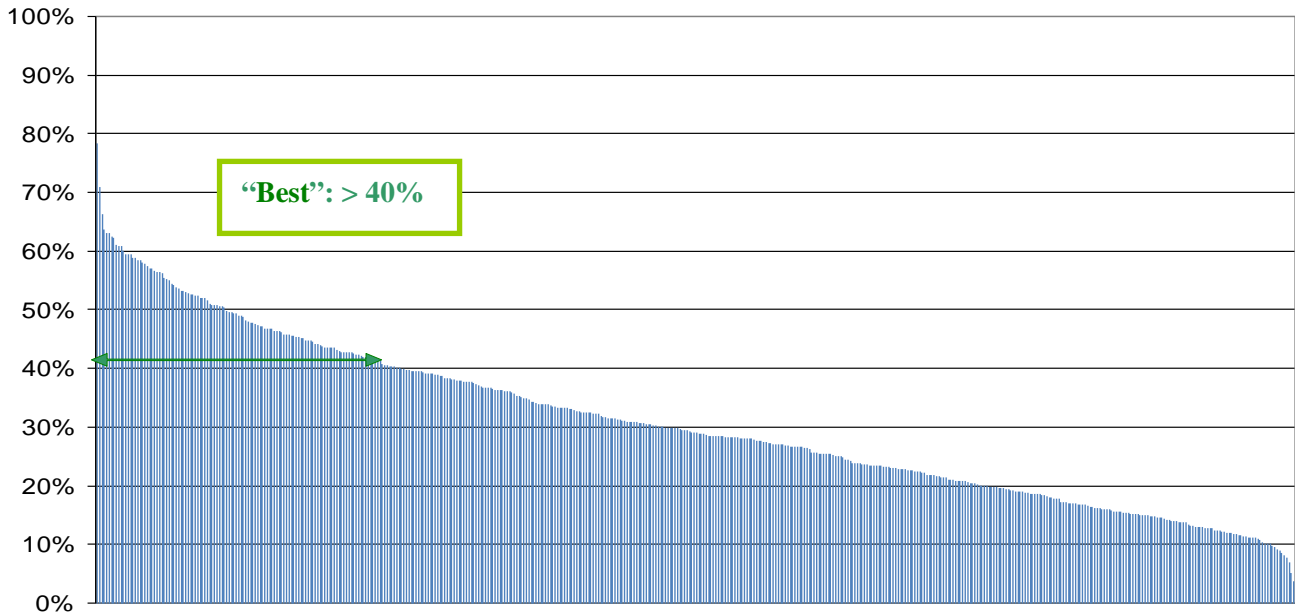
Target (level achieved or surpassed by 25% of herds): 40%
Median (level achieved by the middle herd): 29%
75% level (level achieved or surpassed by 75% of herds): 20%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 20%

% Cows Eligible for Service that Served
(12 Months data for 500 NMR Herds)

"Best": > 40%

N. Percentage eligible for service that conceived: What is the percentage of cows that were eligible for service that had conceived.
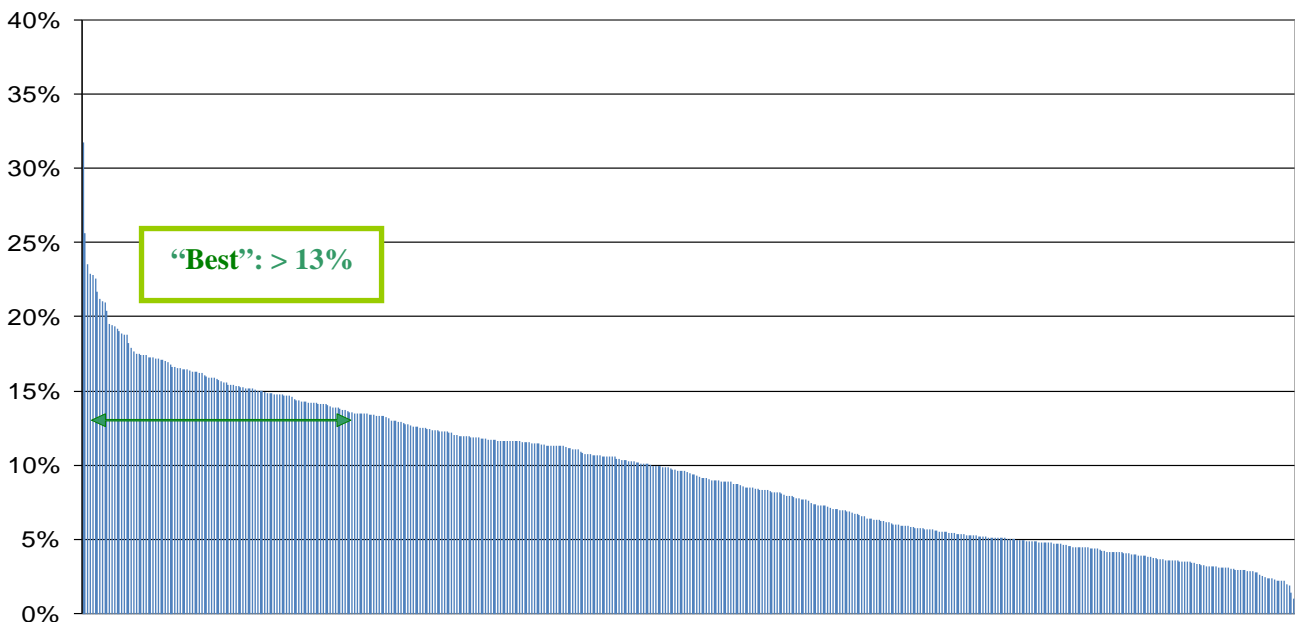
Target (level achieved or surpassed by 25% of herds): 13%
Median (level achieved by the middle herd): 9%
75% level (level achieved or surpassed by 75% of herds): 5%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 8%

% Cows Eligible for Service that Conceived
(12 Months data for 500 NMR Herds)

"Best": > 13%

O. Lifetime milk / cow / year (kg): What was the average daily milk yield of cows in their lifetime (including unproductive periods: time as a heifer, dry period).
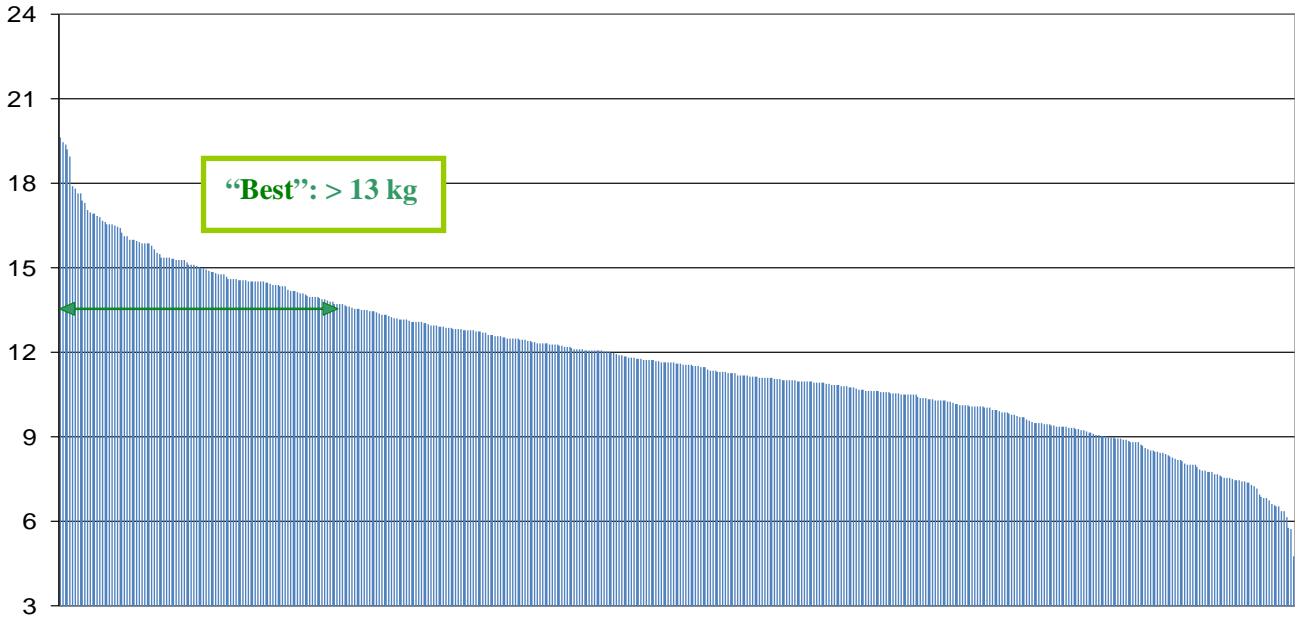
Target (level achieved or surpassed by 25% of herds): 13 kg
Median (level achieved by the middle herd): 12 kg
75% level (level achieved or surpassed by 75% of herds): 10 kg
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 3 kg

Milk / Cow / Day of Life (kg)
(12 Months data for 500 NMR Herds)

"Best": > 13 kg

P. Milk / cow / year (kg): What was the average annual milk yield of all milking cows in the specified year. Average yield per milking cow in 365 days.
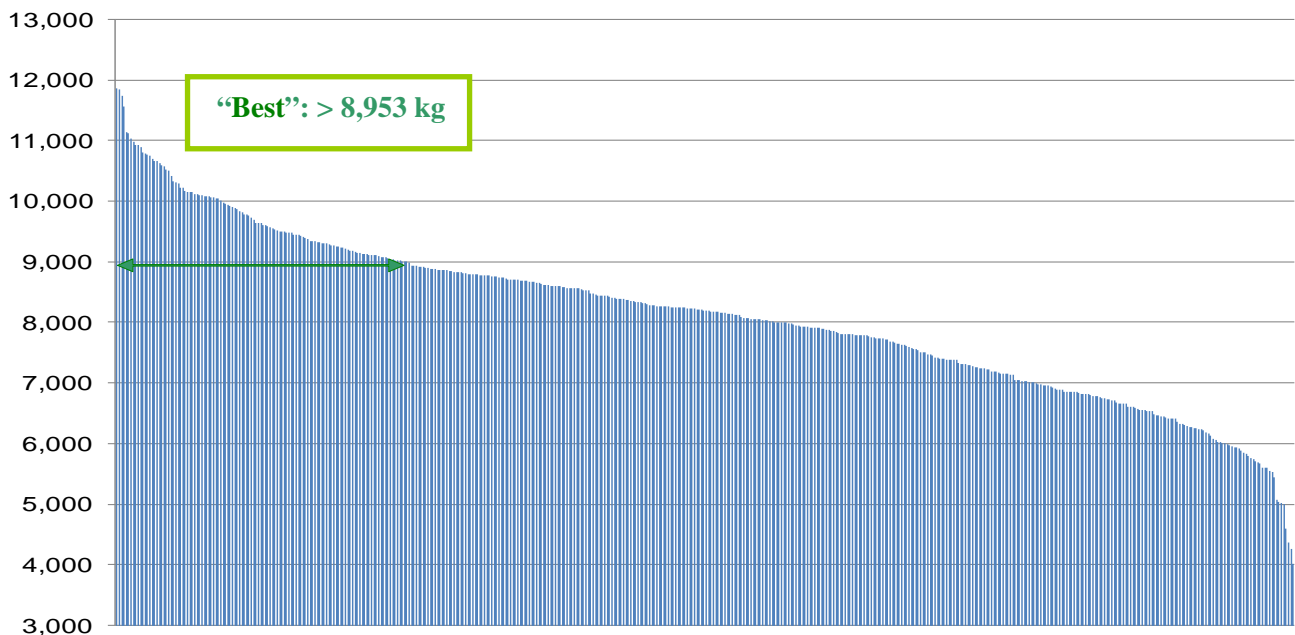
Target (level achieved or surpassed by 25% of herds): 8,953 kg
Median (level achieved by the middle herd): 8,200 kg
75% level (level achieved or surpassed by 75% of herds): 7,170 kg
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1,783

Milk / Cow / Year
(12 Months data for 500 NMR Herds)

"Best": > 8,953 kg

Q. Average protein%: What was the average % protein of all milk samples taken over the year.
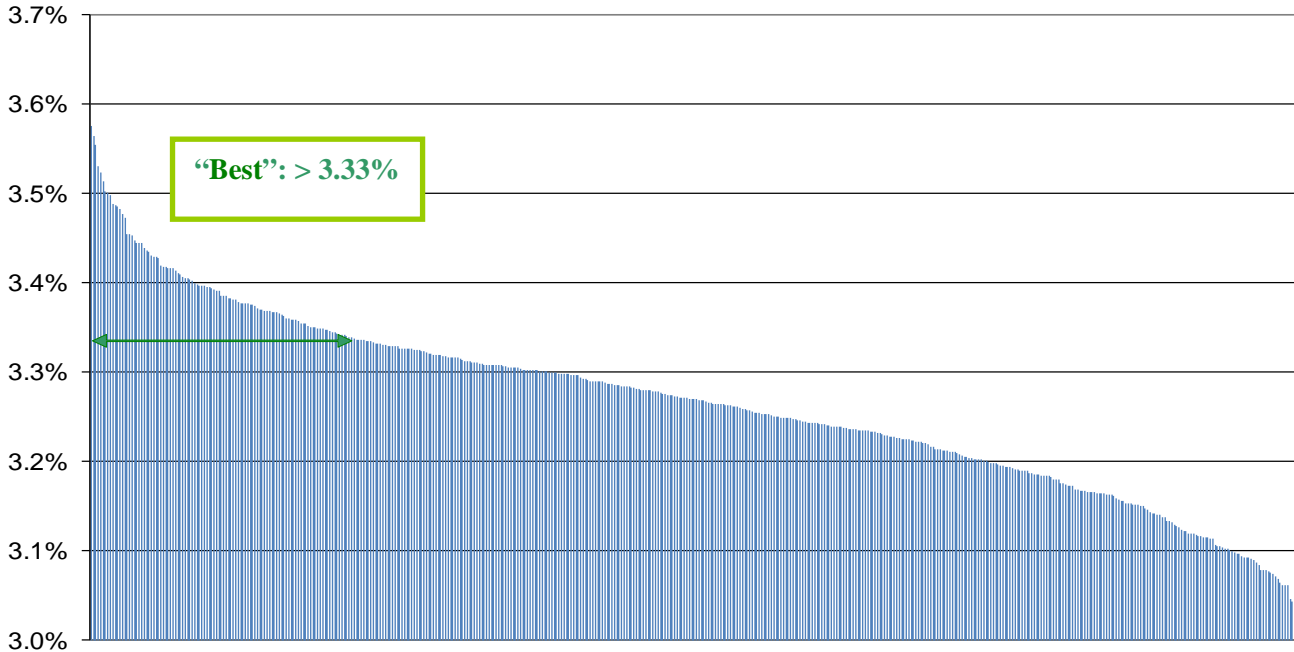
Target (level achieved or surpassed by 25% of herds): 3.33%
Median (level achieved by the middle herd): 3.27%
75% level (level achieved or surpassed by 75% of herds): 3.20%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 0.13%

Protein %
(12 Months data for 500 NMR Herds)

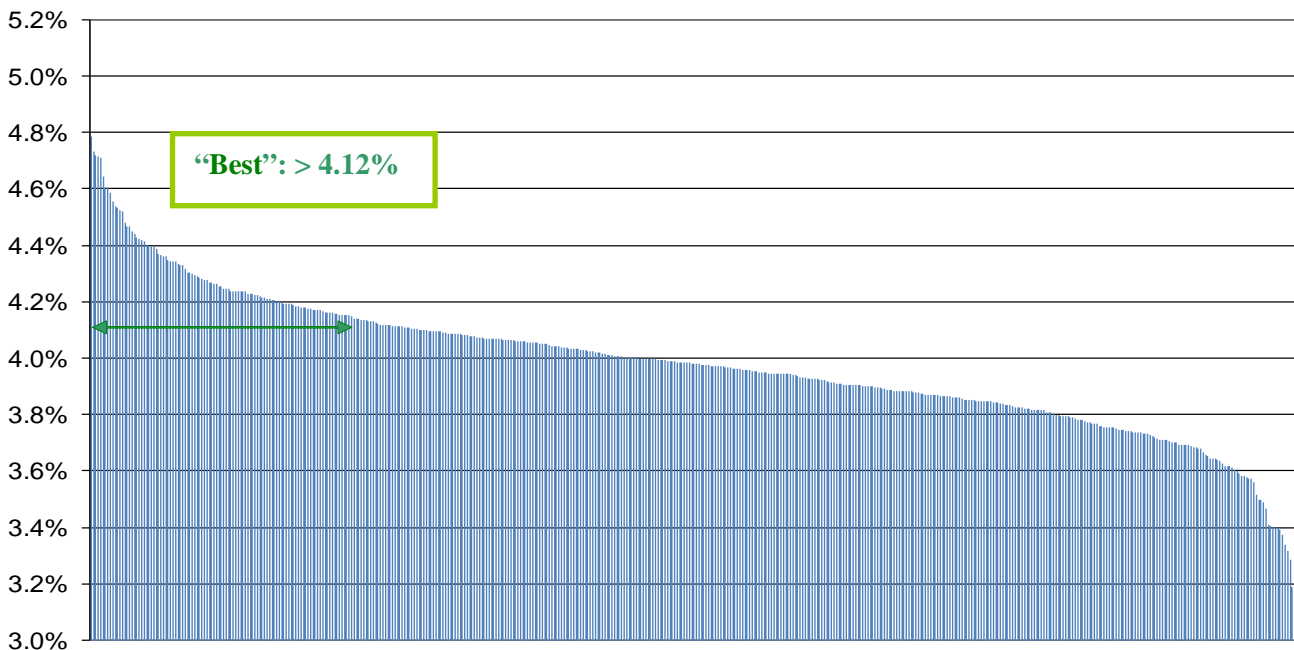**R. Average fat%: What was the average % fat of all milk samples taken over the year.**

Target (level achieved or surpassed by 25% of herds): 4.12%
Median (level achieved by the middle herd): 3.98%
75% level (level achieved or surpassed by 75% of herds): 3.84%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 0.28%

Fat %
(12 Months data for 500 NMR Herds)

13

S. 305 day yield (kg): What was the average yield by day 305 of lactation for all cows reaching day 305 during the year.
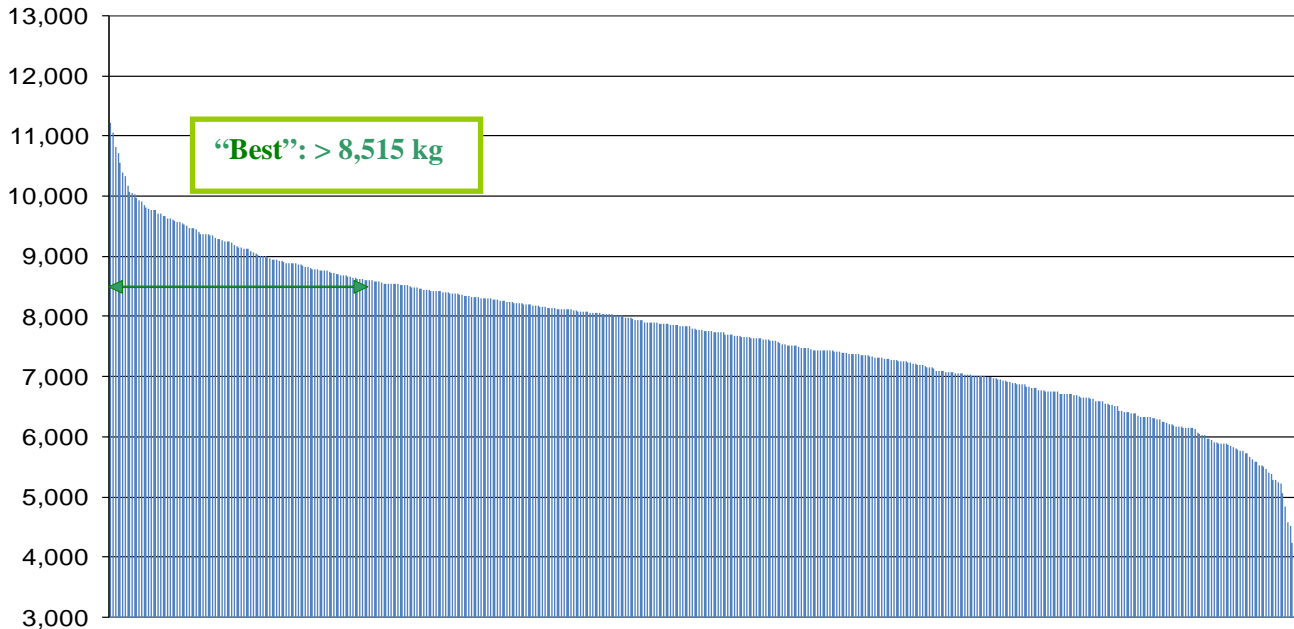
Target (level achieved or surpassed by 25% of herds): 8,515 kg
Median (level achieved by the middle herd): 7,768 kg
75% level (level achieved or surpassed by 75% of herds): 6,960 kg
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 1,555 kg

305-Day Yield (kg)
(12 Months data for 500 NMR Herds)

"Best": > 8,515 kg

T. Average SCC ('000 cells/ml): What was the average SCC of all the milk samples taken in the last 12 months.
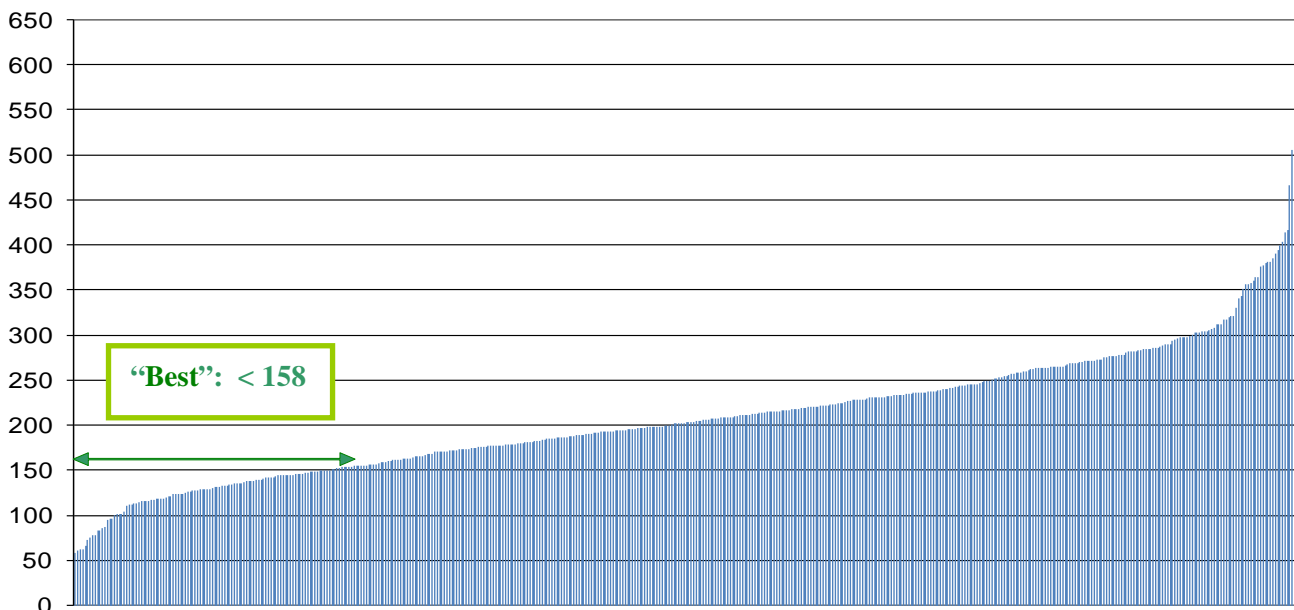
Target (level achieved or surpassed by 25% of herds): 158
Median (level achieved by the middle herd): 203
75% level (level achieved or surpassed by 75% of herds): 249
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 91

Average Somatic Cell Count (SCC '000 cells/ml)
(12 Months data for 500 NMR Herds)

"Best": < 158

U. Percentage SCC >=200,000 cells/ml: What % of milk samples taken in the last 12 months had a SCC over 200,000 cells/ml milk. Indicates the size of any reservoir of infection.
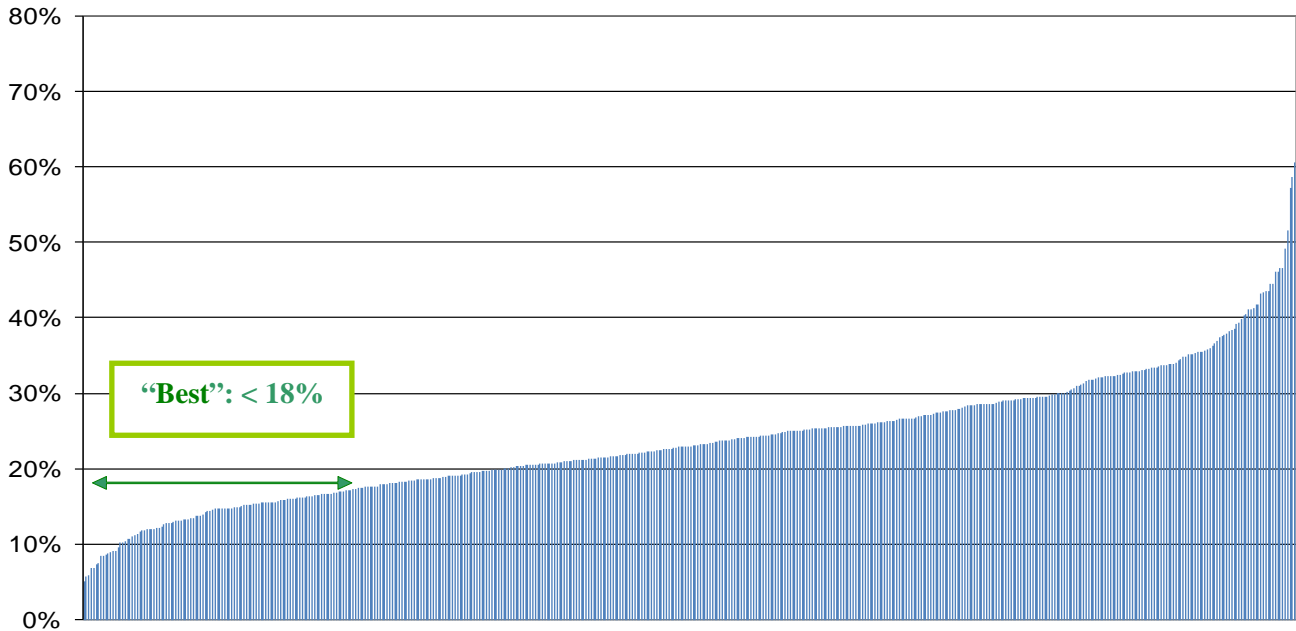
Target (level achieved or surpassed by 25% of herds): 18%
Median (level achieved by the middle herd): 23%
75% level (level achieved or surpassed by 75% of herds): 29%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 11%

% of Milk Samples with SCC >200,000 /ml
(12 Months data for 500 NMR Herds)

V. Percentage SCC >500,000 cells/ml: What % of milk samples taken in the last 12 months had a SCC over 500,000 cells/ml of milk. How many of the cows are major reservoirs of infection.
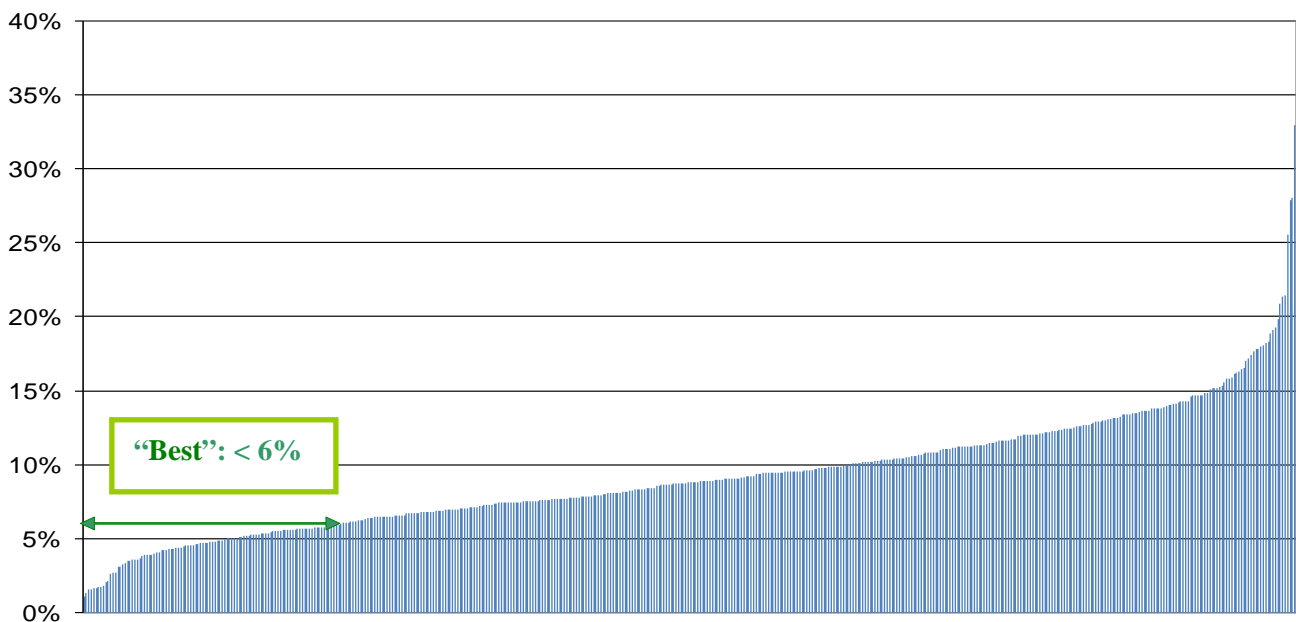
Target (level achieved or surpassed by 25% of herds): 6%
Median (level achieved by the middle herd): 9%
75% level (level achieved or surpassed by 75% of herds): 12%
Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 6%

% of Milk Samples with SCC >500,000 /ml
(12 Months data for 500 NMR Herds)

W. Percentage 1st recording SCC >=200,000 cells/ml: What % of cows started new lactations in the last year with a high SCC (>200,000 cells) at the first milk recording.
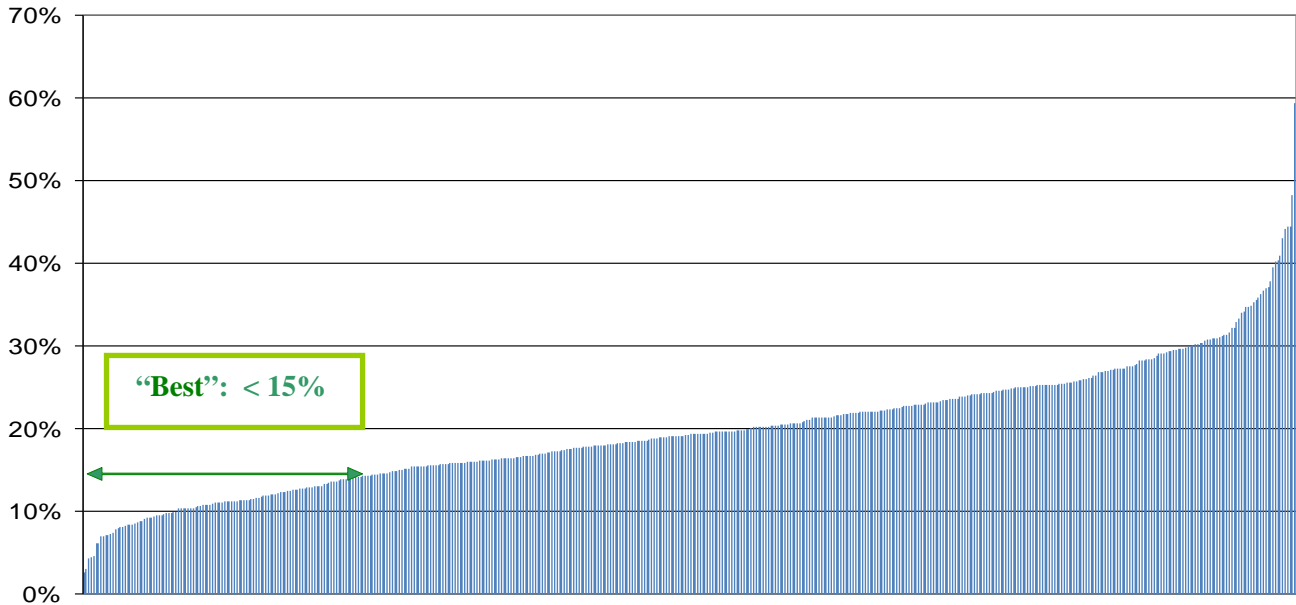
    Target (level achieved or surpassed by 25% of herds): 15%
    Median (level achieved by the middle herd): 19%
    75% level (level achieved or surpassed by 75% of herds): 24%
    Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 9%

% of Cows with high SCC (>200,000/ml) at First Recording in Lactation
(12 Months data for 500 NMR He

X. Percentage chronic SCC >=200,000 cells/ml: What % of all milk samples taken over the last 12 months that were from CHRONIC cows (cows whose milk was also over 200,000 cells at the PREVIOUS milk recordings).
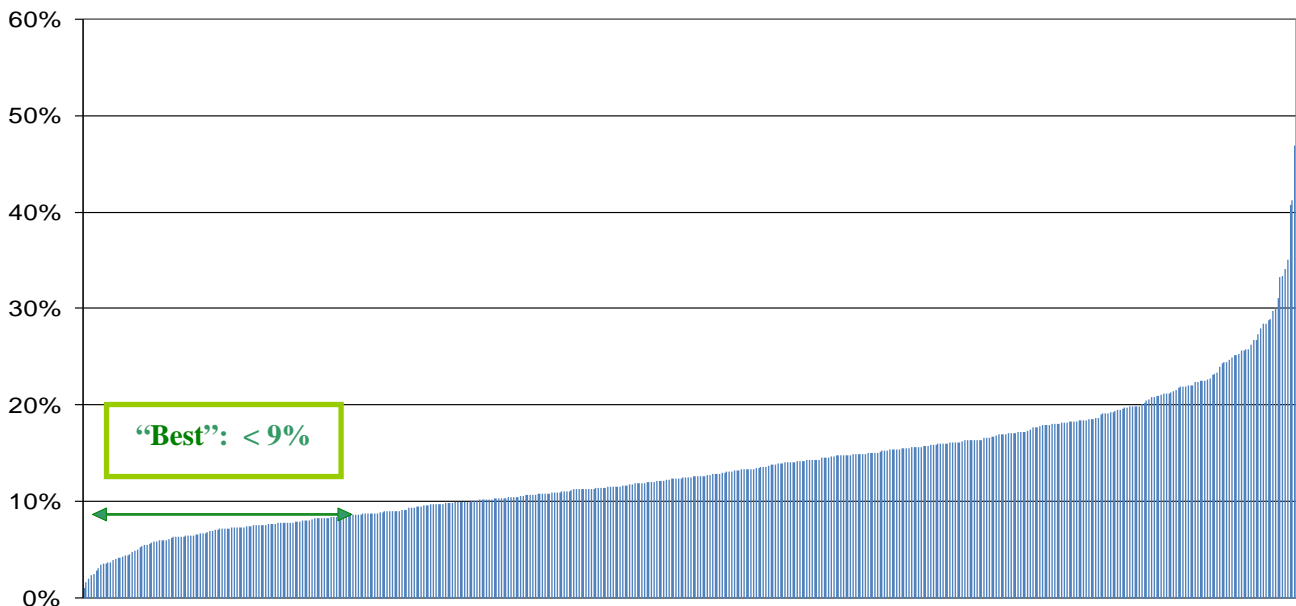
    Target (level achieved or surpassed by 25% of herds): 9%
    Median (level achieved by the middle herd): 13%
    75% level (level achieved or surpassed by 75% of herds): 17%
    Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 8%

% of Cows with Chronic Infections
(12 Months data for 500 NMR Herds)

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Y. Percentage Dry period cure (High:Low): What % of cows calving in the last year that ended their previous lactation with a high SCC (>200,000 cells), started the new lactation with a LOW cell count (<200,000 cells). The % of high SCC cows "cured" by the dry period.
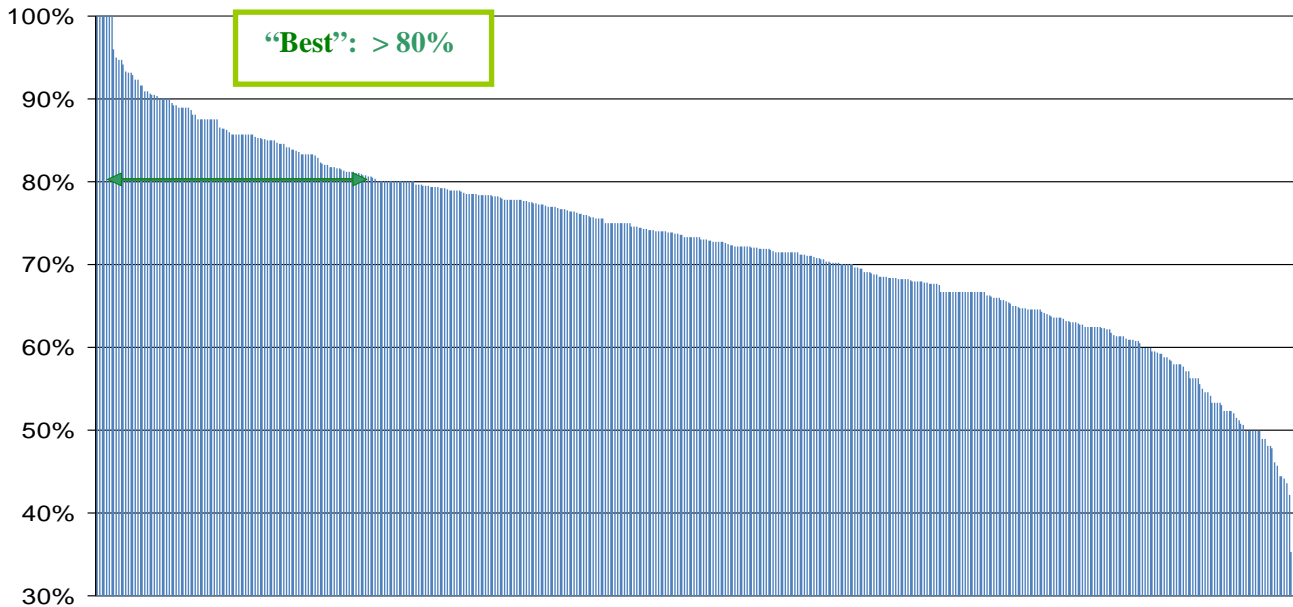
Target (level achieved or surpassed by 25% of herds): 80%

Median (level achieved by the middle herd): 73%

75% level (level achieved or surpassed by 75% of herds): 66%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 14%

% of Cows with Dry Period Cure (High:Low)
(12 Months data for 500 NMR Herds)

"Best": > 80%

Z. Percentage Dry period protection (Low:Low): What % of cows calving in the last year that ended their previous lactation with a LOW SCC (<200,000 cells), started the new lactation with a LOW cell count (<200,000 cells). The % of low SCC cows "protected" through the dry period.
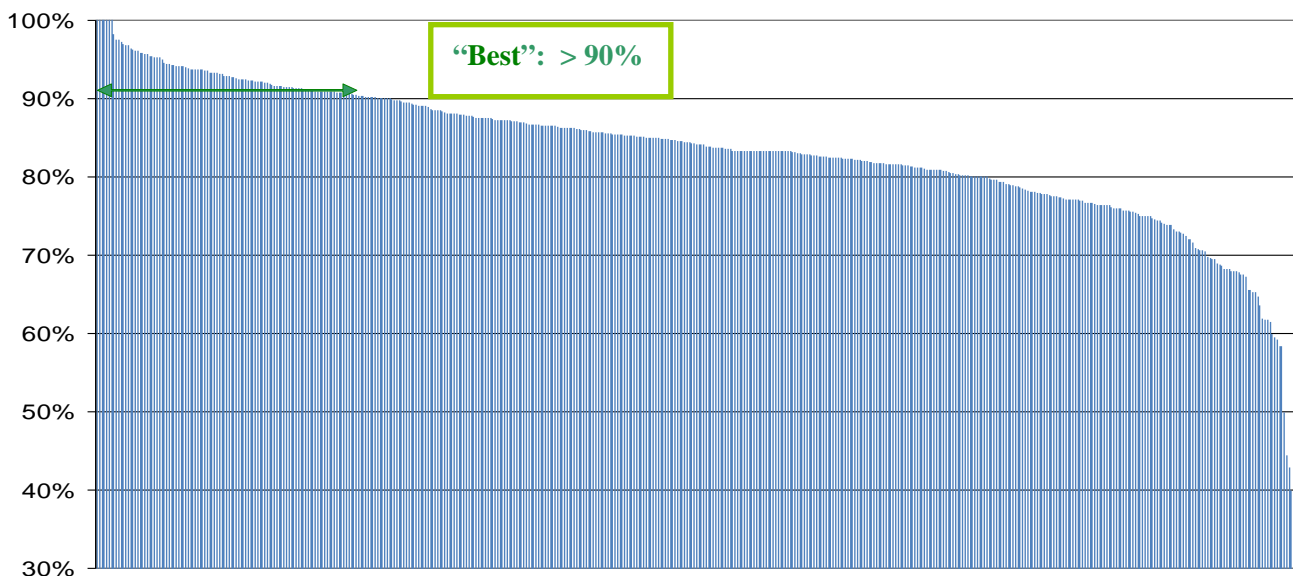
Target (level achieved or surpassed by 25% of herds): 90%

Median (level achieved by the middle herd): 84%

75% level (level achieved or surpassed by 75% of herds): 80%

Inter-quartile range (difference between 1st (25%) and 3rd (75%) quartile herds): 10%

% of Cows with Dry Period Protection (Low:Low)
(12 Months data for 500 NMR Herds)

"Best": > 90%

ZA. Percentage Low at the end of previous lactation: What % of cows calving in the last year had ended their previous lactation with a LOW SCC (<200,000 cells).
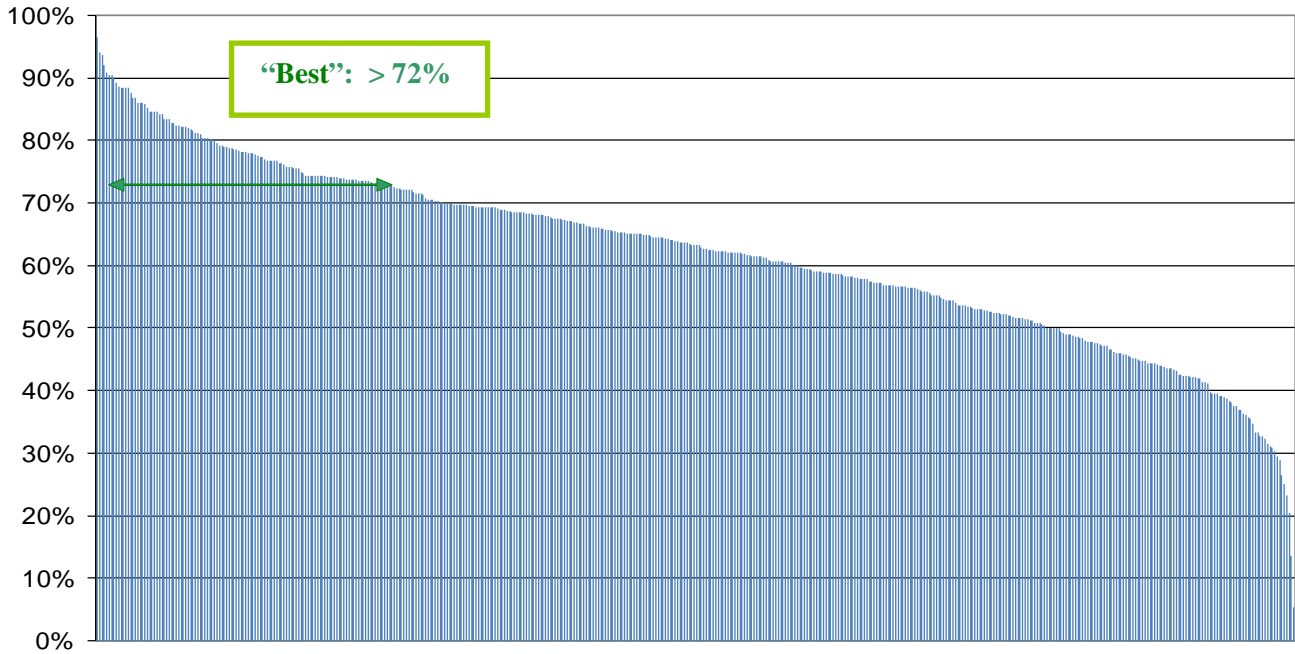
Target (level achieved or surpassed by 25% of herds): 72%

Median (level achieved by the middle herd): 63%

75% level (level achieved or surpassed by 75% of herds): 52%

Inter-quartile range (difference between 1ˢᵗ (25%) and 3ʳᵈ (75%) quartile herds): 20%

% of Cows with Low SCC (<200,000) at the End of Previous Lactation
**(12 Months data for 500 NMR Herds)**

Section 2. The Practical Use of Key Performance Indicators By Farmers And Their Technical Advisers

The figures obtained from this study can be used as "national standards" for comparison with performance in individual herds. The farmer can readily see where his/her herd would appear for each parameter. This provides an ideal basis for informed discussion on the causes of both good and poor performance.

The study also provides uncontroversial target values for the use of farmers and their advisers. To reiterate, the target value is the level achieved or bettered by 25% (one in four) of the herds in the study. By including parameters relating to production, fertility and health, the study acknowledges the dynamic nature of dairy production and the need for high standards across all areas of herd management.

The Key Performance Indicators Report in the InterHerd+ program (Figure 2) provides an overview of performance for an individual herd. In addition to calculating key performance indicators (12 month rolling averages) for each of the parameters covered by this study, the target and inter-quartile range values from the study are used to demonstrate where the herd would fall in a comparison with the 500 herds, thus highlighting that herd's relative strengths and weaknesses.

Figure 2. The Key Performance Indicator Report of InterHerd+
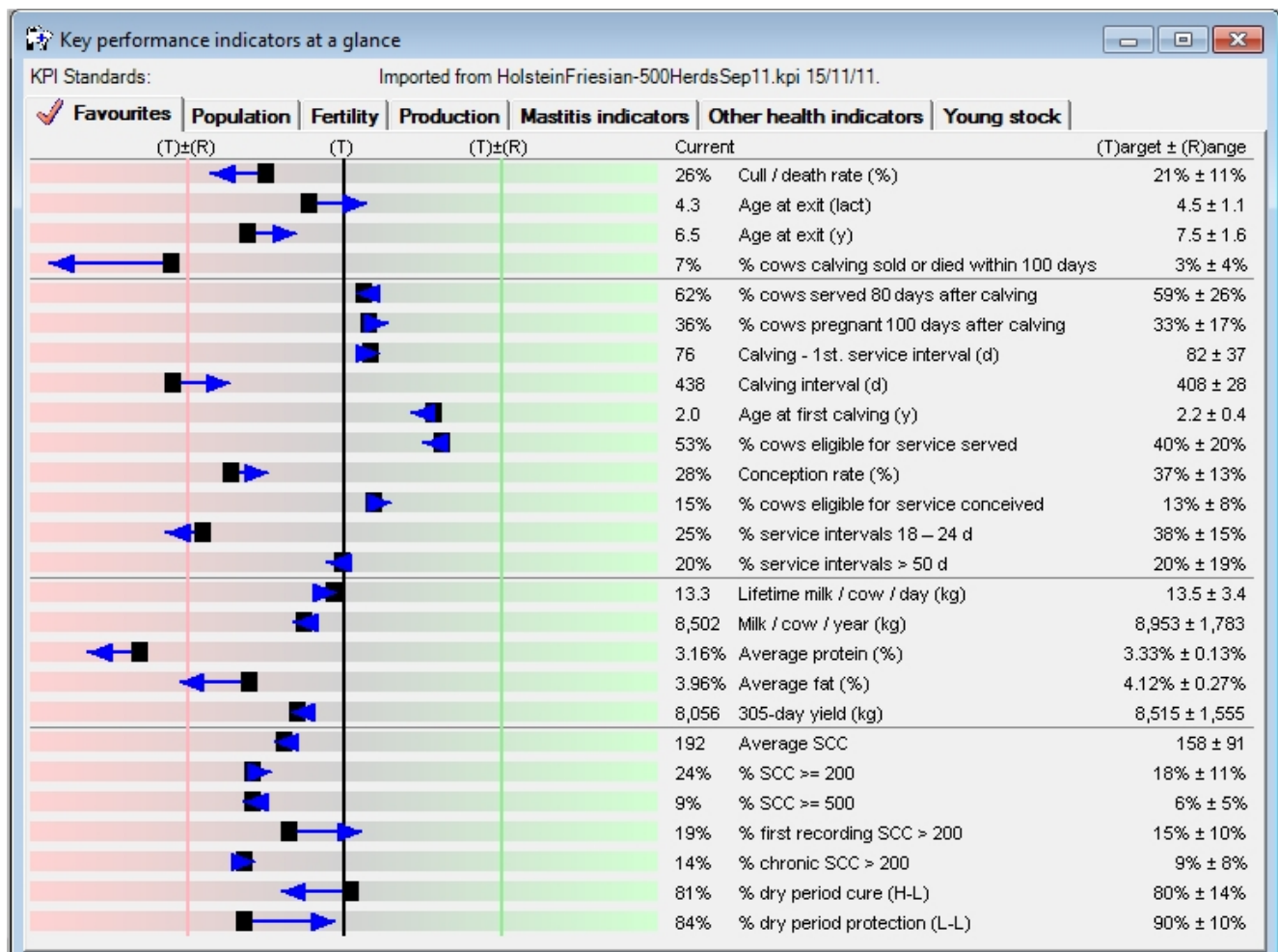
The meaning of the different lines and values against each key performance indicator are explained in Figure 3.
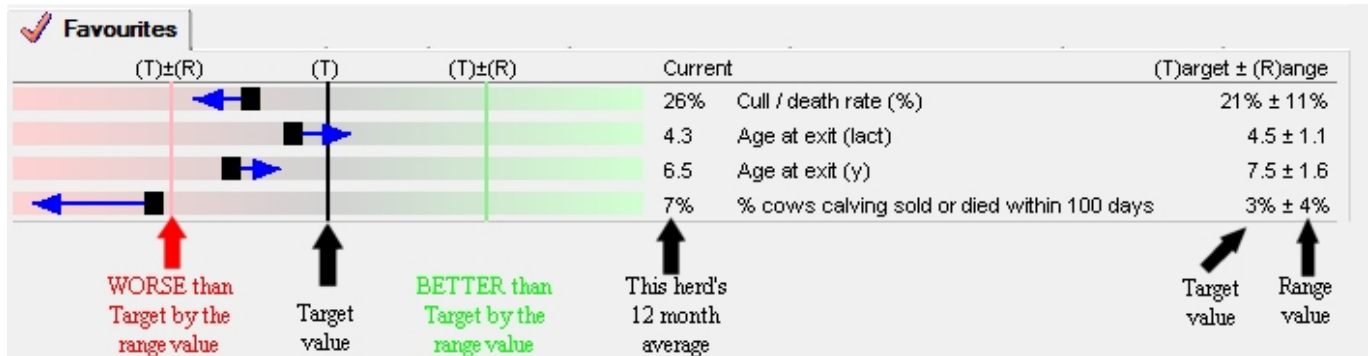
The value given to the left of each parameter title represents the herd's performance over the last 12 months. Thus the herd in Figure 3 had a cull/death rate of 26% over the previous 12 months.

To the right of each listed parameter is a **target** value and a **range** (corresponding to the values given in Table 1)**.** In Figure 3 the TARGET value for cull/death rate is 21% with a range of ±11%.

These values are also displayed graphically to the left of the parameter titles. The target value is represented by the vertical black line. The area to the right hand side is shaded green to denote a performance level that is better than the target value. The vertical green line represents "Better than target by the range".

To the left of the target line is shaded red denoting performance that is worse than the target value. The vertical line represents "Worse than the target by the range".

So in Figure 3 where a lower culling rate is preferable, the green vertical line represents the target (21%) better by the range (11) = a culling rate of 10%. In contrast the red vertical line represents the target worse by the range = a culling rate of 32%.

The positions of the black square and blue arrow show how the current herd is performing for each parameter relative to the specified target and range values. The arrow indicates the direction of change.

- The **black square** is the average value the herd achieved in that parameter over the last **12 months**. So it is the longer-term position of the herd (the value displayed to the left of the parameter title).
- The **blue** arrow head is the herd's average value over the last **3 months**, so the recent performance. The line and arrow show the difference and direction of change between the 3 and 12 month average values. Beware that while this may indicate a significant change in herd performance it may also be influenced by seasonal factors in the 3 month period.

Using the target and range values to highlight a herd's strengths and weaknesses

Herd strengths: This study has set the **TARGET** value to the level achieved by the "BEST" 25% of herds. Thus in the graphic of Figure 4 below, any KPI with a value to the **right (green side) of the black target line** would be "in **the best 25%**" when compared to the 500 study herds. In the herd displayed in Figure 4 the eight parameters of this type are highlighted in green boxes. Note that the majority are in the section of fertility parameters although the overall calving interval and conception rate are relatively poor.

Herd weaknesses: With the **RANGE** set at the difference between the 25 and 75 percentile herds, the vertical red line represents the performance achieved by the 75 percentile herd (the target, worse by the range). Therefore, any parameter that is to the **left of the vertical red line** would be **"in the worst 25%"** when compared with the 500 study herds. In Figure 4 these parameters are enclosed in red boxes. The obvious weaknesses in this herd are high cull rates in early lactation and long calving intervals. The "% service intervals 18-24 days" is also low suggesting poor heat detection.

Average performance levels: Parameters that fall between the vertical black and red lines would fall within the inter-quartile range when compared with the 500 study herds.

Figure 4. Highlighting the strengths and weaknesses of a herd

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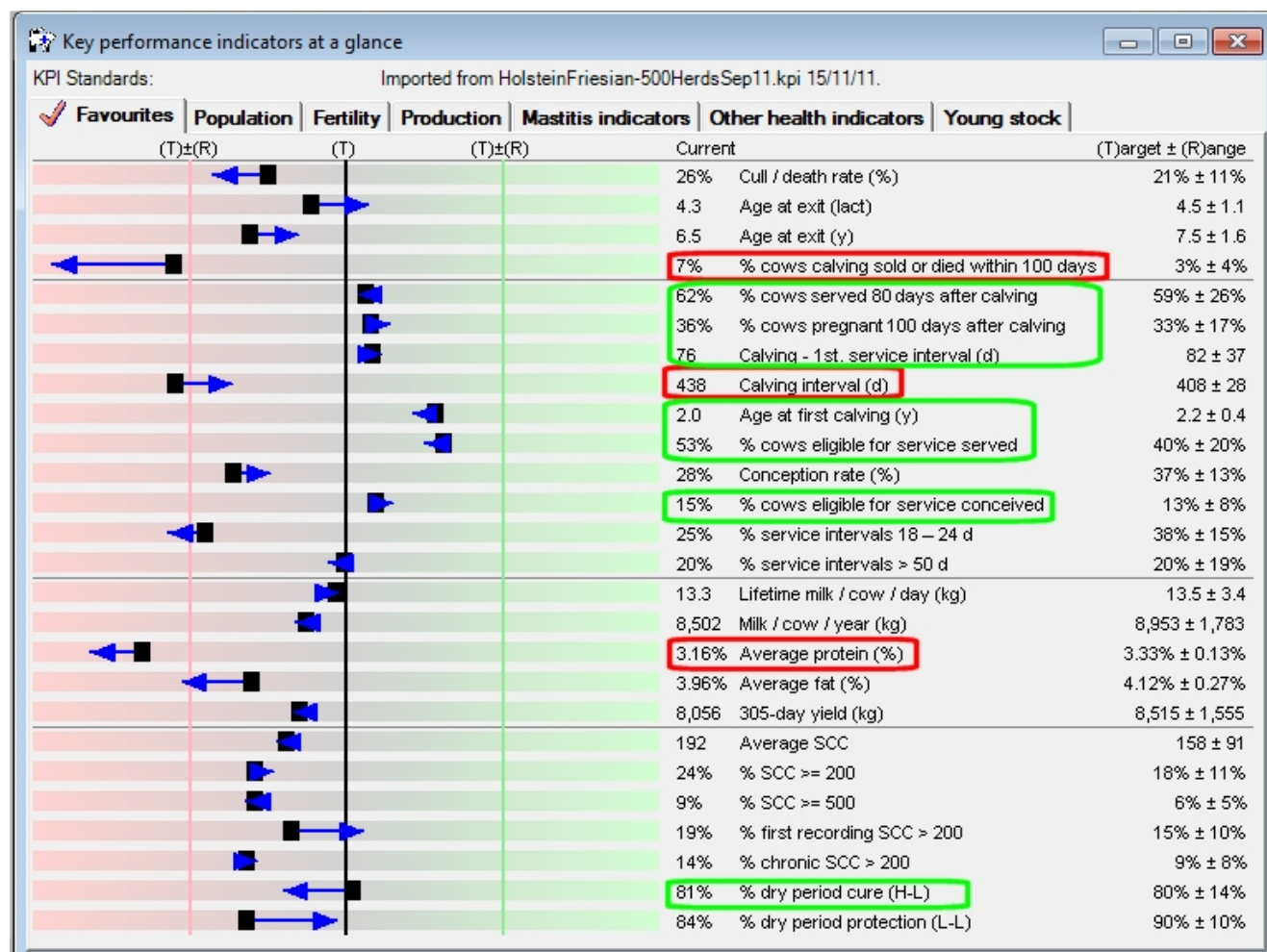
Section 3: Comparison of Key Performance Indicators for the years ending 30/09/2010 and 30/09/2011

The target and median figures from the current study are compared with the results from a similar exercise for the previous year (the year ending 30th September 2010). Table 2 shows changes in the median and target values for each parameter over the interval. The colour of the 2011 value in Table 2 indicates whether it has "improved" (green) or "deteriorated" (red).

Table 2. Comparison of median and target values derived from the two studies of 500 NMR recording herds in 2010 and 2011

Parameter	Median	Median		Target "Best 25%"	Target "Best 25%"
Year of the Study	*2010*	*2011*		*2010*	*2011*
A. Culling rate	24%	26%		18%	21%
B. Culling / death rate in first 100 days of lactation	7%	5%		4%	3%
C. Age at exit (years)	6.6	6.6		7.4	7.5
D. Age at exit by lactations	3.9	3.9		4.5	4.5
E. Percentage Served by day 80	46%	47%		59%	59%
F. Percentage conceived 100 days after calving	26%	25%		33%	33%
G. Calving to 1st service interval (days)	105	98		87	82
H. Calving interval (days)	424	421		409	408
I. Age at 1st calving (years)	2.4	2.4		2.3	2.2
J. Conception rate	32%	31%		40%	37%
K. Percentage service intervals at 18-24 days	30%	30%		38%	38%
L. Percentage service intervals >50 days	32%	29%		22%	20%
M. Percentage eligible for service that served	27%	29%		37%	40%
N. Percentage eligible for service that conceived	9%	9%		13%	13%
O. Lifetime milk / cow / day (kg)	11	12		13	13
P. Milk / cow / year (kg)	7,665	8,200		8,760	8,953
Q. Average protein%	3.27%	3.27%		3.33%	3.33%
R. Average fat%	3.96%	3.98%		4.12%	4.12%
S. 305 day yield (kg)	7,400	7,768		8,300	8,515
T. Average SCC ('000 cells/ml)	210	203		169	158
U. Percentage SCC >=200,000 cells/ml	24%	23%		19%	18%
V. Percentage SCC >500,000 cells/ml	9%	9%		7%	6%
W. Percentage 1st recording SCC >=200,000 cells/ml	20%	19%		15%	15%
X. Percentage chronic SCC >=200,000 cells/ml	14%	13%		10%	9%
Y. Percentage Dry period cure (High:Low)	74%	73%		80%	80%
Z. Percentage Dry period protection (Low:Low)	84%	84%		89%	90%
ZA. Percentage Low at end of previous lactation (SCC<200,000 cells/ml)	60%	63%		70%	72%

Of the 500 herds in the 2011 study, 359 were also included in the earlier study. Table 3 shows the change in values for the parameters in this subset of the total herds. Again, the 2011 figure is coloured to indicate improvement (green) or deterioration (red) since the previous year.

Table 3. Comparison of results derived from 359 NMR recording herds included in the two studies

Parameter	Median	Median	Target Top 25%	Target Top 25%	Bottom 25%	Bottom 25%
Year of the Study	*2010*	*2011*	*2010*	*2011*	*2010*	*2011*
A. Culling rate	23%	25%	**19%**	**21%**	29%	31%
B. Culling / death rate in first 100 days of lactation	7%	5%	**4%**	**3%**	10%	7%
C. Age at exit (years)	6.5	6.6	**7.4**	**7.5**	6.0	6.0
D. Age at exit by lactations	4.0	3.9	**4.5**	**4.5**	3.4	3.3
E. Percentage Served by day 80	46%	48%	**59%**	**59%**	34%	33%
F. Percentage conceived 100 days after calving	26%	25%	**33%**	**33%**	17%	16%
G. Calving to 1st service interval (days)	103	98	**87**	**82**	121	121
H. Calving interval (days)	424	421	**410**	**409**	440	435
I. Age at 1st calving (years)	2.4	2.4	**2.3**	**2.2**	2.7	2.7
J. Conception rate	32%	31%	**39%**	**38%**	26%	25%
K. Percentage service intervals at 18-24 days	30%	30%	**37%**	**38%**	23%	22%
L. Percentage service intervals >50 days	32%	29%	**22%**	**20%**	42%	41%
M. Percentage eligible for service that served	28%	30%	**37%**	**40%**	19%	20%
N. Percentage eligible for service that conceived	9%	10%	**13%**	**13%**	6%	5%
O. Lifetime milk / cow / day (kg)	11	12	**13**	**13**	9	10
P. Milk / cow / year (kg)	8,042	8,221	**8,945**	**9,017**	6,966	7,150
Q. Average protein%	3.26%	3.27%	**3.32%**	**3.33%**	3.18%	3.19%
R. Average fat%	3.95%	3.97%	**4.10%**	**4.11%**	3.81%	3.84%
S. 305 day yield (kg)	7,648	7,840	**8,459**	**8,544**	6,887	6,970
T. Average SCC ('000 cells/ml)	204	203	**163**	**155**	254	250
U. Percentage SCC >=200,000 cells/ml	23%	23%	**18%**	**17%**	30%	29%
V. Percentage SCC >500,000 cells/ml	9%	9%	**7%**	**6%**	12%	12%
W. Percentage 1st recording SCC >=200,000 cells/ml	19%	19%	**15%**	**14%**	24%	24%
X. Percentage chronic SCC >=200,000 cells/ml	13%	13%	**10%**	**9%**	18%	17%
Y. Percentage Dry period cure (High:Low)	75%	73%	**81%**	**80%**	67%	66%
Z. Percentage Dry period protection (Low:Low)	85%	85%	**89%**	**90%**	79%	80%
ZA. Percentage Low at end of previous lactation (SCC<200,000 cells/ml)	62%	64%	**72%**	**73%**	51%	53%

Appendix 1. Key Performance Indicators definitions

The Key Performance Indicators are displayed as both 12 month and 3 month rolling averages.

In the following definitions the average population of cows is calculated using animal days. Every day that a cow is present and in the population at risk during the period of study is a 365th of an animal year. The total animal days is summed and divided by 365 to give animal years, or the average cow population at risk.

Parameter	Description
A. Culling rate	The number of cows dying or culled during the 12 month period expressed as a percentage of the average cow population for the same 12 month period.
B. Culling / death rate in first 100 days of lactation	The number of deaths/culls within 100 days of calving divided by the average cow population up to 100 days (aggregated total animal days up to 100 days after calving, divided by 365).
C. Age at exit (years)	The average age (in days) of cows culled/died in the analysis period, divided by 365.24
D. Age at exist by lactations	The total number of lactations completed by cows culled/died in the analysis period, divided by the number of these culled/died cows.
E. Percentage Served by day 80	The percentage of cows reaching the 80th day after calving that have been served at least once on or by Day 80.
F. Percentage conceived 100 days after calving	The percentage of cows reaching 100 days after calving that have conceived on or by Day 100.
G. Calving to 1st service interval (days)	The average days between calving and 1st service for all cows served for the first time in a lactation during the analysis period.
H. Calving interval (days)	The interval between calvings, in days, for all re-calvings recorded in the analysis period.
I. Age at 1st calving (years)	The age at first calving for all cows calving for the first time during the analysis period.
J. Conception rate	The number of conceptions as a percentage of the total number of services (services to cows culled are included) during the analysis period.
K. Percentage service intervals at 18-24 days	The percentage of all service intervals for cows returning to service during the analysis period that are between 18 and 24 days (equating to one oestrus cycle after the previous service).
L. Percentage service intervals >50 days	The percentage of all service intervals for cows returning to service during the analysis period that are over 50 days.
M. Percentage eligible for service that served	The percentage of cows that are eligible for service (42 days+ after calving) during the analysis period that are served.
N. Percentage eligible for service that conceived	The percentage of cows that are eligible for service (42 days+ after calving) during the analysis period that conceived.
O. Lifetime milk / cow / day (kg)	The average of total milk yield divided by age in days (from birth to culling) for cows leaving the herd during the analysis period.
P. Milk / cow / year (kg)	The total milk produced per cow place in the year. The total milk divided by the average population of cows (both in milk and dry).
Q. Average protein%	The average protein% of all milk recorded during the analysis period.
R. Average fat%	The average fat% of all milk recorded during the analysis period.

S. 305 day yield (kg)	The average production by Day 305 for all cows reaching 305 days after calving during the analysis period.
T. Average SCC ('000 cells/ml)	The average somatic cell count of all milk recorded during the analysis period.
U. Percentage SCC >=200,000 cells/ml	The percentage of all recorded milk samples during the analysis period that had an individual SCC reading of 200,000 cells/ml or higher.
V. Percentage SCC >500,000 cells/ml	The percentage of all recorded milk samples during the analysis period that had an individual SCC reading of 500,000 cells/ml or higher.
W. Percentage 1st recording SCC >=200,000 cells/ml	The percentage of all cows starting new lactations that had a high SCC (>=200,000 cells/ml) reading at the first milk recording in the lactation.
X. Percentage chronic SCC >=200,000 cells/ml	The percentage of all milk samples taken in the analysis period that originated from chronic SCC cows where the current and previous milk samples both had SCC levels of 200,000 cells/ml milk or greater.
Y. Percentage Dry period cure (High:Low)	Of re-calving cows recorded starting a new lactation during the analysis period: the percentage of cows ending the previous lactation with a HIGH SCC (>=200,000 cells/ml) that started the new lactation with a LOW SCC (<200,000 cells/ml).
Z. Percentage Dry period protection (Low:Low)	Of re-calving cows recorded starting a new lactation during the analysis period: the percentage of cows ending the previous lactation with a LOW SCC (<200,000 cells/ml) that also started the new lactation with a LOW SCC (<200,000 cells/ml).
ZA. Percentage Low at end of previous lactation (SCC<200,000 cells/ml)	Of re-calving cows recorded starting a new lactation during the analysis period: The percentage that had a LOW SCC (<200,000 cells/ml) at the last milk recording in the previous lactation.