Technote 13

Investigating a mastitis problem

In this technote:

1. A structured approach to mastitis investigations
2. Review mastitis indicators regularly
3. Seek professional advice if mastitis indicators are above warning levels
4. Plan and conduct the milking-time visit
5. Record problems and actions taken

1 A structured approach to mastitis investigations

A structured, consistent approach to mastitis and milk-quality investigations helps ensure the problem is clearly defined, relevant information is collated and any extra data needed to identify probable risk factors is collected. Following such an approach, as described in this Technote, increases the likelihood that an effective, farm-specific action plan can be developed and implemented.

Before recommending solutions, advisers must be confident that the mastitis problem is accurately defined. This requires a systematic investigation of the problem to identify:

- the nature of the problem - is it grading or high bulk milk SCC (BMSCC), high clinical case rate, or poor teat condition?
- the pattern - is it acute or chronic, when in lactation is it occurring?
- the causative pathogens - what bacteria are causing problem(s) for the herd?

Understanding herd-specific epidemiology and risk factors is essential. A practical way to gain an overview is to assess:

- People – quality of communication, clarity of responsibilities, recent staff changes, compliance with on-farm protocols, any on-farm pressures.
- Cows – herd age structure, culling patterns, fertility-related retention of older cows, recent introduction of cows with unknown mastitis status.
- Farm dairy – maintenance and servicing of plant and milking equipment.
- Environment – the feeding, grazing or housing conditions that may elevate mastitis risk.

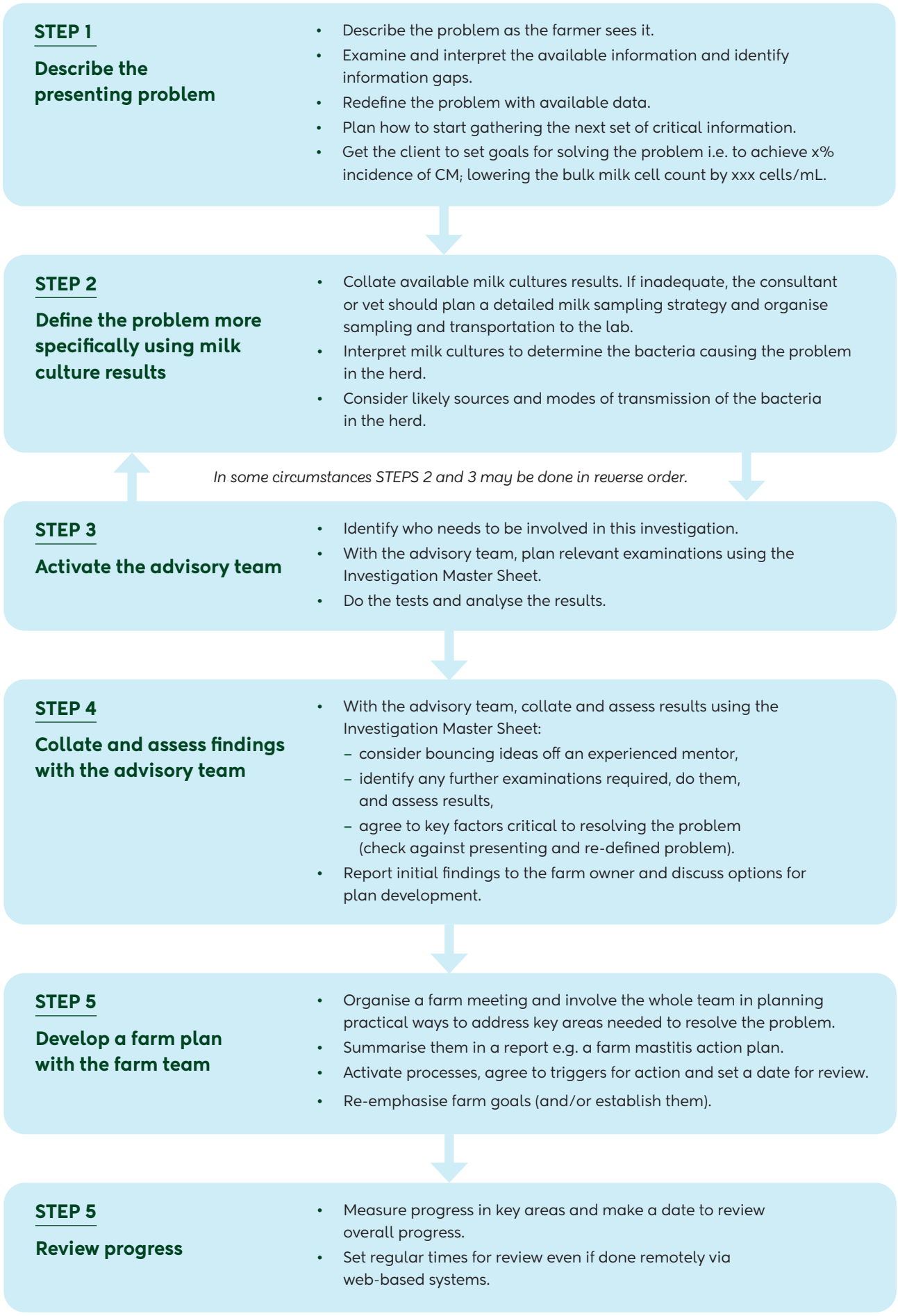
Effective problem definition usually requires coordinated input from a multi-disciplinary team, including veterinarians, milking machine technicians, the farm consultant/adviser, and in some cases the accountant and banker (Figure 1). Developing strong local relationships with key providers of services and information will support quicker, more effective mastitis investigations.

Once the problem is clearly defined, advisers can work with the farm team to agree on 3-4 key factors that must be addressed for progress to be made, develop practical on-farm actions, and set up ongoing monitoring and review processes.

This Technote outlines the Mastitis Investigation Kit, which provides checklists and recording sheets for use during farm visits, and an Investigation Master Sheet to help organise and prioritise findings, so that a workable farm-specific plan can be developed.

➜ Download the **Mastitis Investigation Kit** here or find it on dairynz.co.nz.

Figure 1. Flow chart of the general approach for investigating a mastitis problem



② Review mastitis indicators regularly

Farmers are urged to seek professional advice whenever mastitis-related problems persist, such as:

- Bulk milk SCC is higher than normal
- Herd test SCC shows increasing number of cows with high SCC
- Clinical mastitis incidence is higher than industry benchmarks or above the farmer's own targets.

Warnings can take the form of an alert from a processor, triggered by critical events such as a bulk milk SCC warning or penalty grade (Table 1). Warnings can also appear as a performance trigger or 'trigger for action'. This involves regular monitoring of performance and prompt follow-up when a pre-set threshold is exceeded. A common example of a trigger might be '*any bulk milk cell count above 200,000 cells/mL*'. These triggers are often set at or below formal alert levels, depending on-farm goals (Table 2).

The mastitis **industry benchmarks** are based on large datasets from milk processors, herd test organisations and veterinary organisations. Benchmarks for the best performers (usually top 25%) of herds are provided, with warning levels provided in the **Mastitis Focus Report** that reflect:

- extensive field experience (e.g. teat condition),
- economic penalties (e.g. BMSCC) and likely economic impact of mastitis,
- understanding of mastitis epidemiology (e.g. the presence of less common environmental pathogens or *Staph. aureus*), and
- expert opinion (e.g. using individual cow somatic cell counts (ICSCC) to assess mastitis spread).

The Mastitis Focus Report provides a structured summary to help identify risk areas within a herd and monitor progress after management changes are implemented.

Generate a **Mastitis Focus Report** after each herd test, and after uploading mastitis treatment records.

➜ The **Mastitis Performance Calculator** can be used to identify the benefits of closing the gap between a herd's current performance and industry goals.

Table 1. Take immediate action and seek help when alert levels are reached.

Indicator	Alert levels	Reason for action
Bulk Milk SCC *See **Technote 11***	One or more SCC above grading (e.g. 400,000 cells/mL) or alert level (e.g. 300,000 cells/mL) from dairy company.	Grading for SCC is costly. Action is required to reduce the SCC to below penalty levels.

Table 2. Take action and seek help when trigger levels are exceeded, before problems escalate.

Indicator	Trigger levels	Reason for action
Bulk Milk SCC See ***Technote 11***	Regular spikes in SCC (i.e. increase of 30 - 50,000 cells/mL or more above previous tests) OR Upward trend in SCC is steeper than target curve OR Monthly average SCC above industry average, or a herd's self-selected target for past 3 months.	Herds with BMSCC above 200,000 cells/mL are at risk of grading before the end of the lactation.
Clinical cases *See **Technote 4*** *See **Mastitis Focus report***	More than **5** clinical cases per 100 cows of heifers calved for **monthly clinical case rate at calving**. OR More than **1** clinical case per 100 cows in milk for **monthly clinical case rate in lactation.**	These clinical case rates have been observed in herds with below average performance.
Individual Cow SCC *See **Technote 12*** *See **Mastitis Focus report***	More than **10** cases per 100 cows in milk per month for **new infection rate – subclinical and clinical** OR More than **20%** for **first calver new infection rate**	These estimates are indicators of the spread of infection in seasonally calving herds.
Cultures *See **Technote 4***	The presence of **increasingly common environmental pathogens** isolated in any clinical cases. OR The presence of ***Staph. aureus*** in the majority of culture samples. OR The presence of ***Strep. agalactiae*** in any culture samples.	Isolation of unusual environmental pathogens indicates unique risk factors for the herd. *Staph. aureus* can be contagious and may be hard to cure. *Strep. agalactiae* is highly infectious but has been eradicated from most herds.
Teat condition *See **Technote 9***	**5%** of cows (2% of teats) affected by gross lesions or cracks OR **10%** of cows (4% of teats) affected by dry or rough skin or haemorrhages or teats scored as VR (Very Rough) for hyperkeratosis OR **20%** of cows (8% of teats) affected by hyperkeratosis (VR or R), or redness/blueness, ringing, wedging or openness/ after milking.	Teat condition reflects the quality of milking management, the dairy system and the environment.

③ Seek professional advice if mastitis indicators are above warning levels

NMAC (National Milk Quality Advisory Committee) strongly recommends a team-based approach to mastitis investigations, as resolving complex cases and developing a robust control plan often requires multi-disciplinary expertise.

A designated lead adviser should activate and coordinate the advisory team (i.e. those involved in interpreting information and developing the control plan), manage information flow and keep all relevant parties updated on progress.

Early in the investigation, the advisory team should agree on:

- Appropriate diagnostic tests and on-farm observations
- Organisation of farm visits
- Timing and frequency of data review and team discussions
- Key interaction points with the farm owner/manager including confirming investigation goals, presenting preliminary findings, and discussing control options.

Establishing a realistic, structured timetable and following it improves team efficiency and engagement (refer to Flowchart in Figure 1).

An extended regional and national advisory network is available, and consulting an experienced mentor at critical stages can enhance decision-making, build confidence, and assist with resolving complex issues.

➜ A list of NMAC Accredited Mastitis vets from across New Zealand can be found here on the **DairyNZ website**.

The Mastitis Investigation Kit

The **Mastitis Investigation Kit** consists of:

- **Investigation Master Sheet (Sheet A)** for coordinating the investigation and developing a plan of action; and
- **12 recording sheets (Sheets B to M)** for collecting and interpreting key data.

This Technote outlines each element of the Kit and its use. Investigators should be familiar with the Kit before starting a farm investigation.

Early in the investigation, the advisory team should decide which diagnostic tests and assessments are needed to complement existing information and allocate these tasks accordingly. The Kit should be used to ensure all relevant risk factors are checked, and data is systematically collected and analysed.

This structured approach often uncovers additional issues not directly relevant to the current problem. They can be noted on the Investigation Master Sheet as 'different problem' and addressed separately.

➜ See **page 15** for tips on how to collect data most efficiently at a milking-time visit.

General approach to investigating a mastitis problem

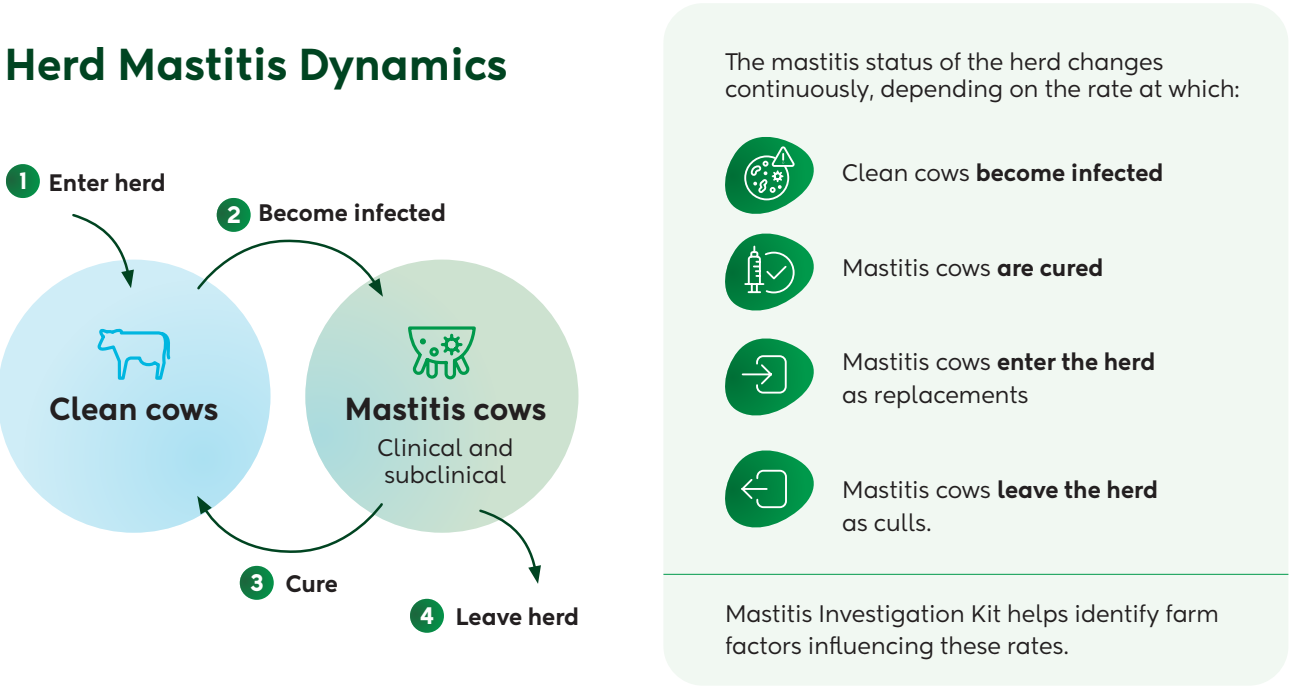
A. Investigation Master Sheet

The Investigation Master Sheet (A1-A7) provides a structured process for identifying the key factors that will shape the mastitis action plan. It is the central tool of the investigation because it is used:

- **By the advisory team** to construct a clear, concise problem definition and allocate tasks
- **By individual team members** to summarise their findings and highlight practices that deviate from industry guidelines
- **As the decision-making hub** for assessing whether these practices are contributing significantly to the problem and identifying the main underlying risk factors.

The Herd Mastitis Dynamics Chart (Sheet A7) supports advisers in creating a visual summary of how herd management influences mastitis in the herd (Figure 2). This helps the team maintain an overall perspective on mastitis control while addressing seasonal or high priority issues. It also serves as an effective communication tool for discussions with herd owners and staff.

Figure 2. A model to describe the ever-changing infection status of cows in a herd.



To improve the likelihood of identifying an effective solution:

1. **Focus on the factors rated as 3 or 4** in importance in the right-hand column of the **Investigation Master Sheet**.
2. **Transfer these** onto the **Herd Mastitis Dynamics Chart** (Sheet A7) according to their area of influence.
3. **Interpret the chart** in the context of the **epidemiology of the major pathogen(s)** present in the herd.
4. **Prioritise the factors** most likely to deliver meaningful improvement.
5. **List these priority factors** on **Sheet A1** (box on front page of Investigation Master Sheet) and include them in your report to the farmer.

B. Farm profile

The **Farm Profile** is a 5-page questionnaire used to:

- summarise the presenting problem (Box 1, Figure 1),
- identify information already available for team assessment, and
- highlight potential leads for further investigation.

The first page provides a broad overview of the client and herd. It contains factual, non-technical information and can be completed by any competent team member.

Farm Profile **Sheets B2-B5** assess farm management practices that influence mastitis and should be completed by an advisory professional, typically a veterinarian. The questionnaire is intentionally concise to maintain focus and ensure that high quality, relevant information is collected.

NMAC recommends advisers gather this information through a personal interview (phone or in person) and complete the pages themselves. This ensures context-appropriate responses, improves data accuracy, and allows follow-up questioning when needed.

Vet technicians can efficiently compile BMSCC, herd test and treatment records, saving veterinary time. Prearranged access to milkquality data enables faster assessment and earlier intervention when problems arise.

The Farm Profile is the only sheet in the Kit that captures information on:

- BMSCC trends,
- numbers of clinical cases,
- drying off strategy and
- the impacts of mastitis on the herd culling policy.

Use the left-hand side of the Farm Profile Sheet B1 to organise the collection of information that is already available. This can be done before a farm visit to make the process of information gathering efficient.

C. Milk cultures

A critical step in mastitis investigations is to determine which bacteria are involved (Box 2, Figure 1). This requires an adequate number of milk cultures, and insufficient sampling is a common error that often stems from perceived cost concerns. However, without identifying pathogens, targeted and cost-effective control is unlikely. The veterinarian is typically responsible for organising sampling, interpreting results, and clearly communicating their importance to the farmer.

The goal is to define which bacterial pathogens are causing the problem. To do this, investigators should obtain at least 20 valid culture results, meaning samples must be collected from at least 25 cows to allow for contaminated or unusable samples.

Sampling strategy depends on the presenting problem:

- **Clinical Mastitis** – collect samples from all cases, prior to treatment. Samples can be frozen and submitted in batches, if required. Include any existing samples or results.
- **High Cell Counts** – collect samples from cows, based on mastitis history or recent ICSCC. Cow selection should be made by the veterinarian to test specific epidemiological hypotheses about mastitis in the herd, and could include:
  - a range of age groups, including heifers,
  - cows with recent SCC rises
  - cows with persistently high SCC across tests or lactations (e.g. maximum SCC from 150,000 to > 1,000,000 cells/mL).

Once cows are selected, sample the quarters most likely to be infected. Use a quarter-level screening test (e.g. Rapid Mastitis Test) and collect from quarters indicating subclinical mastitis.

Cow composite samples (i.e. a roughly equal volume of milk from each quarter into a single sample jar for each cow) may be used to save cost, but they:

- increase the risk of contamination
- have slightly lower sensitivity to detect pathogens than quarter-level samples and
- do not identify which quarters are affected.

Milk Cultures Sheet C can be pre-populated with the selected cows. A separate Sheet C should be used for each batch to track sampling and results.

When sampling a number of cows, avoid collecting samples at milking time. Preferably draft out cows at a morning milking and then sample them immediately before the afternoon milking. This allows sampling to be done in a clean environment.

➜ See **Technote 4.4** for a detailed description of the collection, storage and analysis of milk samples for bacterial culture.

D. Individual cow somatic cell count analysis

Individual Cow Somatic Cell Count (ICSCC) analysis provides valuable herd-level insights of apparent mastitis prevalence across different cow groups (i.e., age, lactation stage, management groups) and helps estimate the new infection rates.

Most ICSCC data are available electronically, and herd improvement organisations provide web-based analysis tools. However, advisers commonly perform simple, targeted analyses, such as those summarised on Sheet D:

1. Comparison of mastitis prevalence across cow groups

Assess the proportion of cows in each age groups with a maximum SCC above 150,000 cells/mL (or 120,000 cells/mL for first calvers). This gives an indication of infection prevalence by age, or stage of lactation, although interpretation may be limited in small groups of cows.

2. Estimate of new infection rate

Evaluate the proportion of first-lactation animals with an ICSCC >120,000 cells/mL during lactation. More than 20% of heifers with a maximum ICSCC >120,000 cells/mL by the end of their first lactation suggests unacceptably high contagious spread of mastitis in the herd.

The Mastitis Focus report flags more than 10 newly infected cows per 100 cows in milk per calendar month as concerning for spread of infection, where the numerator is the number of newly infected cows between herd tests, and the denominator is the uninfected cows at the preceding herd test (i.e. not the whole herd).

3. Number of persistent infections

Determine the proportion of cows with persistent infections (i.e., ICSCC > 50,000 cells/mL in current and previous lactations) at each herd test. This indicates the chronicity of the problem and effectiveness of the last dry period in curing infections.

The Mastitis Focus report identifies persistent infections in two ways, by identifying the number of cows eligible for culling, and by assessing the proportion of clinical cases that have been retreated.

4. Number of cured infections

Calculate the proportion of cows likely cured (i.e. number of cows that are now uninfected at the current herd test, divided by the number that were previously infected (>150,000 cells/mL) at the preceding herd test). Where the interval includes the dry period, this also indicates dry-period cure effectiveness.

Analyses of ICSCCs should be based on regular herd testing data, not on single 'spot' tests. It is recommended to have at least four ICSCCs to determine the status of a cow during lactation.

A cow is classified as infected or uninfected based on:

- her highest (or maximum) cell count taken during the lactation
- an ICSCC exceeding 150,000 cells/mL (or 120,000 cells/mL for first calvers), in NZ herds where *Staph. aureus* and *Strep. uberis* are the main pathogens
- for Mastitis Focus purposes, cows remain infected until they have four or more subsequent tests below these values, or a dry period with antibiotic DCT and one ICSCC below 150,000 cells/mL.

➜ The **Mastitis Focus Report** provides a herd-level analysis of the infection status of the herd from the ICSCC data.

➜ **Technote 12** describes methods of analysing and interpreting ICSCCs.

E. Milking machine dry test (NZMPTA test or equivalent dry test)

NMAC recommends using technicians who are certified by the New Zealand Milking and Pumping Trade Association (NZMPTA) to perform the Dry Test to ensure high-quality testing, standardised reporting, and interpretation based on NZMPTA specifications. This test aligns with the International Standard ISO 6690:2007 (ISO 2007).

A Dry Test assesses:

- **Cluster component compatibility** – to ensure appropriate fit of liners to shells, claw nipples are suitable for average teat size, that cluster balance and weight are appropriate, and cluster air admission meets guidelines.
- **Vacuum regulation effectiveness** – to ensure that the vacuum is appropriate for the milkline height, that the vacuum regulator is functioning, that vacuum reserve is sufficient (unit fall-off test), and vacuum undershoot and overshoot is minimal.

When evaluating the possible contribution of the milking machine to mastitis (Boxes 3 and 4, Figure 1), the advisory team should review the key findings of the milking machine Dry Test report.

Machine technicians may also perform a Wet Test, which evaluates machine performance when air and water, or artificial milk, is pumped through the system. A Wet Test is often used to commission a new installation or a major plant upgrade and may help pinpoint a vacuum regulation problem.

➜ **Technote 6.5** describes different tests that can be carried out by a certified milking machine technician.

F. Performance tests of milking machines

Milking-time performance tests assess how well the milking machine setup matches the herd and measures its function under normal operating conditions. These tests typically include:

- **Cluster compatibility** with average udder and teat size.
- **Vacuum stability** in the milkline and receiver.
- **Measurement of claw vacuum** range during milking.

When evaluating the possible contribution of the milking machine to mastitis (Boxes 3 and 4, Figure 1), use the guidelines for performance tests given in Technote 6 and in the Mastitis Investigation Kit.

These performance tests build on Dry Test findings, and often help to pinpoint the underlying causes of:

- **frequent liner slips** (Sheet G),
- **poor teat condition** (Sheet I),
- **poor cow behaviour** or **slow milking** (Sheet J), or
- **incomplete milking** (Sheet K).

Some veterinarians use their own milking-machine testing meters during milking time investigation as a screening tool to detect gross machine faults. However, these meters may offer less precision than more specialised milking-machine assessment equipment, used by registered NZMPTA technicians.

➜ **Technote 6.2** provides guidelines for interpreting milking routine observations, including milking times and completeness of milking.

G. Milking routines and cup slips

Milking routines

The **milking routines checklist** (Sheet G) is intended for advisers to complete based on direct observations in the dairy at milking – not for milkers to fill out. Some lists allow multiple tick boxes to be selected.

Careful assessment of milking routines often reveals factors contributing to the presenting problem (Boxes 3 and 4, Figure 1). When developing a farm plan (Box 5), improving routines and communication with the on-farm team members is low-cost, motivating and beneficial for mastitis control.

Cup slips

Cup slips or falls occur unpredictably, so experienced observers usually listen and watch for slips while recording other aspects of the routine. The rate of slips or falls per 100 cows milked can be estimated from:

- the average number of cows per milked per hour and
- the time of the first and last recorded slip or fall.

➜ **Technote 6.2** lists the common causes of cup slips and falls.

H. Clinical cases

Clinical case management can be evaluated by reviewing the quality of the **clinical case records** (Farm Profile Sheet B3) and using **Clinical Cases** Sheet H to observe milking-time practices, discuss case-handling with milkers and assess treatment techniques for cases.

➜ **Technotes 4** and **10** describe recommended methods of detecting and treating clinical cases.

I. Teat condition

Formal teat-condition assessment helps identify milking machine, management or environmental factors, or infectious agents, contributing to teat and udder health (Boxes 3 and 4, Figure 1).

- Teat skin condition may be examined before milking but is often easier after milking.
- All other parameters on Sheet I should be evaluated immediately after milking.

➜ **Technote 9.2** provides more on assessing and interpreting teat condition in commercial herds.

J. Cow behaviour and milking time per cow

Cow behaviour

Cow behaviour provides insight into cow comfort, or discomfort, with the milking environment, routine or machine. Behaviour can be scored using systems such as KiSt (Kick, Step; Technote 6).

Observations should be made at different stages during milking:

- whilst cows wait in the stall or bail to be milked
- during teat preparation and cluster attachment
- in the first two minutes of milking
- in the last two minutes of milking.

In herringbone dairies, cow behaviour and milking-time measurements can be recorded concurrently for each cow (working across the sheet). In rotaries, observing different groups of cows is more efficient. See data collection tips at the end of this section.

➜ **Technote 6.2** describes the types of problems that may be occurring for cows showing discomfort at different stages of milking and outlines the KiST scoring system.

Udder and teat hygiene

Dirtiness of the udder and legs provides an indication of the environmental contamination pressure on teats. Cleanliness of udder and/or rear legs can be assessed before or after milking and scored on a 4-point scale, where:

- 1 = clean, free from dirt, up to
- 4 = > 30% of surface area is caked in dirt.

Teat spray coverage should be evaluated after spraying and can be scored visually, as adequate or poor for the front and rear teats. A more detailed assessment can be performed on selected cows using the paper-towel wrapping test, as described in **Healthy Udder** and **Technote 7**.

Milking time per cow

Three key metrics can be derived from careful measurements of a representative sample of cows:

1. **Proportion of cows showing delayed milk let-down**
   - Minimal: fewer than 10% of cows, or
   - Moderate: 10-20% of cows.
2. **Average milk-flow time per cow**
   - See guidelines in **Technote 6**
3. **Average over-milking time per cow**
   - Minimal: mean over milking time <1 minute/cow
   - Moderate: mean is between 1-2 minutes/cow.

This data provides a strong basis for milking management recommendations and helps explain underlying causes of:

- **new mastitis infections,**
- **frequent liner slips** (Sheet G),
- **poor teat condition** (Sheet I),
- **poor cow behaviour** (Sheet J) or
- **incomplete milking** (Sheet K).

Warning bells should ring if, for example, over milking occurs in conjunction with pulsation failure (Sheet E).

➜ **Technote 6** gives the expected milking time for herds producing between 10 and 20 litres per cow per milking and situations that will increase the average cups on time per cow.

K. Completeness of milking and cluster alignment

Completeness of milking

Although there is little recent evidence that under milking increases the risk of mastitis, assessing completeness of milking can still provide useful information about milking machine performance and milking team efficiency (Boxes 3 and 4, Figure 1).

- If incomplete milk-out is suspected, assess by hand stripping at least 25 cows or 100 quarters at the end of milking (Technote 6)
- In herds using efficient milking routines, Max T, or automatic cup removers with 400-800 mL/min cut offs, residual milk measurements are of limited value.

Recent research suggests that there is no long-term loss of production associated with some residual milk, so completeness assessments are rarely undertaken.

➜ **Technote 6** gives a guide to assessing incomplete milking.

Cluster alignment

Poor cluster alignment can reduce milking efficiency. This can be demonstrated visually by manually re-aligning the cluster when milk flow from a cow has nearly ceased.

- Hold the cluster squarely under the udder by manipulating the long milk tube, without applying extra downward pressure.
- Milk flow often resumes when clusters are poorly aligned.

Patterns such as higher residual strip yields from rear versus front quarters, or from left-side versus right-side quarters typically indicate problems with cluster positioning or uneven weight distribution across the four teat cups.

Teat size

Visual or measured assessment of teat size and shape is useful when reviewing liner selection, ensuring liners match herd teat conformation.

➜ **Technote 6** provides more on liner selection.

L. Teat disinfectant

Sheet L is used to assess issues related to teat disinfectant use prior to application (Boxes 3 and 4, Figure 1). This includes product selection, mixing accuracy, storage, and suitability of the stock solution.

- Coverage and application quality are evaluated separately in the milking routine assessment (Sheet G).
- The mixing section of Sheet L is not required on farms using ready-to-use disinfectant products.

➜ Use **Technote 7** to interpret the information and identify any leads to follow up about post-milking teat disinfection.

M. The environment

The environmental checklist supports evaluation of a herd's exposure to environmental mastitis risk, with emphasis on calving areas and practices, and the immediate post-milking environment.

- It is advisable to physically inspect key risk areas at the appropriate time of year, for example the calving areas at calving time, or feedpad areas when in use.
- Udder contamination prior to milking is recorded on Sheet G.

Tips for efficient data collection during milking-time tests and observations

Getting the numbers right

A frequent weakness in mastitis investigations is sample sizes that are too small. When too few cows are observed, the conclusions lack precision, and the time and effort invested yield little value.

NMAC recommends assessing a minimum of 25 cows, ideally, up to 100 cows, for milking-time observations, such as cow behaviour and milk flow times per cow (Sheet J) and completeness of milking (Sheet K).

Technote 9 provides guidelines on the number of teats and cows required to evaluate teat condition:

- Assess all teats of 100 cows to investigate system faults and causes of teat damage.
- Assess smaller numbers of cows (e.g. 50) to identify if a problem warrants further investigation.

Table 8 (**Technote 9**) provides the minimum number of teat abnormalities required to detect different prevalence thresholds, or triggers for action.

Efficient teamwork for data collection

Milking time investigations can be time-consuming and may require multiple people over more than one milking visit. Experienced advisers often need two milking visits to complete most observations. To improve efficiency and cost-effectiveness:

- Prioritise key risk areas from examining available pre-visit data (e.g., herd test results, microbiology).
- Use trained technicians to collect and record data where appropriate.
- Adopt electronic data-capture tools (e.g., phones, tablets) to streamline collection and preliminary analysis.

Options that reduce the need for extensive testing time on farm include:

- Conduct a quick vacuum regulator test for undershoot or overshoot before milking. This is a partial substitute for monitoring receiver vacuum during milking.
- Measure mean claw vacuum before milking, in 3-5 clusters using a flow simulator set at a controlled liquid flow rate of 3 kg per minute (or 5 kg per minute for very high producing cows).
    - This wet test is an acceptable substitute for measuring the mean claw vacuum on 6-10 real cows during milking.
    - In fact, it is a better measurement because the simulator flow rate is known and highly repeatable.

If these strategies are used, **milkline vacuum stability** becomes the only milking-time machine test that needs to be done *during* milking.

- Conduct this in the first 15 minutes of milking when milk flow is likely to be highest.
- On a rotary, use an empty stall for one rotation.
- In a herringbone, record at a convenient milking unit during removal and re-attachment of the first complete set of clusters.

In dairies where milkline size and slope meet current guidelines, **milkline stability testing** may be optional. However, it does provide a neutral 'activity' for a visiting technician while milking staff settle into their routine, before observations are made on milking routines, cow behaviour, etc. It can also reveal practical 'real world' performance issues and allow correlation of events, such as operator actions with measurements.

If a flow simulator is not available, mean claw vacuum can be measured by:

- Pre-installing 3-5 T-pieces between the claw outlet and long milk tube. These are capped when not in use.
- Connecting the vacuum recorder to record mean vacuum at 30 s and 90 s of milking for one cow, then move immediately to the next unit without waiting for the first cow to finish milking.
- Collect from one group of 3-5 cows after milkline vacuum stability testing, then repeat with another group later in the milking.

④ Plan and conduct the milking-time visit

Planning the visit – Before the visit, the advisory team should agree on which on-farm measurements will be taken and allocate tasks. With good organisation, **two people can collect most data in a single milking**, with a follow-up visit by one person if needed. Tasks can be organised as follows:

<table>
<tr><th></th><th>Adviser One</th><th colspan="2">Adviser Two</th></tr>
<tr><td rowspan="2">Before milking</td><td>Assesses environmental factors
Assesses case treatment procedures and recording</td><td colspan="2">• Assesses liner condition checks pulsators
• Checks claw air vents (either hole size or individual claw air admission)</td></tr>
<tr><td>Identifies teat spray active, mixing procedures, storage procedures and usage</td><td colspan="2">• Measures working vacuum and regulator undershoot and overshoot
• Measures mean claw vacuum with flow simulator, and/or pre-installed T-pieces
Where a vacuum meter (e.g., VaDIA) is available, install into one of the claws.</td></tr>
<tr><td rowspan="5">During milking</td><td>Evaluates cup on and off procedures, and milking routine,</td><td colspan="2">• Records milkline vacuum stability (15 minutes) and receiver vacuum (if necessary).
• Records mean claw vacuum on the first group of 3-5 cows (if required).
• Record all audible cup slips and falls.
• Record mean claw vacuum on a second group of 3-5 cows (if required).</td></tr>
<tr><td>Assesses teat condition and teat spray coverage on groups of cows throughout milking</td><td colspan="2">Observes cow behaviour and milking times per cow:
• Behaviour in yard and entry into bails
• Interactions with milkers</td></tr>
<tr><td></td><td>In herringbones:
Observe groups of 3-4 cows, for a whole side</td><td>In rotaries:
• Observe cow behaviour for 25 (or more) cows near cow entry position, note approximate stall position when milk starts flowing strongly into most claw bowls.
• Move to near cups off area and observe another group of 25 (or more) cows for:
  • the average stall position at which milk flow slows or stops for majority of cows,
  • the average stall position at which most clusters are detached,
  • cow behaviour during last 2 minutes of cups on.</td></tr>
<tr><td></td><td colspan="2">• Calculate total cups on time and average milk flow time per cow.
• Measure usual rotation time of the platform to help calculations, while ignoring unusual events or stoppages.</td></tr>
<tr><td colspan="3">Measure completeness of milking:
• Hand-strip all quarters of 25 cows preferably
• Dictate results into a tape recorder or work with an assistant.
• Stop once a quarter clearly exceeds 100 millilitres and record as ‘High’.</td></tr>
<tr><td>Follow up</td><td colspan="3">If two milking-time visits are planned, include one morning and one afternoon milking, as production levels and staffing can differ between milkings.</td></tr>
</table>

5 Record problems and actions taken

The aim is to develop a workable, farm-specific plan. This requires:

- forming a plan with the on-farm team,
- producing a clear, concise written report,
- ensuring actionable steps are listed on a wall chart or visible checklist, and
- scheduling appropriate follow-up.

Adoption of recommendations is more likely when farmers see changes as relevant, achievable and offering tangible rewards, preferably financial (Gardner 1990). Plans developed collaboratively, with adviser guidance, are generally more successful.

Providing a clear written report

The **Investigation Master Sheet** is used to collate findings, prioritise issues, and refine problem definitions until practical solutions can be recommended. Written reports for the owner/manager, and meetings of the farm team and adviser(s) are then used to convert these findings into implementable actions for the situation.

Reports should provide a permanent record and should include:

- Objectives of the original visit
- Key findings from the investigation
- Clear list of agreed actions, including what, by when, and who is responsible
- Follow-up arrangements.

Reports should be brief, ideally one page, with detailed material (e.g., cull cow lists, culture results, herd test analysis) included as appendices. A custom report template improves efficiency and consistency.

Encourage the farmer and team to record relevant information as they implement the plan. Where possible, integrate this into the quality assurance systems or electronic farm records to avoid duplicate record-keeping

It is increasingly incumbent on professionals to document their work carefully. Most advisory services document recommendations and actions taken during client interactions as standard practice. Written records are invaluable to help resolve problems and disputes.

Follow-up

The report should specify:

- which areas need attention to maintain progress,
- the timeline for revisiting progress, and
- who should be involved in future discussions.

For veterinarians who are who are NMAC Accredited to provide mastitis investigations for Fonterra suppliers (or in training) the online database should be updated with all relevant documentation, including reports, Mastitis Investigation Kit outputs and supporting materials.

Acknowledgements

DairyNZ acknowledges the valuable input of veterinarians, milk quality advisers, and industry stakeholders who contributed to the development and review of these resources. Most are representatives of the National Milk-Quality Advisory Committee (NMAC) and have given generously of their time and expertise for the technical review.

Disclaimer

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Key papers

Gardner I. Reporting disease outbreaks. In: *Post Graduate Foundation in Veterinary Science Proceedings* 144, Epidemiology at work, University of Sydney, 1990: 29-42.

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