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Disease incidence in dairy herds in the southern highlands district of New South Wales, Australia

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Abstract

The purpose of this study was to determine clinical disease incidence in eight non-seasonally calving, pasture-fed dairy herds in the southern highlands district of New South Wales. This was a longitudinal population study. The study included all cows that calved between January 1994 and December 1995 and consisted of 2111 lactation records from 1430 cows. The incidence of the more common diseases were: calving-associated disorders, 18.0 cases per 100 calvings (95% CI 16.4–19.8 cases per 100 calvings); metabolic disorders, 5.5 cases per 100 cow-yr at risk (95% CI 4.5–6.6 cases per 100 cow-yr at risk); reproductive-tract disorders, 22.3 cases per 100 cow-yr at risk (95% CI 19.2–25.8 cases per 100 cow-yr at risk); udder disorders, 17.6 cases per 100 cow-yr at risk (95% CI 15.9–19.5 cow-yr at risk) and lameness, 3.7 cases per 100 cow-yr at risk (95% CI 2.9–4.7 cow-yr at risk). In agreement with dairy-cow disease-incidence studies conducted elsewhere, disorders of the reproductive-tract and udder were the most frequent clinical conditions encountered. These findings confirm that dairy herd-health programs should emphasise the control of these two groups of disorders.

Keywords: Cattle; Disease incidence; Incidence density; Cumulative incidence; Herd-health; Australia

1. Introduction

A benefit of monitoring disease events as part of a herd-health package offered to dairy farmers is that valuable information is accumulated on all diseases that are recognised by either the farmer or the veterinarian. This process provides information of the incidence of clinical disease in an environment where accurate and complete recording of disease

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events can be anticipated (Williamson et al., 1978). A knowledge of the expected levels of clinical disease that should be encountered in dairy herds allows veterinarians confidently to identify situations where higher-than-expected incidences of disease exist and assists in determining priorities for preventive programs. Relating the disease incidence to parity, stage of lactation, previous disease history, and level of production identifies those individuals at risk of developing disease conditions and this assists in the further refinement of herd-health care programs.

In spite of the increased use of microcomputers to record cow event and health data since the mid-1980s (a situation that should facilitate the recording and reporting of dairy-cow disease patterns), studies of disease incidence in Australian dairy herds have been few and published studies have been restricted to those conducted in the late 1960s and 1970s (McClure and Dowell, 1968; Williamson et al., 1978).

The purpose of this study was to determine clinical disease incidence in dairy herds receiving programmed herd-health visits in the southern highlands district of New South Wales, Australia. While purposive selection of herds in this study resulted in a group of higher-producing herds compared to the state average, the data in this study nonetheless provide useful estimates of dairy-cow disease incidence under New South Wales farming conditions. With current interest in food safety, it is conceivable that in the near future, producers of milk for human consumption will be required to provide transparent documentation of herd disease status. A secondary objective of this study was to evaluate the suitability of the disease classification system used in this study for this purpose.

2. Materials and methods

This study was conducted on eight non-seasonally calving dairy herds located in the author's area of practice, in the southern highlands district of New South Wales, Australia (Fig. 1).

This was a prospective longitudinal population study. Herd selection was purposive and was based on the herd manager's demonstrated ability to maintain accurate herd records. During 1992 and 1993, each participant herd began a program of monthly health visits under the direction of the author. The primary purpose of these visits were to maintain herd reproductive efficiency by pregnancy testing cows thought to be in calf and by examining and treating reproductive disorders (Blood et al., 1978; Esslemont, 1994). In some herds, advice was provided on nutritional management, the maintenance of milk quality and the management of replacement stock.

As part of the herd-health program provided, the biographical details of all stock on the farm were entered into the computerised database DairyCHAMP (Udomprasert and Williamson, 1990) and managers were requested to record all important production and health events into a dairy (Williamson et al., 1978). Data entered into the dairies for each individual included dates and descriptions of calvings, heats, services, disease events, treatment events, dry-off events, culling events and the associated reasons for culling. Milk-production records from the New South Wales Agriculture Dairy Herd Improvement (DHI) scheme for each participant herd were downloaded directly into the herd database. Milk-production recording was conducted monthly and included (for each

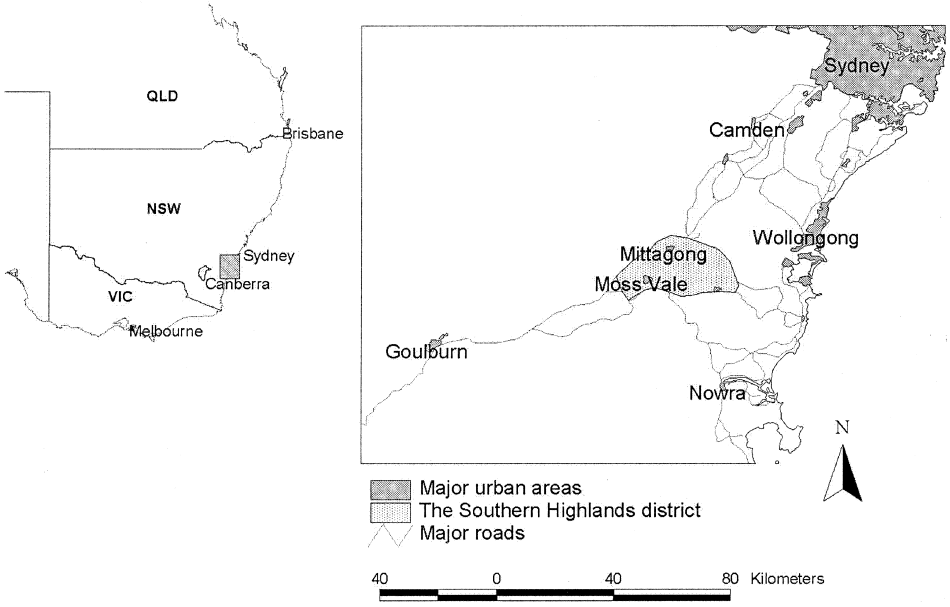

Fig. 1. Map showing the location of the southern highlands district of New South Wales. Abbreviations: QLD — Queensland, NSW — New South Wales, VIC — Victoria.

lactating cow) test-day milk yield (l), test-day fat yield (kg), and test-day protein yield (kg).

Prior to each scheduled monthly herd-health visit, information from the herd dairies was entered into the database by the author. At the time of data entry, a check was made that event information provided was consistent with each cow's previous event history. Where discrepancies were found, clarification was made with manager during the herd-health visit and the corrected event details were re-entered into the database.

Herd managers were instructed to record only disease events that required treatment or direct intervention, according to the definition schedule provided in Table 1. Where a veterinarian attended an animal after a diagnosis was initially recorded by the manager, the diagnosis provided by the veterinarian replaced the initial diagnosis, where appropriate. Managers varied in their ability to differentiate between the different conditions associated with lameness and for this reason lameness disorders were classified according to the location of the causative lesion (that is either the foot, the leg, or elsewhere). The term cystic ovarian disease was used to identify the situation where a cow showed either irregularly short or long interoestrus intervals along with abnormal structures palpable on one or more ovaries. No attempt was made to refine the diagnosis further. Throughout the study period, a few cows ($n = 20$) were treated with intramammary antibiotics on the basis of an elevated individual cow somatic cell count recorded at last herd test. These events were grouped with mastitis events in the disease incidence analyses.

Table 1
Definitions of disease diagnoses

Disease category	Diagnosis	Comments
Calving-associated disorders	Dystocia-assisted delivery	No malposture or foetal oversize reported
	Dystocia-foetal oversize	No malposture; traction required to effect delivery
	Dystocia-foetal malposture	Correction of malposture required prior to delivery
	Dystocia-twins	Twins requiring correction in posture or assistance to deliver
	Obstetric paralysis	Recumbency post-calving accompanied by a history of dystocia and evidence of reproductive tract trauma
	Uterine prolapse	Characteristic clinical signs
Metabolic disorders	Milk fever	Characteristic clinical signs and response to therapy
	Grass tetany	Characteristic clinical signs and response to therapy
	Ketosis	Positive Rothera test and exclusion of a primary cause
Reproductive tract disorders	Reproductive-tract trauma	Characteristic clinical signs
	Retained foetal membranes	Membranes defined as retained if not passed with 24 h after calving
	Uterine infections	Purulent discharge on vaginal examination
	Cystic ovarian disease	History of abnormal oestrus cycles accompanied by abnormal findings on ovarian palpation
Abortion		Foetus/foetal membranes observed and/or oestrus detected after positive diagnosis of pregnancy
Udder disorders	Mastitis	Clinical mastitis or elevated individual-cow somatic-cell count warranting, in the herd manager's opinion, intramammary therapy
	Teat disorders	Includes teat trauma, teat peas, blind quarters, teat lesions
	Udder disorders	Includes ruptured suspensory ligaments, udder oedema
Locomotor disorders	Foot disorders	Any condition affecting the foot (footrot, solar bruising, foot abscess)
	Leg disorders	Any condition affecting a limb proximal to the foot (injuries, joint problems)
	Other musculoskeletal disorders	Any condition causing lameness where the primary lesion is neither the foot or the leg (injuries, disorders of the spine)
Miscellaneous disorders	Rumen disorders	Includes acute indigestion, bloat, vagal indigestion
	Abomasal disorders	Includes left and right abomasal displacements, abomasal ulceration
	Lower digestive-tract disorders	Includes diarrhoea, intestinal obstruction, intestinal volvulus
	Hepatic disorders	
	Respiratory-tract disorders	
	Miscellaneous conditions	Includes pinkeye, septicaemia, localised abscesses, woody tongue, lumpy jaw

At the start of the study period (1 January 1994), all participating managers had been on the herd-health program for a minimum of 6 months and were familiar with the process of maintaining a dairy and recording the appropriate disease diagnoses, if they were encountered. Each cow that calved after 1 January 1994 and before 31 December 1995 was enrolled in the study. After 31 December 1995, each cow was monitored until it was removed from the herd or until a calving event occurred — whichever occurred first. Data recorded in DairyCHAMP was exported to the data management software Microsoft Access for Windows Version 2.0 (Microsoft, Redmond, USA) for calculation of disease incidence.

Incidence density (ID) was defined as the total number of episodes of disease divided by the total number of cow-yr at risk, expressed as cases per 100 cow-yr at risk (Dohoo et al., 1983). For reproductive disorders, the period between calving and conception (or date of removal from the herd if the cow was not pregnant at the time of removal) was considered to be the time at risk. For each disease, a minimum time had to elapse between two disease episodes in order for them to be considered as two separate diagnoses (Dohoo et al., 1983). The minimum times were: reproductive-tract infections, 2 weeks; mastitis, 1 week; teat disorders, 2 weeks; lameness, 2 weeks; digestive-tract disorders, 1 week; respiratory-tract disorders, 2 weeks; and abortions, 100 d.

Only one episode of each disease event was recorded per lactation for disorders associated with calving, and for these conditions cumulative incidence (CI) was used (Dohoo et al., 1983). For abortions, the incidence measure was cases per 100 confirmed pregnancies.

3. Results

3.1. Farm characteristics

Approximately 17% of the state's dairy cattle population of 91 000 head are grazed in the southern highlands and adjoining south coast region of New South Wales. The average herd size in this study ranged from 115 to 173 adult cows. In seven of the eight herds, Holstein–Friesian was the only breed; the eighth herd was made up of an equal mixture of Holstein-Friesians and Australian Illawarra Shorthorns. All farms produced milk that was sold under a quota system to a single dairy-herd co-operative as milk to be used for human consumption. The daily milk quotas for these herds ranged from 1200 to 1900 l per day. Milk production was the primary source of income for all farms in this study. In three of the herds, the sale of surplus heifer replacement stock was a (minor) source of additional income. All farms had been established for at least 15 years and were, in all cases, staffed by two full-time managers.

3.2. Cow husbandry

Cows grazed a pasture mixture of ryegrass and clover all year round. Pasture provided, on average, approximately 70% of the daily energy intake. Small amounts (approximately 2–8 kg per cow per day) of grain-based concentrates fed at milking time provided the

remainder of daily energy requirements. In times of pasture deficit, varying amounts of hay and/or grass silage were fed as supplements. Grass silage, if it was used, was made on-farm; hay was purchased.

3.3. Milk harvesting

Cows were milked twice daily in herringbone milking parlours. Milk yields were measured once monthly by the New South Wales DHI association and assisted herd managers to make drying-off and culling decisions based on production. Managers used a variety of measures to maintain milk quality including teat-dip application at the end of milking and dry-cow antibiotic therapy. To identify cows with subclinical mastitis, all managers used the California Mastitis Test in combination with the results of individual cow somatic-cell counts measured at every second herd recording.

3.4. Breeding practices

These were non-seasonally calving dairy herds. All herds used artificial insemination for at least the first one to three services after calving. Cows that failed to conceive after three services were run with a bull for the duration of standing oestrus in six herds. Artificial insemination was used as the only method of breeding in the other two herds.

For oestrus detection, managers relied on observing their cows during milking and grazing. Kamar heatmount detectors® (ImmuCell, Portland, USA) were used on selected cows. Teaser bulls were not used in any of the herds.

3.5. Replacement management

All farms reared their own heifer replacements. Calves were left with the cow for up to 24 h after birth and were then bucket-fed on whole milk. Calves were weaned at 6–8 weeks of age when they were sent to grazing (usually to an area owned by the farmer separate from the main farm). Six of the eight farms used outdoor calf hutches to rear unweaned calves during the study period.

3.6. Study cohort

During the study period, 1430 cows were monitored over 2111 calving events — resulting in a total observation period of 745 611 cow-d (2043 cow-yr). For reproductive disorders, the total time at risk was 291 374 cow-d (798 cow-yr). During the study period, 588 cows entered the cohort (all as primiparous cows), and 522 (25% of the total of the total lactations started) were terminated by removal from the herd.

Descriptive statistics of 305-day milk yield (l), 305-day milk fat yield (kg), and 305-day milk protein yield are shown in Table 2. For all parity groups, 305-day milk, fat, and protein yields were greater (by inspection) than the New South Wales DHI state average for 1994–1995 (New South Wales Agriculture and Fisheries, 1995).

Table 2
Descriptions of 305-day milk, fat and protein yields by parity group in studied southern highlands dairy herds ($n = 1901$ complete lactation records from eight herds in New South Wales (NSW), Australia)

Production variable	Parity group								NSW DHI mean 1995
	1		2		3–6		≥7		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
305-d milk (l)	5811	955	6662	1180	7365	1243	6994	1037	5736
305-d fat (kg)	222	37	252	46	279	49	263	49	215
305-d protein (kg)	188	30	218	37	239	39	227	34	182

3.7. Incidence measures

Incidence measures were calculated by diagnosis category and by individual codes (Tables 3 and 4, respectively). Among the disease categories, calving-associated disorders, reproductive disorders and udder disorders were the most frequent disease events.

4. Discussion

4.1. Sources of bias

Random selection of farms for this study was not possible as a result of the continuous co-operation that was required of the participant herd managers. Purposive selection therefore appears to have in a set of higher-producing herds compared with the New South Wales DHI association average for the same period. This bias may therefore limit the generalisation of the results of this study to the target population of New South Wales dairy herds. A further source of bias is that all of the participant herds received monthly

Table 3
Between-herd variability in disease incidence in studied southern highlands dairy herds ($n = 8$)

Disease category	Mean	SD	Median	Minimum	Maximum
Calving-associated disorders[a]	18.0	11	15.3	5.0	42.3
Metabolic disorders[b]	5.5	1	5.2	3.9	8.7
Reproductive tract disorders[c]	22.3	11	19.1	8.2	38.7
Abortions[d]	2.3	1	2.1	0.9	4.2
Udder disorders[b]	17.6	11	17.3	6.5	33.1
Locomotor disorders[b]	3.7	3	3.0	0.0	8.2
Miscellaneous disorders[b]	4.1	3	4.1	1.5	9.6

[a] CI: Cases per 100 calvings.
[b] ID: Cases per 100 cow-yr.
[c] Cases per 100 cow-yr open.
[d] Cases per 100 confirmed pregnancies.

Table 4
Total period at risk, cumulative incidence or incidence density (and 95% CI) and time to first diagnosis (from calving) for each of the common diseases in studied southern highlands dairy herds ($n = 8$)

Disorder	Total period at risk	Incidence	95% CI[a]	Days to first diagnosis[b]		
				Q1[c]	Median	Q3[d]
Calving-associated disorders[e]	2111 calvings					
Assisted delivery		12.6	11.2–14.1	0	0	0
Foetal oversize		1.2	0.8–1.7	0	0	0
Foetal malposture		0.4	0.2–0.8	0	0	0
Retained foetal membranes		3.1	2.4–3.9	1	1	5
Obstetric paralysis		0.5	0.3–0.9	0	0	0
Uterine prolapse		0.1	0.0–0.4	0	0	0
Metabolic disorders[f]	745611 cow-d					
Milk fever		5.2	4.0–6.7	0	0	1
Grass tetany		0.1	0.0–0.4	3	6	19
Ketosis		0.05	0.0–0.3	28	28	28
Reproductive-tract disorders[g]	291374 cow-d					
Tract trauma		1.6	0.9–2.8	0	27	72
Uterine infections		19.9	16.9–23.3	14	34	99
Cystic ovarian disease		0.7	0.3–1.6	72	125	212
Abortions[h]	1674 pregnancies	2.3	1.7–3.2	147[i]	174	210
Udder disorders[f]	745611 cow-d					
Mastitis		16.4	14.7–18.3	3	37	129
Teat disorders		1.1	0.7–1.7	24	104	177
Udder disorders		0.05	0.0–0.3	25	49	74
Locomotor disorders[f]	745611 cow-d					
Foot disorders		3.5	2.7–4.4	32	103	209
Leg disorders		0.1	0.0–0.4	19	37	165
Other musculoskeletal disorders		0.1	0.0–0.3	13	26	40
Miscellaneous disorders[f]	745611 cow-d					
Rumen disorders		1.1	0.7–1.6	25	49	112
Abomasal disorders		0.3	0.1–0.6	26	43	138
Lower digestive tract disorders		0.5	0.3–1.0	17	59	134
Hepatic disorders		0.2	0.0–0.6	316	316	316
Respiratory tract disorders		0.1	0.0–0.4	37	70	102
Other conditions		1.3	0.8–1.9	17	81	167
Undiagnosed illness		0.5	0.2–0.9	27	50	150

[a] Fleiss quadratic 95% CI.
[b] Days from calving to first diagnosis.
[c] Q1: 25th percentile.
[d] Q3: 75th percentile.
[e] CI: Cases per 100 calvings.
[f] ID: Cases per 100 cow-yr.
[g] Cases per 100 cow-yr open.
[h] Cases per 100 confirmed pregnancies.
[i] Days from conception to diagnosis.

herd-health visits and this may have resulted in higher estimates of reproductive-tract disorders compared with those studies conducted by questionnaire only.

Bias originating from managers forgetting to record events or misclassifying events is an obvious problem in this type of study. To provide useful data, participant herd managers underwent a period of training to become accustomed to recording details of all animal-health events. To assist this process, it was necessary to provide simple and concise definitions for each of the common disease conditions; during the training period, it was necessary to scrutinise the herd-dairy information to clarify that each disease event recorded matched the condition that was actually encountered. During the training period, this process was intensive (requiring at least 30 min of attention at each herd visit). Once managers were accustomed to the system, scrutiny of herd records was still necessary although the time taken to complete the process was less, at the most 10 min at each herd visit. Regular contact with the participant farmers, regular feedback of their herd performance and anonymous comparison of reproductive performance, production, and disease incidence levels with their peers maintained interest throughout the period of study and enabled (what I believe to be) a high level of data quality to be obtained.

4.2. Disease incidence

During data entry into the DairyCHAMP program, it was necessary to review the disease-event history of each cow to ensure that the necessary time had elapsed between similar disease events (that is, to account for a recovery period). An improvement to this software package would be a warning to the user (at the time of data entry) that a second disease diagnosis is being entered within a pre-defined recovery period. No detailed documentation of DairyCHAMP's method of calculating disease incidence was available and because of this it was necessary to export the raw event data into a data-management program. To facilitate further studies of this nature, it would be helpful if consensus was reached regarding the calculation of incidence for the various dairy cow diseases and that these methodologies be transparently applied to dairy-cow herd-health software packages. If this situation eventuated (and provided that similar disease definitions were used), dairy-cow disease-incidence studies drawn from wider geographic areas and using greater numbers of herds would be possible.

The incidence of each of the major disease categories varied across herds with wide variations recorded for calving-associated disorders, udder disorders and reproductive tract disorders (Table 3). With respect to calving-associated disorders, a large part of the between-herd variation was accounted for by those calvings where delivery was assisted in the absence of any foetal oversize or malposture — a finding that reflects differences in the intensity of husbandry provided by each of the participant herd managers. Variation in the incidence of udder disorders and reproductive-tract disorders between herds reflects differences in managerial styles and skill at controlling each of these conditions (Faye, 1991).

A comparison of the results reported here with other published data is shown in Table 5. Care must be taken in making detailed comparisons between disease-incidence studies in dairy cattle because differences exist in the health conditions that have been recorded,

Table 5
Comparison of disease incidence in dairy cows (ID per 100 animal-years)

Disease category	Switzerland[a]	Michigan[b]	Australia[c]	This study
Calving-associated disorders	8.9	13.8	NR[d]	18.0
Metabolic disorders	11.6	10.2	3.9	5.5
Reproductive tract disorders	152.2[e]	49.9	14.0	22.3
Udder disorders	40.5	33.1	15.3	17.6
Locomotor disorders	16.4	6.6	NR	3.7
Miscellaneous disorders	NR	NR	10.2	4.1

[a] Frei et al. (1997).
[b] Kaneene and Hurd (1990).
[c] Williamson et al. (1978).
[d] NR: not reported.
[e] Included non-clinically apparent reproductive tract disorders such as non-visible oestrus.

the criteria used to define health disorders and the way disease incidence has been reported. Although the magnitude of incidence varied between studies, the relative importance of disease categories was similar with reproductive-tract and udder disorders being the most important. While the overall incidence of reproductive disorders is low in this study compared to others (Dohoo et al., 1983; Gröhn et al., 1989; Frei et al., 1997), it should be appreciated that only cases of identifiable reproductive-tract pathology were recorded — ignoring events such as cows presented for anoestrus post-calving and for failure to conceive.

5. Conclusion

Detailed monitoring of disease events and animal treatments was possible in this group of herds but required commitment on the part of the herd manager, a 3–6 month training period to become familiar with the recording system and close and regular contact with the herd veterinarian. Given these strict provisions, it is my belief that the system of disease classification used in this study is suitable for dairy-herd managers wishing to provide complete documentation of their herd's disease status.

The software used to record animal-event, disease and production data was well-suited for this type of study (although a more comprehensive description of the method used to calculate disease incidence within the package would have been helpful). To facilitate larger-scale studies of dairy-cow disease incidence, definitions of animal disease need to be agreed upon across data-collection centres and similarly, disease-incidence calculations need to be standardised.

In agreement with dairy-cow disease-incidence studies conducted in other parts of the world, disorders of the reproductive tract and udder were the most frequent clinical conditions encountered. These findings confirm the conclusions of other studies that dairy herd-health programs should be emphasise the control of these two groups of disorders.

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