

What a Lost Quarter Really Costs

Prevention, first response, milking on, running the numbers: what the farm actually controls when it comes to teat injury, chronic mastitis and quarter loss

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A permanently lost quarter does not automatically end a cow's productive life. It changes her production, her somatic cell count and the math that decides whether she stays. This article works through four questions in a fixed order: What can be prevented, what has to happen in the first hours after an injury, what do three quarters actually deliver, and how do you live with – and calculate for – a three-quartered cow? It draws on published studies, the genetic evaluation documentation of vit Verden, the German dairy genetic evaluation center, and the culling statistics for the vit region. The article argues from method, not from the author's own farm cases.

Two roads to the same place

A kick from the neighboring cow, getting caught on barn equipment, a crush in the headlocks – those are the images that come to mind first when you think of a three-quartered cow. They are not wrong, but they are only half the story, and probably not the larger half.

The second road is quieter and takes longer. A quarter flares up, is treated, settles down, flares up again. At some point the question is no longer whether it can be treated once more, but whether it should be. That this is the more common road is shown by the reasons quarters are dried off: In a German study of 25 quarters from ten farms in North Rhine-Westphalia, recurrent mastitis was behind 17 cases and a teat lesion behind just one.¹ Anyone who only has the kick in mind is working on the less common cause.

One caveat up front: How common three-quartered cows are in German herds is not documented – there is no survey on it, neither from milk recording nor from herd health programs, only clinic populations and single-farm analyses. Anyone who puts a number on it is guessing.

The order of magnitude at the other end can be documented. In the 2024/25 recording year, 12.8 percent of all cow exits in the vit region were due to udder disease and 2.5 percent to milkability – third place behind infertility and feet and claws. The share rises with herd production level, from 7.8 percent in herds up to 6,999 kg to 13.7 percent in herds above 10,000 kg (about 22,000 lb).² Anyone who raises the production level raises the udder problem along with it.

Prevention: the adjustments in the barn

The three-quartered cow usually gets talked about once she is already standing there. But the farm has more influence before than after, spread across four areas: milking equipment, teat condition, secure footing and dry-off. Milking equipment has the hardest numbers – and it is the area where on many farms nothing has been adjusted for years.

Take-off threshold first. A review of milking machine settings concludes that take-off at a milk flow of 400 or 600 grams per minute (roughly 0.9 or 1.3 lb/min) shortens milking time without negatively affecting milk yield or composition; a take-off threshold of 800 versus 200 grams per minute substantially reduced tissue thickening and hyperkeratosis at the teat end.³ In plain terms: Most systems overmilk at the end, and that costs teat tissue without bringing in milk. The same review calls for a system vacuum of at least 30 to 32 kilopascals, a pulsation rest phase of at least 150 milliseconds and an air inlet in the ISO range of 4 to 12 liters per minute.

Teat condition is an early indicator, not a cosmetic issue. A systematic review of 18 studies concludes that severe teat-end hyperkeratosis is a risk factor for both clinical and subclinical mastitis. Reported figures include 2.28 times the odds of clinical mastitis and 6.01 times the odds of mastitis caused by *Escherichia coli*; mild to moderate hyperkeratosis, by contrast, showed a rather favorable association with somatic cell count.⁴ So not every degree of hyperkeratosis is a problem – the severe kind is. It can be assessed without any equipment: twenty teats immediately after unit removal, once a month, always the same group.

On secure footing, the evidence gets thinner. A German-language literature review on preventing teat injuries lists a tightly attached udder carried above the hock, non-slip flooring, comfortable lying surfaces, avoiding metabolic disorders, regular hoof trimming, well-maintained milking equipment, avoiding overmilking, and udder supports and hobbles.⁵ The review dates from 2002 and quantifies no risk measures. I did not find a peer-reviewed study that relates stall dimensions or floor surfaces to the risk of mechanical teat injury. The measures are plausible and standard advisory practice – documented in the sense of a quantified risk reduction they are not.

THE ADJUSTMENTS BEFORE THE DAMAGE

1 Set take-off earlier

400 to 600 grams per minute costs no milk. Taking units off at 200 grams means milking out teat tissue instead of the udder. The setting is in the controller and can be changed in five minutes – together with the milking equipment technician, not single-handedly.

2 Have the system tested and write down the numbers

System vacuum, pulsation rest phase, air inlet. The test report goes in the binder. Without a baseline, there is no way to tell next time whether anything has changed.

3 Stop overmilking

Attach only once milk is flowing, no hand-stripping of a quarter that is already milked out. Not an equipment problem, but a question of the parlor SOP.

4 Score teat ends monthly

Twenty teats right after unit removal, always the same group, results on a sheet of paper. If the share of severe hyperkeratosis rises, that is a signal to the milking equipment – long before the somatic cell count responds.

5 Flooring, hooves, metabolism

Secure footing in the alleys and at the feed barrier, regular hoof trimming, no unsteady cows. A cow that gets up securely is less likely to step on her own teat.

6 Treat dry-off as a job in its own right

On 765 German farms, the median new infection risk over the dry period was 24 percent in the north, 25 percent in the east and 8 percent in the south, with very wide variation between farms.⁶ The variation is the message: The difference between farms is greater than the difference between regions.

Points 1, 2, 4 and 6 are documented. Points 3 and 5 come from a literature review without quantified risk measures – uncontroversial on the merits, but without an effect size.

What breeding can get hold of is mainly udder attachment. In 29,284 French first-lactation Holsteins, udder depth, fore udder attachment and udder balance were favorably associated with somatic cell score and clinical mastitis, with genetic correlations between -0.29 and -0.46 .⁷ The heritabilities in the German genetic evaluation are workable: udder depth 0.33, front teat placement 0.26, rear teat placement 0.23.⁸ That a deep udder gets stepped on more often is plausible, but not quantified. In any case breeding is the slow road – for the cow that turns up tomorrow morning with blood on the milking unit, it is irrelevant.

The take-off threshold is the cheapest preventive measure on the entire farm. It costs five minutes at the controller.

Teat injury: the time window decides

The most robust German data on acute teat injury come from the Clinic for Ruminants (Klinik für Klauentiere) at Leipzig University: 120 teat injuries in 116 German Holstein cows, May 2012

to July 2017. The teat sphincter apparatus was involved in 70.8 percent.⁹ After healing, 87.4 percent of treated teats could be milked; 7.2 percent were amputated.¹⁰

This figure is often read as an all-clear. It is not. At follow-up after at least 700 days, 21.5 percent of the surgically treated animals had been slaughtered because of problems with that teat or the associated quarter.¹¹ The teat can almost always be saved, and yet a good one in five operated cows later leaves the herd for exactly that reason. These are also patients of a university clinic: What gets referred is what makes the trip to the clinic worthwhile.

The lever lies before the clinic. In a prospective study of 106 lactating cows, the risk of fistula formation was 8.3 times higher when the teat was sutured only 48 to 72 hours after the injury rather than within 24 hours. Suture material and suture technique, by contrast, made no difference.¹² The study comes from Iran and from a grazing system; the absolute level of risk does not transfer to German freestall herds, but the direction very much does. What counts is the hour, not the suture material. Anyone who sees a bleeding teat on Friday evening and waits until Monday has already decided the outcome.

THE FIRST HOURS AFTER A TEAT INJURY

1 Spot it before milking

Blood on the milking unit, milk coming from a wound, the cow flinching during attachment. Anyone who only looks at unit removal has often already used up half the time window.

2 Vet the same day, not the next

The evidence supports treatment within 24 hours; a delay to 48 to 72 hours was associated with considerably more frequent fistula formation. Here the farm determines the outcome, not the clinic.

3 Take the cow out of the group

A bleeding teat in the group gets stepped on a second time. A quiet individual pen with a dry lying surface costs nothing and prevents follow-on damage while you wait for the vet.

4 Do not leave the quarter to itself

Milk stasis increases pressure on the wound and pain. Regular, controlled emptying – by hand and into a separate container – is part of first response, not just aftercare.

5 Record the quarter's cell count before surgery

In a Swiss analysis, a high cell count at admission was an unfavorable prognostic sign for the rest of the lactation. Without a quarter milk sample, there is also no reference value for later.¹³

6 Monitor closely for the first ten days after surgery

Signs of inflammation during this period were likewise an unfavorable prognostic sign in the same analysis. These are the days that decide whether the quarter remains functional – and these are the days when, in everyday farm routine, nobody is most likely to look.

This procedure does not replace the veterinarian's clinical judgment. It sorts out what is in the hands of the milking crew, and it belongs posted in the parlor – that is where the decision is made.

In 100 hard-milking teats, peak milk flow, average milk flow and milk yield before surgery were 20, 14 and 53 percent of the values of healthy comparison teats; six months later they were 79, 76 and 71 percent.¹⁴ A considerable improvement – and proof that the original level is not regained. Anyone who budgets for the old production after teat surgery is budgeting wrong.

And amputation? It is not necessarily the end. In a Canadian analysis of 22 cows with distal partial teat amputation, 13 of the 18 animals that could be followed up – 72 percent – were still in the herd at the start of the following lactation.¹⁵ The sample is small, but it serves as an order of magnitude and contradicts the assumption that amputation is equivalent to slaughter.

When the inflammation does not heal

On the more common second road, the decisive figure is not the bacteriological cure but the complete cure – and the gap between the two is large. In an analysis of 2,883 clinical mastitis cases on twelve farms in northern Germany, the bacteriological cure rate was 73.3 percent, the complete cure rate 21.4 percent and the recurrence rate 18.8 percent.¹⁶ By pathogen, bacteriological cure ranged from 44.7 percent for *Staphylococcus aureus* to 87.1 percent for coliforms.¹⁷

The finding behind it: The pathogen is gone in three out of four cases – yet in four out of five, the quarter has not fully healed. What remains is a quarter with an elevated cell count that can flare up again. In practical terms: Follow-up after mastitis treatment must not end with clinical improvement. Anyone who does not pull a follow-up sample after three weeks only learns about the chronic infection at the next flare-up.

A study from Belgium and the Netherlands of 117 clinical mastitis cases shows how often production does not come back: Only 47 percent of inflamed quarters returned to their expected milk yield within four weeks, compared with 68 percent of the non-inflamed quarters of the same cows.¹⁸ This does not prove the loss is irreversible – four weeks are not a lactation. A study that follows three-quartered cows through a complete lactation does not exist, as far as my research shows.

When a quarter is deliberately dried off, the process works less completely than assumed. In a randomized Danish field trial with 70 cows, 35 percent of the dried-off quarters had still not atrophied by around day 40, and only 6 percent were completely dry; around day 10, swelling, hardening and signs of pain occurred more often.¹⁹ Drying off a quarter is therefore not simply leaving it alone, but an intervention with a course of its own. It should be scheduled, documented and checked daily during the first two weeks – and preferably not placed in peak lactation.

What three quarters deliver – and what it costs

This is where the common account departs furthest from the evidence. The statement that the remaining quarters take over part of the milk production is correct – it just means less than it sounds. In a study from Kiel in which individual quarters were not milked for twelve days, daily yield per cow fell to 75 percent when three quarters were milked; the quarters still being milked increased their output by 4 percent per quarter.²⁰

Four percent per quarter. That is the documented order of magnitude – not a third, not half. The cow ends up at about three quarters of her previous production, which is where simple

quarter arithmetic would put her anyway. The data come from a short-term trial in 1990; for today's production levels, that is a caveat that has to be stated.

Compensation exists. It depends on time, it depends on lactation – and it is partial compensation, never replacement.

The field supplies the number you can calculate with. In the Danish field trial, the production loss of cows with a dried-off quarter was on average 4.1 kg per day (about 9 lb) greater than that of the control cows, with a 95 percent confidence interval of 3.1 to 5.0 kg. The greatest capacity for compensation was shown by multiparous cows in early lactation.²¹

Calculated: A cow loses a quarter on day 120 of lactation. That leaves 185 milking days to day 305. At 4.1 kg of additional loss per day, that comes to 759 kg of milk (about 1,670 lb), or 574 to 925 kg across the confidence interval. At a milk price of €0.45 per kilogram, that corresponds to €342, in a range of €258 to €416.²² That is less than many people expect – and the reason the three-quartered cow rarely fails on milk loss alone. She fails on what comes with it: somatic cell count, labor time in the parlor, milking system. The figure comes from Danish organic farms and concerns deliberately dried-off quarters, not acute injury cases. Anyone who has quarter milk yields from the milking system should plug in the actual production of the quarter – that turns the reference figure into a farm-specific number.

HOW TO RUN THE NUMBERS FOR YOUR COW

Step 1 Determine the remaining days

From today's day in milk to the day this cow would actually be dried off on this farm – not to the end of lactation as the textbook has it.

Step 2 Set the daily loss

With quarter milk yields from the milking system: the actual production of the affected quarter in the last four weeks before the loss. Without them: 4.1 kg per day as a guide, deliberately calculated with the range of 3.1 to 5.0 kg.

Step 3 Multiply by your own milk price

Use your actual mailbox price, not the average producer price. Anyone who receives somatic cell premiums calculates with the price that applies at the expected cell count – not today's.

Step 4 Weigh the cell count risk against it

Three quarters will carry the entire milk volume from now on, so a new infection hits harder than before. This item cannot be put into euros in any serious way, but it has to be named before the math is done.

Step 5 Calculate against the replacement

What does the heifer that is actually available cost – not the one that theoretically would be? And what will she produce in her first lactation compared with this cow on three quarters? Anyone without a reliable number for the heifer has no reliable number for the three-quartered cow either.

The math does not decide anything on its own. It makes sure the decision depends on numbers, not on how the udder looks.

Which quarter is lost makes a difference. In a Lithuanian analysis of 229 cows on milking robots, the front quarters accounted for 42.2 percent and the rear quarters for 57.8 percent of

milk yield in 2016.²³ A Polish study of 1,891 first-lactation cows puts the difference at about 1 kg more per rear quarter at a daily yield of 28.5 kg.²⁴ The gap varies by population, but the direction is stable – and it is precisely the rear quarters that are more often affected by teat injuries. Anyone tackling Step 2 without quarter milk yields should therefore calculate at the upper end of the range for a rear quarter.

Living with the three-quartered cow

If the cow stays, day-to-day routine changes in several places – and the most important change is invisible. Losing the quarter changes the basis on which the somatic cell count is calculated: The composite milk cell count is not an average across four quarters, but a mean weighted by the quarter milk yields.²⁵

Two things follow from this. If a chronically infected quarter with a high cell count drops out of the calculation, the cow's composite cell count falls – even if nothing has improved in the other three. And the milk volume over which the cells of the remaining quarters are spread has become smaller; any increase hits harder than before.

For herd health management, this means: After losing the quarter, a three-quartered cow has to be reassessed, not judged on her old cell count history. Anyone who monitors her only by composite cell count sees an improvement that is not one and misses a deterioration that is. In practice: record a new baseline and set the alert threshold against it – not against the herd threshold.

The California Mastitis Test belongs in the routine, but it has limits. In a study of 520 quarters from 131 cows, the sensitivity of the CMT on day 3 after calving was 56.7 percent for any pathogen and 66.7 percent for major pathogens, with a specificity of about 55 percent.²⁶ As a screening tool it is fast and useful; as a clean bill of health it is not. For the three-quartered cow, then: a CMT at every opportunity when you are at the udder anyway – plus a bacteriological quarter milk sample when deciding whether she stays or when she is to be dried off.

There is some reassurance: According to a German study on 16 farms with 1,126 cows, an infected quarter did not increase the new infection risk of the other quarters of the same cow.²⁷ The three-quartered cow is therefore not a roving source of infection for her own udder. She is a cow with smaller reserves.

THE THREE-QUARTERED COW DAY TO DAY

Mark her visibly – on the cow and in the software

A colored marking that every milker sees before attaching, and an entry in the herd management software. Relief milkers and vacation cover do not know the cow, and a single unit attached wrong is enough.

Do not milk the quarter

Plug the teat cup or shut off the quarter, no hand-stripping. Overmilking is explicitly named in the literature as a risk factor – here on a quarter that is already damaged.

Quarter cell counts instead of composite milk

In these cows the composite value misleads in both directions. Anyone who does not record quarter-level values is monitoring the wrong number.

Set a new alert threshold

Record the baseline after the quarter is lost and set the threshold against that value. The cow's previous history has become worthless as a benchmark.

Adjust production expectations

About three quarters of the previous level, somewhat less with a rear quarter. Anyone who keeps measuring the cow against her old lactation curve will cull her for the wrong reason.

Clarify things with the milking system before deciding

Whether and how a single quarter can be permanently deactivated on your own system is for the service partner to answer – in writing, before the cow stays. With a robot there is the added question of whether attachment works reliably with three quarters.

The effort per animal is small. But it comes up every day, and in places where nobody asks – which is why it has to be written down.

[insert figure: udder of a three-quartered cow, affected quarter visible]

Fig. 1: With good udder health in the remaining quarters, a three-quartered cow can stay profitable over several lactations. What matters is not the missing quarter, but the condition of the other three.

The decision: stay or go

A three-quartered cow is not a reason to cull, but a cow with a changed basis for calculation. The question is not whether she has lost a quarter, but whether she is better on three quarters than the heifer that would take her place. The benchmark is the expected remainder of her own productive life – in the vit region, culled cows in 2024/25 had a productive life of 38.2 months and lifetime production of 31,691 kg (about 69,900 lb).²⁸ A second-lactation cow with three healthy quarters is in a different position than a fifth-lactation cow with an elevated cell count.

- Which quarter was lost – front or rear, and how much milk did it actually give most recently?
- What are the cell counts of the three remaining quarters, measured individually and not derived from composite milk?

- What stage of lactation and which lactation is the cow in?
- How sound is she outside the udder – fertility, feet and claws, metabolism?
- How high is her genetic merit, and does she have offspring in the herd or on the way?
- Is there a rearing place and a heifer that is actually available?
- Will the milking system be able to handle her – and at what effort?

On the last point, an honest answer: Whether and how a single quarter can be permanently deactivated on the common milking robot systems could not be established in this research from a reliable, dated source; the manufacturers' herd management documentation is not public. Anyone facing the decision should ask their own service partner and get the answer in writing. What is documented is that attachment depends on teat arrangement, and that udder conformation traits can be estimated from the robot's teat coordinates with heritabilities between 0.37 and 0.67 – considerably higher than from classification.²⁹

Conclusion: documented, calculated, open

Four statements are documented. First: The more common road to a dried-off quarter is not injury but inflammation that heals bacteriologically and not cytologically. Second: With an injury, the hour decides, not the suture material – and saving the teat is not the same as keeping the cow. Third: Compensation is on the order of 4 percent per quarter. Fourth: Setting take-off earlier, at 400 to 600 grams per minute, costs no milk and measurably protects teat tissue.

Calculated, not measured, is everything that follows from this for the individual farm – the milk revenue math, the comparison with the replacement, the effect on herd cell count. These calculations are only as good as the quarter milk data that go into them. Without them, the decision is made on gut feeling.

Three things remain open: How common three-quartered cows are in German herds has not been surveyed. How their production develops over a complete lactation has not been studied – all available studies end after weeks. And what share barn design and flooring have in the risk of mechanical teat injury has not been quantified. All three gaps concern questions that are decided in the barn every day.

It is not the missing quarter that decides whether the cow stays, but the condition of the other three.

FOOTNOTES AND SOURCES

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- 28** As footnote 2, p. 18: productive life and lifetime production of culled cows; 438,376 culled cows against a live inventory of 1,464,579 cows.
- 29** Poppe, M.; Mulder, H. A.; Ducro, B. J.; de Jong, G. (2019): Genetic analysis of udder conformation traits derived from automatic milking system recording in dairy cows. *Journal of Dairy Science* 102(2), 1386–1396. DOI 10.3168/jds.2018-14838. Reference population: 70 Dutch herds, 12,663 cows in first lactation.

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This article argues from method, not from the author's own farm cases. All figures have been checked against the original sources listed in the footnotes; information that could not be verified was left out, and the remaining gaps are named in the text. The worked examples are labeled as such and should be replaced with the farm's own figures.

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