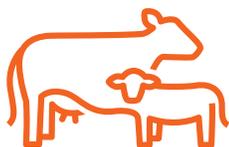


# TECHNICAL BULLETIN

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## **BUILDING A HEALTHIER HERD WITH CLARIFIDE® PLUS**

**Dairy producers can use CLARIFIDE Plus to select heifers based on wellness traits with a goal of a healthier, more productive herd.**

Fernando Di Croce, Anthony McNeel, Brenda Reiter, and Jason Osterstock  
Genetic Technical Services

### **Zoetis Genetics**

333 Portage Street  
Kalamazoo, MI 49007-4931

#### **KEY POINTS**

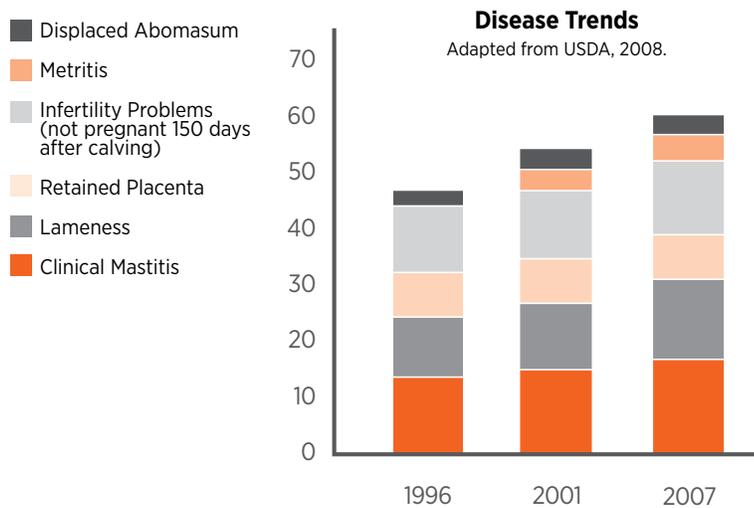
- CLARIFIDE® Plus represents the first commercially available dairy genetic evaluation specifically designed for wellness traits in U.S. dairy cattle.
- CLARIFIDE Plus genomic predictions for wellness traits provide reliable assessments of genetic risk factors for economically relevant health challenges in Holstein cattle.
- The use of Dairy Wellness Profit Index™ (DWP\$™) would be expected to offer similar selection emphasis to that achieved by Net Merit (NM\$), making it a practical consideration for producers that have historically used NM\$, but would apply additional selection emphasis on wellness traits.
- CLARIFIDE Plus provides an expanded suite of genetic selection tools that provide highly relevant information to dairy producers that seek to continue to improve the health, productivity and profitability of the dairy cattle they care for.

#### **INTRODUCTION**

Genetic evaluation and selection in dairy cattle has largely focused on production traits such as milk and protein production. Indirect predictors of health and fertility (e.g., somatic cell score, productive life, daughter pregnancy rate) are available and there is evidence to support some genetic improvement for these traits<sup>1</sup>. However, presumably as a result of genetic antagonisms between production and health traits as well as changes in management practices, data supports increased incidence of many common diseases in contemporary dairy production systems<sup>2,3,4</sup>. Consequently, dairy cows are considered to be less 'robust' than previous generations, which has serious implications for the health and fertility of the modern day dairy cow.<sup>5,6</sup>

Profitable dairy cows are fertile, productive and require minimal extraneous inputs to maintain their health through all phases of production. They generally require fewer veterinary treatments or interventions, without compromising the health, welfare or economic efficiency of the cow, and are less likely to be prematurely culled.<sup>7,8</sup> Genetic improvement programs that incorporate knowledge regarding differences in risk of disease into selection and breeding strategies have the potential to improve profitability of dairy production through improved prevention and control of economically relevant diseases as well as enhanced animal productivity.

**Figure 1: Cow Morbidity by Health Problem.**



Improving health and fitness traits, commonly referred to as functional or wellness traits, through genetic selection presents a compelling opportunity for dairy producers to help manage disease incidence and improve profitability when coupled with sound management practices. To date, direct predictors for wellness traits related to common disease conditions in dairy production have not been readily available in the U.S. CLARIFIDE® Plus represents the first commercially available dairy

genetic evaluation specifically designed for wellness traits in U.S. dairy cattle, providing predictions describing the risk for six common diseases.

Routine dehorning of commercial dairy cattle is also of concern for the industry as it relates to animal well-being and costs associated with routine dehorning methods.<sup>9,10</sup> The selection and breeding of polled stock has been proposed as a strategy for proactively managing these concerns, including use of direct tests for polledness in cattle as well as including the economic benefits within selection indexes.<sup>11</sup> CLARIFIDE Plus includes the Zoetis Polled genomic test prediction in the offering to accurately identify and differentiate homozygous vs. heterozygous polled Holstein animals.

## DEVELOPMENT OF DAIRY WELLNESS PREDICTIONS

Genomic predictions for wellness traits were developed by Zoetis based on an independent database of pedigrees, genotypes and production records assembled from commercial dairies and internal assets. Health events were assembled from on-farm dairy production records provided with consent by commercial dairy producers. Data editing procedures to reduce recorded disease incidence to a common format were developed based on review of event codes in on-farm software and consultation with dairy production and veterinary experts. Targeted phenotypes included:

- Mastitis (MAST)
- Lameness (LAME)
- Metritis (METR)
- Retained placenta (RP)
- Displaced abomasum (DA)
- Ketosis (KET)

All diseases were defined as a Holstein female diagnosed with the respective disease one or more times in a given lactation on the basis of qualifying event codes in on-farm dairy software in the case of commercial data, or clinical research records in the case of internal research assets. As of August 2015, the database used to derive CLARIFIDE Plus predictions incorporated, primarily, large commercial U.S. dairy operations from across the nation and included more than 10 million lactation records; 4 million cases of mastitis; 3 million cases each of metritis, retained fetal membranes, displaced abomasum and lameness; more than 1.9 million cases of ketosis; and more than 15 million pedigree records. Additional records are continuously added to this database on a monthly basis from producer-supplied farm records.

Genomic data was obtained from commercially tested animals with owner consent or available genotypes within Zoetis research databases. More than 100,000 genotypes were available for consideration as of August 2015. Additional commercial genotypes are added on a weekly basis. Genotypes included in the evaluation were derived from both low and medium density genotypes, all imputed to Illumina®

BovineSNP50v2 using an internal imputation reference set and FImpute.<sup>12</sup>

CLARIFIDE Plus predictions are derived from a weekly internal genetic evaluation that employs single-step statistical methods for estimating genomic breeding values. This method for genetic evaluation derives a joint relationship matrix based on pedigree and genomic relationships and provides a unified framework that eliminates several assumptions and parameters, thus enabling more accurate genomic evaluations.<sup>13</sup> Table 1 shows the average reliability of genomic predictions for wellness traits in CLARIFIDE Plus. Among approximately 29,901 Holstein heifers less than 2 years of age within the reference dataset, the average reliability was greater than or equal to 49% for all traits. Notably, as direct predictions for individual wellness traits are not presently available, this represents a substantial increase in reliability from zero. Further, the average reliability of genomic predictions for wellness traits continues to increase as more records are added to the evaluation.

**Table 1:** Reliabilities of Genomic Predictions for Dairy Wellness traits based on a subset of the reference populations of approximately 29,901 Holstein heifers, less than two years of age.

Dairy Wellness Traits	Average Reliability	Standard Deviation	Minimum	Maximum
<b>Mastitis</b>	51	6	19	65
<b>Lameness</b>	50	6	18	65
<b>Metritis</b>	49	6	18	64
<b>Retained Placenta</b>	50	6	18	64
<b>Displaced Abomasum</b>	49	6	18	64
<b>Ketosis</b>	50	6	18	64

**Table 2:** Genomic standardized transmitting abilities (STA) for wellness traits based on a reference population of approximately 76,840 head with wellness trait predictions and CLARIFIDE results.

Dairy Wellness Traits	Average	Standard Deviation	Minimum	Maximum
<b>Mastitis</b>	100	5	76	115
<b>Lameness</b>	100	5	73	115
<b>Metritis</b>	100	5	75	115
<b>Retained Placenta</b>	100	5	71	116
<b>Displaced Abomasum</b>	100	5	69	111
<b>Ketosis</b>	100	5	72	113

### REPORTING OF WELLNESS TRAITS IN CLARIFIDE PLUS

CLARIFIDE® Plus predictions for wellness traits are expressed as genomic standardized transmitting abilities (STA), similar to how type traits are expressed. Values are centered at 100 with a standard deviation of 5. The reference population included 76,840 animals that had wellness predictions and CLARIFIDE results (Table 2). For all wellness trait predictions, a value of 100 represents average expected disease risk and values of greater than 100 reflect animals with lower expected average disease risk relative to herdmates with lower STA values. Higher values are more desirable for all traits, thus selecting for a high STA will apply selection pressure for reduced risk of disease.

CLARIFIDE Plus predictions for the Polled test will be reported as:

- Tested homozygous polled: The genotype demonstrates that the animal is homozygous polled and will always produce a polled animal regardless of the horned status of the other parent. (Coded PP)
- Polled carrier: The genotype reveals a heterozygous polled animal capable of producing a horned progeny. (Coded PC)

- Tested free of polled (i.e., horned): The genotype is consistent with an animal that is horned. (Coded TP)
- Indeterminate: The polled status of the animal cannot be definitively determined. (Coded I)

### TWO NEW DAIRY WELLNESS INDEXES

In addition to reporting of individual wellness traits, CLARIFIDE Plus also reports two economic selection indexes to inform selection decisions. Selection indexes are a critical component of many selection strategies as they provide a path for dairy producers to select for comprehensive genetic improvement across many economically important traits. The use of economic selection indexes helps to ensure that the distribution of selection pressure applied to component traits is appropriately balanced relative to the economic impact of the individual traits on dairy profitability.

To support selection for reduced risk of disease in dairy females, two economic indexes were developed.

- *Wellness Trait Index™ (WT\$™)*. This multi-trait selection index exclusively focuses solely on the wellness traits<sup>1</sup>

(Mastitis, Lameness, Metritis, Retained Placenta, Displaced Abomasum, Ketosis<sup>2</sup> and Polled) and directly estimates potential profit contribution of the wellness trait for an individual animal that will be passed onto the next generation.

- *Dairy Wellness Profit Index™ (DWP\$™)*: This multi-trait selection index includes production, fertility, type, longevity, calving ability, milk quality and the wellness traits, including Polled test results. By combining the wellness traits with those found in the current Net Merit (NM\$) index, DWP\$ directly estimates the potential profit contribution an individual animal will pass along to the next generation.

The economic indexes in CLARIFIDE Plus were derived using standard selection index theory.<sup>14,15</sup> Economic assumptions were derived from those used in NM\$<sup>16</sup> for the case of core traits, and from a review of peer-reviewed literature for wellness traits.<sup>9,10,16-24</sup> Economic values for health traits that are considered in the derivation of NM\$ were removed to avoid double-counting of the contributions of disease to dairy profitability. Economic values were then adjusted within the range of reported values based on the covariance among traits to achieve the final index weights.

To assess the extent to which use of CLARIFIDE Plus wellness trait indexes would alter selection emphasis relative to use of NM\$, the expected response to selection per standard deviation of genetic improvement in the index was estimated.<sup>14</sup> In examining the response of selection between DWP\$ and NM\$, it is clear that use of DWP\$ will result in greater genetic improvement in wellness traits and largely the same selection response for the rest of the traits. There is some decrease in selection

emphasis and expected genetic progress for production traits associated with the use of DWP\$ (Table 3), which is consistent with our understanding of the relationship between increased production and disease risk.<sup>25</sup> However, selection using DWP\$ will increase milk, fat and protein production, just at a slightly lower genetic rate than would be achieved with alternative indexes that do not consider direct selection for wellness traits. Importantly, the use of DWP\$ would be expected to offer very similar selection emphasis to that achieved by NM\$, making it a practical consideration for producers who have historically used NM\$ but would like to apply additional selection emphasis on wellness traits to achieve healthier, more profitable cows.

**Table 3:** Expected response to selection expressed in units of the underlying trait associated with selection using NM\$ and DWP\$ when average NM\$ and DWP\$ are increased by one standard deviation.

Trait	NM\$	DWP\$
<b>MILK</b>	246	200
<b>FAT</b>	16	14
<b>PROT</b>	10	9
<b>PL</b>	1.7	1.7
<b>SCS</b>	-0.06	-0.06
<b>BDC</b>	0.01	-0.02
<b>UDC</b>	0.25	0.21
<b>FLC</b>	0.18	0.16
<b>DPR</b>	0.60	0.69
<b>CA</b>	8.32	8.40
<b>HCR</b>	0.56	0.53
<b>CCR</b>	0.89	0.94
<b>MAST</b>	0.86	2.09
<b>MET</b>	1.64	2.37
<b>RP</b>	-0.01	0.41
<b>DA</b>	1.72	2.05
<b>KET</b>	1.69	2.04
<b>LAME</b>	1.04	2.02

**Table 4:** Traits, Economic and Relative Values for the two Dairy Wellness Trait indexes and the current Net Merit \$ (NM\$)

Trait	Relative Value (%)		
	NM\$	DWP\$™	WT\$™
<b>Mastitis</b>	0	12	41
<b>Lameness</b>	0	8	27
<b>Metritis</b>	0	6	19
<b>RP</b>	0	2	6
<b>DA</b>	0	2	6
<b>Ketosis</b>	0	<1	1
<b>Milk</b>	-1	2	0
<b>Fat</b>	22	17	0
<b>Protein</b>	20	15	0
<b>PL</b>	19	13	0
<b>SCS</b>	-7	-3	0
<b>Body Size</b>	-5	-3	0
<b>Udder</b>	8	5	0
<b>Feet/Legs</b>	3	2	0
<b>DPR</b>	7	5	0
<b>HCR</b>	2	1	0
<b>CCR</b>	1	1	0
<b>CA\$</b>	5	3	0

Table 4 defines the relative values for component traits in each of the two wellness indexes. All indexes are expressed in a dollar value with higher positive numbers indicating the animal has the genetic potential to generate and transmit more profit over her lifetime.

## SUMMARY

Dairy producers have enjoyed the availability of a comprehensive list of economically relevant traits and a robust genetic evaluation system to fuel their genetic improvement strategies. To date, a gap has existed in the ability to improve dairy profitability and dairy cow well-being through direct genetic selection for susceptibility to common diseases. CLARIFIDE® Plus provides accurate genetic predictions for wellness traits derived using cutting-edge genetic evaluation methodology applied to data collected from commercial production settings. The result is an expanded suite of genetic selection tools that provides highly relevant information to dairy producers that seek to continue to improve the health, productivity and profitability of the dairy cattle they care for.

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