THE GLOBAL STANDARD FOR LIVESTOCK DATA

The University of Nottingham

A Veterinary Perspective on Udder Health Recording

Focus on Clinical and Sub-clinical Mastitis

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Introduction

- What can and should we record?
  - Challenges and Pitfalls
- Newer Technologies
- Use and interpretation

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What can and should we record?

- Individual Cow Somatic Cell Counts (ICSCC)
  - Differential cell counts
  - Sub-clinical Mastitis
- Clinical Mastitis
- Aetiology
- Other measures of inflammation
  - Conductivity, CMT, *etc*
- Treatments
- Teat End Callosity Scores

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Somatic Cell Counts (1)

- At the cow level.
  - Qrt level? - technology and cost
  - Bulk tank (later)
- Recording interval
  - Can vary
    - According to farm needs?
    - Genetic evaluations should ‘fit’????
  - Monthly optimal?
  - Target around dry off and calving?

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Somatic Cell Counts (2)

- Some challenges
  - Managing ‘absent cows’
  - More limited use in very low SCC herds
    - Why bother…

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Clinical Mastitis

- Cow ID
- Date
- Quarter(s)
  - LF, LH, RF, RH (+UnK!)
- Severity
  - 1 - Mild (milk signs only)
  - 2 - Moderate (milk and udder signs)
  - 3 - Severe (sick cow)
  - 4 - Toxic

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Aetiology

- Methods
  - Lab based *vs* Farm based
    - Quality control
    - Sens and specs of many on farm kits not established
  - Bacteriology *vs* PCR
    - Pros and Cons for both
- Objective?
  - Contagious *vs* Environmental…
- Inc sensitivity testing?...

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Other Measures

- Conductivity
- CMT
- *etc*

Test	Estimated Sensitivity (%)	Estimated Specificity (%)	Time to result	Location
Milk or cow inspection	80	100	Seconds	Cow side
SCC (DHI testing)	75	75	Minutes	Lab
SCC (On farm testing)*	</=75	</=75	Minutes	On farm
CMT+	75	75	Seconds	Cow side
Conductivity (Hand held)	80	-	Seconds	Cow side
Conductivity (AMS)	-	-	Seconds	Cow side
Milk Temperature	50	70	Seconds	Cow side
Yield – manual assessment	20-40	Low	Seconds	Cow side
NAGase	70-100	95	Minutes	Lab
Milk colour using real time digital camera technology	-	-	Seconds	Cow side
Acute Phase Proteins eg Milk Amyloid A (MAA)	-	-	Minutes	Lab
Lactate dehydrogenase (LDH)	-	-	Minutes	Lab
Adenosine Triphosphate (ATP)	-	-	Minutes	Lab
"Electronic tongue" – using an array of chemical sensors and computer data algorithm processing.	-	-	Seconds	Cow side

- Maybe to record Sub-clinical mastitis and method of detection?

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Treatments

- Clinical and Sub-clinical Treatment
  - Primarily for antibiotic use
- Route
  - Intramammary *vs* Systemic
  - Antibiotic class(es)
- Dose and Duration

- Dry Cow Therapy – ADCT and Sealants

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Teat End Callosity Scores (TEC)

- As an investigative tool?
- On a regular basis?
  - R and **VR**
    - Associated with increased risk of clinical disease
  - S
    - Associated with decrease risk of elevated SCC

N (no ring)
No callosity ring present at the teat end.

S (smooth ring)
Parakeratosis, characterised by a smooth or slightly rough callosity ring at the teat end.

R (rough ring)
Hyperkeratosis of the teat epidermis and eversion of the teat end.

VR (very rough ring)
Hyperkeratosis of the teat epidermis with keratin fronding of the teat orifice and severe teat end eversion.

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‘Newer’ Technologies

- Differential cell counting
- Cow-side and ‘on-farm’ testing
- How and when do we integrate these technologies
  - Lack of validation
  - Lack of standardisation
  - Lack of calibration

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SCC and Clinical Mastitis Data

Need Both!

USE AND INTERPRETATION

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SCC Data Interpretation

- Disease Monitoring
  - 200,000 cells/ml threshold
    - Higher threshold in early lactation?
  - ‘Virtual High’ for the absent cow
- Management
  - Segregation and cow selection
  - ADCT selection
- ‘Slate wiped clean’ at dry off (not calving)
- Lag phase

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Simple Definitions

- In lactation
  - <200K to >200K = new IMI
  - 2 of 3 >200K = Chronic
- Across the dry period
  - Movements around the 200K threshold
    - Fresh Calver Infection Rate
    - Dry Period Cure Rate
    - Dry Period New Infection Rate

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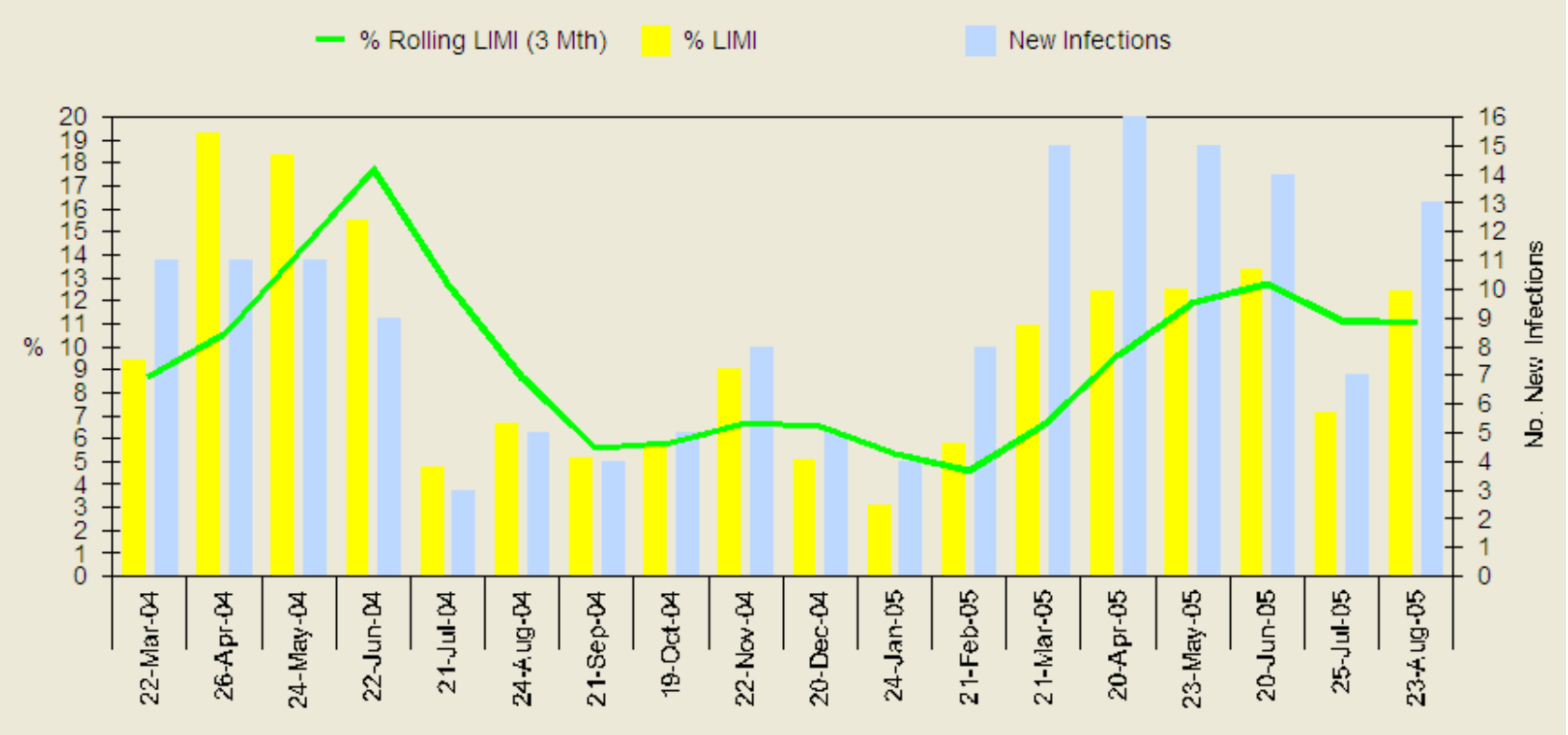
Lactation New Infection Rate



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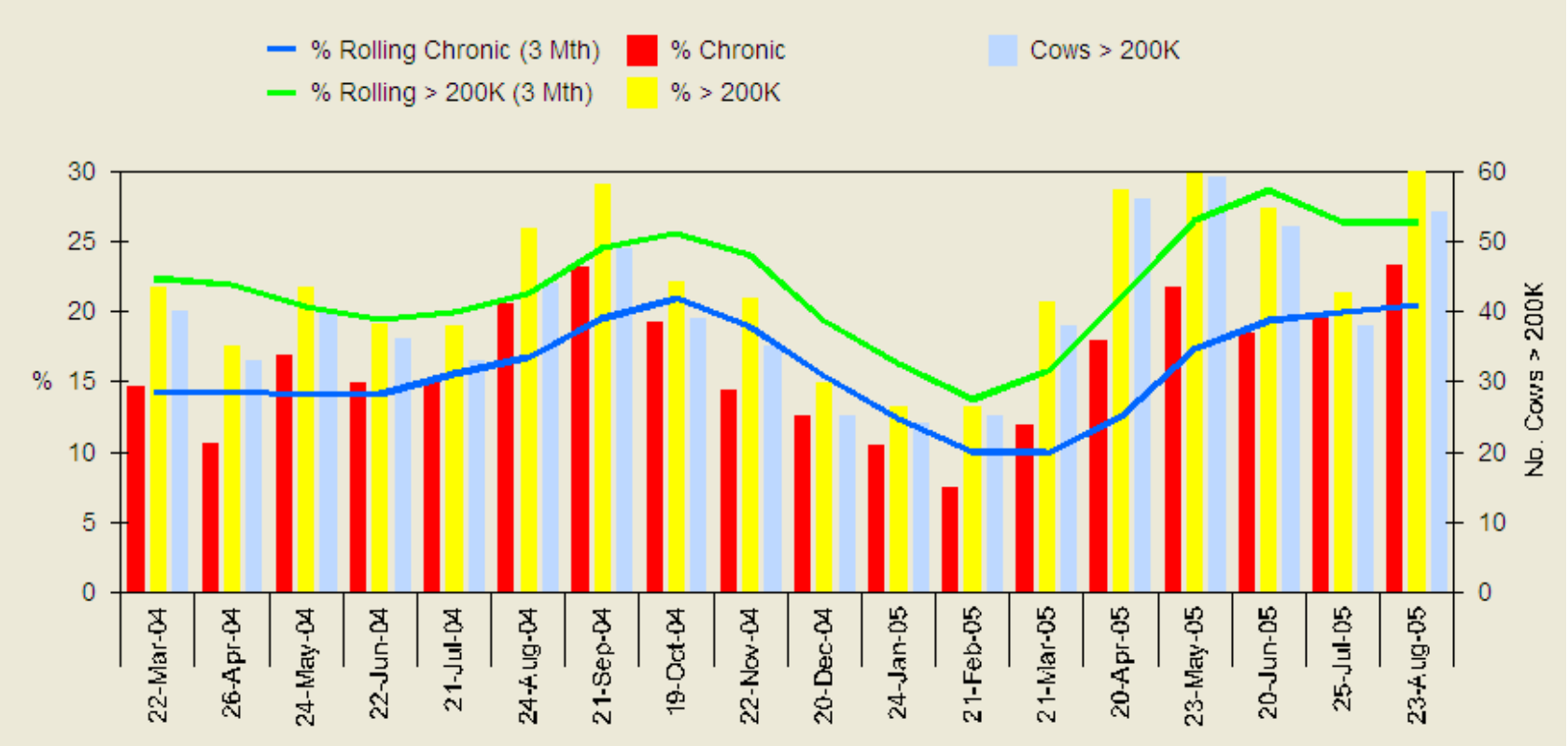
Infection Prevalence (>200)



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The Importance of Integrating Clinical Mastitis Data

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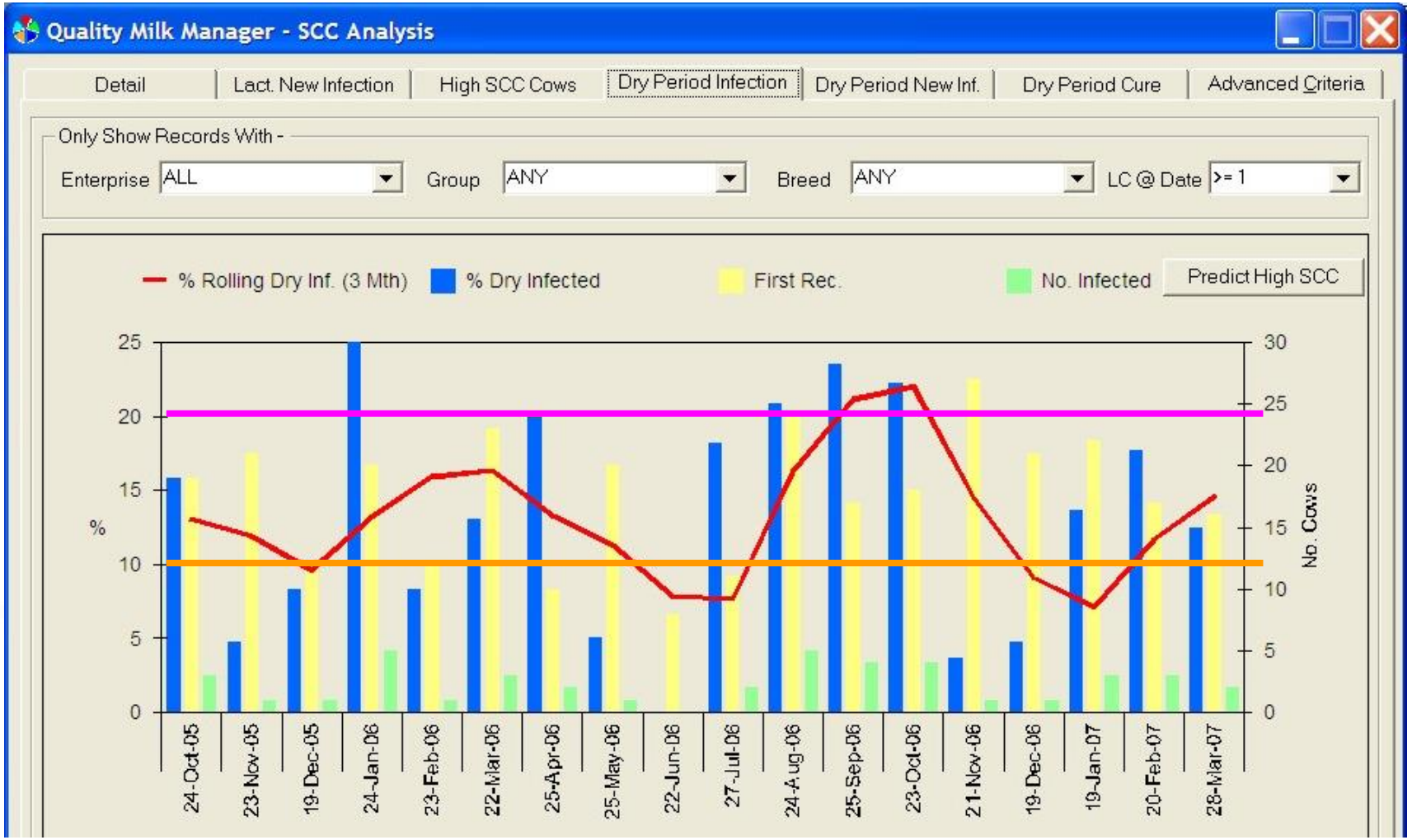
Without integration of CM Data



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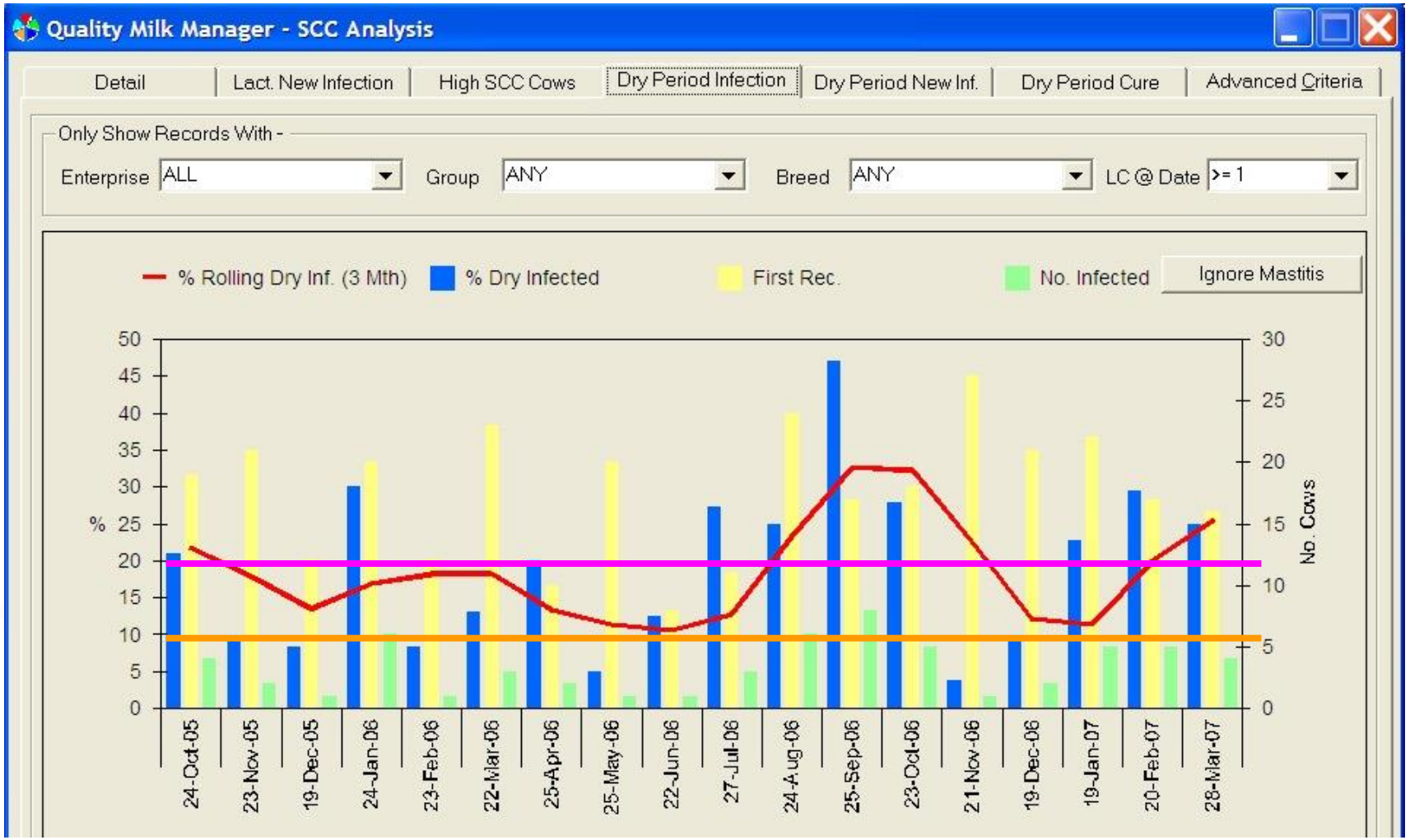
With integration of CM Data



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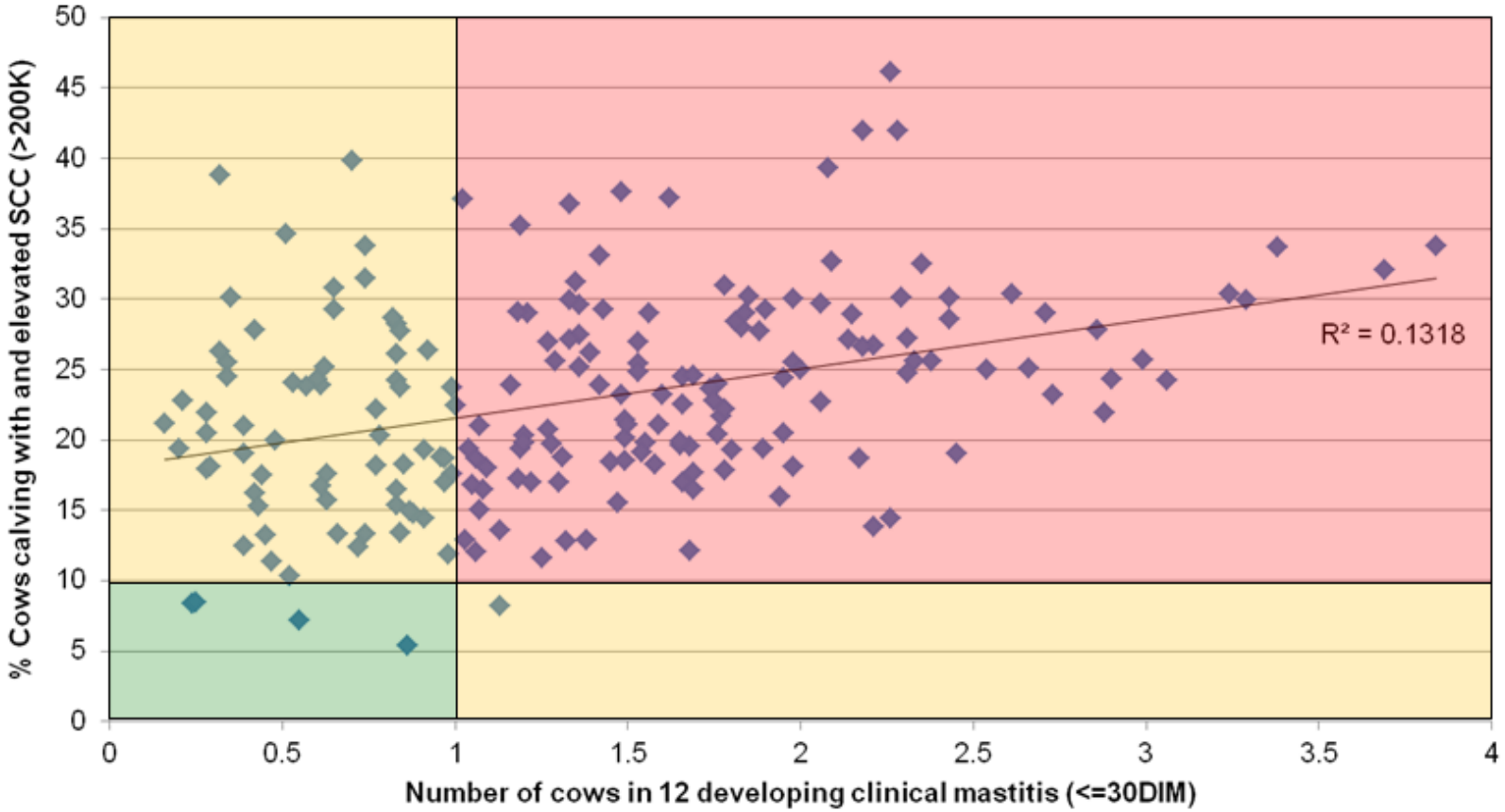
Does SCC predict Clinical Mastitis?



n = 200 UK dairy herds

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CM Data Interpretation

- Predict Origin of Infection
  - Dry *vs* lactating period
- Most analysis at the cow level
  - Some qrt level indices used
- 'Slate wiped clean' at dry off (not calving)
- Focussed on index (1st) cases
  - Lag phase (7 days)
- Also consider severity

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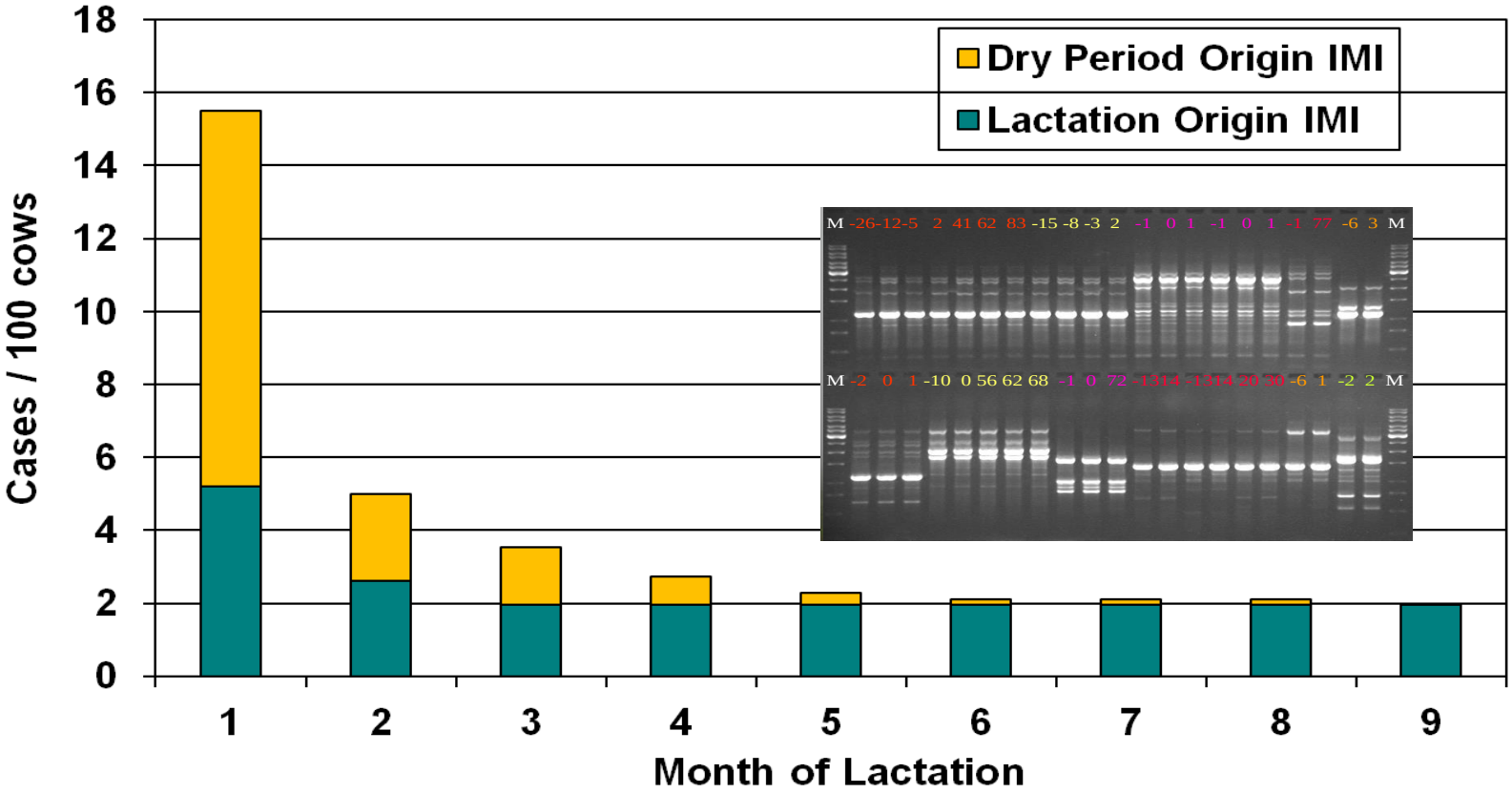
Origin of Clinical Mastitis



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Patterns of Clinical Mastitis

- Temporal pattern of development of disease
- INDEX (first) cases during lactation
  - ≤ 1 in 12 cows get clinical mastitis in first 30 days of lactation
  - ≤ 2 in 12 cows get clinical mastitis in the rest of lactation

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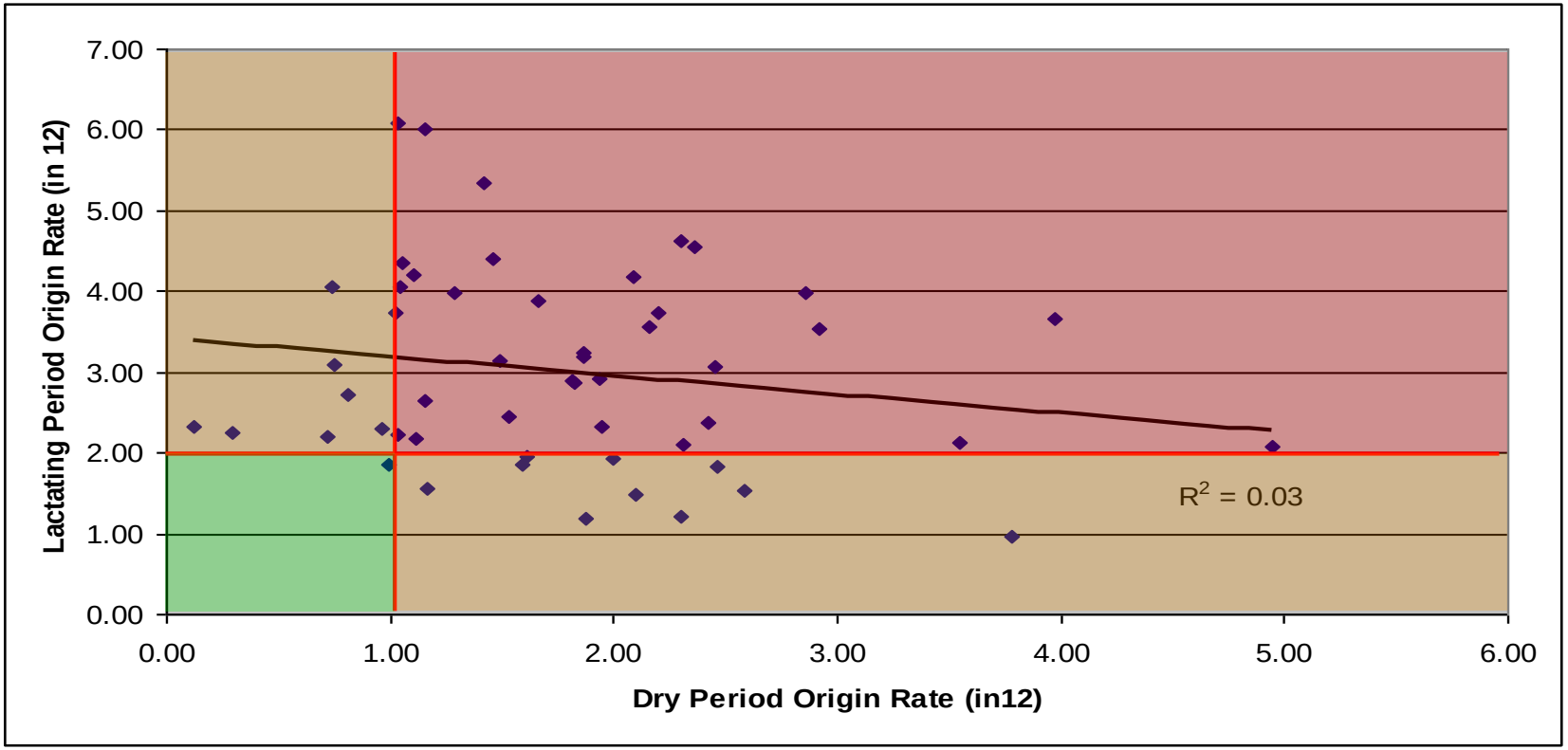
Relationship between Dry Period and Lactating Period Clinical Mastitis Rates



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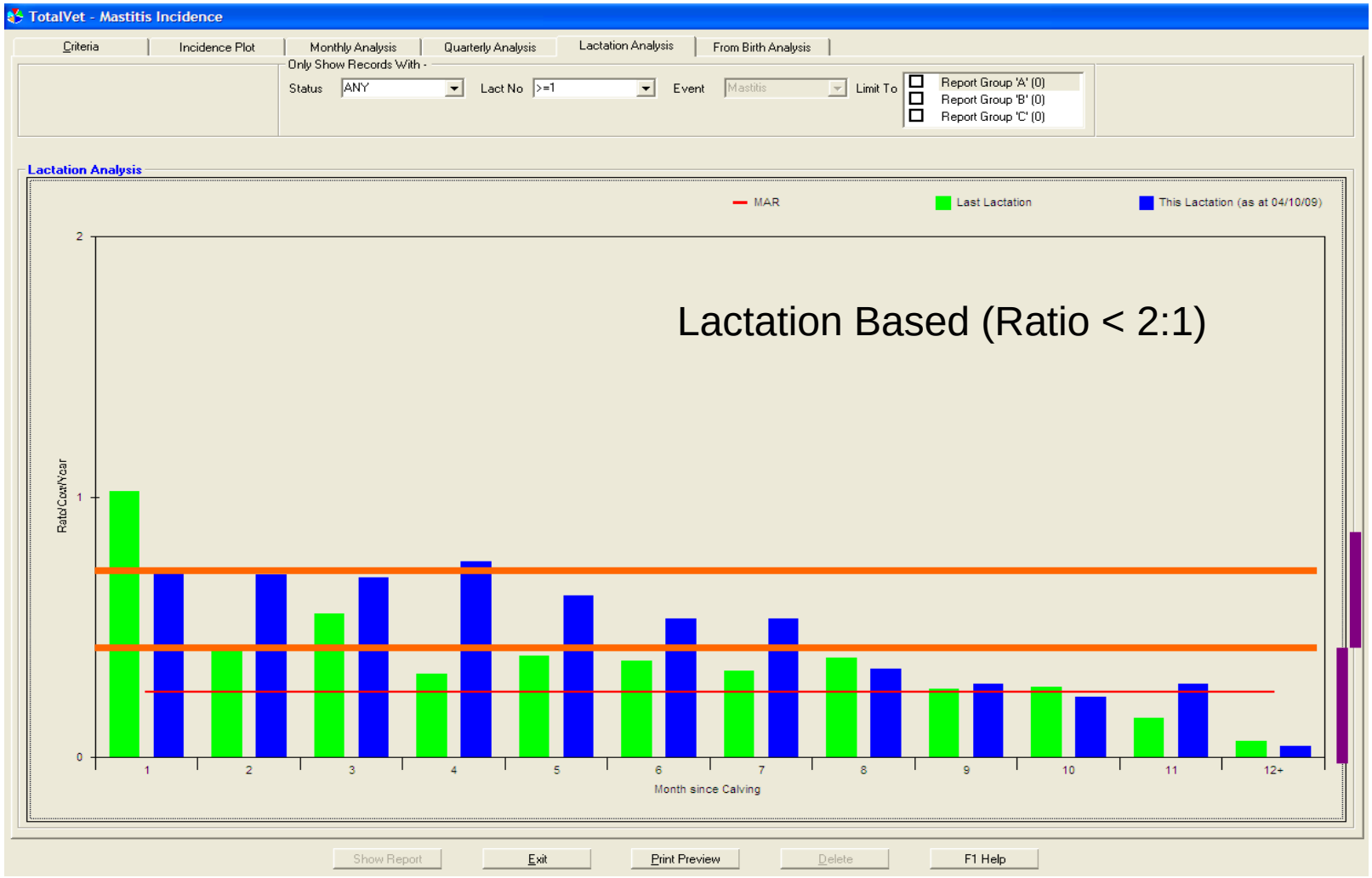
Clinical mastitis - Temporal Distribution



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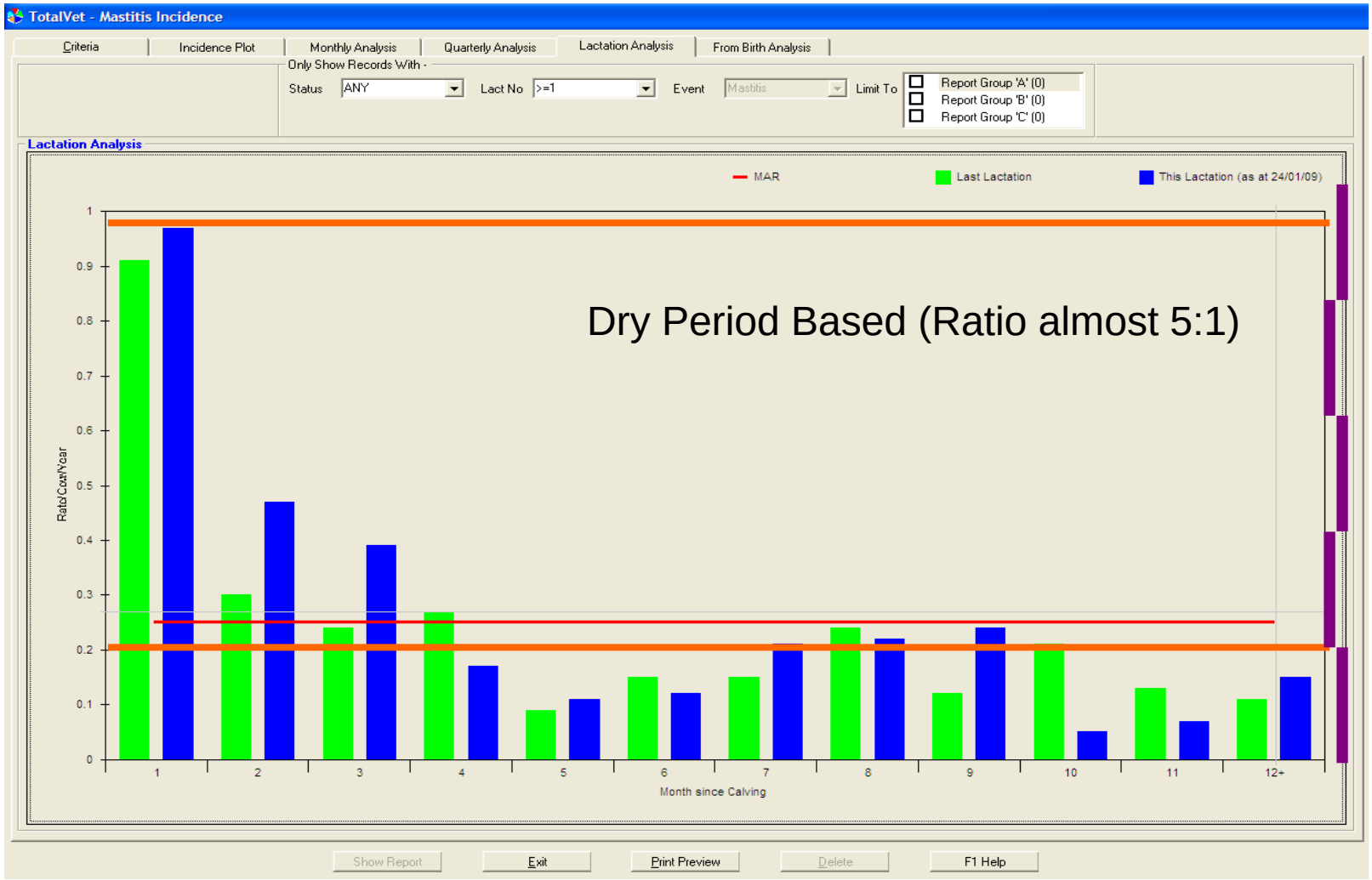
Clinical mastitis - Temporal Distribution



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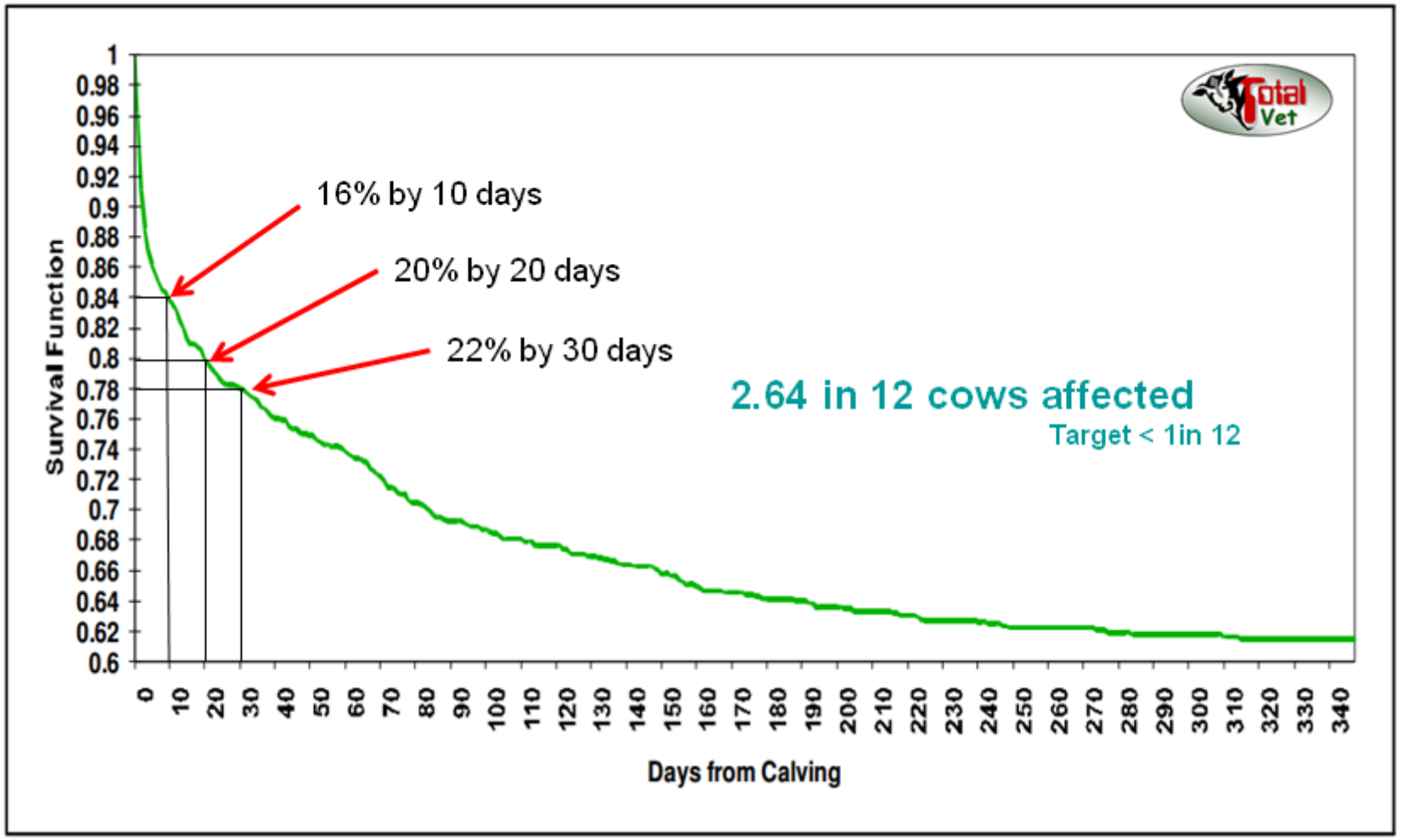
Clinical Mastitis Survival Curve



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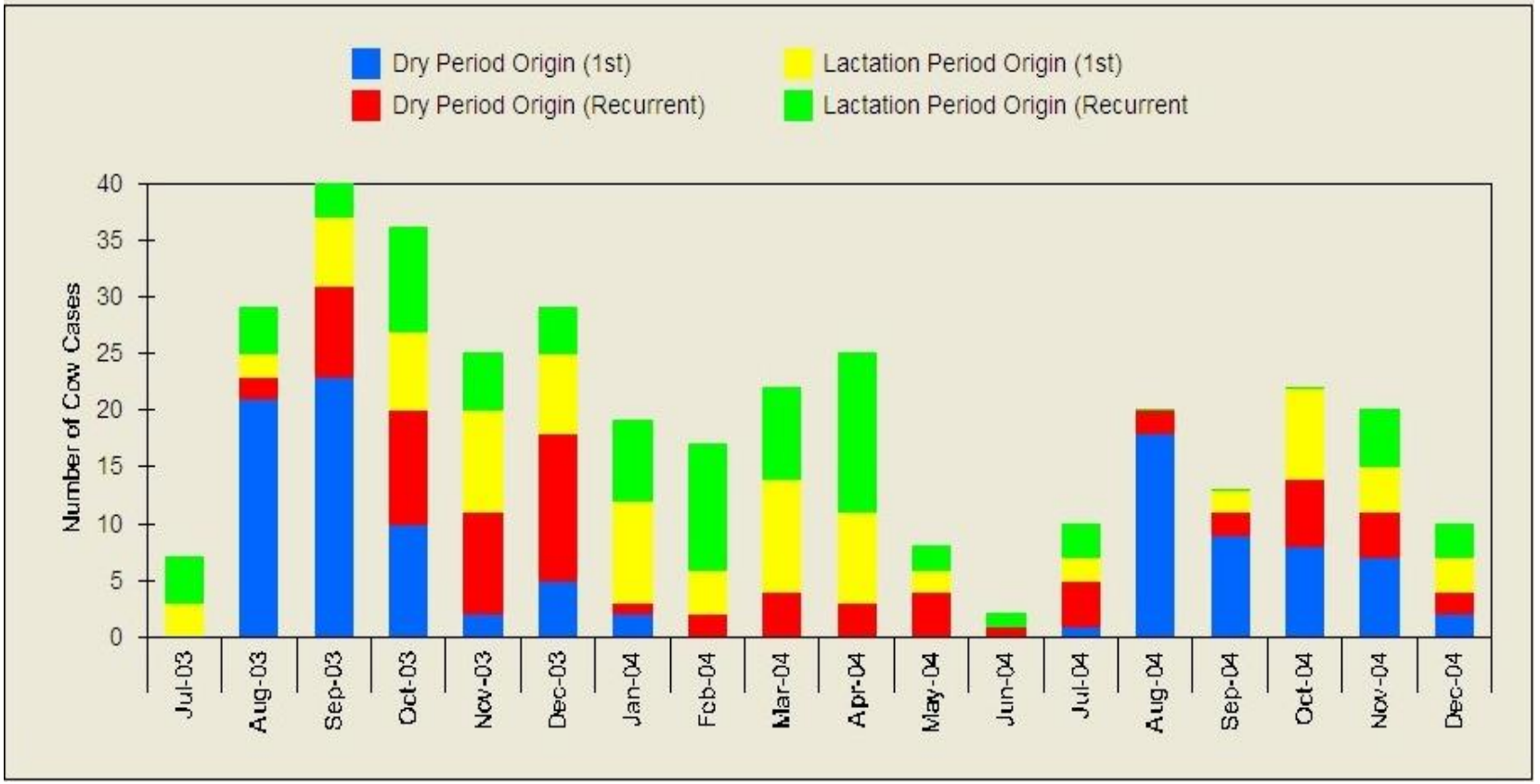
Monthly Mastitis Analysis



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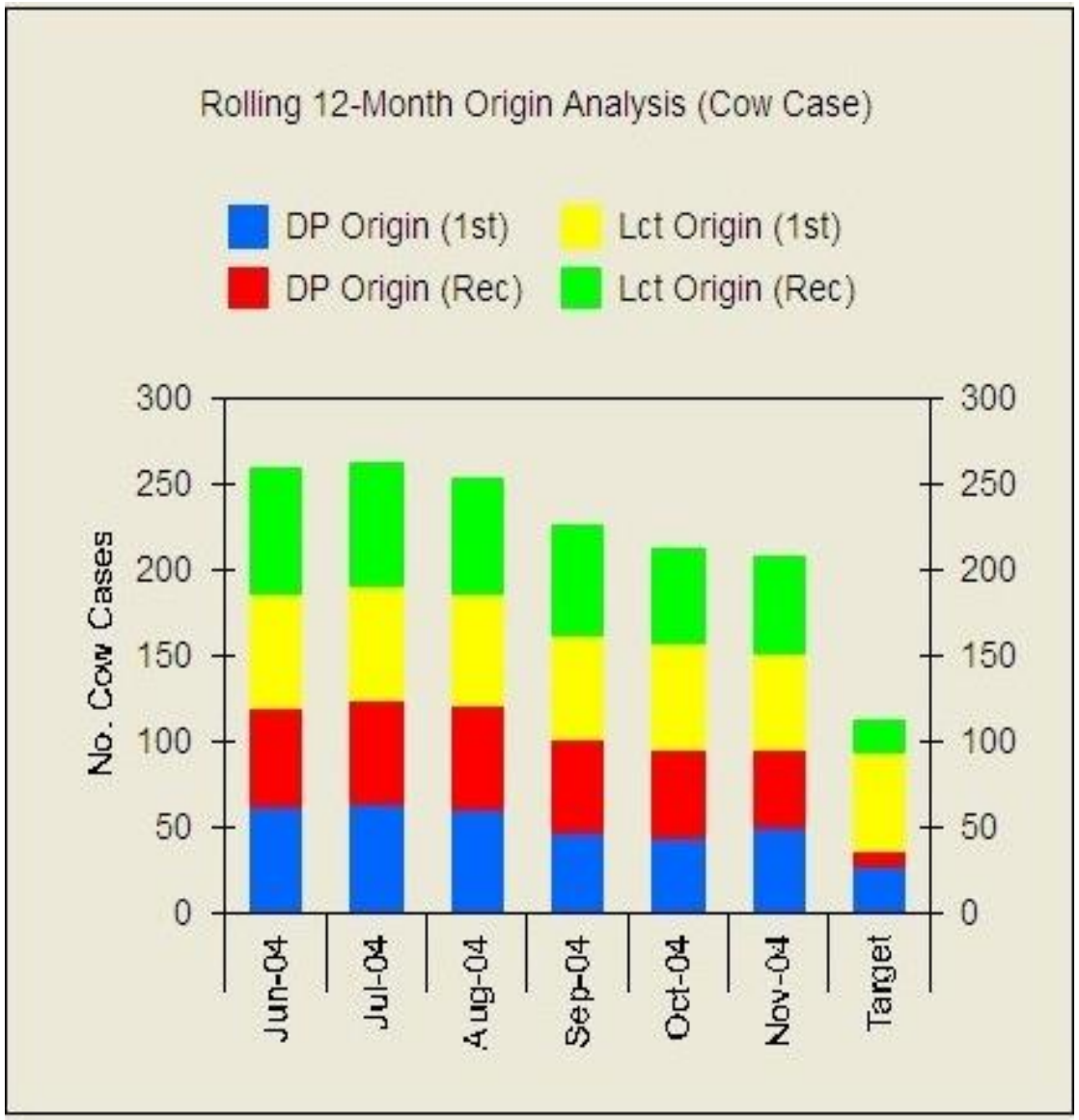

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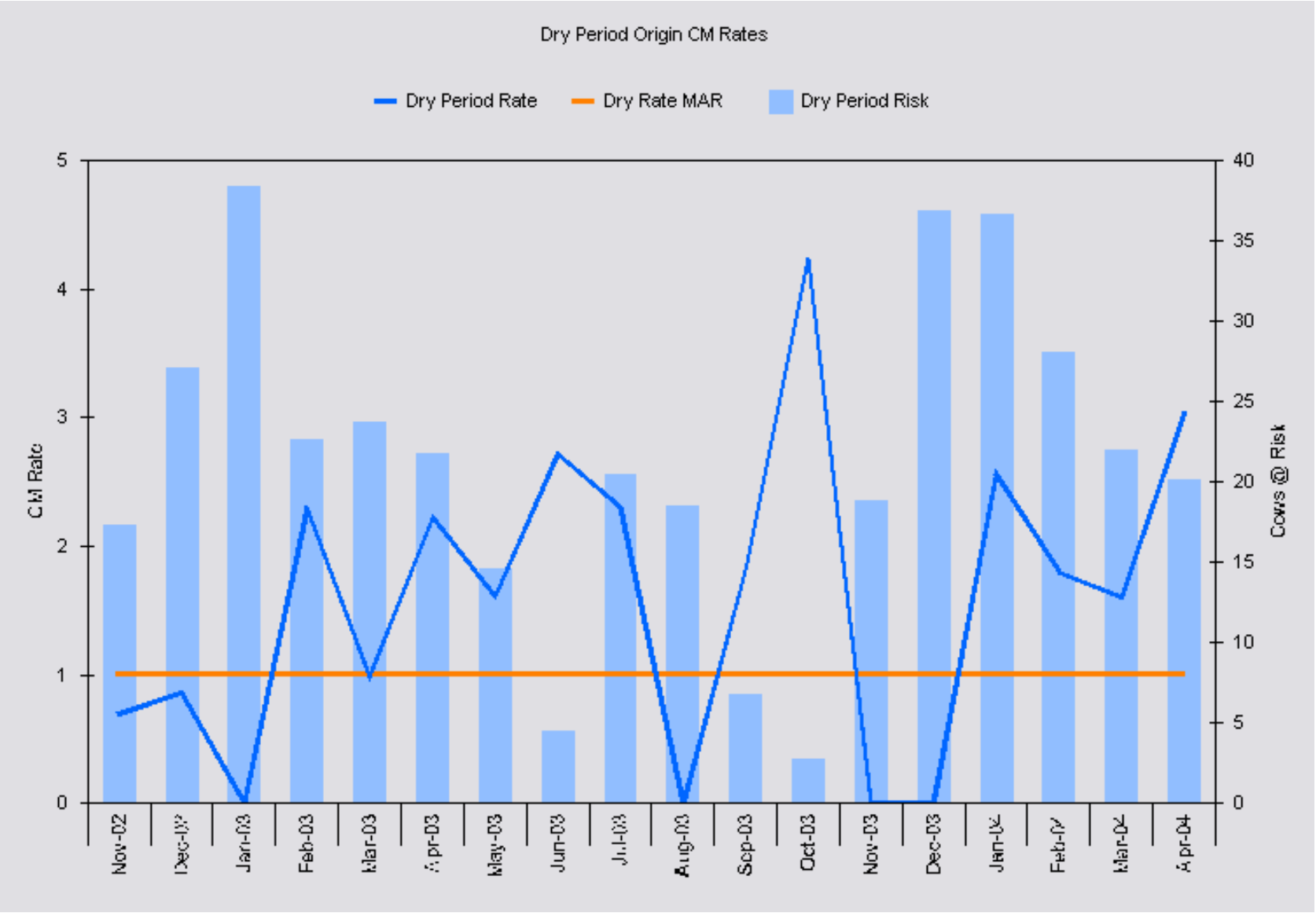

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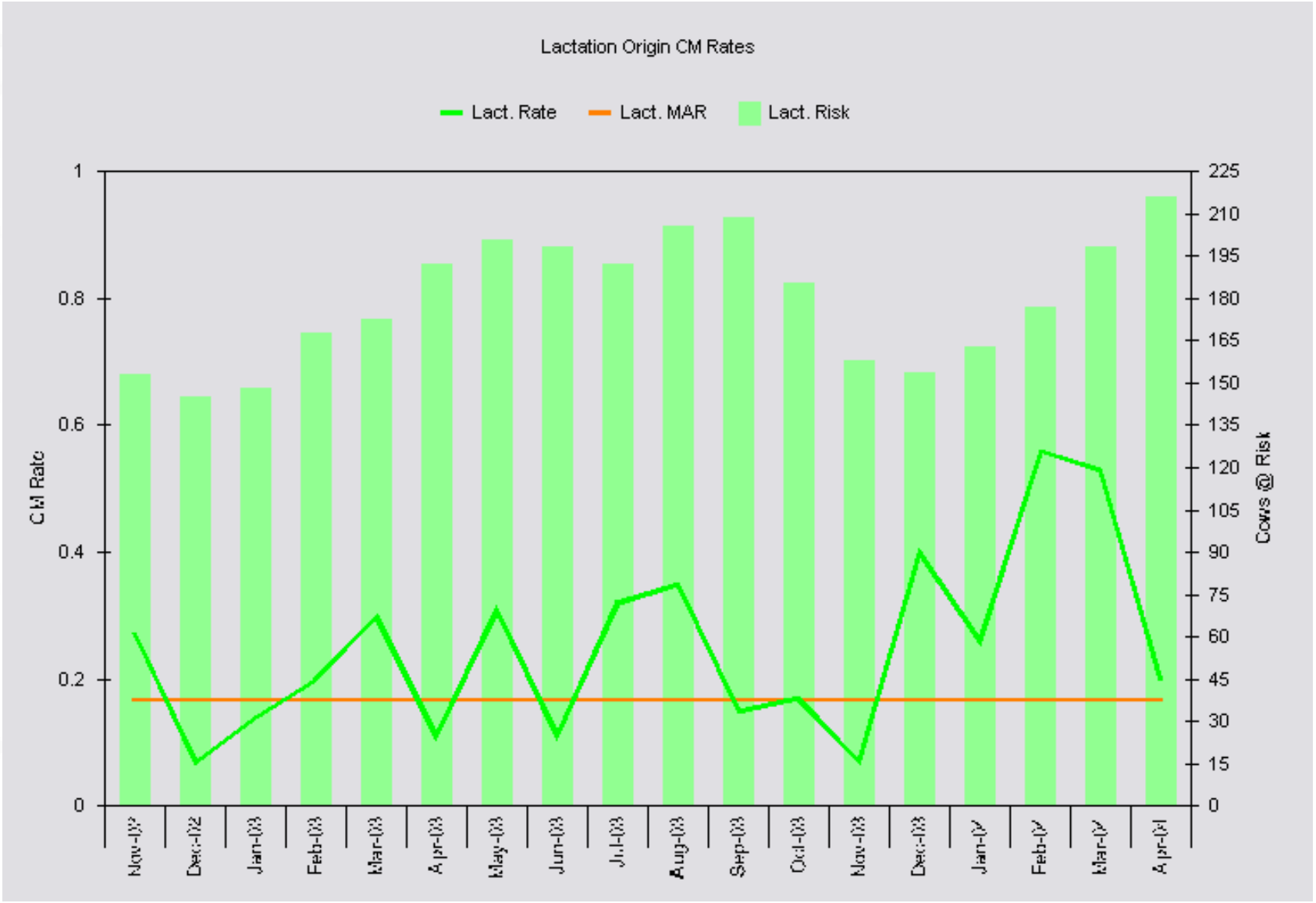

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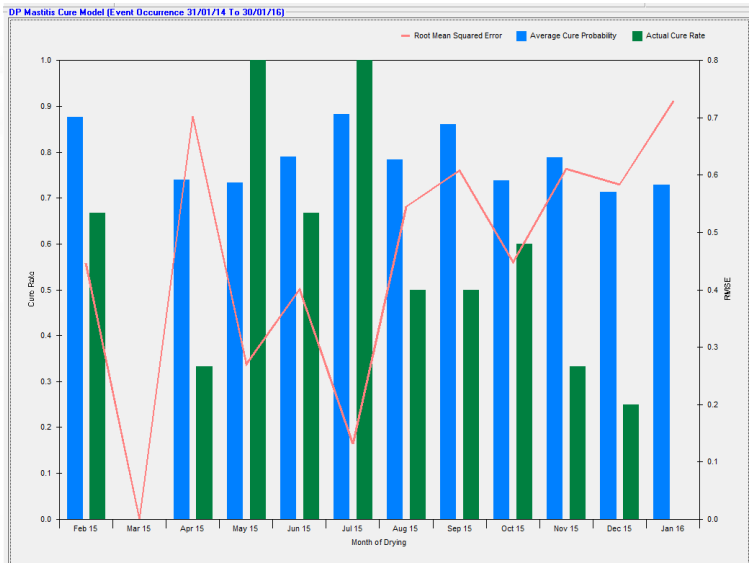

Inc DCT Decision Making

MONITORING MASTITIS TREATMENT OUTCOMES

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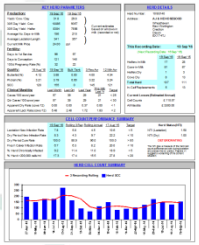
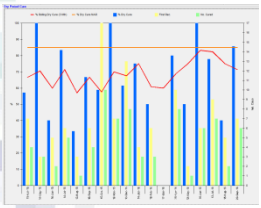
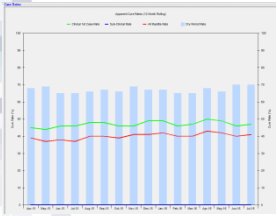
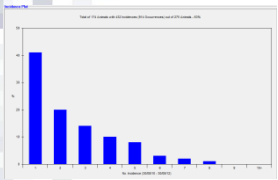
Historic Reports









- **Dry Period** Cure Rates
  - Herd Mastitis Summary report
    - Rolling 3-month and 12-month averages
  - Somatic Cell Count Analysis report
    - Month on month variation

- **Lactating Period** Cure Rates
  - Mastitis Analysis report
    - Rolling 12-month average 1st case and all case cure rates
      - Based on next three SCC<200,000 cells and no recurrence
  - Incidence Plot
    - Proportion of cases only treated once
      - 1st case ‘clinical’ cure

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Cure Rates in Lactation

- ‘Treatment Outcomes’ Report
  - Mastitis Event CuSum
  - Mastitis Flexi cure analysis
    - Allows associations with apparent cure rate to be investigated
    - Day of the week
    - Operator (detection)
    - Treatment used (product)
    - Treatment quantity
    - *etc*

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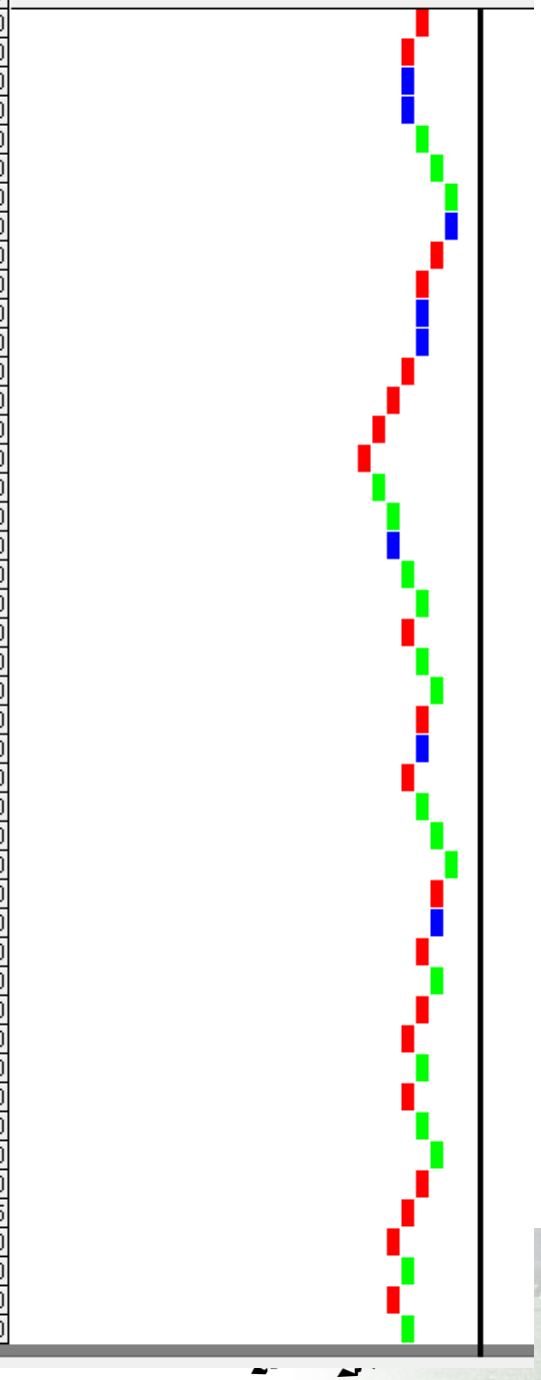
Event CuSum (Event Occurrence 01/01/14 To 31/12/15)

Code	Date	L.No	DiM	Treatment	Days	Qty
835	04/07/14	3	133	Combiclav Mc	5	10.0
611	31/07/14	5	174	Combiclav Mc	3	6.0
769	07/09/14	3	405	Combiclav Mc	4	8.0
198	24/09/14	10	5	Combiclav Mc	1	6.0
875	05/10/14	3	188	Combiclav Mc	3	9.0
978	11/10/14	2	5	Combiclav Mc	3	9.0
842	09/11/14	3	81	Combiclav Mc	3	6.0
835	16/11/14	3	268	Combiclav Mc	3	6.0
811	24/11/14	4	72	Combiclav Mc	3	6.0
932	14/12/14	2	148	Combiclav Mc	3	6.0
487	15/12/14	8	86	Combiclav Mc	3	6.0
343	14/01/15	3	91	Combiclav Mc	3	6.0
723	15/01/15	4	193	Cobactan	4	8.0
975	19/01/15	3	129	Combiclav Mc	3	6.0
988	19/01/15	2	178	Combiclav Mc	3	6.0
813	26/01/15	3	324	Combiclav Mc	3	6.0
975	28/01/15	3	138	Combiclav Mc	3	6.0
932	16/02/15	2	212	Combiclav Mc	4	8.0
119	02/03/15	7	2	Combiclav Mc	2	4.0
126	10/03/15	1	278	Combiclav Mc	3	6.0
955	28/03/15	3	51	Combiclav Mc	2	4.0
611	01/04/15	6	20	Combiclav Mc	3	6.0
978	13/04/15	2	189	Combiclav Mc	3	6.0
91	16/04/15	2	32	Combiclav Mc	3	6.0
441	18/04/15	7	17	Combiclav Mc	4	8.0
113	19/04/15	4	396	Cobactan	4	16.0
712	23/04/15	4	289	Combiclav Mc	3	6.0
757	24/04/15	4	102	Combiclav Mc	4	8.0
791	01/05/15	4	122	Combiclav Mc	2	4.0
441	03/05/15	7	32	Combiclav Mc	4	8.0
611	09/05/15	6	58	Cobactan	5	10.0
642	11/07/15	6	325	Combiclav Mc	1	1.0
723	12/07/15	4	371	Combiclav Mc	3	6.0
802	15/08/15	4	343	Cobactan	5	10.0
596	06/09/15	7	55	Cobactan	5	10.0
791	07/09/15	4	251	SYNULOX	2	3.0
56	29/09/15	2	57	Cobactan	4	8.0
932	30/09/15	3	72	Cobactan	4	8.0
5	02/10/15	3	60	Cobactan	4	8.0
932	24/10/15	3	96	SYNULOX	3	6.0
846	07/11/15	4	65	SYNULOX	3	6.0
842	24/11/15	4	107	SYNULOX	3	4.5
664	07/12/15	6	32	SYNULOX	4	8.0
948	12/12/15	4	55	SYNULOX	3	6.0
835	26/12/15	5	25	SYNULOX	4	8.0
932	27/12/15	3	160	SYNULOX	4	8.0



Mastitis Event CuSum

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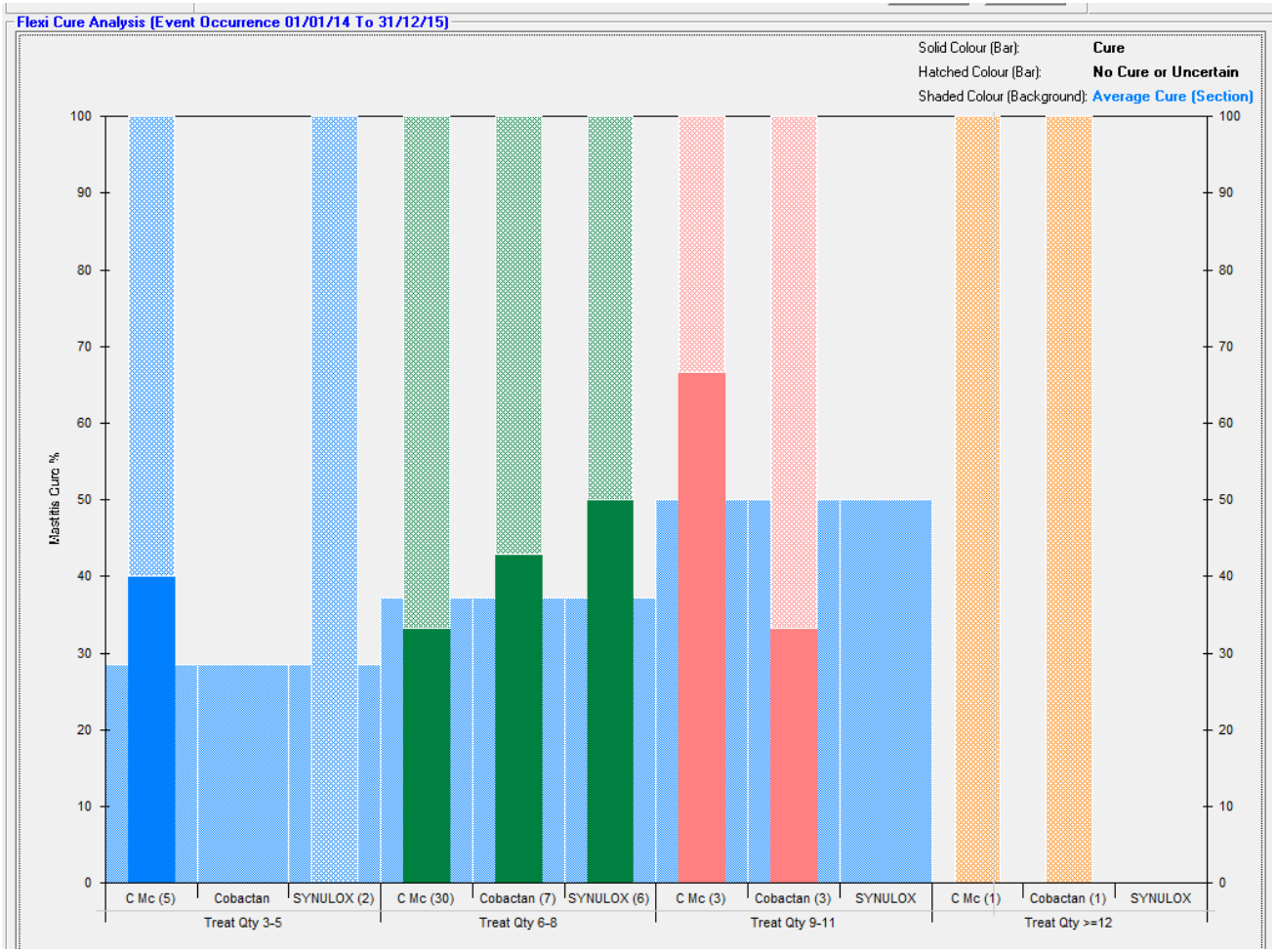
Cure by Treatment & Quantity



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Dry Period Cure Rate

- Drying-off list
  - Variable thresholds
    - heifers / older cows
    - periods of monitoring
  - estimation of cure for high cell count cows
    - See Henderson *et al* (2015)
- 'Treatment Outcomes' Report
  - 'Actual' v 'Predicted dry period cure rate
  - Rolling 12 month performance
    - Is the herd achieving better or worse than predicted?

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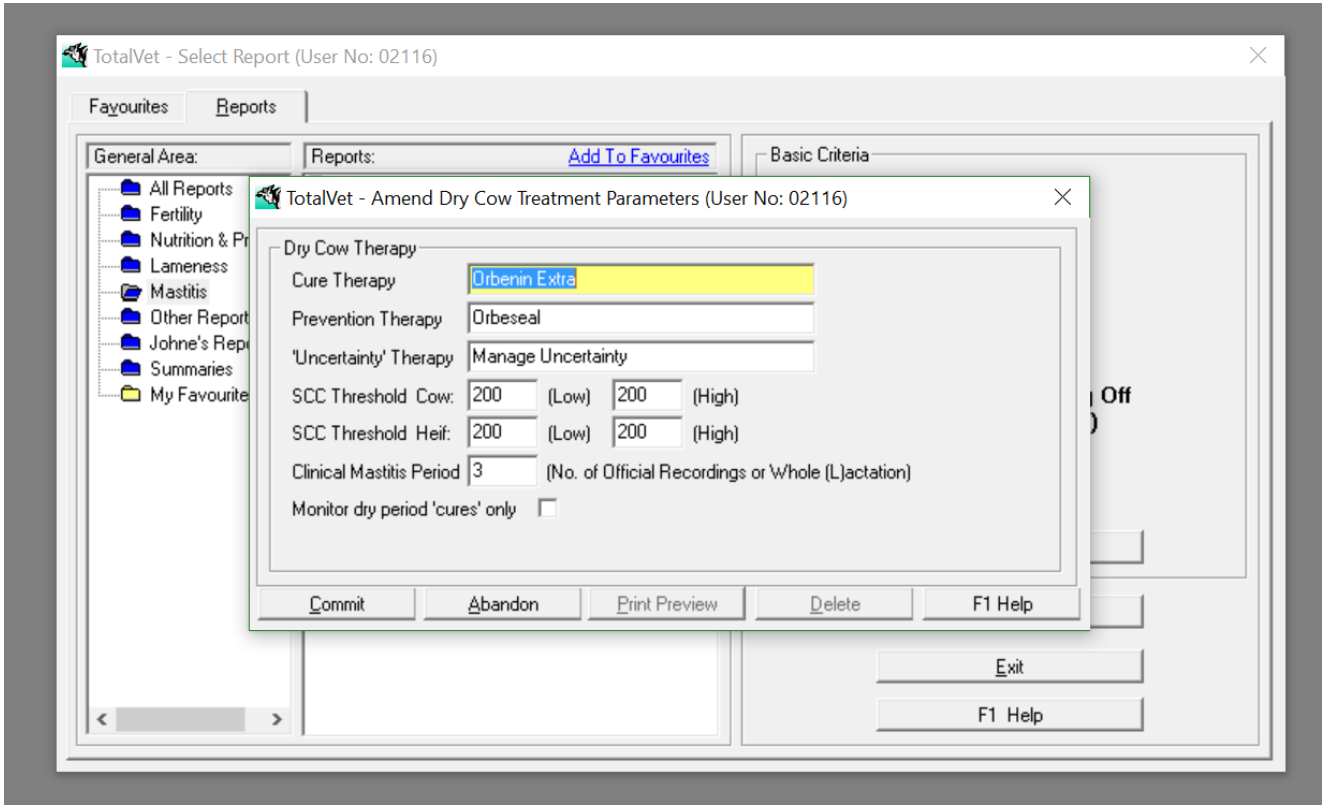
DCT Decision Making



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Drying-Off List

								Cell Count History						
Code	EarTag	L.No	Served	PD	Dry	Due	CM Date	10/02/16	10/03/16	13/04/16	Inf. Status	Sug. Treatment	Cure Prob.	Notes
947	UK281005200947	2	12/09/15	+	22/04/16	21/06/16		188	179	248	Infected	Select for Cure	0.89	
931	UK281005700931	2	13/09/15	+	23/04/16	22/06/16		135	187	250	New (Milk)	Select for Cure	0.89	
3	UK281005201003	1	22/09/15	+	02/05/16	01/07/16		46	48	72	Uninfected	Select for Prevention	-	
986	UK281005600986	1	22/09/15	+	02/05/16	01/07/16		183	180	270	New (Milk)	Select for Cure	0.92	
918	UK281005100918	3	28/09/15	+	08/05/16	07/07/16		Absent	Absent	Absent	Uncertain	Select for Cure	0.79	
510	uk281005600510	3	30/09/15	+	10/05/16	09/07/16		Absent	Absent	Absent	Uncertain	Select for Cure	-	
962	UK281005300962	2	01/10/15	+	11/05/16	10/07/16		154	452	247	Chronic	Select for Cure	0.89	
903	UK281005700903	4	02/10/15	+	12/05/16	11/07/16		245	372	806	Chronic	Select for Cure	0.71	
938	UK281005700938	2	02/10/15	+	12/05/16	11/07/16	15/12/15	96	41	104	Recovered	Select for Prevention	-	
921	UK281005400921	2	03/10/15	+	13/05/16	12/07/16	29/07/15	Absent	Absent	Absent	Uncertain	Select for Cure	0.90	
571	UK281005400571	4	06/10/15	+	16/05/16	15/07/16		Absent	Absent	Absent	Uncertain	Select for Cure	-	
927	UK281005300927	3	18/10/15	+	28/05/16	27/07/16		22	434	175	Uncertain	Select for Cure	0.75	
494	UK282983600994	2	20/10/15	+	30/05/16	29/07/16	08/11/15	12	45	136	Recovered	Select for Prevention	-	
572	UK281005500572	5	22/10/15	+	01/06/16	31/07/16		643	760	846	Chronic	Select for Cure	0.39	
920	UK281005300920	3	28/10/15	+	07/06/16	06/08/16		61	92	141	Uninfected	Select for Prevention	-	
421	UK282983501021	2	03/11/15	+	13/06/16	12/08/16		31	46	76	Uninfected	Select for Prevention	-	
945	UK281005700945	1	08/11/15	+	18/06/16	17/08/16		159	194	265	Infected	Select for Cure	0.93	
991	UK281005400991	1	12/11/15	+	22/06/16	21/08/16		63	87	55	Recovered	Select for Prevention	-	
995	UK281005100995	1	12/11/15	+	22/06/16	21/08/16		63	54	130	Uninfected	Select for Prevention	-	
994	UK281005700994	1	17/11/15	+	27/06/16	26/08/16		156	127	167	Uninfected	Select for Cure	-	
992	UK281005500992	1	18/11/15		28/06/16	27/08/16		102	107	93	Recovered	Select for Prevention	-	
901	UK281005500901	4	19/11/15	+	29/06/16	28/08/16		48	63	101	Recovered	Select for Prevention	-	
965	UK281005600965	2	19/11/15	+	29/06/16	28/08/16		27	24	39	Uninfected	Select for Prevention	-	
990	UK281005300990	1	21/11/15	+	01/07/16	30/08/16		302	303	207	Chronic	Select for Cure	0.90	

24 Cows Listed

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Predicted Cure @ Drying-Off

								Cell Count History						
Code	EarTag	L.No	Served	PD	Dry	Due	CM Date	13/07/16	18/08/16	20/09/16	Inf. Status	Sug. Treatment	Cure Prob.	Notes
F470	UK342153401151	6	26/12/15	+	05/08/16	04/10/16	14/10/15	116	Absent	Absent	Uncertain	Cepravin+Orbeseal	-	
F522	UK342153201296	5	31/01/16	+	10/09/16	09/11/16		65	73	Absent	Uncertain	Cepravin+Orbeseal	-	
F661	UK342153101876	3	03/02/16	+	13/09/16	12/11/16		104	155	Absent	Uncertain	Cepravin+Orbeseal	-	
F637	UK342153701756	3	05/02/16	+	15/09/16	14/11/16		635	417	367	Chronic	Cepravin+Orbeseal	0.54	
F743	UK342153401564	2	05/02/16	+	15/09/16	14/11/16		17	28	29	Uninfected	Orbeseal ONLY	-	
F556	UK342153601433	5	06/02/16	+	16/09/16	15/11/16	31/01/16	48	81	238	New (Milk)	UbroRed+Orbeseal	0.73	
F664	UK342153301885	3	08/02/16	+	18/09/16	17/11/16		86	72	357	New (Milk)	Cepravin+Orbeseal	0.90	
F1363	UK342153501761	4	08/02/16	+	18/09/16	17/11/16		25	55	200	New (Milk)	UbroRed+Orbeseal	-	
F761	UK342153602245	1	13/02/16	+	23/09/16	22/11/16		222	184	177	Uncertain	Cepravin+Orbeseal	0.87	
F643	UK342153701777	3	15/02/16	+	25/09/16	24/11/16	24/03/16	811	1160	730	Chronic	Cepravin+Orbeseal	0.50	
F442	UK342153600985	6	16/02/16	+	26/09/16	25/11/16		64	92	227	New (Milk)	UbroRed+Orbeseal	0.78	
F616	UK342153301675	3	16/02/16	+	26/09/16	25/11/16		392	267	Absent	Uncertain	Cepravin+Orbeseal	0.70	
F670	UK342153501831	3	19/02/16	+	29/09/16	28/11/16	22/08/16	432	836	236	Chronic	Cepravin+Orbeseal	0.83	
F766	UK342153502244	1	20/02/16	+	30/09/16	29/11/16		26	78	404	New (Milk)	Cepravin+Orbeseal	0.94	
F617	UK342153501649	3	22/02/16	+	02/10/16	01/12/16	05/07/15	716	209	498	Chronic	Cepravin+Orbeseal	0.48	
F691	UK342153701966	2	01/03/16	+	10/10/16	09/12/16	30/06/16	48	71	158	Recovered	UbroRed+Orbeseal	-	
F726	UK342153202080	2	02/03/16	+	11/10/16	10/12/16		19	27	33	Uninfected	Orbeseal ONLY	-	
F565	UK342153301507	5	04/03/16	+	13/10/16	12/12/16		21	23	44	Uninfected	Orbeseal ONLY	-	

18 Cows Listed

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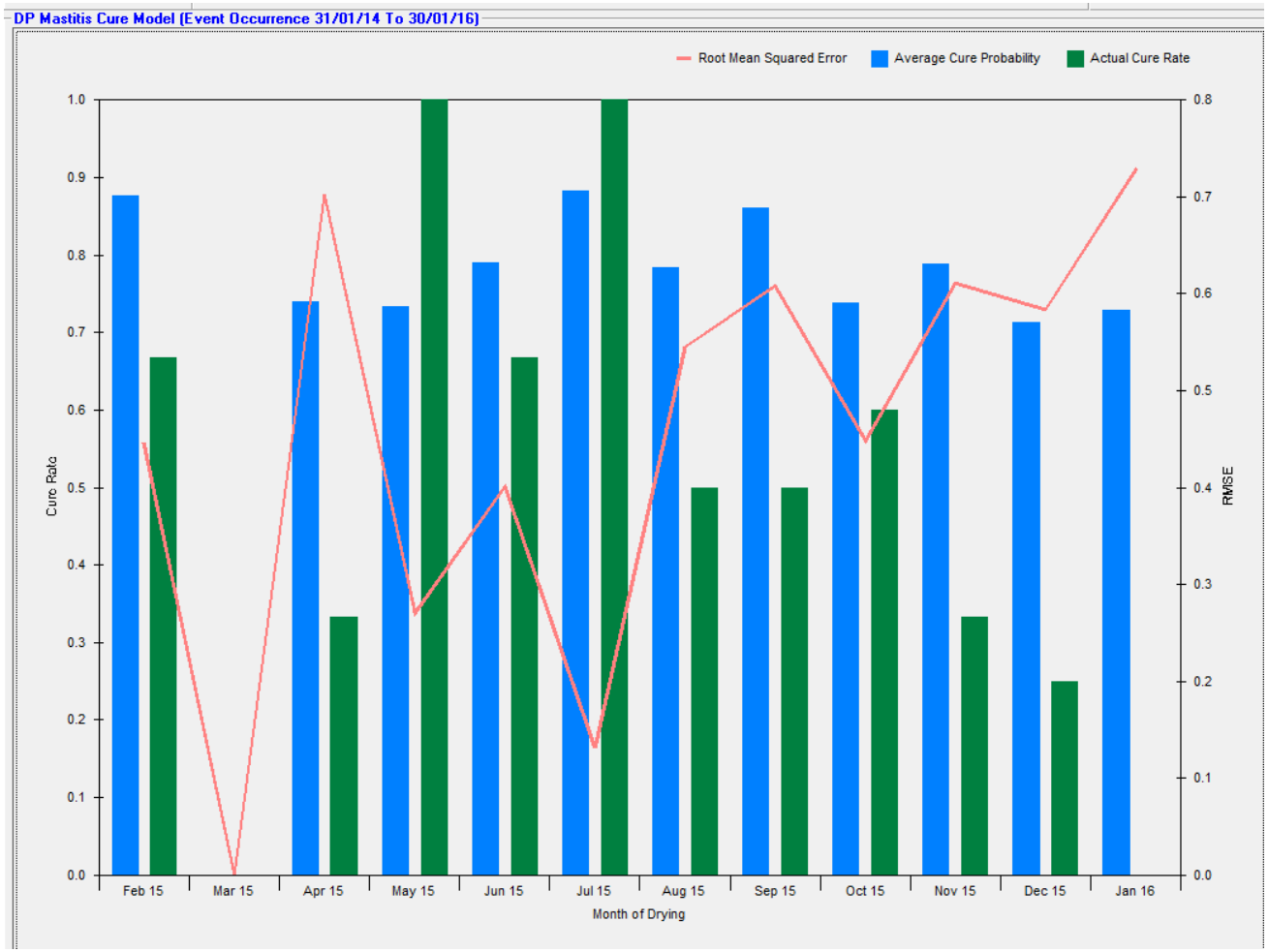
$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}[(Outcome_i] - Cure\ Probability_i)^2}$$

Actual v Predicted DP cure



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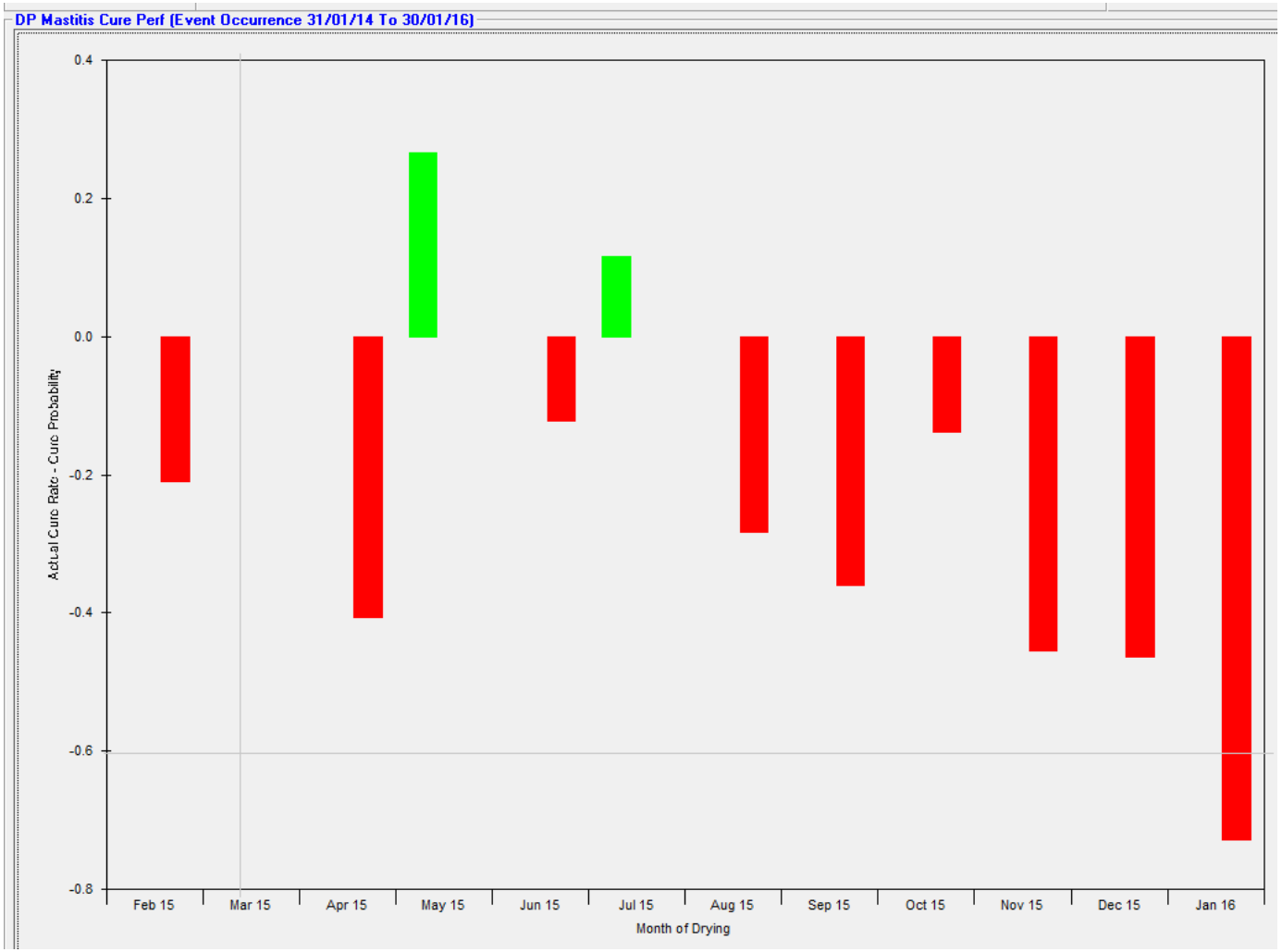
Dry Period Cure Performance



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Performance During the Dry Period

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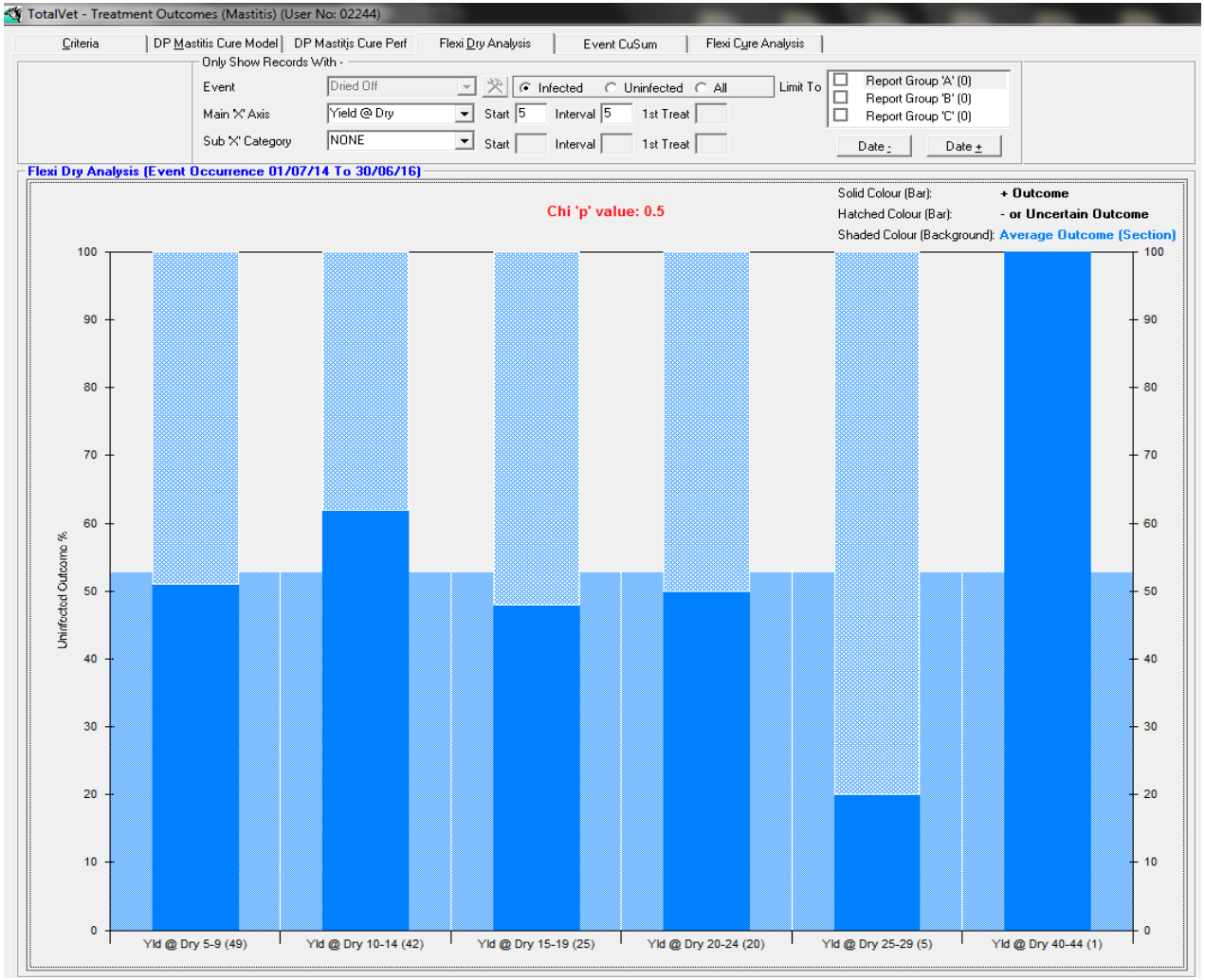
DP Cure by Yield @ Drying-Off



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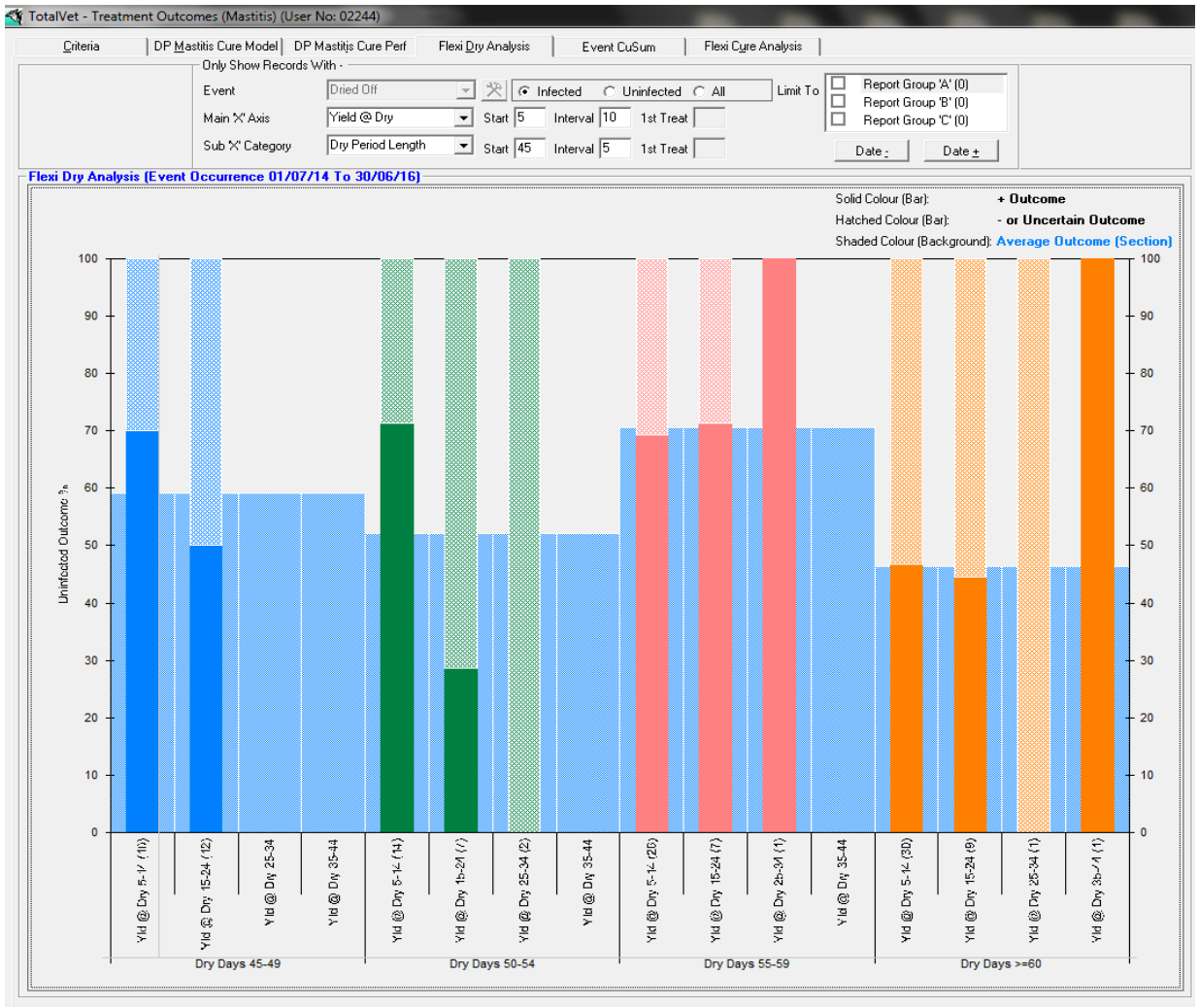
DP Cure by Yield & DP Length?



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Summary

- Milk recording and production data is invaluable to the practitioner in managing the modern dairy herd
- Clinical mastitis data is an essential component
- Additional treatment data adds significant ‘power’ to the approach

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Questions

Mastitis

Cull Toxic Intramammary

Systemic

Fluids

Antibiotics Welfare Resistance Milk Costs

Tube

Cow **Aetiology**

NSAID Quality

SCC

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