Technote 7

Applying effective post-milking teat disinfection

In this technote:

Effectiveness and correct application of post-milking teat disinfection

Milk from infected quarters contains bacteria that can contaminate teat cup liners and transfer pathogens to the teat skin of 5 to 6 subsequent cows (Phillips 1982). More bacteria on the teat skin increases the risk that some will gain entry to the gland, increasing the mastitis risk.

Post-milking teat disinfection is the most effective mastitis control measure (Hillerton 1997), by:

- Reducing the bacterial load at the teat orifice and on teat skin and
- Maintaining the teat skin in healthy condition.

Field trials show post-milking teat disinfection reduces new infections by ≥50% for *Staph. aureus* and *Strep. agalactiae* (Bramley 1992), with NZ studies showing similar reductions for *Strep. uberis* (Williamson & Lacy-Hulbert 2013).

In New Zealand, most farmers use spraying as it is considered quicker and easier (Woolford 1995), but teat coverage is critical for efficacy (Pankey & Watts 1983). Dipping is more common in Europe and the US as it is considered more effective for achieving good coverage. It is important that the entire teat barrel (everywhere the liner has touched) is disinfected and not just the teat end.

Investigation of mastitis problems usually requires an assessment of the whole teat disinfection process, including the product used, preparation, storage and handling on farm, and the method and efficiency of application to teats (Ryan 1991). Milking time assessments on 200 poor performing NZ herds revealed only 12% were achieving good teat spraying practices (Joe *et al* 2010). Typical on-farm problems include:

- failure to mix to label recommendations
- failure to measure components accurately
- addition of inappropriate emollients, and other additives
- use of poor quality water
- incorrect or prolonged storage of teat disinfectants
- inadequate coverage of the teat skin.

The presence of *Corynebacterium bovis* in a herd signals inadequate teat disinfection (Bramley *et al* 1976). A high number of cows affected by this minor pathogen can impact the bulk milk SCC (Hillerton *et al* 1995) and can increase the risk of *Strep. uberis* new infections in unprotected glands at dry off (Woolford *et al* 2001). Effective post-milking disinfection can control the spread of *C. bovis* (Pankey *et al* 1996; Hillerton *et al* 1999), although established infections may require an appropriate antibiotic DCT at dry off.

Best practice involves:

- Disinfecting the entire teat barrel (not just the orifice).
- Ensuring appropriate product selection, preparation, and application technique.
- Evaluating disinfection protocols during mastitis investigations.

➜ **Technote 5** provides more information on control of *Corynebacterium bovis.*

① Use a registered teat disinfectant

Teat disinfectants are designated as a veterinary medicine under the ACVM Act (1997).

The Agricultural Compounds & Veterinary Medicines (ACVM) team, administered by the Ministry for Primary Industries (MPI), is the regulatory body that controls the importation, manufacture and sale, and use of agricultural and veterinary chemicals in NZ. Chemicals used in agriculture in NZ must be registered with ACVM unless they meet the criteria for exemption from registration or have another type of authorisation for use (such as approval under a special circumstance approval or trial approval). Note that products applied to the teats of lactating animals are never exempt from registration.

Registered products are assigned a unique ACVM Registration Number that must be displayed on all product labels and advertising materials. The wording required by ACVM is in the form: "Registered pursuant to the ACVM Act 1997, No. A####."

> MPI maintains a list of registered veterinary medicines, agricultural chemicals and vertebrate toxic agents on its website. Consumers may also contact the ACVM industry liaison group to obtain information on the registration details of specific products, via e-mail: approvals@mpi.govt.nz

Product registration

The product registration process involves the review of trial data and technical information to provide an assurance of efficacy and safety with respect to human and animal health, environmental impact and its likely impact on trade relating to the use of the product within the NZ dairy industry. The ACVM standards and guidelines for evaluation of product efficacy, target animal safety (animal welfare), and residue profiles can be downloaded from the MPI website.

The assessment process is both comprehensive and rigorous in scope, covering:

- Chemistry, toxicology and manufacture of the product and its ingredients, including conformance to Good Manufacturing Practice (GMP) and approval of the manufacturing site(s)
- Efficacy of the product in reducing mastitis risk specific to causal organisms and environmental conditions in New Zealand
- Animal welfare with particular focus on irritancy of teat skin under 'normal' and adverse climatic conditions
- Milk residues and milk quality (taint) issues stemming from product use

All claims regarding product efficacy require validation according to the ACVM Standards and Guidelines.

Companies invest considerable resource in registering products and their compliance with ACVM Good Manufacturing Practice standards is regularly assessed through manufacturing plant audit and registration.

Off-label use of registered products

Registered products are assessed for efficacy, target animal safety, and residues when used as stated on the approved label. Use of registered products in a way that is contrary to the label, or "off-label" use, can put animals at risk if the product does not work as intended, and can put farmers at risk of fines covering consequential risk or loss by dairy processors. Examples of such practices include:

- Mixing of a teat disinfectant in a non-compliant fashion e.g. by mixing at a different concentration than what is stated on the label, or with something other than an emollient and water.
- Use of a post-milking teat disinfectant product for pre-milking teat disinfectant, which has not been registered for this use.

Note that product labels carry a regulatory statement that says: "It is an offence for users of this product to cause residues exceeding the relevant MRL in the Food Notice: Maximum Residue Levels for Agricultural Compounds".

➜ **Technote 4.8** describes the off-label use of products under veterinary supervision.

Unregistered products

Unregistered products can be identified by the fact that they have no ACVM Registration Number on the label and are not on the ACVM database. Farmers using unregistered products risk applying ineffective treatments, having chemical residues in milk or meat, and causing harm to the environment, human health or animal health. Supply of un-registered product for sale is an offence under the ACVM act. MPI does not undertake routine inspection to detect unregistered products but relies on reports from industry and the public.

There are cases where there is no registered veterinary medicine that may fit the treatment needs of the animal when used either as approved or off-label. In these cases, an unregistered product can be used, but only when a veterinarian authorises that use under an ACVM exemption (use of human medicines, or specially compounded veterinary medicines) or with an ACVM Special Circumstances approval (trade name product not registered in New Zealand).

Reporting adverse experiences with products

The ACVM act makes provision for surveillance of and enforcement of the regulatory requirements relating to product registration. It is the responsibility of the public, industry stakeholders and other regulatory agencies to notify MPI's ACVM team whenever a breach of registration is suspected or identified. This can include any breach that poses a risk, including risks caused by product inefficacy, safety or animal welfare risks, and residue compliance risks. The conditions regarding enforcement and response are detailed on MPI's website.

② Active ingredients in teat disinfectants

More than 10 different disinfectant active ingredients have been used in teat disinfectants throughout the world since the early 1980's. The **NMC (The Global Milk Quality Organisation)** reviewed and summarised all peer-reviewed literature on teat disinfectants published between 1980 and 2009 (National Mastitis Council 2012).

Most products rely on one active ingredient but there are products that use a mix of active ingredients. Active ingredients currently registered in NZ include:

- iodine
- chlorhexidine
- acid anionic compounds (dodecyl benzene sulphonic acid)
- chlorine and Chloramine T
- lactic acid.

Iodine-based disinfectants

Iodine-based teat disinfectants (or iodophors) contain organic iodine complexes combined with surfactants, detergents and emollients. The antimicrobial spectrum includes bacteria, viruses and fungi. Iodine kills microorganisms through oxidation/reduction reactions that disrupt protein synthesis, nucleotide actions and structure of lipid membranes. Free iodine also reacts with organic material, so the bactericidal activity is reduced when exposed to dirt and milk residues.

Iodine chemistry is complex. Only a small fraction of iodine is present as free iodine (typically 2–3 ppm), which is the bactericidal form. The remaining iodine is bound within complexes to hold it in solution and replenish the free iodine as it is consumed. Measurements of total available iodine do not directly reflect antimicrobial performance, as free iodine is difficult to quantify.

Products must be acidic (pH <6.5) to maintain iodine stability, which can irritate teat skin, so emollients and humectants are commonly included. Surfactants are also added to aid wetting on teat skin and penetration into organic matter and bacterial cells. Iodine-based teat disinfectants have no residual antimicrobial activity once dry, and effective killing may require up to 10 minutes of contact, though activity begins immediately on application.

> Measurement of total iodine concentrations is possible in the field using simple test kits available from teat disinfectant suppliers.

Chlorhexidine

Chlorhexidine gluconate is a colourless, odourless organic compound that is readily soluble in water. A colouring agent is commonly added to aid visibility. Antimicrobial activity is primarily against bacteria, with limited efficacy against viruses and fungi. Some Gram-negative environmental pathogens (e.g. *Pseudomonas*, *Serratia*) show reduced sensitivity to chlorhexidine.

Chlorhexidine binds to lipids in teat skin, where it can accumulate and provide residual protection. It kills bacteria by disrupting bacterial membranes. As a cationic molecule, chlorhexidine reacts with negatively charged ions (e.g. carbonate, phosphate, chloride) present in hard water or chlorinated water, forming inactive complexes. This necessitates higher use rates in hard water. Optimal activity occurs at pH 5.0-8.0 and emollients are commonly added to support teat condition.

Acid anionic compounds (e.g. DDBSA)

Acid anionic disinfectants use anionic surfactants as active ingredients. They have rapid bactericidal action (~30 seconds) against many bacteria, with moderate efficacy against some viruses and fungi. However, at least one active ingredient (dodecyl benzene sulphonic acid, DDBSA) does not effectively control *Corynebacterium bovis* or coagulase negative staphylococci (now non-aureus staphylococci; Pankey *et al* 1984; Pankey *et al* 1985)

The bactericidal action is thought to result from disruption of the cell membranes, causing leakage and cell death. Optimal efficacy occurs at a pH of 2.0-3.0 with effectiveness rapidly declining as the pH rises above 4. Water hardness has minimal impact except in extremely hard water (>400ppm). Emollients are added to mitigate the skin irritating effects of low pH.

Chlorine-based disinfectants

Chlorine compounds provide rapid, broad-spectrum antimicrobial activity. Their effectiveness depends heavily on correct mixing and fresh preparation, as activity declines with storage.

- Acidified sodium chlorite systems generate chlorine dioxide via a chemical reaction between Part A, citric acid and Part B, sodium chlorite.
- Chloramine T (toluenesulfonylamide sodium or Tosylchloramide sodium) is slightly alkaline (pH at or above 8.5) and releases hypochlorite when added to water. This rapidly oxidises bacteria and viruses on contact.

Both forms are highly effective but require strict adherence to manufacturers' instructions.

Lactic acid

Lactic acid is an organic acid produced by fermentation that has been used as a bio-preservative in fermented products and foods. It is also a normal by-product of human and animal metabolism.

Its antimicrobial activity is through acid stress and free radical damage to bacterial cell walls and is most effective against Gram-positive bacteria, particularly when combined with surfactants or other actives. For this reason, lactic acid is often used in multi-active formulations.

A practical consideration is that lactic acid can be particularly corrosive to steel and spray equipment, requiring appropriate material selection and maintenance.

Sensitivity to disinfectants

Bacterial resistance to teat disinfectants is not recognised as a problem at present in NZ although there is some evidence that certain bacteria, particularly Gram-negative organisms, have the capacity to be more resistant to certain disinfectants. The link between use of disinfectants and antimicrobial resistance remains uncertain (van Dijk *et al* 2022).

➜ Key characteristics of these different actives are compared in the Table on the next page. See **section 7** for more on addition of extra emollients to disinfectants.

Characteristics of different active ingredients of teat disinfectants in New Zealand

Characteristics	Iodine	Chlorhexidine	Acid anionics
Mode of Action	Oxidizing agent	Oxidizing agent	Non-oxidative surfactant, disrupts membranes
Gram-positive efficacy (e.g., *Staph. Strep.*)	Excellent	Excellent	Good
Gram negative efficacy (e.g., *E. coli, Serratia*)	Excellent	Moderate (*Serratia* and other Gram negative pathogens can be resistant)	Moderate (less potent than oxidizing agents)
Speed of kill	Rapid (within 30 secs)	Rapid (within 30 secs)	Seconds to <1 min
Organic load tolerance after milking	Moderate (reduced in heavy dirt)	Moderate	Low to moderate
Optimal pH range	4.0 – 5.5	5.0 – 7.0	2.5 - 4.5
Skin conditioning	Requires emollients	Good with added emollients	Requires emollients
Mixing requirements	Simple dilution with water (+/- added emollient). Mix daily or as required	Simple dilution with water (+/- added emollient). Mix daily or as required	Simple dilution with water.
Stability	Good (protect concentrate from heat and sunlight)	Good	Highly stable in concentrate and dilute form

Characteristics	Chlorine dioxide	Chloramine-T	Lactic acid
Mode of Action	Oxidizing agent	Oxidizing agent	Lowers pH, disrupts membranes
Gram-positive efficacy (e.g., *Staph. Strep.*)	Excellent	Excellent	Good, when combined with other actives
Gram negative efficacy (e.g., *E. coli, Serratia*)	Excellent	Excellent	Good, when combined with other actives
Speed of kill	Rapid (within 30 secs)	Rapid (within 30 secs)	Seconds to <1 min
Organic load tolerance after milking	High, even in dirty environments	Low – improved with emollient	Moderate
Optimal pH range	5.0 – 7.0	8.0 - 10.0	3.0 – 4.5
Skin conditioning	Good with added emollients	Good with added emollients	Excellent, often with emollients
Mixing requirements	Requires daily mixing of two products, plus emollient	Mix a powder with water each milking	Simple dilution with water (+/- added emollient). Mix daily or as required
Stability	Working solution stable for 1-3 days. Stable concentrates	Working solution stable for 1-3 days. Concentrate powder very stable	Highly stable in concentrate and dilute form

3 Selection of a teat disinfectant on farm

Farmers should regularly review their satisfaction with the teat disinfectant they are using and avoid making arbitrary decisions about product selection at the time of purchase. Factors to consider are:

Effectiveness:

The industry relies on ACVM's registration process to establish that all products available on the market are effective in New Zealand dairying conditions. Published information on product efficacy is usually available from the product manufacturer.

Particular recommendations may be made by advisers in special circumstances. For example, a herd experiencing a mastitis outbreak with a pathogen such as *Serratia* may be advised to avoid using a chlorhexidine product.

Suitability for a specific farm:

The equipment used to mix and deliver teat disinfectant, the water quality available on farm to mix teat disinfectants, and the ability to store concentrate out of direct sunlight and extremes of cold and heat, which all impact the effectiveness of teat disinfectants.

Section 7.5 summarises the impact of water quality on different products, **section 7.8** the different delivery approaches, and **section 7.10** the service and maintenance requirements.

Occupational health issues:

Adverse reactions in milking staff such as skin reactions (on the hands and exposed skin), respiratory and eye sensitivity problems may be the result of an allergic response to an ingredient in a product, or may result from heavy exposure due to faulty settings, siting of spray equipment or poor operator technique.

The method in use should be assessed, and the type of disinfectant may need to be changed if staff members have adverse reactions. A review is appropriate whenever new staff begin milking.

Teat skin reactions:

Teats should be regularly checked to ensure the skin is supple and in good condition. Corrective changes may involve altering the concentration of emollient or changing the product. It is important to monitor changes closely whenever a new product is used.

If any changes are noted, it is important to report it to ACVM as an adverse event report to help support ongoing post-registration product monitoring and management.

Visibility:

Teat disinfectants which are visible on the teat skin enable operators to more easily assess their success in achieving good teat coverage. Section 7.9 describes how to assess teat coverage. outlines the issues to be addressed regarding application.

Price:

There is considerable variation in the shelf price of teat disinfectant products. To compare prices, it is helpful to calculate the cost per cow per milking.

For manual spraying application, 20 mL per cow per milking is the recommended use rate, so 20 L of made-up solution should be sufficient to spray 250 cows for 4 milkings.

Using this scenario, the cost of teat spraying a cow per milking can generally vary between 2 and 5 cents but can be as high as 10 or 15 cents, depending on the product used, volume of stock purchased, and recipe used.

Shelf life:

When purchasing teat disinfectant products, farmers should ensure that the quantity purchased will be finished prior to the expiry date specified on the label.

Remember to remove expired products to avoid accidental use.

Milk residues:

The ACVM's registration process also ensures that no product available on the market should leave unacceptable milk residues when used according to the label directions.

There have been no problems identified in NZ of residues in milk under normal use of post-milking teat disinfectants.

Problems have been identified when disinfectants have been used in an off-label fashion.

④ Teat disinfectant preparation and storage

Dairy farmers in NZ prepare the majority of teat disinfectant solution from products purchased as concentrates. Only one product is available in NZ as a ready-to-use (RTU) product.

Whether the concentration of the active ingredient in a teat disinfectant's final mix is maintained for hours or days, depends on a complex interaction of factors, including the amount of water in the mix, the quality of the water used, the product chemistry and active ingredient, and the ambient temperature and the ambient temperature.

Some solutions remain stable for long periods under excellent storage conditions. In the case of iodine, the rate of loss of iodine is doubled when the mixed solution is stored at 40°C compared with 30°C or less. The level of available iodine is also reduced if containers are not well sealed to prevent ingress of contaminants, water quality is poor, inappropriate emollients are added, or if the solution is contaminated with milk, dirt or other organic matter.

Water with very high iron and manganese content can affect the stability of prepared teat disinfectant solutions. For this reason, it is strongly recommended that teat disinfectants are made up with water that is used for food contact surfaces in the farm dairy. Farm dairy water standards are defined in the MPI Animal Products Notice: Production, Supply and Processing (MPI 2025). The standard defines limits for acceptable microbiological quality and nominal physical contaminants, as measured by turbidity.

To ensure the stability of teat disinfectants mixed on farms, it is recommended that either:

- Products are mixed in-line so that fresh product is constantly available, or that
- Fresh teat disinfection solutions are made up for use within 3 days, or as recommended on the label.

General requirements for making up teat disinfectant solutions include:

- Use a clean, rinsed container for storage,
- Use a clean, rinsed, dedicated measuring container,
- Only use water sources approved for milk contact surfaces,
- Cover securely to prevent accidental or environmental contamination,
- Store inside, out of direct sunlight and in a cool area; do not store at temperatures >40°C,
- Store stock solution out of direct sunlight and in cool areas.

⑤ Use high-quality water for mixing

Because teat disinfection is such a key part of mastitis prevention, the water used to mix disinfectants must not reduce their effectiveness. Several water quality factors can interfere with the bacterial killing power of teat disinfectants:

- **Alkalinity:** This a measure of the buffering capacity of water and is expressed in parts per million of calcium carbonate ($CaCO_3$). Water with high alkalinity (>500 ppm $CaCO_3$) reduces available iodine in iodine-based disinfectants and alters pH in acid anionic disinfectants.
- **Hardness:** Hard water, containing high levels of cations (such as calcium, magnesium and sometimes manganese) should be avoided as it can reduce disinfectant activity. Hardness is expressed as the concentration of calcium cations (Ca^{2+})
- **Organic Matter:** Water should be clear, odour-free, and free of sediment and suspended solids, as per MPI Animal Products Notice: Production, Supply and Processing (MPI 2025). Organic matter and moderate bacterial loads consume free iodine. Chlorhexidine forms insoluble salts with organic acids and tannins.
- **Chlorine:** High chlorine levels form insoluble salts with chlorhexidine, whilst iodine-based and acid anionic disinfectants are less affected.
- **Iron/Manganese:** These are common in bore water and can interfere with chlorine-based disinfectants and can cause deposits on equipment. For this reason, it should not be used to make up teat disinfectants.

Farm dairy water that is tested regularly and shown to be compliant with the regulatory requirements for water that comes into direct or indirect contact with raw milk is appropriate for mixing teat disinfectants.

Any concerns about water quality should be discussed with the teat disinfectant provider.

Always use dedicated containers for teat disinfectants to avoid contamination from other farm dairy detergents or chlorine residues.

Farm dairy water standards are set out in MPI Animal Products Notice: Production, Supply and Processing (MPI 2025). This requires that water:

- Does not result in microbiological, chemical or physical contamination of raw milk
- Has *E. coli* absent in 100mL
- Has turbidity less than 5 NTU, or equivalent
- Satisfies an approved hazard identification analysis.

When assessing water quality reports, check the parameter being described as both alkalinity and hardness are measured using the same units (parts per million $CaCO_3$). The buffering capacity of a solution is expressed as carbonate content (CO_3) and its hardness is expressed as the concentration of calcium cations (Ca^{2+}).

Testing the final mix of teat disinfectant solutions

For teat disinfectants that are mixed on farm, it is important to be able to regularly check the recipe and procedures for making it up. Automatic mixing systems also require regular maintenance. On farm testing of the final mix is possible - see the teat disinfectant provider for support.

Concentration of the active ingredient in the final mix can also be affected by factors that affect performance of the concentrate, such as temperature-related changes in viscosity, which affects pump delivery systems, incorrect storage conditions, i.e. avoid direct sunlight or extremes of hot and cold, or expiry dates.

⑥ Mix products according to the label directions

Mix teat disinfectants according to label directions. Products have been designed to provide the correct level of active ingredient at the recommended use concentrations. The ACVM registration process for teat disinfectants places a high weighting on performance, and testing is done at the manufacturer's recommended use concentrations.

Often, label statements refer to different application rates relative to weather conditions. These variations relate to the greater level of emollient required for teat condition in adverse weather conditions. More concentrated solutions provide more emollient and greater antimicrobial protection. It is important that on each farm the steps for mixing teat disinfectant are clearly established and the task of mixing is allocated to staff that understand how to do it. Field examination of 200 problem farms (Joe *et al* 2010) found that only 33% of 200 farms were able to make up their teat disinfectants correctly.

The availability of automated mixing systems now provides an option for farms that experience difficulties in mixing solutions consistently. Expiry dates and storage of the stock concentrate out of direct sunlight and away from temperature extremes should also be considered.

The viscosity of some products can vary with ambient temperature, which affects the volume delivered through pump systems in auto-mixing systems. This may mean that less concentrate is drawn into the mixing vessel in winter when the temperature is cold and the product is more viscous, and the opposite can occur in summer. Contact the teat disinfectant equipment supplier for support.

If testing shows the concentration of the active ingredient in the final mix is incorrect, check that:

- the mixing rate used on farm is correct
- components are measured accurately
- the type and amount of emollient used is appropriate
- the water used is visibly free of organic matter and colloid
- the water used is not alkaline or hard
- the stock product is within expiry date
- the stock product is sealed and stored appropriately
- the mix is made up freshly
- the containers used to mix the teat disinfectant are clean.

➜ The DairyNZ **Healthy Udder Guide** provides tips and reminders on the correct way to mix up teat disinfectants.

⑦ Maintain teat condition, by adding additional emollient if required

An emollient is a compound used to soften or condition teat skin. The addition of emollients to teat disinfectant can improve teat skin health and so reduce the likely reservoir of mastitis pathogens in teat sores and cracks, including hyperkeratosis. They have an important role in mastitis control for these reasons.

Many teat disinfectants contain emollients when they are sold, especially those formulated with relatively low pH where skin irritation would be expected without some additional protectant.

Emollients registered for addition to specific teat disinfectants on farms can be found on the ACVM list of registered products, available here on the **MPI website**. Common emollients include food-grade glycerine and sorbitol. Other unapproved materials should not be used.

The overall performance of a teat disinfectant depends on:

- the bactericidal activity of the disinfectant component,
- the skin conditioning properties of the emollient, and
- effective delivery through the teat spray system.

Studies found that:

- addition of up to 9% glycerine in an iodine-based teat dip led to an improvement in teat skin condition in 30 dairy herds in the UK but no further benefit was observed at 24% (Bramley 1981);
- formulations with 10% additional glycerine in an iodine-based teat dip helped reduce *Staph. aureus* colonisation and was associated with faster healing of teat chapping lesions in the US (Fox *et al* 1991, Fox 1992); and
- skin condition in a Danish research herd milked robotically was significantly better when the teat spray contained 8% glycerol compared with 2% glycerol (Rasmussen *et al* 2002).

Addition of emollients has been reported to reduce bactericidal activity, but the evidence is not consistent. Using emollient at a concentration higher than 15% is more likely to affect the viscosity and interfere with delivery of a product through the spray system.

It is recommended that the concentration of total emollient in the final solution should be no more than 15%

Many registered teat disinfectants are marketed with some emollient incorporated. More emollient may be added to bring the concentration in the final mix up to a maximum of 15%, with instructions provided on the label. This should occur in situations of high challenge i.e. when teats are exposed to adverse weather and muddy conditions, and the risk of new infections is high (see Table on next page).

➜ **Technote 9** describes the evaluation of teats and teat lesions.

Recommendations for adding extra emollient

	High challenge	Low challenge
Examples of different conditions	• Wet and cold weather • Muddy pastures • High degree of teat dryness • High level of teat end damage • Bulk milk SCC above herd target • Clinical case rate above target	• Dry and warm weather • Dry pastures • Little teat dryness • Little teat end damage • Bulk milk SCC below herd target • Clinical case rate below target
Emollient concentration	Add extra emollient (5-10%) to provide a total maximum emollient concentration of **15%** in the final mix.	Check if extra emollient is required, to provide an emollient concentration of **5%** in the final mix.

Guidelines for adding emollient

1. As a practical guide, 'no teat spray currently on the market can cope with a NZ spring without extra emollient'.
2. Calculating the amount of emollient to add requires knowledge of:
   - Total volume of made-up teat spray required
   - Concentration of emollient in the teat spray concentrate
   - Final total concentration in the final mix
3. Additional emollient should displace some of the water, not teat spray concentrate.
4. Contact your teat disinfectant supplier to determine emollient concentration in the teat spray concentrate.

➜ The DairyNZ **Healthy Udder Guide** provides tips and reminders on the correct way to make up teat disinfectants.

Example calculation:

Total volume required = 20 litres of made-up product. This is sufficient to spray 250 cows x 2 milkings x 2 days at 20 mL per cow per milking.

Concentrate Product Y contains 23 g/litre iodine and 300 g/litre glycerol, labelled to mix in the ratio of 1 litre concentrate to 6 litres of water (1:6).

When mixed according to label, the solution contains 0.34% of iodine and 4.5% of glycerol (300 g/L x 1/7 of glycerol = 45 g/L). In 20 L of mix, the total amount of glycerol will be 900 g (45 g/L x 20 L).

To bring the emollient concentration up to 15% in the final mix (equivalent to 3000 g in 20 L), add a further 2000 g (approximately 2 L) of glycerol.

Reduce the water by the volume of glycerol added i.e. less 2 L. Volumes in the final mix to achieve 20 litres with 15% emollient and 0.34% iodine are:

3 litres Product Y
2 litres glycerol
15 litres water
= 20 litres total

8 Teat disinfection methods and application

The quality and consistency of application is the single most important determinant of effective teat disinfection. Incomplete teat coverage of every cow at every milking is the most common cause of poor performance.

Achieving consistently good coverage is challenging and depends on both operator technique and equipment choice and maintenance.

Operator factors can be improved by:

- Training all operators on why and how teat disinfectants work
- Ensuring safe access and visibility so teats can be disinfected properly
- Designing work routines to support consistent technique throughout milking.

Equipment factors can be improved by:

- Selecting a disinfectant and delivery system appropriate for the dairy layout
- Regularly checking, cleaning and maintaining the equipment to ensure correct delivery and coverage.

Despite the common saying that 'it is the drip at the end of the teat that's important', coverage is not considered adequate unless there is disinfectant on the whole surface of the teat.

Spraying

Spraying is the most widely used method in NZ, as it integrates easily into the milking routine. Key requirements for effective spraying include:

- Spray from below with a circular motion to coat all sides of all teats.
- Use vertically-directed spray nozzles as they achieve better coverage than horizontally-directed jets.
- Solid-cone spray patterns achieve better coverage than hollow-cone patterns.
- The nozzle openings can become blocked and corroded. They should be checked regularly for blockages and delivery of an even cover of droplets, spreading to ~10 cm diameter when sprayed upwards onto paper from ~10 cm.
- Droplets should not be excessively fine (<10 micrometres in diameter), as drift reduces effectiveness.

Spray systems may be:

- **Manual pressurised units** with approx. 2L capacity, suitable for about 100 cows
- **Semi-automatic systems** where delivery is via a pressurised line, with one or more suspended wand applicators in the milking area
- **Fully automated systems** which are installed at or near the exit bail or under each bail in a rotary, or just after the exit in a dedicated lane, for a herringbone dairy.

Automated systems can produce variable coverage and typically require higher disinfectant volumes. Regular checking is required to ensure teats, and not udders and legs, are being sprayed.

Dipping

Teat dipping involves hand-held dip cups, typically 200-400 mL in size, often with a squeeze bottle and a one-way valve to deliver fresh solution. Immersion of each teat usually ensures full coverage of the teat barrel, provided cups are deep enough and adequately filled. Dip cups should be emptied before refilling rather than topped up.

Dipping can facilitate better and more reliable teat coverage and reduces exposure of operators to aerosols. However, it generally requires more time than spraying when preparation, refilling, and application are considered, so for this reason, it is not commonly used in NZ.

Auto-dipping

Automated dipping systems are emerging in NZ. These systems apply teat disinfectant within the teat cup, immediately before cup removal. The cups are then flushed with sanitised water (e.g. containing peracetic acid) before being made ready for attachment to the next cow. Some systems may discard a small volume of milk to prevent residues entering the vat.

Studies in the US have shown that automated systems can outperform manual dipping when cows' teats were heavily challenged with mastitis pathogens (e.g. *Staph. aureus* or *Strep. uberis*) immediately before milking (Galton 2004). Commercial systems in the UK (Olde Riekerink *et al* 2012) have shown benefits for reducing bulk milk SCC and individual cows SCC.

Volume required

As a general rule, the volume required to achieve good coverage varies by application method:

- Hand dipping – requires **10 mL** of solution per cow per milking
- Hand spraying – requires **20 mL** of solution per cow per milking
- Auto spraying – requires **30-40 mL** of solution per cow per milking
- Auto dipping – requires **14 mL** of solution per cow per milking.

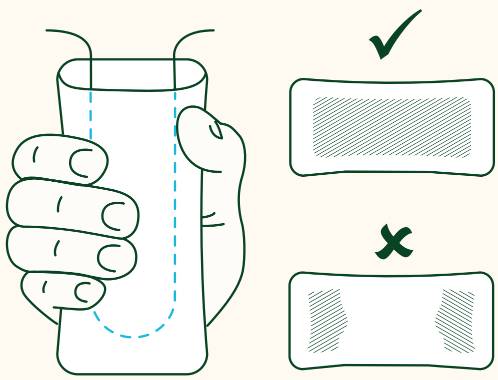
9 Check teat coverage regularly

Careful operators and well-adjusted automated systems can both achieve very good teat spray coverage, but both can perform poorly if technique or equipment is suboptimal. Encourage milking staff to regularly assess their own and others' teat spray coverage. Simple checks include:

- Visual assessment of teat condition for signs of inadequate teat disinfection
- Visual inspection of several cows to confirm if all sides of the teat barrel are being covered.
- Use the paper-towel test to check coverage by wrapping a paper towel around the barrel then carefully removing it to examine the wet or stained area.
- Check the volume of disinfectant used per cow:
    - at least 20 mL per cow per milking for hand spraying
    - 30-40 mL per cow per milking for automated spraying.
    - Calculate by measuring total disinfectant used over two milkings and dividing by total number of cows milked.
- Check application time by, for example, measuring how long it takes to fill an empty 20 mL syringe barrel and comparing this with the time taken for an operator to spray a cow.
- Test the spray pattern of automated or walk-over systems by holding a piece of white card, filter sock or inflated white glove, horizontally at the level of the udder while the sprayer operates.

Regular review of teat disinfection performance with an adviser reinforces correct technique, supports staff training, and maintains awareness of the importance of this task for effective mastitis control.

Checking coverage with a paper towel



⑩ Regularly service teat spray equipment and review use

Encourage farmers to clean and check teat spraying equipment on a regular basis, as some equipment may require daily or weekly checks.

Routine checks for maintenance of teat spraying equipment include:

- ensuring spray nozzles are not blocked or worn,
- checking filters for blockages in the spray line,
- inspecting tubes for any cracks or leaks. Stains on the floor underneath the spray line may alert users to a problem,
- examining each individual spray unit for dirt, damage or corrosion,
- ensuring that the container of stock solution of teat disinfectant does not contain sediment and is protected from environmental contamination.

Encourage farmers to regularly review (e.g. annually) their satisfaction with the teat disinfectant they are using and avoid making an arbitrary decision at the time of purchasing new stock.

Factors to be considered when selecting a product include:

- Skin reactions on the hands and arms of milking staff. Hands should be wetted before being exposed to teat disinfectant, to reduce irritant properties. The type of disinfectant may need to be changed if it has caused dermatitis on hands of any staff in the farm dairy. Products should be reviewed when there are changes in staff. People who wear gloves will have less skin exposure to disinfectants.
- Reaction of teat skin to disinfectants. Teats should be regularly checked to ensure the skin is supple and in good condition. Corrective changes may involve altering the concentration of emollient or changing the product. It is very important to monitor changes whenever a new product is used.
- The concentration and/or choice of active ingredient for the herd situation. Published information on product efficacy is available from the product manufacturer.
- The method of application. If there is a problem with teat coverage, check the equipment and operator technique. Consider changing the method of application (e.g. from auto teat spraying to manual teat spraying) if the problem continues.
- Facilities available for safe and appropriate storage of concentrated products, and correct mixing and storage of the working solution.

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