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A Detailed Investigation of the Effects of Premature Isolation and Predictive Factors on the Healthcare of Dairy Cows and Calf

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Abstract

The practice of prematurely separating calves from their cow has the dairy sector under increased criticism, putting it at crossroads. Due to its possible effects on the mental health of cows and calves, this long-standing practice in dairy production has come under ethical criticism. The purpose of the research was to look at the impacts of premature isolation and predictive factors on the healthcare of dairy cows and calf. Only published English-language publications that directly compared the health of dairy cows or calves in artificial suckling systems were accepted for inclusion. The language exclusion, publication date, irrelevant topic, study design, outcome measure and duplicate publication are excluded from this research. The PRISMA protocol for conducting systematic literature reviews was observed. Using carefully chosen and tested search phrases, searches were conducted in Pubmed, Scopus and Web of Science. A final sample of 40 papers that discussed the health of cows and calves was produced as a consequence of this approach. Overall, the studies on cow and calf scours indicated that suckling had no impact or it was advantageous. There was no discernible risk factor associated with cow-calf interaction in the research that addressed various diseases. In conclusion, there is inconsistent evidence in favour of early separation in the scientific, peer-reviewed literature on cow and calf health.

Keywords: Isolation, Cow and Calf, Healthcare, Behaviour, Milk Production, Disease

INTRODUCTION

Dairy cows are herd animals that coordinate their activities and seldom venture outside the group's protective enclosure. But when the calving season draws near, this behaviour can alter. Domesticated cows rose on pasture separate from the herd to give birth and certain wild ungulates exhibit a similar tendency for self-isolation. Cattle cannot isolate themselves during parturition. Isolation is an indication of disease in laboratory rodents. Dairy cows are vulnerable to illness following calving and behaviour is used to identify sick animals (1). Dairy cows are vulnerable during the change from dry to lactation. The physical demands of calves are great and the process of going from one stage of breastfeeding to the next carries a significant risk of illness (2). It is advised that cows calve in distinct facilities that they are brought into when calving is about to occur since farm sizes have grown and the high number of calving requires supervision, which is difficult in today's dairy industry. It is advised to utilize separate calving pens since pre-parturient cows are known to prefer seclusion as calving time approaches; in several nations, calving in separate pens is mandated by legislation to guarantee a clean, uninterrupted parturition (3). When cows and their calves are separated from the herd before it is socially or medically ideal, this is referred to as premature isolation. The production, stress levels and general health of the cow and the calf are impacted by this approach (4). To apply management measures that enhance the health and wellbeing of dairy cattle, it is imperative to comprehend the effects of early isolation and identify predictive variables. Premature isolation can affect dairy cows' and calves' health in a number of ways. Early separation from the dam can have an adverse effect on the calves' capacity to obtain the vital colostrum, which can weaken their immune systems and make them more vulnerable to illness (5). Isolation can cause social and environmental stress, which can impede calf growth overall and lead to behavioural problems. Premature

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isolation of dairy cows can lead to elevated stress levels, which can have a severe impact on milk production, reproductive efficiency and immune system function in general (6). Premature isolation causes calves to lose out on important interactions and lessons from their moms. Difficulties with nutrition, sociability and general growth can result from this. To ensure a healthy and fruitful future for the calf in the dairy herd, it is essential to attend to its physical and psychological requirements at this crucial stage (7). The incorporation of predicted criteria becomes imperative as the dairy sector wrestles with the moral and health-related implications of early isolation. Agriculturalists and veterinarians use measures to lessen the adverse effects of isolation on cows and calves by spotting and managing certain stresses early on. This study investigates the effects of premature isolation along with predictive factors on the healthcare of dairy cows and calves.

The study (8) indicated that there is room for improvement in the long-term impacts of early-life physical, social, dietary and maternal constraints. There has to be more research done on the long-term effects of artificial rearing systems on dairy calf behaviour, cognition, performance and health metrics. The article (9) provided the last weeks leading up to parturition in dairy calves are physiologically demanding and a key factor in determining how well the animals perform in subsequent output. To prevent the animals from becoming more stressed at this time, external stressors should be properly handled. Performance drawbacks are varied and stem from intricate physiological reactions. The study (10) created an Isolation box test (IBT) for calf dairy farms and ascertains if behavioural reactions to the IBT were connected to personality characteristics identified by conventional testing after the calves were weaned. Accelerometers affixed at five points on the outside of the box were used to quantify calf movement during the IBT. The study (11) emphasized how cattle, particularly diarrheal calves, can pose a significant risk to the study region by spreading AMR genes and multidrug-resistant enter pathogenic Escherichia coli (MDR-EPEC). It is recommended that Egypt ban the use of antibiotics on dairy farms without a prescription. The study (12) extended cow-calf interaction in dairy farm calf raising techniques offer advantages for the health of the cows and the calves as well as greater public acceptability of the farming methods. On contemporary dairy farms, nevertheless, it can be difficult to manage cows and calves together, especially for pasture-based operations. The study (13) examined papers that addressed public perceptions of the treatment of calves in dairy farming, with an emphasis on the latter. They demonstrate that most study participants are either ignorant of or opposed to these practices. The primary reasons this technique is disapproved are that it is thought to be unnatural and stressful for the animals. The study (14) aimed to find cow-calf contact (CCC) systems that strike a compromise between the advantages for calf development and health and the drawbacks of sellable milk and weaning anxiety. A reunited calf and cow pair was evaluated for 20 minutes before, 2.5 hours after, or 9 hours during the milking in the morning and evening. The study (15) determined the emotional states of dairy cows that were either full-time (23 h/d), part-time (10 h/d) or had no reach with their calves. About a month after calving, the cows were given the visual judgment bias test (JBT), which is the standard of excellence for determining an animal's optimism or negativism.

METHODS AND MATERIALS

In this section we discuss about the investigation of the effects of premature isolation along with predictive factors on the healthcare of dairy cows and calf.

Search strategy

The Web of Science (WoS) database, which enables the incorporation of Boolean operations (i.e., AND, NOT, OR) to tie combined words or sentences together with wildcard reductions (denoted as *) to identify a range of potential types of words, was used for systematically searching. To accommodate for different spellings, the $ sign was used. (“Cow-calf” OR “cow/calf” OR “isolation/ separation* OR “herd/farm” OR “behaviour* OR “economic-prevention” OR “economic/prevention” OR) AND (“disease*). Figure (1) depicts the Prisma flow diagram.

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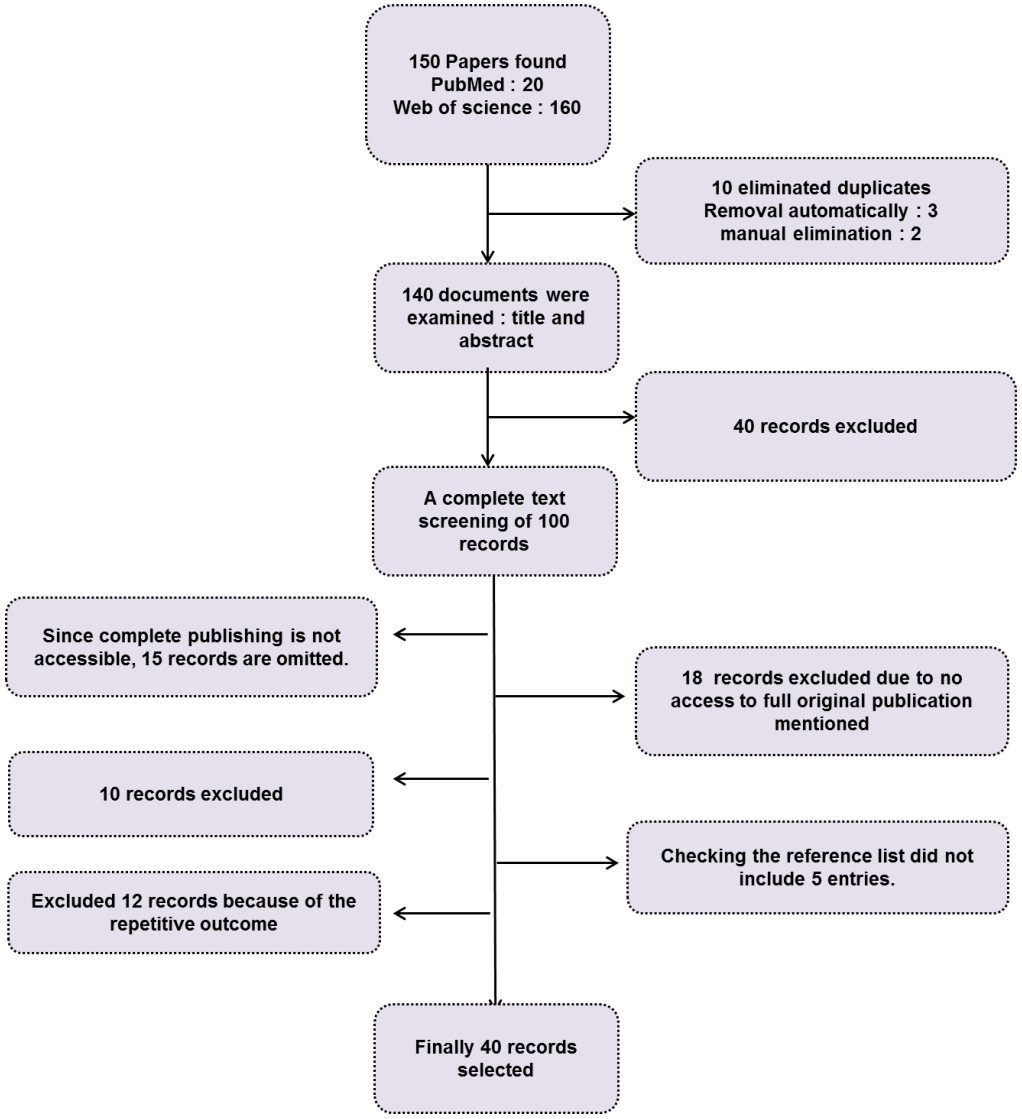

Figure (1). Selection study of PRISMA Flow diagram (Source: Author)

Inclusion criteria

➢ A direct examination of the effects of cow-calf interaction or suckling on dairy cow or calf health was required for articles to be included; these requirements included being peer-reviewed, comprehensive, written in English and available in full-text format.

Exclusion criteria

➢ The exclusion criteria for this study encompass language, publication date, irrelevant topic, study design, outcome measure and duplicate publication.

Behavioural changes in calves

The study examined the impact of local anaesthetic administrations 11 days following the treatment to see whether persistent discomfort occurred at the moment the necrotic tissue was released from the head. A saline injection or a local anaesthetic was given to disbud female Holstein and Jersey calves' corneal nerves on each side of the head (16). During the course of 75 minutes, they counted how the following 8 actions occurred cleaning, bucks/jumps/kicks, head shakes, head touches, head scratches, ear flicks and tail flicks. This study evaluated the usefulness of behavioural and physiological responses as early illness indicators by examining the

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development of Neonatal Calf Diarrhoea (NCD) in calves treated in an experiment using rotavirus (17). The study examined the behaviour of forty-five dairy calves kept with their mothers in half-day or whole-day systems (where the cows are only separated from the calves twice a day for milking). The calves were, on average, 3, 5 and 7 weeks old when the data were video collected during a 24-hour period (18). When the cows reappeared after their morning milking, half-day calves found their mother more quickly than whole-day calves. Animals that have vocalizations can use them to express their emotions. Researchers in Southern Brazil examined 42 beef cows, together with their 24-hour-aged calf, which had never been separated from their moms before. 5 Blond d'Aquitaine (BLON), 6 Brahman (BRAH), 15 Charolais (CHAR) and 16 Limousin (LIMO) bulls were among the dams, all of them were the daughters of Taurine crossbred moms (19). The research employed an experimental illness challenge paradigm with Mannheimia haemolytica (MH) to evaluate elements of sickness behaviour in dairy calves are kept in groups. Table (1) describes the behavioural changes in calves afterward (20). The Holstein bull calves were kept in groups according to their age and body weight in pens with sand bedding. They were fed grain concentrate on a daily basis and received pasteurized waste milk (8 L/d) every two hours.

Table (1). Manuscript comparison of behavioural changes in calves (Source: Author)

Ref.	Objective	Groups compared	Number of animals	Summary
(16)	The impact of administering local anaesthetic 11 days following the treatment was to see whether persistent discomfort existed when the scalp's necrotic tissue began to separate.	11 day	24	Calves administered lidocaine 11 days post-disbudding displayed behavioural changes in line with a decrease in pain during the numbing phase, followed by a resumption of sensibility as the anaesthesia subsided.
(17)	Sensing technology can be able to identify the behavioural and physiological changes that cows go through in the period leading up to calving.	14 day	43	The amount of milk consumed, the side and shoulder infrared thermography (IRT) temperatures, the frequency and length of lying sessions and the amount of time spent at the water trough exhibit promise as useful early markers of illness.
(18)	45 dairy calves were kept with their mothers in either a half-day or whole-day arrangement, with the cows leaving the home twice a day to milk. The calves' behaviour was examined.	Half-day	45	Research that focuses more directly on evaluating emotional states is recommended since half-day dam-calf interaction can have good and negative effects on calf wellbeing.
(19)	To characterize and compare vocalizations along with additional behavioural indicators of cow-calf couples in terms of feeling supportive environments, unfavourable circumstances, as well as the possible impact of parity category, calf sex and genetic group on these cues.	No previous separation	42	Increased tail flapping and more head, ear and torso motions were seen in the negative-valenced situation of cow-calf separation that increased sniffing activity in both cows and calves.
(20)	To employ an experimental illness challenge paradigm, including MH, to define the elements of sick behaviour in	14 day	12	In comparison to healthy calves in the same pen, they discovered that calves exposed to MA in an

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	dairy calves kept in groups.			experimental illness-challenged paradigm had a variety of altered behavioural patterns and clinical symptoms of a moderate illness state.

Effects on milk production and performance in cows

Single-locus polymorphism genetic selection could have advantageous prospects for enhancing milk qualities in locally not chosen cow breeds that exhibit poor levels of productivity. Given that these resilient breeds are grown in conventional extended and systems that are semi-intensive that heavily use grazing assets, more research into the genetic and feeding interactions strategy is warranted. For the Modicana breed of cattle, feeding regimens and genetic variations near the locus of DGAT1 K232A, both affected the fatty acid profiles and milk content (21). The investigation looked at whether they influenced Chinese Holstein milk FA characteristics genetically (22). The research validated how Chinese Holstein milk fatty acids are affected by carboxypeptidase M (CPM) genetics (23). Re-sequencing the complete exon patterns and the flanking 3000 bp upstream and downstream areas of the CPM gene revealed seven SNPs. The study offered family Lipase members J (LIPJ) and K (LIPK) yet they were in close proximity to two of them (24). To determine if the LIPK and LIPJ have substantial impacts on the genetics of dairy cows' milk fats, this research is a follow-up. The study examined K232A is the diacylglycerol acyltransferase (DGAT1) alteration in bulls of the Italian Holstein breed was identified by allele frequency. Additionally, the impact of the alteration on the somatic cell score, milk production composition and coagulation traits (curd stiffness and rennet coagulation duration) was estimated (25). The DGAT1 mutation on chromosome 14 was genotyped for this reason in 349 Italian Holstein calves. The K allele's copy number was reduced on the individual's de-regressed predicted breeding value to conduct a correlation study. Table (2) presents the milk production and performance in cows.

Table (2). Milk production and production traits (Source: Author)

Ref.	objective	breed	Production trait	Country	summary
(21)	It is worthwhile to look at the relationship between feeding system and genotypes, considering these resilient breeds are grown in conventional extended and rather intensive systems that make extensive use of grazing resources.	Modicana cattle breed	MY	Italy	The study looked at the DGAT1 locus polymorphism's impact in Modicana cows for the first time, as well as how it interacts with feeding practices.
(22)	The researchers looked at whether they influenced Chinese Holstein milk FA characteristics genetically.	Chinese Holstein	FA	China	In summary, research first identified the genetic influences of the MOGAT1PRLR, CHUK and MINPP1genes on the characteristics of milk FA and investigated the possibility of functioning alterations.

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(23)	To verify how Chinese Holstein milk fatty acids are affected by CPM genetics.	Chinese Holstein	MFA	China	The post-GWAS approach was used to first identify three putative causative mutations and validate the substantial genetic effects of CPM on the fatty acids in milk in dairy cattle.
(24)	The investigation confirms whether the milk fats in dairy cattle are influenced by the LIPK and LIPJ genes.	Chinese Holstein	FA	China	The study is the first to show that the genes LIPK and LIPJ are correlated with milk FAs. The SNPs that were found could be used as marker genes to improve milk FA breeding efforts in dairy cattle.
(25)	To identify the frequency of alleles of the Italian Holstein bulls with the K232A mutation in DGAT1 and to determine how the mutation affects coagulation along with somatic cell score characteristics, milk production and composition.	Italian Holstein Italy	MPTs + milk coagulation properties	Italy	Found that although the K232A mutation had no effect on SCS, it had a positive effect on the capacity of milk from Italian Holsteins to coagulate.

Economic implications of healthcare challenges

The research proposed a socio-economic methodical approach that adapt to the vast range of farm, market and societal variables as well as cow-calf raising methods. Using a system-theoretical structural analysis of the relevant literature and comprehensive cost accounting from a model case study including two model farms (26), they list the financial and significant non-financial components that should be comprised in a socio-economic assessment. To ascertain the degree of cow fetal waste and its economic ramifications, retrospective research was conducted at the slaughterhouse in Jigawa state during a six-year period (2016–2021). Fetal waste and the total number of cows killed at the Hadeja slaughterhouse were assessed. There was a difference in the amount of fetal waste throughout the wet and dry seasons. The financial effects of fetal waste were assessed (27). The study looked at cow production and found that it faces significant obstacles in the areas of sustainability, underscoring the need to support livestock systems that are economically and ecologically sustainable. Furthermore, in the majority of European nations, the intake of animal protein is far above the recommended daily allowance (28). The protein transition, which is characterized as the animal balance and substitute foods high in proteins, is promoted as a chance to encourage better diets and a way to lessen the negative environmental consequences of cow rearing. The study (29) assessed the possibility of mismatched economic incentives in the beef sector by combining the effects of a cow-calf operation's genetic panel results and the feedlot outcomes that were anticipated. Early separation is linked to poor animal welfare as it is seen as a sacrifice of an animal's natural state for consumption by humans. It is critical to pay attention to stakeholders' concerns if the dairy business is to remain sustainable. The industry will thus need to be aware of the implications and the finances required for animal welfare programs to be successful. The research looked at the viability of extended cow-calf contact (CCC) from an economic standpoint for dairy producers in Norway. The research uses production data from 94 farms to do a lasso regression to examine the economic effects of CCC (30).

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Disease prevention strategies

Antimicrobial therapy used prophylactic that decreases the colonization of pathogens in the airways; the rise in antibiotic resistance raises worries about public health and necessitates the invention of novel management methods. The study used PCR in real-time to determine the pathogens' frequency related to the shipping of 231 cattle imports, or 10% of 49 trucks travelling from southern Italy to France (31). The analysis speculated on measures to lessen the effects of bovine respiratory disease (BRD). The article examined Tick and tick borne diseases (TTBDs) and their epidemiology, the effects on animals' health, the economy, management and related issues in Uganda. Because Uganda has a climate that is ideal for them, ticks are a common vector of economically significant diseases (32). Ticks carry many infections that, if neglected, can cause animals to become ill and die, leading to economic damage in addition to the physical harm they wreak on their hosts. The most common illness for which antibiotics are prescribed in Californian cow-calf farms is BRD, which is prevalent in cattle herds. Usually used to cure or prevent disease, antibiotics are used in light of growing worries about bacteria becoming resistant to them in animals or about those diseases transferring from animals to humans. This review compiles research published in English that describes the disease's risk factors and practical preventative measures for cow-calf enterprises. It has been determined that a number of organizational and animal variables raise the risk of BRD (33). The study assessed Thuringia's voluntary efforts to manage Johne's disease (JD) between 2015 and 2020. The program's primary objectives in impacted herds were to reduce frequency by yearly testing to identify animals producing the infectious agent, killing these animals and sanitation measures to interrupt the infection cycle (34). Hemateophagous arthropod vectors carry the Lumpy Skin Disease Virus (LSDV), which infects cattle and water buffalo that causes severe illness. The lack of comprehensive data about the innate and adaptive immune response to LSDV impedes the creation of disease-controlling instruments. The work offered a comprehensive examination of the immunological experimental reactions of calves infected with LSDV by means of needle injection or arthropod injection with virally positive Vectors, including Stomoxys calcitrans and Aedes aegypti (35). Table (3) depicts the various disease prevention strategies.

Table (3). Comparison of various disease prevention in cows and calves (Source: Author)

Ref.	objective	country	Disease name	diagnostic	Summary
(31)	The analysis of Real-time PCR revealed the infections' frequency and suggested potential mitigation techniques for BRD.	Southern Italy	BRD	Real-time PCR	Indicated measures taken at the farm of origin before loading would be more successful in boosting calf immunity and lowering the development of BRD risk.
(32)	The epidemiology of ticks and TTBDs, their effects on the economics and the health of cattle, as well as the control and related issues in Uganda.	Uganda	TTBD	Clinical Analysis	To establish a sustainable system in Uganda, it has been suggested that the whole strategy for TTBD economic control be completely re-evaluated.
(33)	The scientific literature in English on articles about the risk factors for the illness and preventive methods that are pertinent to cow-calf operations has been included in this research.	California	BRD	Clinical diagnosis	When given in the appropriate situations, vaccinations have been beneficial. Although their effectiveness in improving immunity appears to be limited, diet and nutritional supplements can be useful.

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(34)	To evaluate Thuringia's voluntary JD control initiatives.	Thuringia	JD	ELISA tests	The research indicates that, with veterinarian guidance, enough testing resources, financial assistance and measures to avoid the reintroduction of MAP, for a long time, JD control could be attained at the herd level.
(35)	The immunological responses of calves that were injected with LSDV utilizing virus-positive Stomoxys calcitrans and Aedes aegypti vectors, either by needle injection or insect infestation.	-	LSDV	ELISA diagnostic	Calves injected intravenously or intradermally showed a quick humoral and immunological reaction mediated by cells to LSDV, according to a thorough examination of their immunological response.

Management practices and isolation of cows and calves

The research examined the management strategies used on modest family farms that house less than 100 cows. Small farms are crucial to a nation's economy since they make up the bulk of farms in the EU and throughout the globe (36). A major factor is inadequate management variables impacting the health and survival of calves on cattle ranches, where the well-being of the calves is crucial to the herd's sustainability. The study characterized Uruguay's pastured dairy herds' structures related to child rearing and pregnancy, as well as methods of organization that might affect the well-being of the young animals. Research on the connections between calves healths coupled with management choices might help shape procedures and protocols for bettering calf health, particularly in sicker calves after a challenging delivery (37). The west of Canada and to look into the relationship between the demographic characteristics of the herd and the incidence of calving support, sickness, death and the use of calving and colostrum administration methods at the herd level (38). The study offered that they lack immune-globulin, newborn calves primarily depend on colostrum to deliver immunological components for their first defence (39). Poor colostrum management techniques, such as how the colostrum is stored on the farm and how it is fed, can have an impact on the immunological components of the colostrum, in turn, the newborn calf's immune condition. The study examined the associations between calf health and management practices, mortality, microclimatic conditions along with the calves' air quality were investigated using data from 25 dairy farms in Italy (40). It turned out that calf health and mortality, pen design, placement, temperature, humidity as well as certain management techniques were connected to the microbiological air quality in the pens.

CONCLUSION

In the dairy business, the practice of prematurely taking calves from their mothers has drawn ethical criticism and put the sector at a critical crossroads. A final sample of 40 published English-language studies addressing the health of cows and calves in the systems was found using stringent inclusion criteria. A variety of health indicators were the study's primary focus, with scour-related problems receiving special attention. Furthermore, there is a lack of research to support the idea that separating dams and calves right away might help to reduce the risk of a number of diseases. Future research might examine how precision livestock farming methods can be used to create prediction models that improve dairy herd healthcare management overall.

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