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Dairy theriogenology: Practitioner, professor and producer perspectives☆

1. Introduction

It is indeed a high honor to receive the Bartlett Award and to address this joint meeting of the Society for Theriogenology (SFT) and the American College of Theriogenologists (ACT). My duties at the University of Minnesota and the University of Illinois, in addition to serving as President and Secretary of the ACT, allowed me to become acquainted and work with some of the true founders of theriogenology. What a wonderful experience! How could I ever thank Dr. Steven Roberts for authoring a textbook [1] that was so complete and meaningful? It was my primary source of detailed information for much of my graduate work. Then, I had the honor of serving with Dr. Roberts and others for many years on examination committees for both practitioners and ACT Diplomates.

My career has really been three careers in one lifetime. I was in dairy practice for 10 years. Next I was in graduate school, followed by teaching and research in theriogenology for 22 years. My third career was as majority partner and manager of dairy (1850 cows) for 9 years. Each career was rewarding and each one seemed better than the previous. In this article, I will share my career experiences in theriogenology and give my perspectives for the future of this discipline.

2. Personal background

Most of my background involved working with Holstein dairy cattle. I grew up on a family dairy farm in northwest Wisconsin. I worked for 1 year on the farm after high school, and then enrolled in a pre-veterinary college program at River Falls, WI, USA in the fall of 1954. Wisconsin did not have a veterinary school at that time, so students usually applied to the University of Minnesota. I still remember that they had 448 applications, but could only accept 48 students. I was notified that I was number 4 on the waiting list, then 3, then 2, and then 1, but still not accepted. I was extremely fortunate to be accepted at Oklahoma State University, so I enrolled there in the fall of 1956.

Following graduation, I returned to my hometown in Wisconsin and purchased a dairy practice. This was my dream and I fully expected to spend my entire life there. However, during the first month of practice, I knew I was in serious trouble. Most clients asked me to conduct examinations to diagnose pregnancy or determine the cause of infertility. My theriogenology training had consisted of one three-credit lecture course in Obstetrics and Gynecology. However, the University of Minnesota had developed a new and extensive Theriogenology Section, which included numerous reproductive laboratory sessions, frequent trips to abbatoirs to practice transrectal palpation, and routine transrectal palpation in many private dairy herds. Minnesota graduates were in practice all around me; although they routinely diagnosed pregnancy at 30–35 d, I had to struggle to locate both ovaries and diagnose much more advanced pregnancies. Fortunately, Dr. Elmer Woelffer (winner of the 1986 Bartlett Award) presented a workshop at our summer meeting and showed us many reproductive tracts in early stages of pregnancy. This experience allowed me to return home and survive. Three years later, my skills were nearly as good as those of the average Minnesota graduate.

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I remained in this practice for 10 years. Although the AI industry was capturing most of the dairy cow market, dairymen were struggling to make AI work. A very common request was for intrauterine antibiotic infusions of repeat-breeder cows; dairymen that had poor results with AI were convinced that it was due to low-grade uterine infections. Furthermore, although they thought natural service would make the situation worse, in most cases the introduction of a bull resulted in cows rapidly becoming pregnant.

Another common call was ''I have several cows that I cannot catch in heat''. Examination often revealed normal cycling cows. Prostaglandins were not yet available, but veterinarians soon learned that careful examination of the CL would sometimes lead to fairly easy enucleation, which resulted in estrus a few days later. The risks involved with this dangerous procedure are well known.

It seemed that half of my practice involved reproduction. I became interested in advanced training in dairy reproduction and began to explore my options. I started with the Veterinary Science Department at the University of Wisconsin-Madison, where I met Dr. O.J. Ginther. He informed me that the majority of research funds for graduate programs in Physiology of Reproduction were in the Dairy and Animal Science Departments. Dr. Ginther suggested I visit Dr. L.E. Casida, who was looking for a veterinarian as a graduate student for a long-term project to study ''The effects of early postpartum breeding verses later postpartum breeding in dairy cows''. I was accepted and thus began the second phase of my career. It was a remarkable opportunity to be jointly mentored by these two outstanding scientists.

I would be remiss if I did not comment on Dr. Casida's legacy; he spent his entire 40 years career at the University of Wisconsin, conducting research and training graduate students. While I was there, he had nine full-time graduate students and several postdoctoral students. He always seemed to have adequate research funds to support both graduate students and research. He was tough on all graduate students and even tougher on veterinary graduate students. I was graduate student number 96 of a total of 99. We were assigned 1 h each week to give him our progress report. Right behind his desk, were over 90 theses from his graduate students. It was an intimidating scenario for each week's meeting; you knew who the master was, and you knew you were another young graduate student that must be molded and mentored.

Dr. Casida trained many of the prominent reproductive physiologists in the USA. His research resulted in numerous major discoveries in bovine reproduction. The following are three of his most noteworthy findings.

(1) He developed the first effective treatment (pituitary extract) for cystic ovaries in dairy cattle [2]; the work was published in 1944. Dr. Casida collected pituitaries from abbatoir-derived heads and actually used a trocar to force the mixture under the skin.
(2) He was the first to show that progesterone delayed and prevented ovulation in several species. Later, these findings were studied in humans, leading to the development of the birth control pill. These scientists rightfully credited Dr. Casida's earlier research in animals as the pioneer work leading to this major discovery.
(3) He was first to show that removal of the uterine horn ipsilateral to the CL would prolong its lifespan. This was repeated many times in cattle and sheep, demonstrating the local relationship between the uterus and the ovary. Endometrial extracts were studied, leading to the eventual discovery of prostaglandins.

Dr. Casida probably had the largest reproductive research program at any major university in the USA. However, currently nearly all universities have several departments with faculty that have a PhD in reproductive physiology. I speculate that the total number of PhD reproductive physiologists involved in research in the USA ranges from 300 to 400, whereas the total for all veterinary schools in the USA might be 75–100. Furthermore, it is noteworthy that there are other departments at universities that are conducting research and contributing to the discipline of theriogenology.

Following completion of graduate school in 1973, I worked 1 year at the Wisconsin Veterinary Diagnostic laboratory. My primary job was investigating infertility and abortion problems in Wisconsin herds. I convinced my director to allow me to organize and teach a 2-d workshop on reproduction for dairy practitioners. This included palpation and examination of abbatoir-derived tracts. This was well accepted by practitioners and was subsequently repeated on many occasions.

Next, I joined the theriogenology faculty at the University of Minnesota, enabling me to work with Ray Zemjanis, Edward Mather, Borje Gustafsson, Brad Seguin, Robert Wescott, Louis Archbald, Shirley Johnston, and many outstanding graduate students. We moved into new facilities and had a fully funded research program. It was truly a great time in my life and I was fortunate to be associated with such an excellent Department of Theriogenology.

In 1980, I moved to the University of Illinois. My appointment was head of the Food Animal Section. I taught a dairy herd health management course for 10

years. We brought in specialists to teach major subjects (e.g. nutrition and mastitis). The take-home message was always *herd health management* and *profit for clients*. Most of my graduate students were in theriogenology, but I also had two in mastitis and one in nutrition.

Following early retirement (1991) from the University of Illinois, I ventured into another area of teaching. This was the period of time when ''Production Medicine'' became the new buzzword. Production medicine programs were started at many veterinary schools; the intent was to bring together all major aspects of dairy herd health (theriogenology, nutrition, mastitis, calf and heifer programs, cow comfort, lameness problems, etc.), with special emphasis on computer management of data and profit for clients.

Dairy veterinarians from other countries became interested in production medicine. They viewed it as an opportunity to become better practitioners and perhaps full-time dairy consultants. My wife, Shirley, and I soon became busy organizing 1 week courses on ''Production Medicine'' for Japanese veterinarians. We also worked with dairy practitioners in Wisconsin and California to host Japanese veterinarians for 2–3 d of private dairy practice experience in the USA. This program with Japan was very successful and was repeated many times over the last 15 years. We also organized several smaller seminars for veterinarians from Brazil and India.

In 1998, I also began writing a monthly ''Production Medicine Newsletter'', sponsored by a Japanese veterinary pharmaceutical company (Kyoritsu Seiyaku Corporation, Tokyo, Japan). It is translated and distributed to all dairy veterinarians in Japan. This year marks the 10th anniversary. Dr. Chester Rawson and I have recently started sharing these duties.

This was also the time period (1995) when a few large dairy herds were starting to appear in the upper Midwest. The key feature appeared to be construction of large, free-stall curtain barns, with chimney-type natural ventilation. Manure could be stored in large lagoons for 1 year. This was the start of a major dairy revolution for cold-weather states in the northern USA.

A former theriogenology graduate student from Minnesota (Dr. Farhad Vahdat) had been managing large dairies in California. Dr. Vahdat encouraged me to join him and start a new large dairy somewhere in the upper Midwest. The idea fascinated me and appeared timely. I started to develop a business plan; in the process, I received an education in finance! Banks are quick to say no to new business ventures with no track record. We finally raised sufficient cash (and more importantly, cash in reserve for business down turns). The bank approved our loan and we constructed Hill Top Dairy, LLP (1850 cows) near Brookings, SD in 1998. My third career was just beginning.

3. Veterinary services at Hill Top Dairy

I intended to do much of the veterinary work, but soon learned that we needed help. The following is a description of veterinary involvement in five major areas.

3.1. Nutrition

We employed an experienced, self-made veterinary consultant for all our nutrition work. His involvement included ration balancing, monitoring feed particle size, urine pH, body condition score, milk production, and a lot of general consulting on herd problems. He visited the herd every 2 weeks and worked closely with our feeder and herd manager.

3.2. Herd veterinarian

We employed a group practice to treat individual cows, including surgery on those with displaced abomasums. They also helped train our herdsmen to perform limited diagnosis and treatment of sick cows. Herd veterinarians performed some of the routine transrectal palpation and assisted with dystocias. They were certainly a valuable and trusted resource.

3.3. Theriogenology

We used a comprehensive Presynch, Ovsynch and Resynch program. Therefore, we did limited estrus detection (nearly all cows were inseminated by timed AI). Our semen supplier (Alta Genetics, Inc.), providing training (and refresher courses) for all of our inseminators. This service, performed every 3 months, included a review of all synchronization procedures and all semen handling and AI techniques. In addition, this company employed two board-certified theriogenologists (Dr. Arun Phatak and Dr. Chester Rawson) to visit herds with reproductive problems. This was a great program and resulted in very high reproductive performance for our herd. Our herd veterinarian and I performed pregnancy examinations.

3.4. Mastitis

We used a mastitis control program offered by the company that purchased our milk (Land O'Lakes,

Inc.). This person was very knowledgeable in milking machine function and somatic cell count (SSC) problems. He worked closely with our parlor maintenance person and trained him to do most of the routine milking machine tests. The herd veterinarians provided diagnostic and treatment advice as needed. They also helped us train our hospital manager. We usually had 15–20 cows in our hospital pen; most were being treated for mastitis. Mastitis consultants were employed whenever we had too many clinical cases, or SSC was too high. They were veterinarians that either had their own consulting business or worked part time for large dairy equipment companies. They were true specialists and gave excellent, current advice.

3.5. Calf rearing and heifer health programs

Calves and heifers were raised off-site at two locations. Veterinary services were provided by experienced local practitioners. Veterinarians worked closely with our calf and heifer growers regarding protocols for prevention, vaccination, and treatment. Our herdsman and I performed spectrometer analysis of blood protein concentration to monitor our colostrum program.

4. Requirements for operating a successful dairy

In my opinion, there are two requirements for a profitable dairy business. The first one is you must have a very strong passion and commitment for the business. It is a 24-h/d, 7-d/week business, and the owner must be there. Dairying is the most ''management intense'' business I know. Protocols must be followed and all details performed on a timely basis. Your passion must include the ability to manage money, pay down debt, and prepare for decreases in milk prices.

The second requirement is the owners must have a true compassion and respect for all employees. The employees are the true owners of the dairy, because they have invested themselves in the business. They must be given the opportunity to take on ownership. These owner–employees must be well paid, trained, re-trained, and given feedback on job performance. Happy, well-paid and well-trained employees are usually associated with a profitable dairy.

There are certainly additional requirements that contribute to success on dairy farms. However, the two described above will nearly always guarantee success, even with below-average cows and facilities. Practitioners understand the important role of these two requirements; it enables them to make recommendations consistent with the owner's management style.

5. What veterinary services will dairies use in the next decade?

Dairies will always need help and advice from theriogenologists. Dairymen must have pregnant cows; each new pregnancy adds $500 in value. Dairymen need a certain number of new pregnancies each week. If they fail, they will seek help. In the following sections, I predict the future for specific services or specialty areas.

5.1. Transrectal palpation for pregnancy diagnosis

I believe there will be a slow decline in this service. The following are specific reasons to support this claim:

(a) An ELISA test for Pregnancy Specific Protein B (PSPB) can be used to diagnose pregnancy 30 d after breeding. The test is accurate, cost-effective, and results are available in 27 h. Demand for the test increased to nearly 300,000 in 2007 (Dr. Garth Sasser, 2007, personal communication). These tests are being marketed through veterinary clinics or private laboratories.
(b) Transrectal ultrasonography for pregnancy diagnosis is becoming more common and in demand. A few large dairies employ non-veterinarians, trained in transrectal ultrasonography, to examine cows for pregnancy (Dr. Chester Rawson and Dr. Arun Phatak, 2008, personal communication). Having someone on-site that can conduct pregnancy diagnosis is valuable; therefore, I expect large dairies will seek out these individuals.
(c) Transectal palpation for pregnancy by non-veterinarians. A few large dairies employ lay persons that have learned how to palpate cows for pregnancy. The larger the herd, the more likely they are to employ or train someone on site to diagnose pregnancy. Small and medium-sized herds will continue to use transrectal palpation for pregnancy for many years.

5.2. Theriogenologists employed by AI companies

I believe that AI companies will continue to hire highly skilled and board-certified theriogenologists to serve as consultants for large, as well as some medium to small dairies. The AI companies work closely with large accounts. If reproductive performance decreases, theriogenologists are consulted. Although they focus on

reproduction, they must be able to evaluate the entire dairy. Alta Genetics, Inc. has hired two board-certified theriogenologists (Dr. Arun Phatak and Dr. Chester Rawson) to perform these duties. It was noteworthy that board certification was an important reason in their selection.

5.3. Theriogenologists employed by the veterinary pharmaceutical industry

These individuals must also be competent to serve as consultants for the entire dairy. Although reproduction is the most fundamental part of a dairy, nutrition and mastitis control are also important. The veterinary pharmaceutical industry works closely with large herds and will send out their consultants if a dairy is having problems. I believe that both AI and veterinary pharmaceutical companies will hire more theriogenologists. Furthermore, large milking equipment companies will continue to seek veterinarians with advanced training and knowledge in mastitis control.

5.4. Theriogenologists in private practice

It is clear that the number of ACT Diplomates in private practice has increased since 1983 [3]. Although the rate of increase may be slowing, theriogenologists have had positive and important impacts on service to dairymen.

5.5. Dairies need more veterinary teachers

There is a terrific opportunity for veterinarians to teach refresher courses to herdsmen, inseminators, and milkers. These courses need to be updated and repeated every 3 months, for perpetuity. We had a problem finding good, qualified teachers. Dairy employees respect veterinarians and would welcome their help. I strongly urge veterinarians to review their semen handling skills and furthermore, to ask a producer if you can inseminate 10 cows. Compared to the other inseminators, you will not always be in first place, but you should always be near the top. You understand the physiology behind every step in the process. Establish your own AI pregnancy rate on several dairies, earn even more respect from the employees and owners, and then prepare and deliver training sessions.

Milkers also need refresher courses every 3 months. This is another great opportunity for veterinarians to perform on-site teaching. You understand the physiology, bacteriology, disinfection, and food-safety principles. I recommend that you first observe several milker training sessions before preparing your own brief and well-reasoned lesson plan. It is always wise to include new information from profession or lay publications, including the National Mastitis Council. A pizza party prior to the classes should be standard practice.

5.6. Dairies need additional research

To validate the need for ongoing research, consider the declining pregnancy rates all over the world! The pregnancy rate in lactating cows was 65% in 1951, but declined to 40% in 1996 [4]. Now it is even lower. It is difficult to blame this all on high milk production and inbreeding. Virgin heifers are expected to have the highest degree of inbreeding, yet their pregnancy rates have not declined.

Cross-breeding need to be closely evaluated as a strategy to solve calving, reproductive, and longevity problems. Reproductive traits such as high bull fertility and daughter pregnancy rates (DPR) have promise and need to be recommended by veterinarians. We used many high-fertility sires on our dairy; they consistently yielded above-average pregnancy rates. Although the heritability of fertility is low, current measurements do work and should be recommended.

Research in the last 40 years has given us prostaglandins and GnRH, the two most widely used pharmaceuticals in dairy practice. Additional studies on sexed semen, detection of estrus, and synchronization procedures are also indicated.

6. Perspectives on education for theriogenologists

Papers written by previous Bartlett Award winners have each commented on future education for theriogenologists. It is clear that the authors have devoted substantial time to carefully ponder this issue. All of these authors show their commitment and steadfast dedication to theriogenology. These papers should be required reading for committees and individuals involved in revising theriogenology graduate student-residency programs.

I would also like to offer my suggestions regarding the future direction of theriogenology. Most of my comments will be directed toward cattle. First, it is pertinent to consider recent historical information regarding developments in veterinary medicine and the dairy industry.

World demand for dairy products has been growing at 2.8% per annum, whereas supply is increasing at only 1.6%. The dairy industry in the USA is expanding and has dramatically increased exports. Herds are getting larger and the cost of production has decreased due to economies of scale. It is reasonable to expect that dairy veterinary practice will concurrently expand.

The American Association of Bovine Practitioners (AABP) is a species-specific organization. It has experienced substantial growth; the current membership is approximately 6000 veterinarians, and I believe that more than half of these are true species specialists. The mission statement of the AABP is to enhance continuing education of its members and the *economic success of their clients* [5]. The AABP has a 23-member reproduction committee that works closely with the SFT. The association sponsors dozens of pre-convention seminars on most areas of dairy practice, and their annual convention attracts 600–800 veterinarians. They have substantial financial resources, enabling them to fund scholarships and research projects. Furthermore, they are currently raising funds to start their own foundation; several ACT and SFT members were recruited to assist with fund raising. The AABP has a close working relationship with the pharmaceutical and nutrition industries.

Nearly 20 years ago, the concept of ''Production Medicine'' emerged. It was designed primarily for bovine practitioners. Sometimes these new programs were called Population Medicine. The emphasis was on economics and the herd, rather than the individual animal. Some of the economic emphasis may have evolved from veterinarians working in the swine industry. The concept was very well accepted by practitioners and veterinary colleges. Many colleges felt it was urgent to develop production medicine programs. Limited resources resulted in some faculty and residency positions being changed from theriogenology to production medicine positions (personal communications with veterinary schools, 2008). I am in the process of surveying selected theriogenology sections on this issue and hope to present data at the annual meeting. Production medicine has a strong species emphasis, whereas theriogenology is regarded as having a strong discipline orientation. Several production medicine programs at veterinary colleges started to offer ''Production Medicine Certificate'' programs for dairy practitioners. There was great interest and participation for several years, but lack of permanent funding is a common problem.

It is clear to me that many colleges have reduced their theriogenology programs, whereas production medicine programs have concurrently increased. The current question is ''How do these programs proceed in the future?'' When a theriogenologist is called in to evaluate a herd reproductive problem, do they also need to be a species specialist? They need to evaluate cow comfort, lameness problems, mastitis, milk production, and transition programs. Some bovine theriogenologists need to be species specialists, whereas others do not.

My first recommendation is dairy theriogenology training programs shall provide the option for a discipline track, as well as a species-specialist track. We must develop a close working relationship with production medicine programs. State support for budgets has been declining for many years. We should remember the economic realities of higher education; theriogenology is only one portion, and it must compete for resources [6]. Adding new faculty positions is possible, but difficult. Our long-term objectives should be to develop research, graduate training, and teaching programs in conjunction with production medicine units.

7. Can we attain adequate depth of the theriogenology discipline while keeping a sufficient emphasis on production medicine?

For an overview and analysis of the historical as well as the future perspectives on the discipline/specialty evolution, I refer the reader to Gustafsson's Bartlett presentation [3], which also provides interesting international aspects.

I believe that faculty attitude and academic controls are already in place to assure ongoing, adequate depth in our discipline. Resolutions passed by theriogenology faculty at Educator's Conferences clearly state that faculty insist that graduate students be trained in scientific methods. Committee members for graduate students in MS and PhD programs must be from different departments. Students must be trained in experimental design and analysis. Thesis research must be properly designed and written in appropriate scientific style, with rigorous statistical analysis. Graduate committees look carefully at each candidate's courses and research program; advisors soon learn that they must not present their student to the committee for oral and preliminary examinations unless they are prepared. I had the privilege of serving as advisor for 15 MS and 5 PhD students. Based on my experience, if there is a weakness in the graduate student's program, the graduate committee will identify it and recommend corrective action.

My assessment is that we currently have controls in academia that require research competence in graduate

degree programs. We need to insist that faculty employed in theriogenology have adequate training in scientific methods. The head of the theriogenology section has the responsibility for setting the example and promoting research; faculty development is fundamental to academia.

There is another important source of scientists working in reproductive research at all major state universities. Let me cite a specific example. When I did my graduate studies at the University of Wisconsin (1969–1973), they had an Endocrinology-Reproductive Physiology training program, with research faculty from seven departments (Animal Science, Dairy Science, Veterinary Science, Medical School, Zoological Research Center, Genetics, and the Primate Center). Each department had several faculties with a PhD in the Physiology of Reproduction; Animal and Dairy Science had the most. I speculate that most major universities currently have at least 15–20 scientists performing research on reproduction in various species. All of these departments are adding depth to our discipline. Therefore, if we take care of our own program, we should be successful.

Over the past 20 years, at some veterinary schools, tenure-track professorships have been changed to clinical educator tracks. Clinical educators (sometimes called clinical professors) have primary responsibility for field programs and clinic teaching duties. Many do not have research appointments and are not trained in scientific methods. Although this conserves budgets in both the short- and long-terms, it also curtails research. We need to reverse this trend. I believe all clinical faculties should be trained in research and have a 25–50% research appointment; this will add depth to all clinical specialties.

My next suggestion is that we should strive to have the animal portion of Animal and Dairy Science (excluding plant and soil sciences) in the same department as Veterinary Medicine. This is not a new suggestion, as it has been discussed in various countries, and is probably closest to reality in Europe. Sweden is an example of a strong veterinary program which recently merged with a strong program in Animal Sciences. I believe merger would benefit both departments. We have worked well together in the past and our research interests and graduate programs are similar. A team approach should allow us to serve the industry better. We all know that state support is decreasing, so the need to win the support of industry is critical. New rules for research animal care include more veterinary involvement. I believe this merger will eventually happen and I support it.

A fifth suggestion is for the SFT, ACT, and veterinary colleges to work on funding for an independent professor's chair for theriogenology. Would not it be great if each veterinary school had an independent and fully funded chair in theriogenology? This chair must be located in the clinical department. It could serve as a permanent anchor for research and ensure depth to the discipline.

In continental Europe and Scandinavian countries, veterinary colleges originally created independent departments for animal reproduction, which were later called Departments of Obstetrics and Gynecology [3]. Thus, an independent chair in reproduction was established nearly 100 years ago at the Royal Veterinary College in Sweden. It currently has more than 20 faculties and confers three or four PhD degrees each year [3]. I wonder what role the funded chair played in the development of what might be the largest theriogenology academic unit in the world?

8. Summary of long-term educational plans for dairy theriogenology

(1) We need training programs that provide a discipline option.
(2) We need training programs that provide a species-specialist option.
(3) We must work closer with production medicine programs.
(4) Graduate degree programs have internal controls that assure adequate training in scientific methods.
(5) We must be certain that directors of theriogenology sections are trained in research methods and promote faculty development.
(6) Major universities have faculty in several departments performing research in reproduction; this adds depth to the discipline of theriogenology.
(7) We need to reverse the trend of converting tenure-track positions to non-tenure track positions.
(8) We need to forge mergers between animal and dairy science departments and veterinary schools.
(9) We need to fund development for independent professor chairs in theriogenology.

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