A brief, recent history of bovine superovulation and pregnancy data in North America

John F. Hasler, Vetoquinol USA, Inc.

Superovulation data:

Superovulation of cattle in North America (NA) has been practiced commercially for over 40 years. The gonadotrophins that are available commercially have changed with time, some are no longer in production and currently only Folltropin is licensed for use in cattle. In spite of this, the number of embryos produced per flush, be they either transferrable or freezable, has actually changed very little over the last 40 years. However, there have been improvements in the protocols, and in the reliability of obtaining successful flushes. Originally, donors were started within a day or two, plus or minus of mid-cycle following a natural estrus or a prostaglandin induced estrus. This system worked quite well and continues to be used, especially in management systems where behavior estrus or heat can be observed. However, the availability of intravaginal progesterone devices and the development of protocols using either estrogens or GnRH has made it possible to greatly expand the flexibility of superovulation protocols. Donors can be superovulated in groups, with no need to consider the stage of the cycle for individual animals. As estrus does not need to be observed, this greatly reduces the labor component of the program. Also, it has been widely accepted that donors can be repeatedly superovulated on a shortened between flush interval, on them order of every 30 to 35 days. For many years, it was considered necessary to allow donors to go through two heats between superovulations, a process that usually took about 60 days. The shortened inter-flush intervals now employed have led to the production of more embryos per unit time, but not more per flush.

Seidel, et al., 1978, reported a mean of 6.7 transferrable embryos from 24 cows in Colorado superovulated with the original Armour FSH-LH in and in 1980, Schneider, et al. reported a mean of 6.0 embryos from 519 beef cows superovulated with Burns-Biotec FSH-P (a continuation of the original Armour brand). Some large commercial data sets were reported in the 1980s, including Looney, 1986, 6.4 embryos from almost 1,300 Brangus cows, 6.5 embryos from 141 Simmental cows and Hasler, et al., 1983, 6.4 embryos from more than 600 different, individual Holstein cows. In the ensuing years, many more commercial data sets were published or presented at conferences, with similar with similar mean embryos numbers. In addition, a number of academic studies were published, but the data were often based on small sample sizes and, of course, the conditions of cattle maintenance and the efficiency of embryo recovery do not always reflect commercial conditions in the field. Lastly, a very impressive data set on mean embryo numbers involving more than 8,000 flushes over a 20 year period from 1987 through 2006 was made available to this author. Involving only cattle in the Canadian province of Quebec, the mean number of embryos on a yearly basis ranged from 6.1 to 7.0.

The commercial associations representing the USA (AETA) and Canada (CETA) collect ET data yearly from members. Data for a recent six year period for the two countries is shown in Table 1. It is clear that the mean number of embryos has not changed much from the numbers reported in the 1980s. One feature of superovulation that is often overlooked, is that the mean does not reflect the huge range of responses observed in cattle. Most experienced ET practitioners have occasionally recovered 40, 50 and even 60 or more embryos from a flush. On the other extreme, depending on the cattle breed and management, 10 to as many as 20% of superovulated cattle fail to produce a single good embryo when flushed. In his 1986 paper on beef cows in Texas, Looney reported that for 2,048 collections yielding a mean of 6.2 embryos, 64% of the collections were below the mean and only 36% above the mean.

Embryo transfer data:

In NA, for more than 20 years approximately 60% of dairy cow embryos have been frozen following collection and 80% of beef embryos. Data are then generated for pregnancy results following the transfer of both fresh and frozen-thawed embryos. Another factor that changed during the evolution of the commercial ET industry is that non-surgical (NS) transfers replaced surgical methods over a period of years. Some practitioners adopted the NS approach around 1980, but it was not until about 1980 that the NS approach was widely accepted and adopted. Commercial charges for ET originally were most often based on the confirmation of pregnancy at 60 or more days following ET.

Table 1. The largest and smallest numbers of donors flushed following superovulation and mean numbers of embryos collected from beef and dairy cows in the US and Canada between 2010 and 2015.

	USA				Canada			
	Beef		Dairy		Beef		Dairy	
Years 2010 - 2015	No. Donors*	Mean no. Embryos*	No. Donors	Mean no. Embryos	No. Donors	Mean no. Embryos	No. Donors	Mean no. Embryos
Smallest no.	22,700	6.8	10,300	6.0	2,000	6.8	7,800	6.6
Largest no.	29,800	7.2	15,500	6.3	2,400	7.9	10,900	7.3

**To the nearest 100; **To the nearest 0.1*

However, this has gradually changed to the wide-spread policy of charging a fee for the embryo transfer and not for a successful pregnancy. This has resulted in significant lack of data in the NA industry because many farmers do not report detailed pregnancy results back to the ET practitioner. As a result, the AETA ceased collecting pregnancy data some years ago, wheras the CETA still collects it as shown in Table 2..

Table 2 Pregnancy data for fresh embryo transfers in selected years provided by members of the AETA and CETA.

Year & Country	No. Transfers	% Pregnant
2000 - USA	75,600	62.3
2002 - “	59,700	62.7*
1999 - Canada	19,400	59.2
2000 - “	23,600	62.1
2008 - “	12,100	59.7
2013 - “	12,300	58.3

*includes a mean of 59.5% in the North East USA and 68.4% in the North West USA.

It is clear from the data above that overall pregnancy rates reported in both the US and Canada did not vary appreciably during the years reported. Pregnancy rates did vary within different areas of the US, with the North West reporting higher pregnancy rates than the North East. This was also evident in the work conducted by this author when comparing pregnancy rates in Holstein heifers in California, where pregnancy rates on some dairies were routinely above 80%, which was higher than what was obtained on the majority of farms in the NE US.A brief assembly of publications presenting data on pregnancies following ET with fresh frozen embryos in various regions of NA over more than 30 years is contained in Table 3.

Table 3. Pregnancy data from published studies for individual commercial ET programs in North America

Reference	Breed & Parity	Location	No. transfers	% Pregnant	Embryos
Hasler, et al., 1980	Beef cows	Colorado	516 Surg. – mid. ventral	51.0	fresh
Wright, 1981	Beef cows and heifers	Texas	2,200 NS	59.0	fresh
Etherton, et al., 1986	Dairy heifers	Ontario, Canada	38 Surg. - flank	77.1	fresh
Hasler, et al., 1987	Dairy heifers	Pennsylvania	7,700 Surg. - flank	71.3	fresh
Coleman, et al., 1987	Dairy heifers	Ohio	1,200 Surg. - flank	74.6	fresh
Putney, et al., 1988	Beef cows and heifers	Texas	18,500 NS	55.4	fresh
Leibo, et al., 1998	Dairy " Beef "	USA " " "	5,500 3,300 3,200 5,900	60.3 59.3 54.5 54.2	Frozen - EG " - Gly " - EG " - Gly
Hasler, 2001	Dairy heifers Dairy heifers	California	1,500 (Surg. – flank) 500 NS	79.9 78.8	Fresh "
Hasler, 2001	Dairy heifers " " Dairy cows " " Beef cows " "	California & Pennsylvania (combined)	6,600 4,000 800 500 1,600 1,300	68.5 58.8 52.8 47.1 67.3 57.2	Fresh Frozen - Gly Fresh Frozen - Gly Fresh Frozen - Gly
Looney, et al., 2004	European beef Brahman beef	Texas	455 270	63.5 43.7	Frozen* " *combined EG and Gly

The data in the preceding table represent only a very small sample of what has been published regarding pregnancy rates over the past 40 years. The data were selected with the goal of illustrating the range of pregnancy rates in different parts of NA, beef versus dairy breeds and frozen versus fresh embryos. Obviously, it is beyond the scope of this presentation to delve into all the factors that potentially affect pregnancy rates of transferred embryos. Some of the most obvious include virtually everything that involves the embryos, including age, stage, quality, handling medium, and embryo breed. In addition, practitioner skill is an important variable. All the factors that go into recipient management, plus climate, season, recipient breed and parity are also key factors. Lastly, caution must be observed when comparing fresh versus frozen embryo pregnancy rates in commercial operations. In many cases, the best quality embryos are frozen while the lower quality embryos are transferred fresh. This often makes good economic sense. However, the resulting pregnancy rates often do not reflect the actual differences were frozen versus fresh embryos of equal quality compared. It is the author's opinion that when everything else, including recipients, embryo quality and environmental factors are equal, fresh embryos result in a 5 to 10 percentage point higher pregnancy rate compared to frozen embryos.