



# Which herds benefit from using teat sealants?

Teat sealants provide a non-antibiotic approach to protecting uninfected cows from environmental mastitis bacteria during the dry period. They are inert compounds that physically prevent bacteria from entering the udder through the teat end, an intervention that mimics the natural defence mechanism of a keratin plug, closing each teat canal at drying-off.

External teat sealants, where an artificial polymer or latex skin is sprayed over the teat end, have been used with limited success as they tend not to persist on the teat for more than a few days or weeks (Hayton and Bradley 2001). In contrast, field trials overseas have shown that infusing non-irritant, insoluble material into the udder at drying-off is very effective in preventing new infections of environmental mastitis bacteria during the dry period and at calving.

Teat sealants have been used in New Zealand herds since 1996 and more than 400,000 tubes are sold there annually. The first commercially available teat sealant in Australia was launched at the end of 2002. Dairy farmers and their advisers now need to know where teat sealants fit in their dry cow strategies and the practicalities of using them. Because there is no Australian research or experience with the product, this information comes from overseas.

## How teat sealants work

The teat sealant available in Australia (marketed by Pfizer and known as Teatseal<sup>®</sup> locally or Orbeseal<sup>®</sup> on some overseas markets) does not contain antibiotic and is composed of 4 grams of 65% w/w bismuth subnitrate in a paraffin base. This viscous material sinks to the lower teat sinus after infusion and remains there without hardening or setting until it is removed by suckling calves or by manually stripping the quarter.

Teat sealants protect cows that have open teat canals and are therefore vulnerable to infection – especially in the early dry period before the keratin plugs have formed in the teat canals and around calving when they have been lost from many teats. The benefits could be significant as typically 50% of teat ends remain open seven days after drying-off and 5% of teat ends never close (Williamson et al 1995).

Overseas studies have shown repeatedly that teat sealants protect uninfected quarters from becoming infected with clinical and subclinical mastitis during the dry period (Berry and Hillerton 2002, Huxley et al 2002, Williamson 2001, Woolford et al 1998).

### Confidence – Moderate

Overseas results show that internal teat sealants protect uninfected cows. Although there is no experience with applying the technology in Australian dairy herds, it has been successfully used in New Zealand.

### Research priority – High

It is important to understand practical issues that determine the success of using teat sealants in Australian dairying systems.

A model that enables advisers to assess the cost benefit of dry cow strategy options in individual herds would be useful.

Bismuth is a heavy metal used in many industrial, pharmaceutical and cosmetic processes.

### Outcomes of overseas field trials of non-antibiotic teat sealant (4 g of 65% w/w bismuth subnitrate in a paraffin base) used at drying-off to protect uninfected cows

Outcome	Result	Investigators	Comment
New intramammary infection during the dry period (as measured by milk cultures taken at drying-off and calving)	Less in cows treated with teat sealant than in untreated cows (21/197 vs. 62/201, $p < 0.001$ ).	Berry and Hillerton 2002 (United Kingdom) <sup>a</sup>	<i>Strep uberis</i> was the predominant isolate causing new infections in both the teat sealant and untreated cows.
	Less in teat sealant than antibiotic-treated quarters (103/928 vs. 145/940, $p < 0.01$ ). No significant difference when analysed at the cow level (81/232 vs. 100/235).	Huxley et al 2002 (United Kingdom) <sup>a,b</sup>	Although the incidence of new <i>Strep uberis</i> infection was similar in both groups, there was a significantly higher new infection rate with <i>E coli</i> in quarters (and cows) treated with antibiotic ( $p < 0.01$ ).
	Less in teat sealant than untreated quarters (37/659 vs. 74/662, $p < 0.01$ ).	Williamson 2001 (New Zealand)	<i>Strep uberis</i> caused most (69% of) new infections in untreated quarters. Coagulase negative staphylococci accounted for 73% of isolates in teat sealant quarters.
Clinical mastitis during the dry period	Less in teat sealant than untreated cows (0/197 vs. 6/204, $p = 0.0167$ ).	Berry and Hillerton 2002 (United Kingdom) <sup>a</sup>	
	Too few cases to assess differences between teat sealant and antibiotic-treated quarters (0 vs. 2).	Huxley et al 2002 (United Kingdom) <sup>a,b</sup>	
	Less in teat sealant than untreated quarters (6/659 vs. 37/662, $p < 0.01$ ).	Williamson 2001 (New Zealand)	More than 95% of isolates from quarters clinically affected with mastitis during the dry period were <i>Strep uberis</i> .
Clinical mastitis in the first 100 days after calving	Less in teat sealant than untreated quarters (1/505 vs. 18/528, $p < 0.01$ ). Too few cases to assess differences between teat sealant and antibiotic-treated quarters (1/505 vs. 2/528).	Woolford et al 1998 (New Zealand) <sup>b,c</sup>	All new clinical infections during the dry period were due to <i>Strep uberis</i> .
	Equivalent for teat sealant and untreated quarters (figures not given)	Berry and Hillerton 2002 (United Kingdom)	
	No significant difference between teat sealant and antibiotic-treated quarters (30/948 vs. 35/968). Over the first two months of lactation, less in cows treated with teat sealant than in untreated cows (6 vs. 22, $p < 0.01$ ).	Huxley et al 2002 (United Kingdom) <sup>b</sup> Woolford et al 1998 (New Zealand) <sup>b,c</sup>	The particular pathogens responsible for the clinical infections after calving were not determined.

a. 'Minor pathogens' (including coagulase negative staphylococci and *Corynebacterium* spp) were excluded from analysis in the United Kingdom studies

b. The active ingredient of the antibiotic used in these studies was 250 mg cephalonium (Cepravin®, Schering-Plough)

c. There were four treatment groups in Woolford's study: untreated quarters, teat sealant, long-acting antibiotic and teat sealant plus the antibiotic cloxacillin.

The size of the treatment benefit varies between herds, probably depending on factors such as the level of exposure to environmental pathogens and the proportion of teat ends open at the beginning or end of the dry period. The average benefit to the New Zealand herds was a 2 to 5-fold reduction in new intramammary infections (compared to untreated quarters), and more specifically, a 10-fold reduction in *Strep uberis* infection. The protection that teat sealants confer against *Strep uberis* during the dry period is an important finding (Berry and Hillerton 2002, Woolford et al 1998, Williamson 2001) given that this bacteria is a common environmental pathogen in the United Kingdom, New Zealand and Australia.

Two studies have compared teat sealants with the traditional means of prophylaxis, using a long-acting antibiotic formulation of Dry Cow Treatment (Huxley et al 2002, Woolford et al 1998). Antibiotic Dry Cow Treatment is very efficient at preventing new infections over the dry period and at calving, and is thought to protect cows by eliminating bacteria in the teat canal, promoting closure of the teat canal, and killing any environmental pathogens that enter the teat canal prior to the formation of the keratin plug (Woolford et al 2001). Teat sealants provided equivalent levels of protection to Dry Cow Treatment in the New Zealand study, whereas Huxley's group found they were more efficient at protecting quarters from *E coli* infections during the dry period. The reason for the superior performance of teat sealants in Huxley's study is not known, but could possibly arise from exposure to pathogens late in the dry period or use of a broad spectrum antibiotic with less than complete efficacy against Enterobacteriaceae.

More information is required to establish how long the benefits of using teat sealants extend into the subsequent lactation as there was insufficient power to detect differences between treatment groups in early lactation in recent studies (Huxley et al 2002).

The outcomes of the overseas field trials may not be directly transferable to the Australian system of dairying because of differences in the environment and drying-off and pre-calving management of cows. As teat sealants are adopted as a dry cow strategy option in Australia, it will be important to establish what factors are important for success.

## Herds that will benefit from using teat sealants in their dry cow strategy

With the advent of teat sealants, Australian dairy herds now have three dry cow strategy treatment options:

- blanket antibiotic Dry Cow Treatment of all cows;
- selective antibiotic Dry Cow Treatment of infected cows and teat sealant in uninfected cows; and
- selective antibiotic Dry Cow Treatment of infected cows.

Strategies using selective antibiotic Dry Cow Treatment and teat sealants require decisions about the likely infection status of individual cows and should only be considered by herds participating in milk recording (or an equivalent level of diagnostic testing).

A global perception of the need to reduce antibiotics in food producing animals prompted the research into teat sealants (although JETACAR 1999 found there was a low risk of antibiotic use in dairy cattle contributing to the development of resistance in human pathogens). As such, teat sealants will be an attractive option for many dairy farmers – especially those catering for niche markets, such as organic produce.

In Australia, teat sealants are being sold through veterinarians (although they are an unscheduled veterinary medicine) to ensure they are appropriately placed in a herd's dry cow strategy. The challenge for veterinarians is to be able to advise their clients of the most suitable dry cow strategy for their herd.

Teat sealants are designed to protect uninfected cows in low-prevalence herds; and at risk of infection during the dry period. The rules of thumb used to ascertain these conditions are outlined in the revised Fact Sheet C (February 2003) of the Countdown Downunder Farm Guidelines for Mastitis Control on the opposite page.

### Identifying uninfected cows in low prevalence herds

The prevalence of mastitis in the herd gives the first indication of whether cows in the herd are likely to be free of mastitis. By definition many cows in high prevalence herds have mastitis, including some of the cows that test negative to the commonly used diagnostic tests. In Australia, the prevalence is regarded as high if more than 25-30% of cows in the herd have mastitis. Teat sealants are only recommended for use in herds that do not have a high prevalence of mastitis. They should not be used in herds where the prevalence of mastitis is uncertain.

For practical purposes, cows in low prevalence herds that are likely to be free of subclinical mastitis are identified by Individual Cow Cell Counts (ICCC) and their history of mastitis. The recommendation for using teat sealants in Australia is that cows have had no episode of clinical mastitis in the current lactation and at least three cell counts below 250,000 cells/mL.

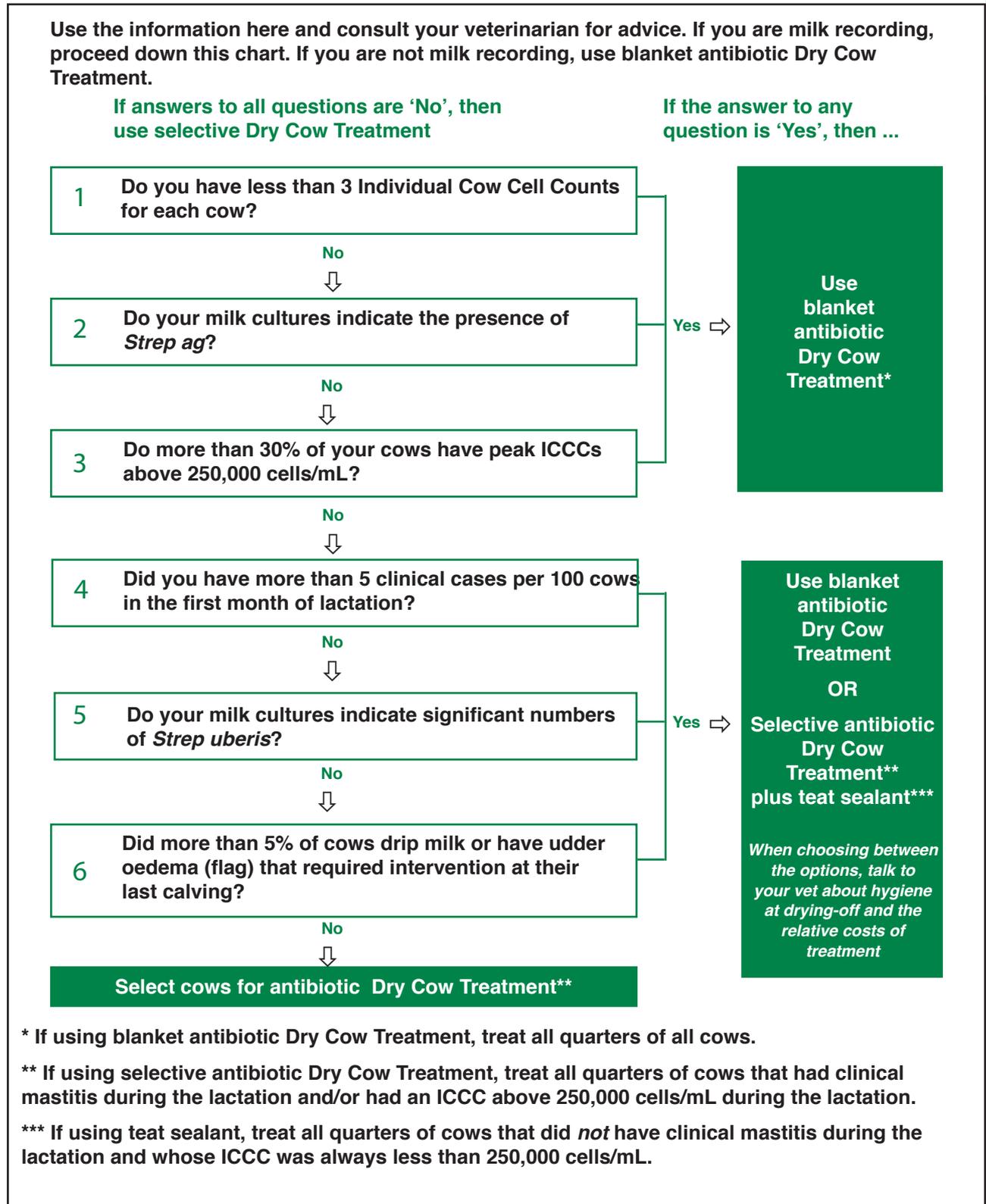
The ICCC threshold used to define an infected cow in Australia differs from the thresholds used in New Zealand (150,000 cells/mL for cows) and in the United Kingdom research herds (200,000 cells/mL). It was chosen by the Australian dairy industry to minimise use of dry cow antibiotic in uninfected cows because, in low prevalence herds, most cows with peak cell counts above 250,000 cells/mL will be infected.

### Identifying herds at risk of infection during the dry period

Only uninfected cows should be treated with teat sealants.

Technote 12, page 5, describes how different ICCC thresholds affect mastitis diagnosis.

Guide to choosing an appropriate dry cow treatment strategy from revised Fact Sheet C (February 2003) of the *Countdown Downunder Farm Guidelines for Mastitis Control*.



Herds that lead feed or have high producing cows are more likely to have cows that drip milk and are at greater risk of being infected with mastitis around calving.

The Mastitis Investigation Pack in revised Technote 13 (February 2003) contains information on clinical case rates and udder condition (Sheet B), milk cultures (Sheet C) and environment at calving (Sheet M) to help assess dry cow strategy.

Technote 4.13 discusses the management of three-teater cows at drying off.

Use Fact Sheet B of the *Countdown Downunder Farm Guidelines for Mastitis Control* to train clients in the correct way to give intramammary treatments – as it is equally relevant for administering internal teat sealants.

Technote 17.1 advises batching cows at drying-off, with one person handling about 20 cows per hour, to ensure the standard of treatment is maintained.

Do not massage the udder after infusing teat sealant as the material must sit in the teat sinus to be effective.

As environmental conditions over the dry period and at the next calving are not known at the time of drying-off, the risk of acquiring new infections is based on previous observations and experience with the herd and farm. Field experience in Australia is that cows that have tight, swollen, dripping udders at calving are likely to be at risk of acquiring environmental mastitis infections. This is consistent with previous work that found cows leaking milk at drying-off were more likely to develop clinical mastitis in the early dry period (Schukken et al 1993).

Herds where it is appropriate to use teat sealants have the option of blanket antibiotic Dry Cow Treatment (see Fact Sheet C). If advisers are confident of the infection status of cows in the herd and the herd management – and the cost of teat sealant is similar to a long-acting antibiotic Dry Cow Treatment – then the choice is a personal one. Use of teat sealants as the means of prophylaxis helps reduce (the sometimes complex) management issues associated with antibiotic Dry Cow Treatment at calving.

### Practical aspects of using teat sealants

Teat sealants should be administered immediately after the last milking at drying-off to all four quarters of susceptible cows. It is not appropriate to use teat sealants in three-teater cows.

Heifers have been treated three weeks before calving in field trials in New Zealand, but the size of the treatment benefit (about half the reduction in new infection rate observed in adult cattle) was outweighed by the risks to both the operators and heifers (personal communication Murray Woolford).

#### The importance of using good hygiene at administration

Researchers and veterinarians experienced in using non-antibiotic teat sealants stress the importance of using a good aseptic technique because of the potential to introduce bacteria into the teat with any treatment given through the teat canal.

Veterinarians should not recommend teat sealants in situations where the infusion presents an infection risk: for example if farm workers have not been adequately trained in administering intramammary treatments, are not likely to have sufficient time to do the job properly or do not have access to clean facilities.

The teat sealant material can become very thick and difficult to administer in cold weather. Under no circumstances should the tubes be directly placed in warm water as they can become contaminated with bacteria. To assist infusion, the options are to place the tubes in a warm environment prior to use (such as a warm room) or to immerse the product container in a larger bucket containing hot water (a bucket in a bucket).

As with all intramammary treatments, udders should be checked for swollen quarters each day for a week after the infusion, as recommended in Guideline 18 of the Countdown Downunder Farm Guidelines for Mastitis Control.

### The consequences of inadvertently treating infected cows

Although there is limited published information, there must be considerable field experience with the consequences of using teat sealant in cows with existing intramammary infection given the potential for misclassifying infected cows as uninfected. Authors of a recent study did not observe clinical mastitis during the dry period or at calving in any subclinically infected quarters that were treated with teat sealant (Berry and Hillerton 2002). The cost of using teat sealant in infected cows appears to be economic rather than clinical, arising from the lost opportunity for curing existing infections during the dry period and the risk of building up a subclinical reservoir of mastitis infection in the herd.

The intentional use of teat sealant in quarters likely to be infected with mastitis is off-label and any veterinarian recommending this must fully explain the consequences to their client.

### The advantages of treating cows with teat sealants and antibiotics

The farming community is asking whether uninfected cows given a combination of antibiotic Dry Cow Treatment and teat sealant have a better level of protection. There is no information on the chemical and physical compatibility of combined treatments, but two trials have used teat sealants immediately after infusing cloxacillin (Godden et al 2003, Woolford et al 1998). No additional protection was afforded to uninfected cows in the New Zealand study (Woolford et al 1998). In the study in the United States, cows given both treatments had a slightly higher level of protection than those given cloxacillin alone but, not surprisingly, the regimen did not increase the cure rate in infected quarters (Godden et al 2003).

### How long teat sealants persist

Internal teat sealants persist in the lower teat sinus in varying amounts until the end of the dry period (at least 100 days) (Woolford et al 1998). Although some cows leak milk despite being treated with teat sealant at drying-off, field observations in New Zealand are that the leaking milk does not appear to expel teat sealants (Williamson 2001). Preliminary reports suggest that the production level of Australian cows at drying-off, which is higher than their New Zealand counterparts, is unlikely to affect the persistence of internal teat sealants.

It is important not to confuse flecks of teat sealant material with clots of mastitis. An easy way of differentiating is by rubbing the material between gloved fingers – teat sealant is greasy and smears away to nothing.

In Australia, Teatseal® (Pfizer) was registered with a:

- Nil minimum dry period
- Withholding period of 96 hours for milk (the minimum statutory period required for withholding colostrum from the vat)
- Nil meat withholding period for the meat of treated cows
- Nil withholding period for the meat of calves that suck from treated cows.

### Managing residual teat sealant material at calving

Teat sealant material is visible in the foremilk of all treated quarters after calving with flecks persisting up to three weeks in some quarters (Berry and Hillerton 2002), and is removed by sucking calves or manually at milking. Although some calves may have difficulty sucking treated cows, teat sealants pass through the calves without any problems.

Discrete lumps of material should not reach the bulk milk tank if the milk filter is in place (Williamson 2001). After passing through a milk filter, bismuth levels in bulk milk have been reported at 10 parts per million on the first day of lactation declining to less than one part per million by day 5 (Woolford and Williamson 1997). The residual material does not cause any problems for milking machines.

To minimise residual material in milk, Countdown Downunder recommends hand stripping all quarters of newly calved cows to remove teat sealants (wearing gloves) and withholding the colostrum for the statutory 96 hours (8 milkings).

Although there are no requirements associated with the trade of treated cows, it is good practice to identify treated cattle and notify purchasers of the treatment.

### Effects on tests for inhibitory substances

Teatseal® (Pfizer) has no effect on screening tests for antibiotics, such as the Delvotest, and no effect on dairy starter cultures (data on file Pfizer).

## Key papers

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