Developments in Dairy Herd Health programs: progress and prospects.

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Introduction

Veterinary advisory programs (VAP) for dairy herds have been developed since the 70's. The first developments have been in the area of herd fertility (de Kruif & Brand, 1978; Esslemont et al., 1985), later on followed by areas such as mastitis control programs (Neave et al., 1969; Kingwill et al., 1970; Bramley & Dodd,1984), vaccination schemes (Hjerpe, 1990), tactic or strategic endoparasite control programs (Armour et al., 1987; Ploeger, 1989). Characteristic for such programs were the population – i.e. herd – approach instead of the individual approach, the rather mono-disciplinary way of operating and the purely technical nature of such activities respectively.
Only in the 80's the concept of VAP changed gradually. Farm management was seen as the key to the whole farm operation, where operational, tactic and strategic management had their place. Based on the intensification of dairy farming due to the need to increase farm productivity, the average time spent per cow decreased. The latter lead to so-called production diseases and reproductive failures. Management became in need for proper technical support to achieve the goals the farmers set. One of the ways this could be provided was through a holistic veterinary and zootechnical herd health and production management (HHPM) program which brings the information from the different farming areas into an integrated farm advisory service (Brand, Noordhuizen & Schukken, 1996).
Since the 90's another development in the livestock production sector is taking place: the consumer demands with regard to the safety of food of animal origin, the husbandry methods applied by the farmer as related to animal welfare and the environment, and quality aspects in the broadest sense (Noordhuizen & Welpelo, 1996) are increasing. It could be a challenge for veterinarians to play an active role in this respect at both the farm level and throughout the whole food production chain (Lievaart et al., 2000).

In this presentation attention is given to the forenamed developments and the prospects for the near future are discussed.

Herd Fertility Schemes, HFS

Herd Fertility Schemes (HFS) have been developed specifically to support the farmer in his operational management with regard to fertility performance of his cows. Increasing numbers of cows per man and the intensification of production resulting in high milk yields, decreased the time spent per cow. One of the outcomes was that estrus detection efficiency and pregnancy rates dropped. Therefore, the regular planned herd visits by the vet who checked the reproductive status of the cows by rectal palpation was highly welcomed.

Cows not seen in heat, cows with irregular cycle, repeat breeders, pregnancy testing, prebreeding checks and vaginal discharge are reasons for a clinical examination of the reproductive tract. The farmer received the advice from the vet on the spot: predicted estrus dates, non-pregnant but cycling, treatment of endometritis etc. These HFS-activities are displayed at the level of operational management. Additionally, the vet assessed the herd performance with regard to the fertility status of the herd: performance figures could be calculated on a periodical basis of e.g. 6 months or one year. Examples of such performance figures are given in Table 1.

Table 1. An example of performance figures in herd fertility over 1 year in a 125 cow Holstein Frisian dairy herd

# heifers & # cows calved	34	88
ave. age of heifers at calving (days)	781	---
# abnormal calvings	4	1
# retained placentas	2	4
# calves born alive & dead	118	6
ave. calving interval (days)	---	387
# abortions	0	2
ave. interval calving – 1st estrus (days)	23	26
ave. interval calving – 1st service	76	62
ave. interval calving – last service	111	123
ave. interval calving – conception	101	118
ave. conception rate 1st service (%)	58	61
# services per conception	1.8	2.1
estrus detection efficiency (%)	48	53

Performance figures could be drawn from a wall chart where all cows appear in order of their calving date (subsequent estrus and service dates, disorders, pregnancy checks, dry off dates, culling were listed as well), but also from computer programs either in a batch procedure at a central computer or in a stand-alone system on the farm (Noordhuizen, 1984).
These average performance figures could already be used as an indicator for herd performance if target figures had been set by the farmer beforehand, facilitating a comparison. When a problem was detected, these figures could be broken down into frequency distributions and further down to the individual cow level. In such a way the problem could be well defined, potential causes identified and proper advice given. These activities are at the operational-tactical level.
A substantial drawback of this HFS was that usually the other farming areas were not comprised in the program. Hence it could occur that advice at the cow level to breed a cow at a certain time after calving had not been checked with other issues such as lameness, body condition score and milk yield level.

Mastitis control program, MCP

The mastitis control programs (MCP) proposed by Neave et al. (1969), Kingwill et al. (1970) and Bramley et al. (1984) in the 70's-80's were an example of an integrated approach of a herd problem within the area of udder health in its broadest sense. In addition to a clinical and subclinical mastitis pathogens inventory, attention was given to an adequate milking machine function, a proper milking technique and best possible drying off treatment advice and culling of problem cows. This so-called 5-points schedule has proven its high value over the past decades, namely in situations where streptococci were prevailing in a herd and management procedures such as milking technique and hygiene could be improved, as well as milking machine function. This became especially true for herds with increasing milk production levels.

During the last decades, other pathogens have proven to become more predominant; examples are coliforms and *Staph. aureus*. These pathogens have an other epidemiology than the streptococci, and occur specifically in low bulk milk somatic cell count herds. The disease resistance of the high yielding cow as well as environmental conditions play a paramount role in this epidemiology (Schukken et al., 1989; Barkema, 1998).
Furthermore, an increase in teat end callosity is currently often observed in dairy herds of high genetic value and high milk yield level. The role of the milking machine (e.g. vacuum) in relation to the form and position of the teats is a key issue, and may lead to increased risks for udder infections. The changing pathogen pattern, the cow's disease resistance (as related to nutrition), teat condition, milking machine and genetics all point to the necessity to approach the dairy farm in a multidisciplinary rather than a mono-disciplinary sense.

Vaccination Schemes, VS

The execution of vaccination schemes (VS) is in many countries a substantial part of any dairy herd health program. The rationale behind this is either providing protection against a whole spectrum of disease causing agents, or taking part in a disease control and eradication program. Geographically and generally spoken, the former is often addressed in the Americas, while the latter is part of the European strategy not in the least because of the high impact that the general public opinion or the consumers have on applied livestock production methods (animal health and welfare, use of anti-microbials, residues and hormones, non-vaccination strategy).
The VS are an example of combined operational and tactic level activities. An overview was given by Hjerpe (1990).
The past years have shown that VS have usually been combined with other earlier named programs, such as HFS and MCP.

Endoparasite Control Program, ECP

Control programs to control endoparasite burdens in cows (ECP) became of relevance in the 80's – 90's when e.g. Ploeger et al. (1989) and Armour et al. (1987) proved the relevance of subclinical infection levels for milk production performance in both cows and heifers. Moreover, it was shown that immune function in first and second calf cows could be impaired by insufficient sensibilisation to endoparasites. In addition to tactic and strategic deworming programs, emphasis was put on proper grassland exploitation, especially in Europe on intensive but relatively small dairy operations. In advisory programs for young stock rearing both elements have their place in such a way that farm-specific advice on this subject can be given.

Herd Health & Production Management programs, HHPM

The HHPM programs center around farm management, its goals and decision-making processes (Brand et al., 1996). These programs address all those areas of dairy farming at the same time, where the veterinarian could show his expertise: i.e. production and nutrition, udder health, claw health, young stock rearing, herd fertility, other diseases, disease eradication or control programs, vaccination programs, cattle welfare, use of anti-microbials, control of residues, and milk quality.
The foundation for addressing all these areas is in the *protocol*, a standard operational procedure for HHPM, comprising routine monitoring as well as problem Analysis and preventive actions (see Fig.1).

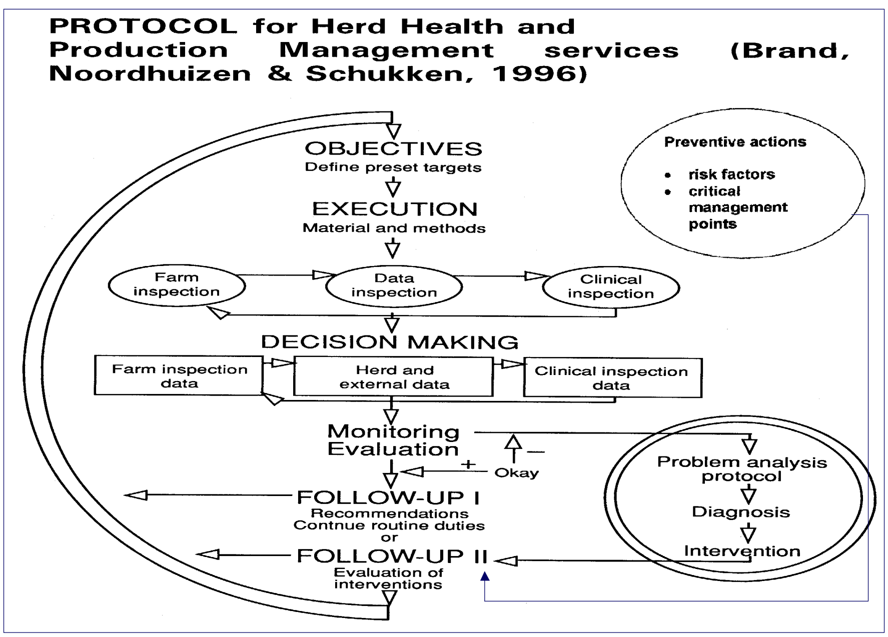


Fig.1. The protocol, a standard operational procedure for applying HHPM service.

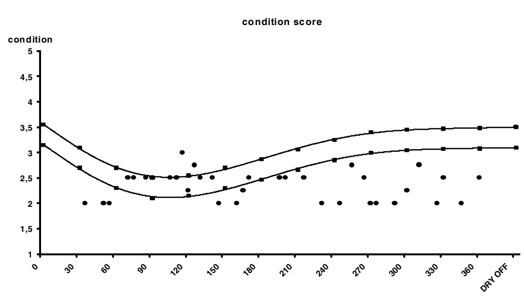
The key is in the holistic approach of the dairy operation instead of focussing on separate disciplines, e.g. fertility alone. The objectives of a HHPM program is to support the farmer in reaching his farming goals. Such goals may be highly variable between farms: from purely economic to organic or to mixed farming (nature conservation or recreation included). Farming goals determine which veterinary-zootechnical targets have to be set. For some farmers a specific goal may be to achieve a milk yield level per cow per year of 10.000 kg, while other farmers may prefer a level of 8000 kg based on organic farming. The calving interval related to these levels will most probably differ as well. It is the sake of the vet to set the technical program targets according to these individual farmer's goals.

At the start of a HHPM program both the farmer and the vet should – independently - draw a *SWOT assessment* of the farm in the different areas; these are compared for detecting match or non-match. Next, the farmer should be asked about his priorities in addressing particular areas, such as udder health or lameness.
In the execution of a HHPM program the *regular farm visit* plays a key role. During that visit the *routine monitoring* takes place. In Table 2 some examples of monitoring activities are presented.

Table 2. An example of routine monitoring activities in HHPM

Cow/herd level	Farm environment	Farm information
Body condition score	Milking technique	Performance figures
Rumen fill score	Hygiene procedures	Milk recording data
Faeces score	Nutrition & pasturing	Milk quality data
Claw score	Housing conditions	Roughage analysis
Teat end score	Climatic factors	Soil analysis
Repro examinations	Boiler temperature	Surface water quality
Growth measuring	Rodent/insect control	Quality audit reports
Clinical cow examination	Other managerial activities	

Monitoring is conducted in order to obtain signals of (potentially) deviating herd/farm performance. In Fig. 2 examples are given of body condition scoring: one abnormal pattern and one normal pattern. In the former case, it would be advisable to screen e.g. the herd rations and whether diseases are prevalent.



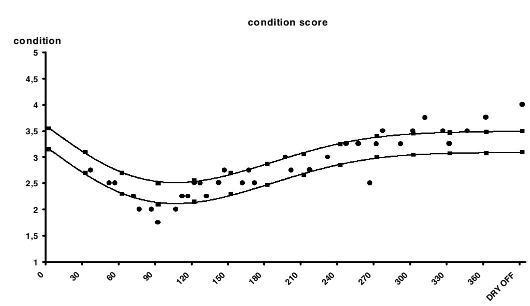


Fig. 2. Examples of an abnormal and normal body condition scoring pattern.

Farm monitoring can be regarded as an overall farm inspection, the pre-stage of problem analysis or an epidemiological survey where risk factors for disorders are searched for in order to provide means for elimination or control of that disorder. Certainly within a group-practice setting, such epidemiological surveys can be conducted. Examples have been described by e.g. Frankena et al. (1992). Such a survey yields a list of risk factors for one or more disorders, as well as a quantification of their contribution to the occurrence of that disorder, the parameter being the *relative risk* or the *odds ratio* (Noordhuizen et al., 1997). An example of such a list of risk factors for dermatitis digitalis is given in Table 3.

Table 3. Example of quantified risk factors for *dermatitis digitalis*

Variable	Class	Odds ratio (OR)
Parity	1	1.32
	2	1.05
	3	1.00 (ref.)
Breed	> 50% HF	1.20
	> 50% FH	1.02
	> 50% MRIJ	0.12
	Other	0.34
	HF x FH crossbred	1.00 (ref.)
Lactation stage	dry	0.34
	pre-top	0.81
	top (50-70 d.i.m.)	1.70
	post-top	1.00 (ref.)
Herd size	< 50 cows	0.61
	> 65 cows	0.74
	50-65 cows	1.00 (ref.)
Milk yield	< 7000 kg/cow/year	0.47
	> 8000 kg/cow/year	0.39
	7000-8000 kg/cow/year	1.00 (ref.)
Access to pasture	limited	1.51
	free	1.00 (ref.)
Walking distance	> 200 m	5.37
	< 200 m	1.00 (ref.)
Walking path condition	metalled	2.56
	grass	1.00 (ref.)
Pasture level	low	0.53
	high	0.59
	intermediate	1.0 (ref.)

OR > 1 means that the risk as compared to the reference value (ref.) is increased; OR < 1 means a decreased risk; OR= 1 means there is no association.

The strength of such epidemiological surveys is that contributing risk factors can be ranked according to the impact they have on disease occurrence at population level. On the individual farm it is checked with this list which risk factors are prevalent there and which are not. In this way it is easier to set priorities in addressing risk factors through managerial action, especially when cost-benefit calculations have been done. This is the area of risk management.

Problem analysis is carried out when routine monitoring points to deviations in performance or when acute problems occur. Problem definition is the primary step: which animals are involved to what extent, with which disease when, where and under which conditions. It specifically regards the close examination of animals, farm conditions (risk factors) and available information during one, often more, farm visits. The synthesis of all information should lead to a herd diagnosis and a written plan of action, including follow-up visits to check the results of the advice given or the intervention conducted. It will be clear that this type of activity usually is retrospective in nature: first a problem has to arise, then further action is taken.

Such a problem can sometimes be very costly. It will also be clear that a farmer is much more interested in a preventive approach on his farm, not in the least to control costs: investment is preferred above losses.

Prevention can be done on the basis of vaccination programs (VS) or endoparasite control programs (ECP) on the one hand, and risk management on the other hand. If, for example, the major risk factors for the main disorders on a farm are known (see Table 2). *Risk management* means that the farmer has insight in the sites on the farm where the respective risk factors exert their effect, that he has the means to monitor their impact and that he is able to take corrective measures in order to prevent the disorders from occurring. It should be noted in this context that not all risk factors can be eliminated (e.g. buildings) or controlled (e.g. prevalent breeds).
As can be noted, most fields of attention in the HHPM program regard veterinary and zootechnical aspects of dairy farming. Quality is addressed because the milk factory reports on the quality of milk with regard to bulk milk bacteria counts and somatic cell counts which are associated with udder health. Shortly, this concerns the quality of the delivered product "milk".

Food Chain Quality Assurance: the dairy sector

During the last decades, consumers have increasingly paid attention to livestock industry. This was partly caused by the food-borne disasters such as mortality due to hamburger consumption (VTEC), outbreaks of salmonellosis or cryptosporidiosis, and the epidemic of BSE in Europe. Food safety plays a paramount role in the consumer attitude towards livestock industry. On the other hand, the general public puts increasing demands on the way that farmers produce. In this situation it is not food product safety, but rather husbandry method with regard to animal health and welfare, and to environmental issues. And although the consumer perception of the livestock production sector appears to be highly biased by lack of knowledge and although there is a large gap between farmers community and the urban population, it has become paramount to the farmer to meet with the quality demands set by the general public. Pig and poultry sectors have counteracted through the formation of Integrated Food Chain Quality Assurance programs (Harbers, 1991).
The cattle sector responds with Quality Assurance Programs (QAP) in the area of microbiological hazards, residue control and welfare (Knudsen, 1997; Ryan, 1997),

or environmental pollution and control (Knudsen, 1997) or through an integrated program (CQM).
CQM, Chain Quality Milk, has been formulated in The Netherlands in 1998 by a joint action of the Dutch farmers' association and the milk industry, and will soon become compulsory for dairy farmers (Brouwers & Franse, 1997): this regards the concept of a license to produce and license to sell. The Dutch CQM comprises 6 modules:

Animal health and welfare
Handling and storage of anti-microbials (a.o. withdrawal periods)
Milk harvesting and storage
Hygiene and disinfection procedures
Feed and feedstuffs
Environment, water and waste management.

First of all, a general change in attitude and mentality is strived for, based on a kind of *Good Farming Practice code* (hygiene practices, managerial actions).

Each year the demands in each module are becoming stricter. A vet who wants to serve such a CQM farm needs to act according to an undersigned *Good Veterinary Practice code* to obtain access: development of the concept of a license to serve. Quality is now defined in a broad sense: not only the product is involved but also the production method.

One could ask what other role the vet could play in this CQM context, preferably associated with a HHPM program for reasons of efficiency and economics.

Quality control can be conducted according to different concepts: ISO-9000, Good Manufacturing Practice codes, Total Quality Management, Hazard Analysis Critical Control Points, HACCP (Evans & Lindsay, 1996; Schiefer, 1997). The latter appears to be the best choice so far for the farmer who wants to act according to quality control principles (Noordhuizen & Welpelo, 1996). It is very farm-specific, least labour-costing, not requiring much documentation, focussed on risk management, high degree of self-management, expected high benefit-cost ratio, suitable for certification, health status demonstrable.

Key issues in HACCP are: production process decomposition, hazard identification, risk assessment, definition of critical control points and critical management points, monitoring of the production process, planning of corrective measures, risk management.

An example of a production process decomposition diagram for a dairy farm is presented in Fig.3 (Noordhuizen & Frankena, 1999).

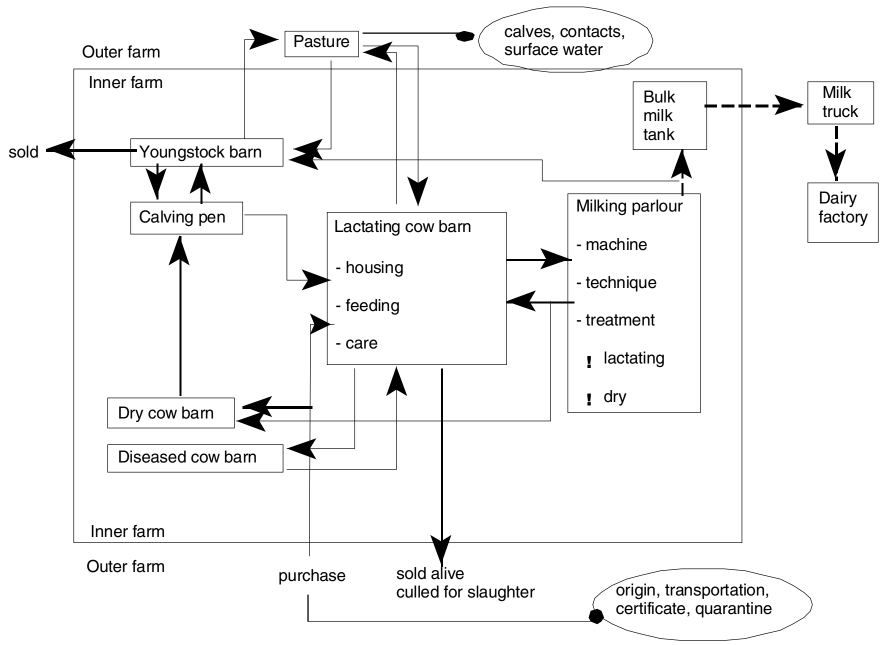


Fig.3. An example of a production process decomposition diagram of a dairy farm.

Fig 3 shows where the animals on the farm pass from one step to an other, including the pathways and pasture plots. Hazard identification could mean that predominant disorders are identified as well as the risk factors contributing to their occurrence. These risk factors are assigned to the respective sites in the production process where they exert their impact. Critical control points, CCP's, and critical management points, CMP's, then need to be defined on the basis of these risk factors.

CCP is a measuring point, a condition or a sequence in the production process which is related to the hazard, for which the control is crucial and where measuring of deviation can be done based on accepted target and tolerance levels, for which corrective measures are available which on their turn lead to full restoration of control.
Examples of CCP are: bacteria counts per ml milk; milking machine cleaning water temperature; air velocity in the barn; animal (blood)check before delivery.

CMP is a point, a condition or a sequence in the process which is related to the hazard but where control cannot be fully guaranteed because there are no target levels or tolerances defined or which is hard to measure but which is still crucial in the process of control. CMP focuses on the best possible practice to reduce a risk or its impact.
Examples of CMP are: serotiters; managerial actions to deny access of calves to pastures where recently manure has been spread which potentially carries salmonella bacteria.

The CCP and CMP together form the on-farm monitoring network. Monitoring thus is the common ground under both the HHPM service and the HACCP application. Hence it is clear that there could be a closer link between HHPM and HACCP. HACCP appears to work for microbiological hazards so most probably it could be used for the control of animal health risks.
Examples of some applications of CCP's and CMP's will be provided during the presentation, using the control of salmonellosis and/or paratuberculosis (Johne's disease) as illustration.

Concluding remarks

Many developments in herd health programs have taken place over the last decades. The most important drive is that dairy farmers desire a certain management support in their operational, tactical and strategic decision-making. They desire this from different experts among who the vet is still a paramount one. Given the different sociological farming styles (Van der Ploeg, 1994) it is crucial that HHPM advice is given tailor-made. Some generalist farmers only want to have an overall farm advice from a trusted vet, while other high tech farmers want a second expert opinion of their vet on specific issues for which they like to receive the whole analysis documentation. Usually it is recommended that the vet joins a farm expert team including a nutritionist and an economist. This team may function in the centre of the network around the farm: other specialists are called in when needed, reports are available from each team mate and are made available to third parties. Each team mate carries out the monitoring needed; information is subsequently integrated into a holistic farm advice, agreed upon by all team mates.

With respect to quality assurance at farm level, it is absolutely needed that the vet is properly trained in quality concepts and methods (Evans & Lindsay, 1996) if he/she desires to play an additional role on the farm. It may very well represent the added value of the vet in the next decades. A properly trained vet will be able to monitor the CCPs and CMPs at the farm, hence supporting the farmer in his quality control efforts by adequate advice.
One of the main advantages of quality control application would be that emphasis will be on disease risk management instead of disease control on the farm. This means that focus is on prevention rather than on curative action, and hence will be more cost-effective.

It is foreseen that this quality control goes beyond the current issues of residues, antibiotics use, or even animal health. It can very well be that also animal welfare will be included as could be environmental issues. The first steps have been made in e.g. the Netherlands and Denmark with the latter. Currently, practical welfare scoring indices are being developed and tested in the field. With regard to environmental issues surface water quality indicators have been developed, as well as farm mineral status bookkeeping.

The prospects for the vet in the near future are broad. Question is, whether vets would like to meet with the challenges put forward through the market demands, and whether our veterinary curricula are sufficiently dynamic to adjust itself to those market demands. And finally, the vets in the field have their own responsibility to adopt new opportunities instead of considering such new demands as threats.

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