David Letterman’s top ten reasons for dairy cow infertility

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Introduction
Numerous factors contribute to the failure of cows to become pregnant. This paper, which is based on scientific studies and observations from more than 40 years of conducting pregnancy examinations for herd managers, categorizes common factors that lead to infertility in cows. Following is a ranking of these factors in ascending order—a “Top 10” listing, à la David Letterman, but with elucidation backed by scientific references.

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Reasons for infertility

10. Early embryonic death (EED). One paper\(^1\) reports that 88% of cows contain a fertilized ovum five days after breeding at estrus. However, only approximately 30% of the cows will be diagnosed pregnant at 42-45 days, when the embryo is implanted in the uterus. Many experts calculate the conception rate as the number of cows pregnant divided by the total number of cows serviced. As reproductive science has evolved, newer strategies suggest that a host of other reasons, besides failure to conceive, contribute to infertility. Some of these reasons\(^2\) include:

- Endometritis, which creates a hostile uterine environment. This issue will be addressed later in this paper.
- Endometrial fibrosis, which creates an environment that will not nourish the embryo prior to implantation.
- Prostaglandin injections that are inadvertently administered to a previously-bred cow.
- Genetic incompatibility between gametes, causing a failure of the embryo to develop.\(^1\)
- Nutritional deficiencies, such as vitamin E/selenium or copper, which occasionally result in herd-wide EED.
- Nutritional excesses, such as high dietary degradable intake protein (DIP), can also be embryocidal.\(^3,4,5\)
- Toxicity from several mycotoxins, including zeralanone, dioxynivenol (DON), ergotamine and aflatoxins, frequently cause EED, in combination with other factors.
- Environmental stress of high temperatures may cause significant EED.

Minimizing the above issues increases fertility.

9. Body condition scores of 2.0 or less on a 1.0-5.0 scale significantly delays the return to normal ovarian cyclicity and causes severe infertility.\(^6\) Management procedures that minimize weight loss at calving contribute to improved pregnancy rates.

8. Inappropriate close-up dry cow rations prior to calving often create severe metabolic diseases at calving.\(^7\)

- A dietary cation-anion difference (DCAD) in excess of +10 causes close-up dry cows to develop:
  - Subclinical or clinical hypocalcemia at calving
  - Retained fetal membranes
  - Delayed involution
  - Endometritis
  - Suppressed immune response
  - Delayed returns to ovarian cyclicity
  - Lower conception rate

- Dietary energy above 1.3 MegCal/kg. fuels appetite suppression. In this condition cows are prone to:
  - Highly mobilized non-esterfied fatty acids (NEFA)
  - Rapid weight loss, which delays return to ovarian cyclicity
  - Displaced abomasum, which is another contributor to excessive weight loss

No dietary factor has a greater positive impact on dairy cow fertility than implementation of an appropriate transitional dry cow program that utilizes a palatable, well-formulated low-DCAD, low-energy/high-fiber diet.

7. Mastitis. It has been reported that cows that have at least one high somatic cell count (SCC) score prior to conception will require 48.7% more time and 0.49 more services to achieve a pregnancy.\(^8\) The odds of a
pregnancy decreased by 44% with a high SCC linear score prior to breeding. Cows with a high SCC during the first 90 days of gestation had a 1.22 increased risk of abortion over cows with a low linear SCC. Mastitis prevention plays a significantly positive role in improving pregnancy rates.

6. Low heat detection rate. Ferguson, et. al. reported that most herds had a heat detection rate of less than 50%. Several reports demonstrate that low heat detection rates can be alleviated by timed AI programs.

5. Endometritis. Cows with endometritis not only have a hostile uterine environment but a series of biological events that affect every aspect of cow fertility. The primary organisms causing endometritis in dairy cows are *E. coli*, *Arcanobacter pyogenes*, *Prevotella sp.*, *Fusobacteriaum necrophorum* and *Fusobacterium nucleatum*. *E. coli* occurs by day 7 after parturition, producing lipopolysaccharides (LPS) and causing serious consequences. The LPS converts prostaglandin (PG) $F_2\alpha$ to PGE by a phospholipase A2-mediated mechanism. Lipopolysaccharides stimulate the cow’s immune response, because toll-like receptors attach to the LPS secreted by the *E. coli*. Toll-like receptors flood the uterine environment with cytokines, chemokines, opsonins, antimicrobial peptides and anti-inflammatory proteins such as *a*-glycoprotein and haptoglobin. The LPS negatively affects the aromatase cascade, which is a key link in expressing estradiol from androgens. Not only does LPS have a luteotropic effect through conversion of PGF$\_2\alpha$ to PGE, lower production of estradiol causes dominant follicles to be smaller and less likely to ovulate because of the interruption of ovary and pituitary interactions. Cows with reduced peripheral estradiol levels also tend to exhibit fewer signs of estrus.

The most severe bacterial effects on the uterus are caused by *Arcanobacter pyogenes*. It expresses a virulence gene, which produces a cytotoxin called pyolysin. Pyolysin kills endometrial, endothelial and stromal cells, thus enhancing uterine disease. If a cow with uterine disease ovulates, its level of plasma progesterone is lower than that of a normal healthy cow’s.

Bovine herpes virus IV is also associated with uterine disease. It appears that latent infections may be a prominent feature of this virus. No one will likely determine the prevalence of herpes IV in dairy cows until a vaccine is developed to prevent it.

For cows with endometritis, conception rates can be improved by using a protective sheath on the Cassou gun at a second AI service. However, a protective sheath makes little difference in conception at first service.

4. Sub-acute rumen acidosis (SARA). The mechanism is not well understood, but herds with SARA have lower pregnancy rates. One may deduce the indirect effect that SARA can have on reproductive efficiency by way of lameness and abscesses. However, many veterinarians, including myself, believe that SARA has a direct negative effect on reproduction. Research to address this is needed; there is little definitive information in the scientific literature. Rumen acidosis is diagnosed by using the Penn State Particle Separator Box, ruminocentesis, observations of clinical signs, and butterfat tests. It is often noted that incidence of lameness is more common with displaced abomasums. Addressing dietary issues related to rumen acidosis often improves pregnancy rates and many other production-related problems.

3. Reproduction management implementation. Timed artificial insemination, known as Ovsynch, is the most effective method for reproductive improvement through the synchrony of placing semen in the uterus just prior to ovulation. This has resolved much of the issue of low heat detection efficiency.

The following real-life narrative describes quite well the importance of Ovsynch implementation:

The manager of a 1,000-cow herd had been highly effective in maintaining a high pregnancy rate. However, from one weekly visit for pregnancy examinations to the next, the number of cows diagnosed pregnant decreased by two-thirds. Little in the way of explanation was discovered through an extensive diagnostic investigation that included tests for BVD, leptospirosis serology, urine examinations, review of ration formulations, bulk tank milk urea nitrogen tests and semen integrity. Coincidentally, the employee who had been managing the herd’s timed insemination program had recently left for another place of employment. The herd manager took on the responsibilities of administering the GnRH and PGF$\_2\alpha$ injections. He immediately discovered that the automatic
syringe used to give the PGF₂α injections was cracked, causing most of the PGF₂α to spray out the side of the syringe barrel onto the ground. Once the automatic syringe was repaired, the pregnancy rate returned to the expected level.

2. Persistent infections from bovine virus diarrhea (BVD). Much has been written about persistently infected BVD (PI-BVD) animals in scientific literature and the lay press, but there has not been adequate dissemination of information about cows developing ovariitis and chronic oophoritis from BVD virus. This is frequently overlooked. Yet, in my experience, it is a big player in infertility in herds with active BVD or a PI-BVD animal. There is no treatment for ovariitis other than a) implementing rigid biosecurity and b) giving the client an informed prognosis that it may be six months after BVD has been eradicated from a herd before optimum fertility returns.

1. Probability. By virtue of probability, about half of all coins flipped will land heads, the rest tails. Continued flips of coins that initially came up tails will again result in about half landing heads up. Probability works much the same with cow pregnancies.

Pregnancy rates are a far better measure of cow fertility than conception rate, bull stud non-return rates or percent cows open. While more sophisticated formulas are used to calculate an overall herd pregnancy rate via various software programs, in its simplest form, the pregnancy rate can be calculated as the Heat Detection Rate X Conception Rate.

Conclusion

Even though the preceding factors are ranked in reverse order of importance, any of them, alone or in combination, can cause significant harm to the reproductive program of a dairy herd.

References
