



## HCD: Haplotype associated with Cholesterol Deficiency

Earlier this summer, Canadian Dairy Network (CDN) announced the discovery of a new genetic anomaly in the Holstein breed (see "*Discovering Genetic Anomalies from Genotyping*", July 2015 at [www.cdn.ca](http://www.cdn.ca)). Recently, researchers in Europe were successful in identifying the causative gene underlying this genetically recessive anomaly and a gene test is expected to become available. Since August, CDN has been providing carrier probabilities for the Haplotype associated with Cholesterol Deficiency, referred to as HCD. The discovery of the gene for HCD provides an excellent opportunity to take a closer look with updated information.

### What is HCD?

The main visible characteristics of calves affected by HCD include illness, usually chronic diarrhea that does not respond to medical treatment, which translates into poor growth, weight loss and early mortality normally before six months of age. Researchers found that affected calves had extremely low levels of blood cholesterol, which prohibits the normal deposition of fat body tissues. In terms of genetic inheritance, only calves that have inherited the undesirable HCD gene from both parents (i.e.: homozygous) will be affected. The oldest known source of this gene is Maughlin Storm (HOCANM5457798) so affected calves must have this well known sire as an ancestor on both sides of their pedigree.

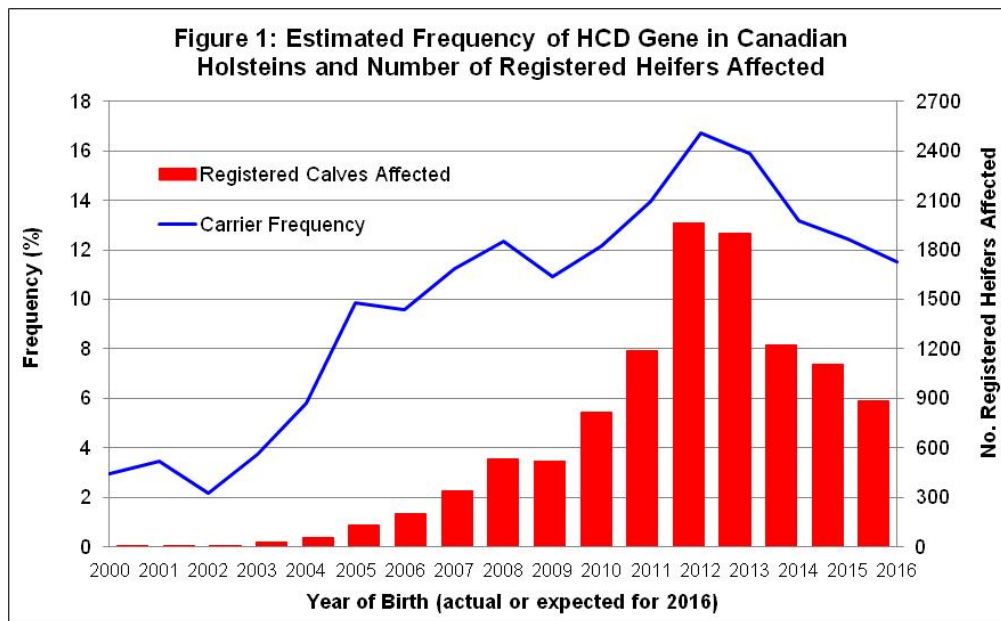
### Methodology Improvements for HCD Analysis

Since the discovery of this genetic anomaly, CDN implemented procedures for identifying genotyped animals that are "Carriers" versus those that are "Free" and then publishes an HCD Carrier Probability of 99% versus 1%, respectively. For various reasons, some genotyped animals cannot be clearly allocated to either of these groups so CDN calculates a Carrier Probability between 1% and 99% for them. A similar calculation of HCD Carrier Probability values is also done for all non-genotyped animals in the CDN database based on the probabilities for its parents and close relatives.

Since the initial publication of HCD Carrier Probability values in August, CDN has significantly improved the associated calculations. One major advancement was the determination of HCD status as "Carrier" versus "Free" for progeny of Dudoc Mr Burns, who carries the genetic anomaly, but the usual analysis of haplotypes for HCD could not categorize his progeny. The new discovery of a gene test is an important step forward when identifying the HCD status for progeny of animals like Mr Burns. The gene test will also be an improvement for animals that have been genotyped with a low density panel instead of a panel with 50,000 SNPs or more and for animals with parents that are not genotyped.

### Frequency in Canadian Holsteins

CDN recently used insemination data to conduct a more thorough analysis for estimating the frequency of HCD Carriers in the Canadian Holstein population as well as the number of registered heifers born in Canada that were likely affected by HCD and died early in life (Figure 1). This analysis confirmed the earlier result that the frequency of Carriers in the Canadian Holstein breed peaked at nearly 17% for heifers born in 2012 but this is predicted to be lower than 12% for heifers born in 2016. Carrier animals are not directly a problem in the population but if they are mated to another carrier animal, then 25% of resulting calves would be affected. In terms of the number of registered Holstein heifers born in Canada that were likely affected by HCD and suffered early mortality, CDN estimates a total approaching 2,000 for heifers born in 2012 but less than 900 are expected to be born in 2016.



### Finding HCD Results

The CDN web site is the ideal place to look for results associated with the HCD status for any animal. Once you use any search tool to find a specific animal, you can click on the link to the "Pedigree" page to access the HCD Carrier Probability values for the animal as well as its parents and grandparents. Storm is shown below as an example of an animal with an HCD Carrier Status of 99%. Some animals may have a single (\*) or double asterisk (\*\*) next to the carrier probability value. Those with a double asterisk are expected to be affected animals that die before 6-8 months of age, whereas those with a single asterisk have only a possible chance to be affected.

**MAUGHLIN STORM** [GenoTest Form](#) [Breed Association](#)

Summary Genomics Prod. Type Functional Mastitis Calving Progeny **Pedigree** Inbreeding

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**Pedigree Tree**

**HOCANM5457798**      **MAUGHLIN STORM**      **STORM**

ET BW CVF BRC BLF  
 0073HO02012      HH: 1%, 1%, 1%, 1%, 1%      Born 26-AUG-91      1.35%INB      17%R  
HCD: 99%

For bulls, the Group Query tool allows you to list bulls that are known to be Free for HCD (Probability = 1%) versus those that are Carriers (Probability = 99%) or possible Carriers (Probability of 2% to 98%). This can be done separately from genomic young bulls and proven sires.

### Managing the Impact of HCD

For all inseminations performed in 2015, 90% were conducted using semen from bulls that are known to be Free of the HCD gene. This means that only 10% of all matings in Canada during 2015 involved a sire that is either a known or a possible carrier of HCD. In fact, following the December 2015 genetic evaluation release, there are only five of the Top 100 LPI proven sires that are HCD Carriers and this count drops to only three among the Top 100 proven sires by Pro\$. Among the Top 100 genomic young bulls marketed in Canada only a couple are HCD Carriers. This situation among sires available for A.I. significantly reduces the possibility of producing calves that would be affected by HCD. Computerized mating programs offered by

some A.I. companies consider the HCD Carrier Probabilities to avoid matings that risk producing an affected calf. To determine the chance that a mating could produce a calf affected by HCD, you can multiply the Carrier Probability of the sire by the value for the dam and then divide by 400. For example, a known carrier sire with a value of 99% mated to a cow with HCD 50% displayed on the CDN web site leads to a probability slightly higher than 12% (i.e.: [99x50]/400) that a resulting calf will die from HCD. In the near future the CDN web site services are expected to be expanded to allow producers to assess matings based on the risk of producing pregnancies and/or progeny affected by HCD or other haplotypes and genetic anomalies.

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## MAUGHLIN STORM

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### Arbre généalogique

HOCANM5457798

MAUGHLIN STORM 

STORM

0073HO02012

ET BW CVF BRC BLF

HH: 1%, 1%, 1%, 1%, 1%

Né le 26-AOÛ-91 1,35%CON 17%P

HCD: 99%