GENETIC EVALUATION FOR COW LIVABILIITY

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When genetic evaluations for **Productive Life** (**PL**) were introduced by USDA's Animal Improvement Programs Laboratory in 1994, U.S. dairy producers were handed an extraordinary opportunity to produce healthier cows. The good news is, it actually happened; when **Predicted Transmitting Abilities** (**PTA**) for Productive Life were incorporated into selection programs, the deterioration occurring in pregnancy rate for five decades (16 percentage points[1]) was soon reversed. In addition, genetic increases that were occurring in **somatic cell score** (**SCS**) that were revealed when PTA for SCS was initiated also were reversed and udder health improved as well. Now another genetic evaluation will be provided in August 2016 so producers will have a new tool to help even more. The new evaluation is **PTA for Cow Livability** (**PTA** $_{\text{C.LIV}}$) which predicts *cow's transmitting ability to remain alive* while in the milking herd. In contrast, PTA for Productive Life (**PL**) predicts transmitting ability for *how long a cow is expected to remain in the milking herd before dying or being culled*. Livability is just one of the several traits that determines Productive Life, yet one with a high economic influence that to date had not been accounted for adequately.

Populating US dairy herds with cows capable of longer productive life gave producers more opportunity for voluntary culling as they needed to dispose of fewer animals for health or management reasons. When a cow is sold for dairy or beef (voluntary or involuntary culling), the sale income is returned to the owner. In contrast, if a cow dies, or is euthanized as a consequence of 'downer cow syndrome', there is total loss of income. Just knowing which cows are likely to remain in the herd the longest is not the entire story. Instead, additional benefit comes from knowing which cows are likely to provide income at disposal. Because cow mortality rate averages 7% each lactation, death claims 20% of the U.S. cows while in the milking herd[2]. Conversely, 80% of cows remain alive permitting the producer to recoup their disposal income when they exit the herd. The lost 'disposal income' from current U.S.

cows that will die is about $2.2 billion (20% × 9.2 U.S. million cows x $1200/cow) or $800 million per year.

Fortunately, in spite of the fact the heritability of mortality is low at 1.3%[3], accuracy of PTA for Cow Livability is quite high as termination codes have been recorded in DHIA for decades. Over 92 million lactation records for 32 million cows have termination codes in the national database. As a result, genomic predictions having high accuracy can be derived for AI bulls for the new trait. Even the Reliability for young genomic tested bulls without daughters averaged 56%. Correlations between PTA for Cow Livability and PTAs for other traits have been calculated and vary considerably. For bulls having Reliability of 80% or higher, the correlation was 0.70 with Productive Life, 0.45 with Daughter Pregnancy Rate, but was rather low with the milk traits.

Cow Livability is defined such that *if the cow died this lactation, the trait was* set to 0%; *if the cow lived through this lactation, it was* set to 100%. To place it on a lifetime scale, the results are multiplied by 2.8 since average lactations per cow is 2.8. The table below show the average PTAs of animals that fall into the quintiles for Lifetime Net Merit $.

Table 1. Average PTAs of AI Holstein bulls with birthdates since January 1, 2000 for a number of traits[4] grouped by percentiles for Lifetime Net Merit Dollars (NM$).

Percentile	NM$	PTA_{Milk}	PTA_{Fat}	PTA_{Prot}	PTA_{DPR}	PTA_{SCS}	PTA_{PL}	$PTA_{C.LIV}$
80 to 99	+588	+1043	+52	+38	+1.3	2.2	+5.6	+2.1
60 to 79	+423	+944	+34	+30	+.9	2.2	+3.8	+1.4
40 to 59	+310	+612	+25	+22	+.4	2.2	+2.6	+.9
20 to 39	+197	+432	+18	+16	0	2.3	+1.4	+.2
0 to 19	-53	-164	-2	-2	-.8	2.4	-.8	-1.1

[4] PTA=Predicted Transmitting Ability, Prot=Protein, DPR=Daughter Pregnancy Rate, SCS=Somatic Cell Score, PL=Productive Life, C.LIV=Cow Livability

The top quintile of bulls for Net Merit Dollars had $PTA_{C.LIV}$ that averaged +2.1% while the bulls in the lowest quintile averaged -1.1%. This indicates the top quintile bulls will have about 3.2% more

daughters that will not die during their milking life than will the lowest quintile bulls. Because the average of cow remaining alive throughout their entire milking life is 80%, a bull that is +2.1 is expected to have 82.1% of his daughters that remain alive while a bull from the lowest quintile is expected to average 78.9% (breed average of 80.0 - 1.1 = 78.9% that remain alive). This 3.2% difference in a 244 cow herd (the average DHIA herd size) would produce $9,400 in additional income.

Eventually the PTA for Cow Livability will be incorporated into all 4 *lifetime merit indexes*, but this will be completed after users become more familiar with the new trait. When this happens, the weight given to Productive Life is expected to decline from about 19 to 14%, and the emphasis assigned to Cow Livability will be near 7%. Thus, the total emphasis of cow longevity would increase to 21%. Having Cow Livability is one more step toward adding value to the genetic information that will improve dairy producers' profitability. Producers participating in DHIA can help to improve the reliability of this trait by accurately reporting the reasons why cows leave their herds.

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[1] Council of Dairy Cattle Breeding. 2016. Trend in Daughter Pregnancy Rate for Holstein or Red & White Calculated April 2016. Accessed June 1, 2016. https://www.cdcb.us/eval/summary/trend.cfm

[2] Norman, H.D., L. M. Walton, and João Dürr. Reasons that cows in Dairy Herd Improvement programs exit the milking herd (2014). CDCD Res. Rpt. (16-02). 2016. *(Popular Publication)*

[3] Miller, R.H., M.T. Kuhn, H.D. Norman, and J.R. Wright. Death losses for lactating cows in herds enrolled in Dairy Herd Improvement test plans. J. Dairy Sci. 91(9):3710-3715. 2008.