INCREASING INFORMATION FROM SOMATIC CELLS

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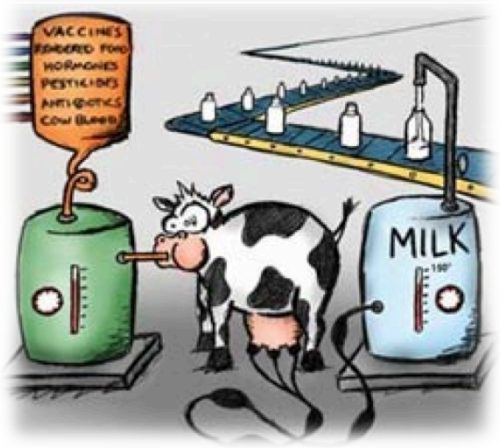
OUTLINE

- Context
  - Mastitis & Somatic Cell Count (SCC)
  - Cost of mastitis
- New Approach
  - Type of data
  - Data-editing
  - Trait definitions
  - Model & Results
- Conclusions



CONTEXT

- Mastitis is one of the major diseases in dairy herds
- It induces economic costs for breeders mainly due to worsening of milk quality and increase of health care cost
- Somatic cell count (SCC) is an indicator of both resistance and susceptibility of cows to intramammary infections

MASTITIS SOMATIC CELL CONTENT

Mastitis = inflammation of the mammary gland in response to a harmful agent or stress that comes from the environment

DEFINITION	SOMATIC CELL COUNT (SCC/ml)	BACTERIOLOGY	CLINICAL
LATENT INFECTION	**≤ 100,000**	**-**	**-**
INFLAMMATION	**> 100,000 ≤ 200,000**	**-**	**-**
SUB-CLINICAL MASTITIS	**> 200,000**	**+/-**	**-**
CLINICAL MASTITIS	**> 200,000**	**+/-**	**-**
CHRONIC MASTITIS	**> 400,000**	**+**	**+**

COST OF MASTITIS

- DIRECT LOSS
  - Lower milk production
  - Loss of milk quality
  - Loss of premium on milk price or application of penalities
  - Lower cheese yield
  - Cost of therapy to be carried out

- INDIRECT LOSS
  - Increase of recovery rate
  - Negative effect on fertility (> calving-conception interval, > infertility risk, delayed first ovulation)
  - Increase of involuntary culling

LOSS OF MILK PRODUCTION WITH REFERENCE TO THE AVERAGE OF SCC

Linear Score	SCC	Average SCC	Loss/d		Loss per lactation	
			1st lactation	≥ 2nd lactations	1st lactation	≥ 2nd lactations
0	0-17.000	12,500	0	0	0	0
1	18.000-34.000	25,000	0	0	0	0
2	35.000-70.000	50,000	0	0	0	0
3	71.000-140.000	100,000	0.3	0.6	90	180
4	141.000-282.000	200,000	0.6	1.2	180	360
5	283.000-565.000	400,000	0.9	1.8	270	540
6	566.000-1.130.000	800,000	1.2	2.4	363	726
7	1.131.000-2.262.000	1,600,000	1.5	3	454	908
8	2.263.000-4.525.000	3,200,000	1.8	3.6	544	1,088
9	4.526.000-9.999.000	6,400,000	2.4	4.8	732	1,464

***Jeff Reneau, 1990**

IDENTIFICATION OF MASTITIS

- DIRECT MEASURES corresponding to the diagnosis of inflammation with a positive bacteriological examination and observation of clinical cases
  - Accurate
  - Repeated and expensive tests on a large scale

- INDIRECT MEASURES linked with inflammation of the udder
  - Somatic cell count (SCC)
  - Electrical conductivity of milk

MASTITIS RECORDING SYSTEM

- Mastitis is not widely implemented in disease-recording systems in many countries

- Lactation-mean SCC or test-day SCC are generally used as indirect mastitis indicators

- Other traits that are derived from SCC have been suggested as alternatives to improve genetic evaluations for mastitis resistance, such as :
    - maximum SCC,
    - standard deviation of SCC,
    - patterns of SCC peaks (ex: Canada & The Netherlands)

WHAT HAPPENS IN THE WORLD

…INTERBULL DATA…

- Two type of EBVs are considered by Interbull:
  - Somatic cell score (SCS)
  - Udder health (MAS) → as trait
    → when missing same as SCS field

- **In total 29 countries send SCS info**
  - **Only 4 countries** send also udder health (MAS) info (Canada, Scandinavian countries, France and The Netherlands)

AVERAGE SCC *VS* SCC PEAKS

	1 td	2 td	3 td	4 td	5 td	6 td	7 td	8 td	9 td	10 td	Lactation mean
Cow 1	100	100	100		**2500**	100	100		100	100	400
Cow 2	400	400	400	400	400	400	400	400	400	400	400

????? Who is the most affected ?????

Cow 1 : a **single** episode over 400,000 cells/ml

Good chance of responding positively

Cow 2 : **always** values of 400,000 cells/ml

Absence of peaks

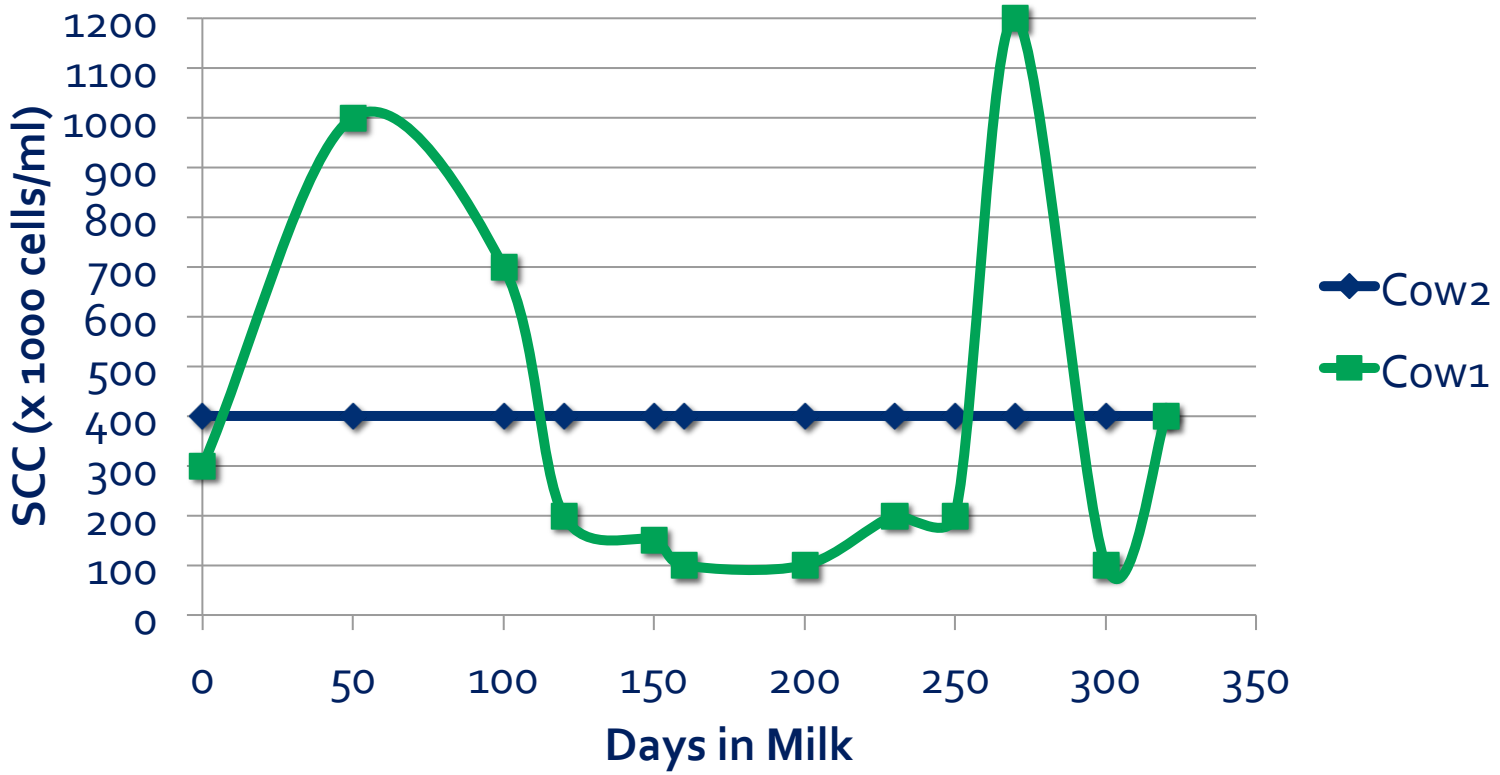
Chronical mastitis

..important to understand the probability of falling ill and the risk to become chronic.....

SCC PATTERN EXAMPLE

……It's important to realize the trend of cells during lactation…

Constant (Cow 2) Fluctuating (Cow 1)



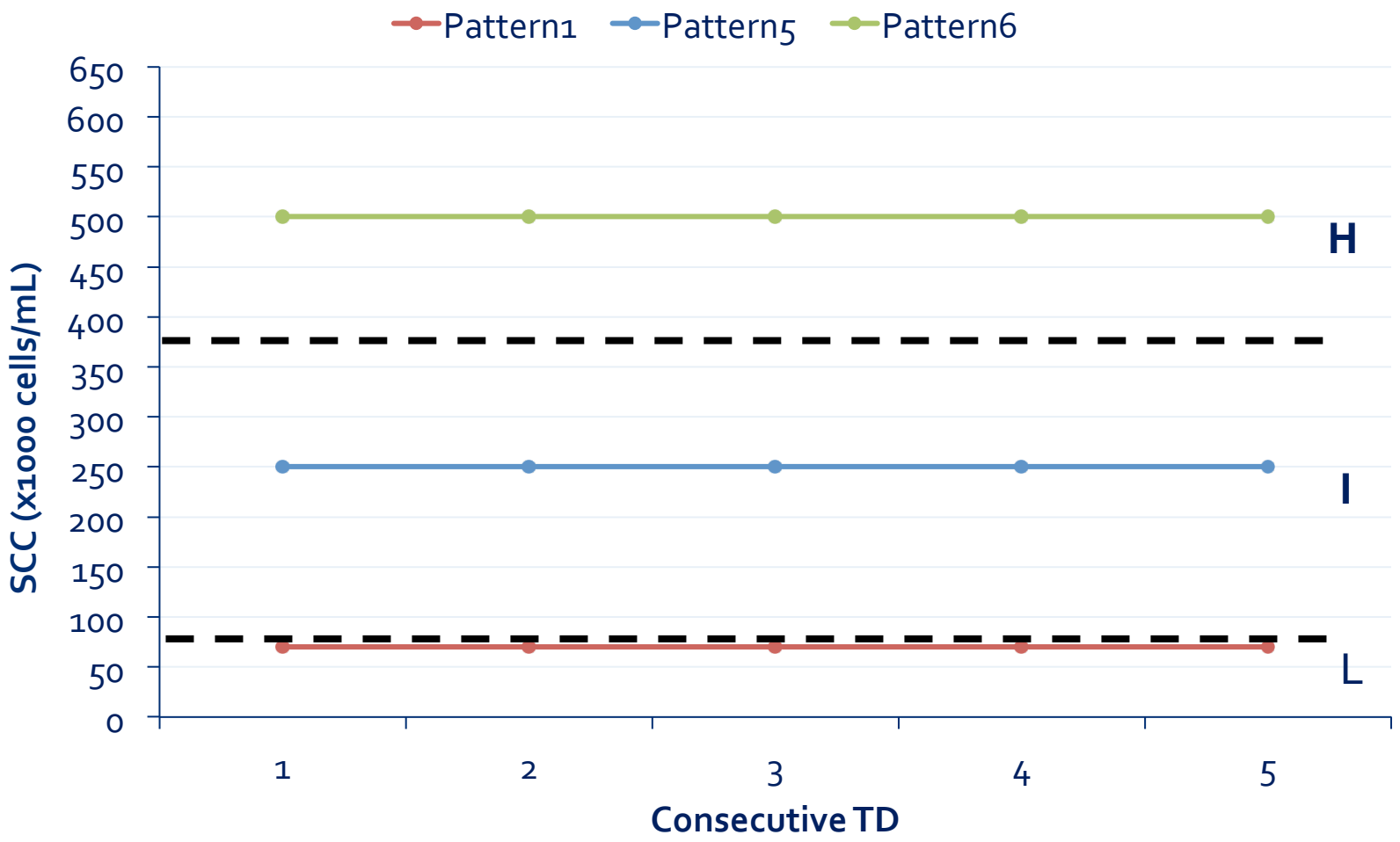
DATA-EDITING

- Only first parity cows (for the moment)
- Cows with at least 3 TDscc records,
- Cows with 1st TD ≤ 60 days after calving
- Cows TDs interval ≤ 70 days

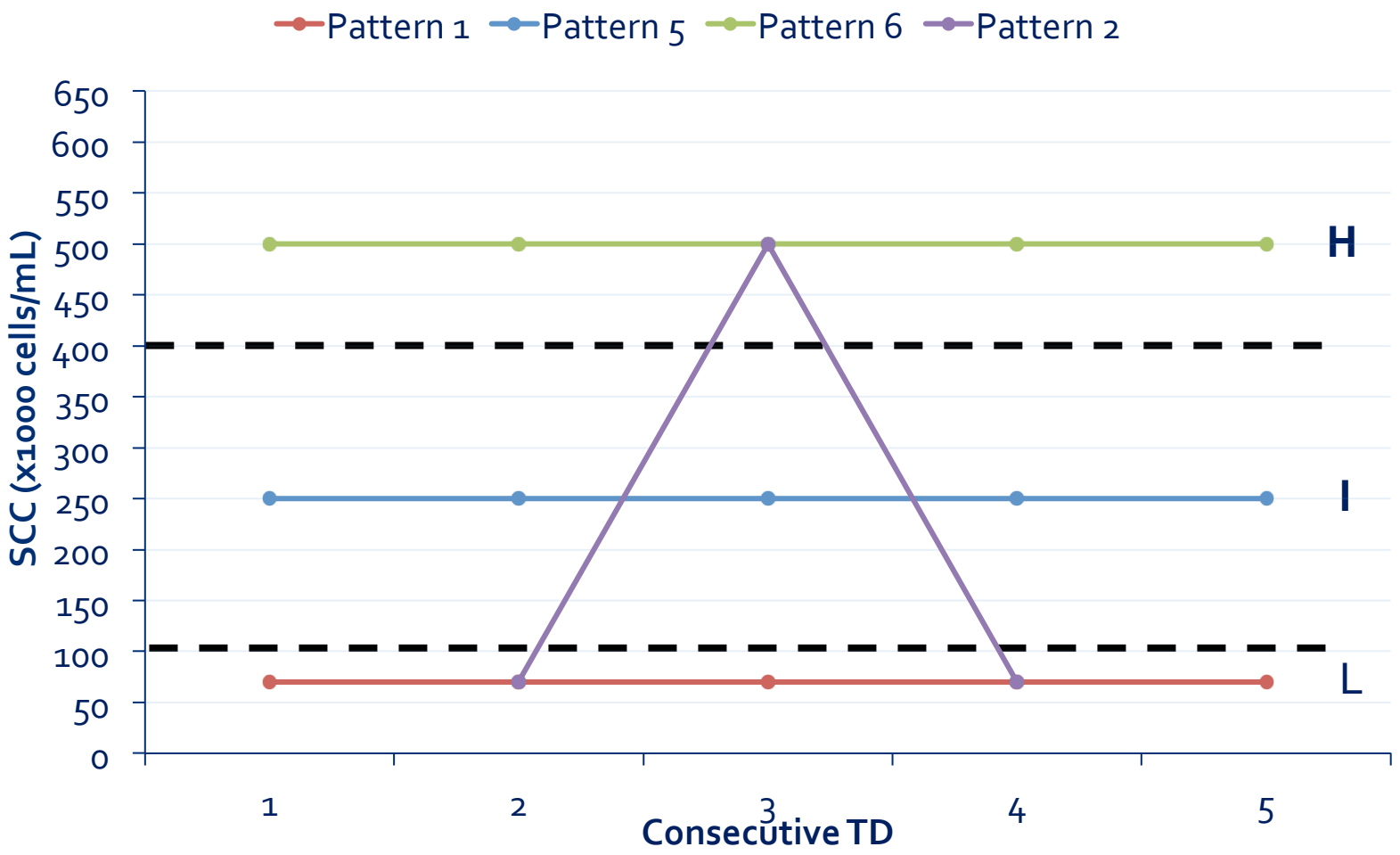
- Within lactation SCC patterns have been defined:
  - **L** = "Low" (< 100,000 SCC/mL)
  - **I** = "Intermediate" (100,000-400,000 SCC/mL)
  - **H** = "High" (> 400,000 SCC/mL)

- Several samples distributed in the population were analyzed in order to get an idea of trend repeatability

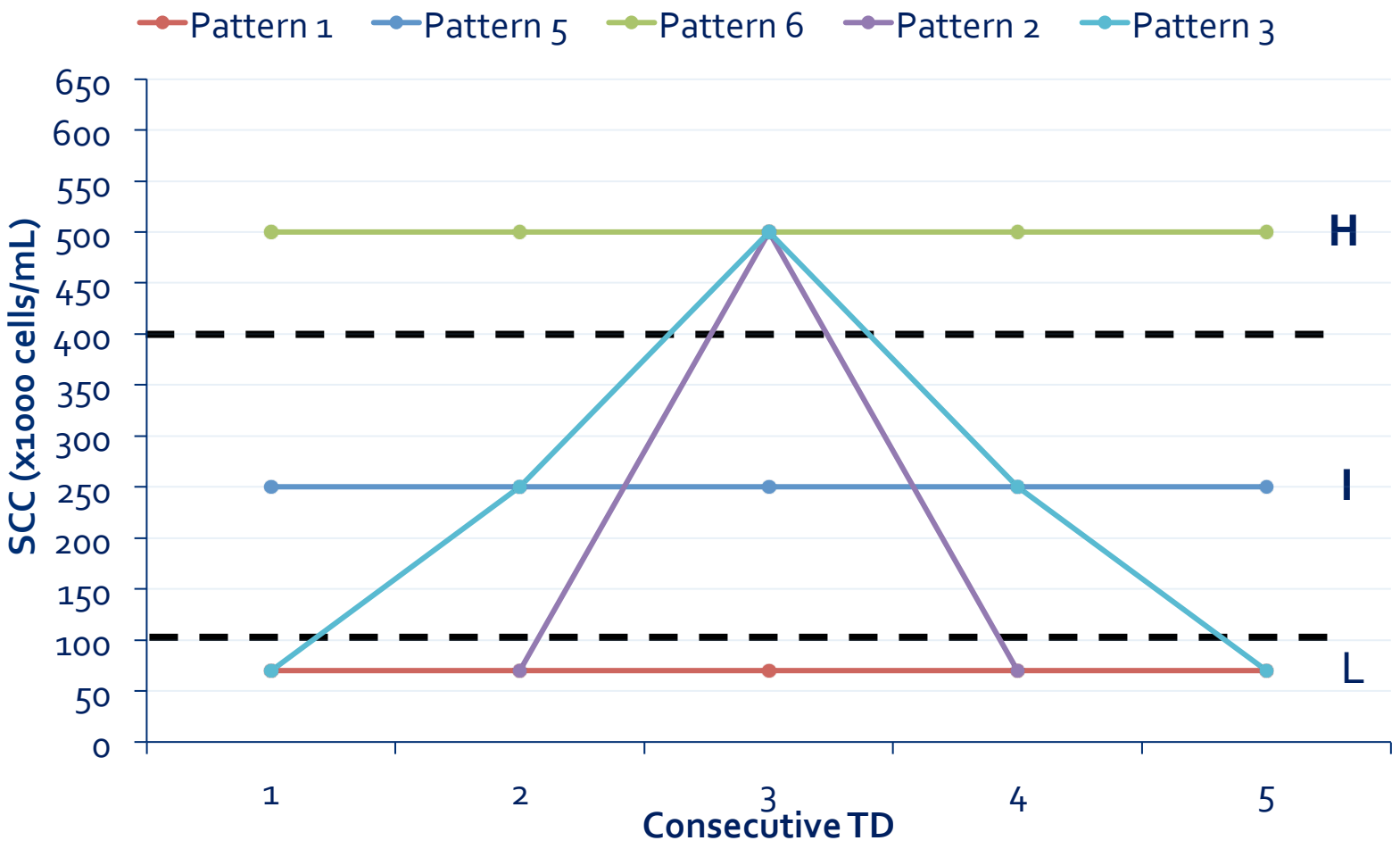
SEVERAL DIFFERENT SCC PATTERNS 1



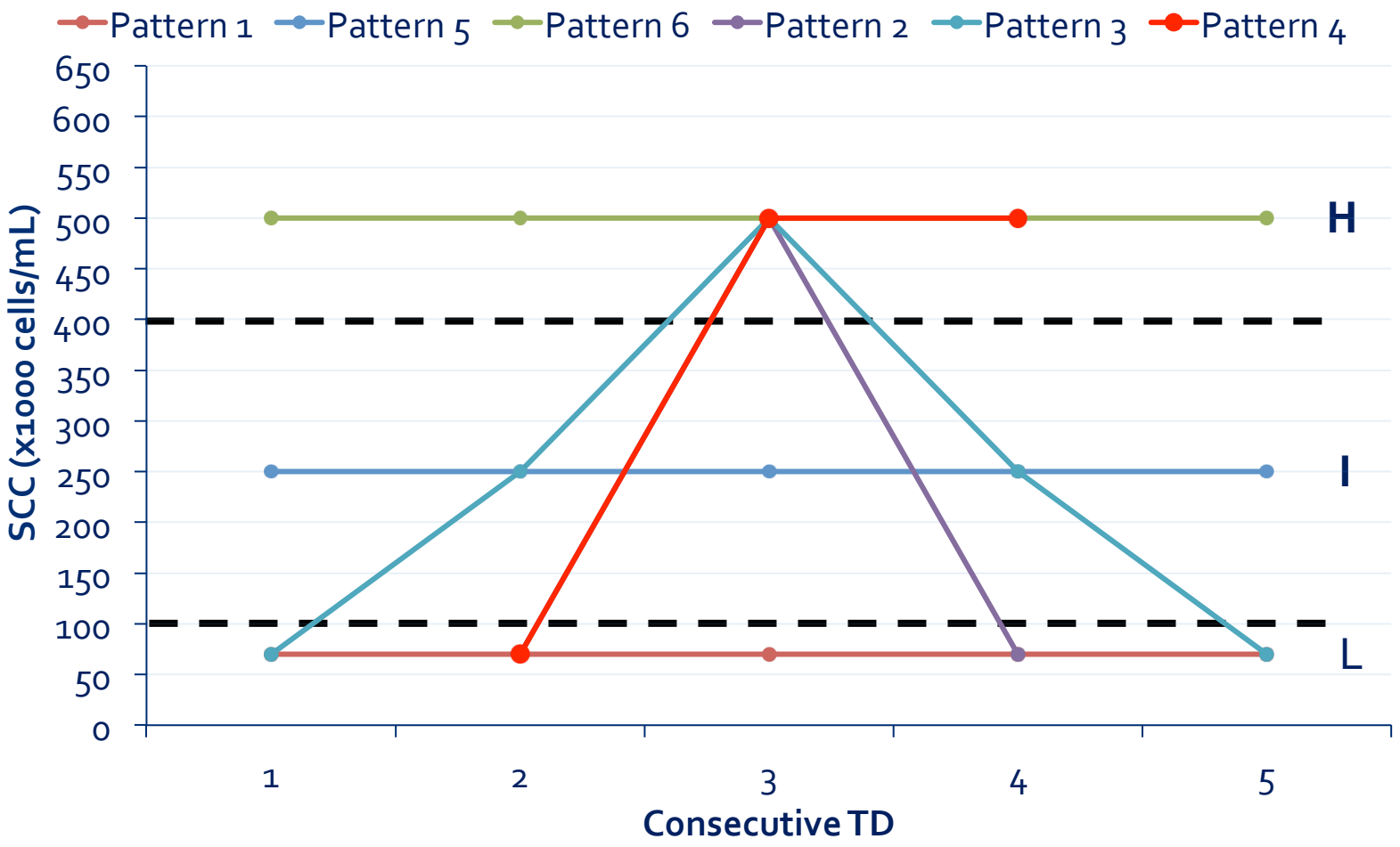
SEVERAL DIFFERENT SCC PATTERNS 2



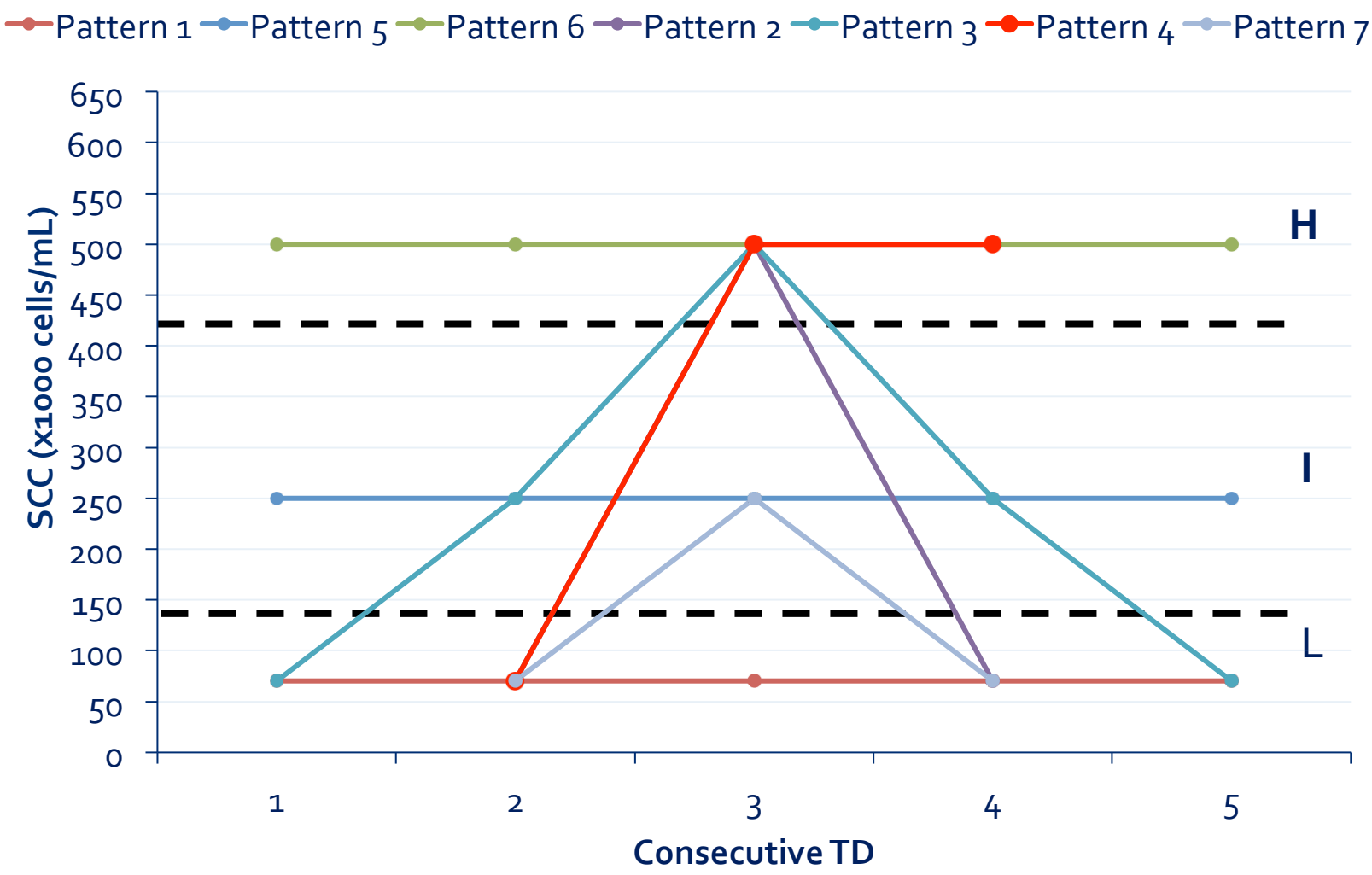
SEVERAL DIFFERENT SCC PATTERNS 3



SEVERAL DIFFERENT SCC PATTERNS 4



SEVERAL DIFFERENT SCC PATTERNS 5



TRAIT DEFINITION FOR GENETIC EVALUATION

TRAIT	Description
SCS_{150}	Average SCS from 5 to 150 days of lactation
$SCS_{151\text{-}305}$	Average SCS from 151 to 305 days of lactation
SCS_{TOTAL}	Average SCS in the entire lactation
INFECTION	(0/1): 1 = cow with at least 1 TD identified as **I** or **H** within lactation
SEVERITY (%)	Ratio between n° TD **I** + **H** and the total n° of TD within lactation
PEAK	Presence of peaks **L-H-L** or **L-H-H** within lactation
	0 = no peaks 1 = at least one of the two peaks
SCM	Sub-clinical mastitis:
	0 = no peak **L-L-H** within lactation 1 = presence of peak **L-L-H** within lactation

INITIAL DESCRIPTIVE STATISTICS

	Preliminary Dataset ANAFI (46.304 records)	
Trait	**Mean±SD**	**Range**
SCS_{TOTAL}	3,43±1,61	-0,69 to 9,27
SCS_{150}	3,10±1,68	-3,23 to 9,33
$SCS_{151-305}$	3,38±1,74	-2,06 to 9,66
INFECTION	0,82±0,38	0 or 1
SEVERITY (%)	38,99±32,45	0 to 100
PEAK	0,13±0,33	0 or 1
SCM	0,26±0,44	0 or 1

$$Y = HYS + Age{\downarrow}c + n\_tdm + \text{animal} + \text{error}$$

GENETIC PARAMETER ESTIMATION

	Dataset ANAFI	
Trait	h^2	σ_g
SCS_{TOTAL}	0,11	0,483
SCS_{150}	0,06	0,399
$SCS_{151\text{-}305}$	0,10	0,517
INFECTION	0,03	0,063
SEVERITY (%)	0,13	11,02
PEAK	0,01	0,025
SCM	0,02	0,053

FIRST EBVS CREATED

- Currently 3 new **EBV SCS_{150} - $SCS_{151\text{-}305}$ - Severity** (%)

- Starting to combine an aggregate index for Udder Health and comparing with the actual TDscs

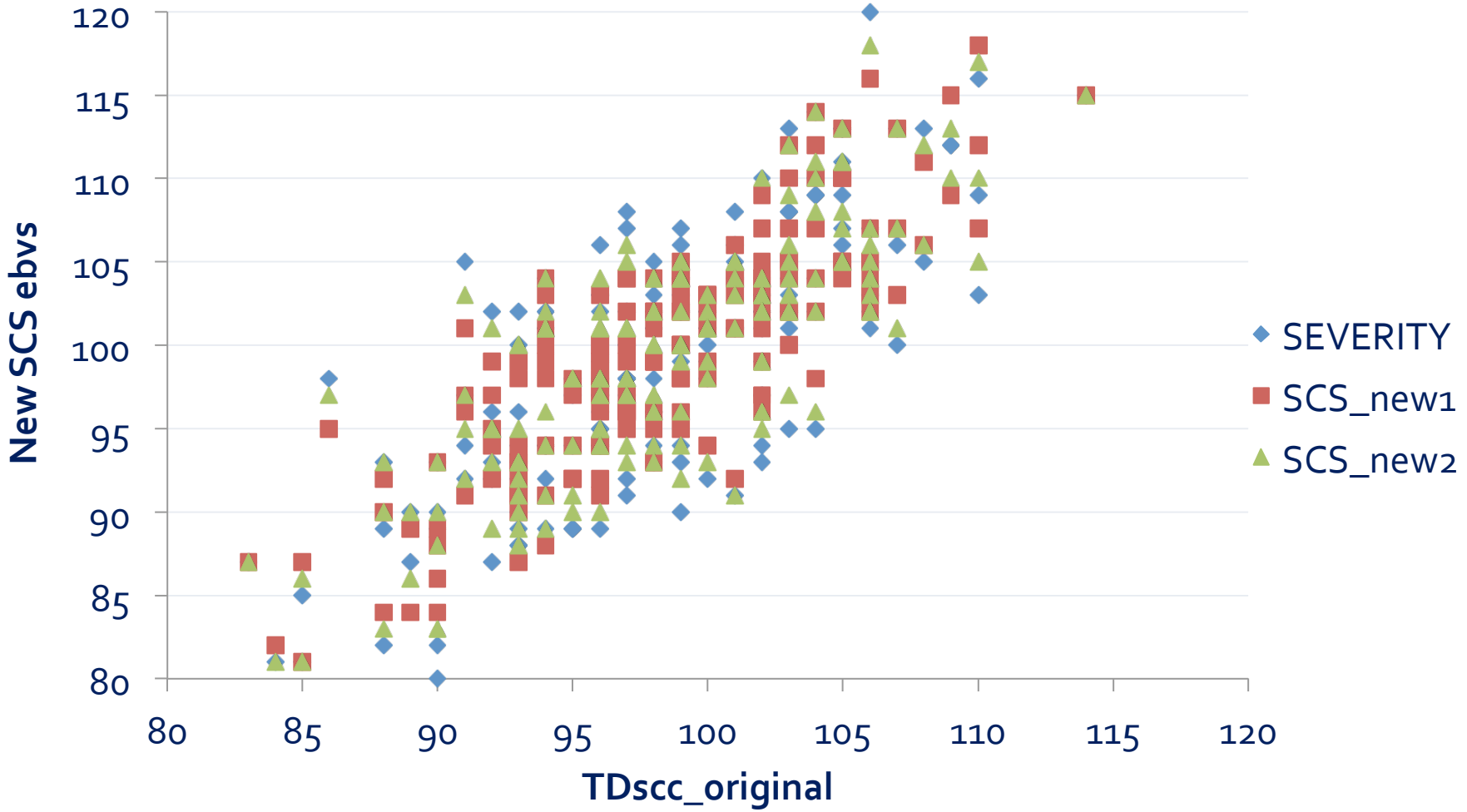
  - SCSnew1 = 0,33*EBV SCS_{150} +0,33* EBV $SCS_{151\text{-}305}$ + 0,33*Severity

  - SCSnew2 = 0,15*EBV SCS_{150} +0,15* EBV $SCS_{151\text{-}305}$ + 0,70*Severity

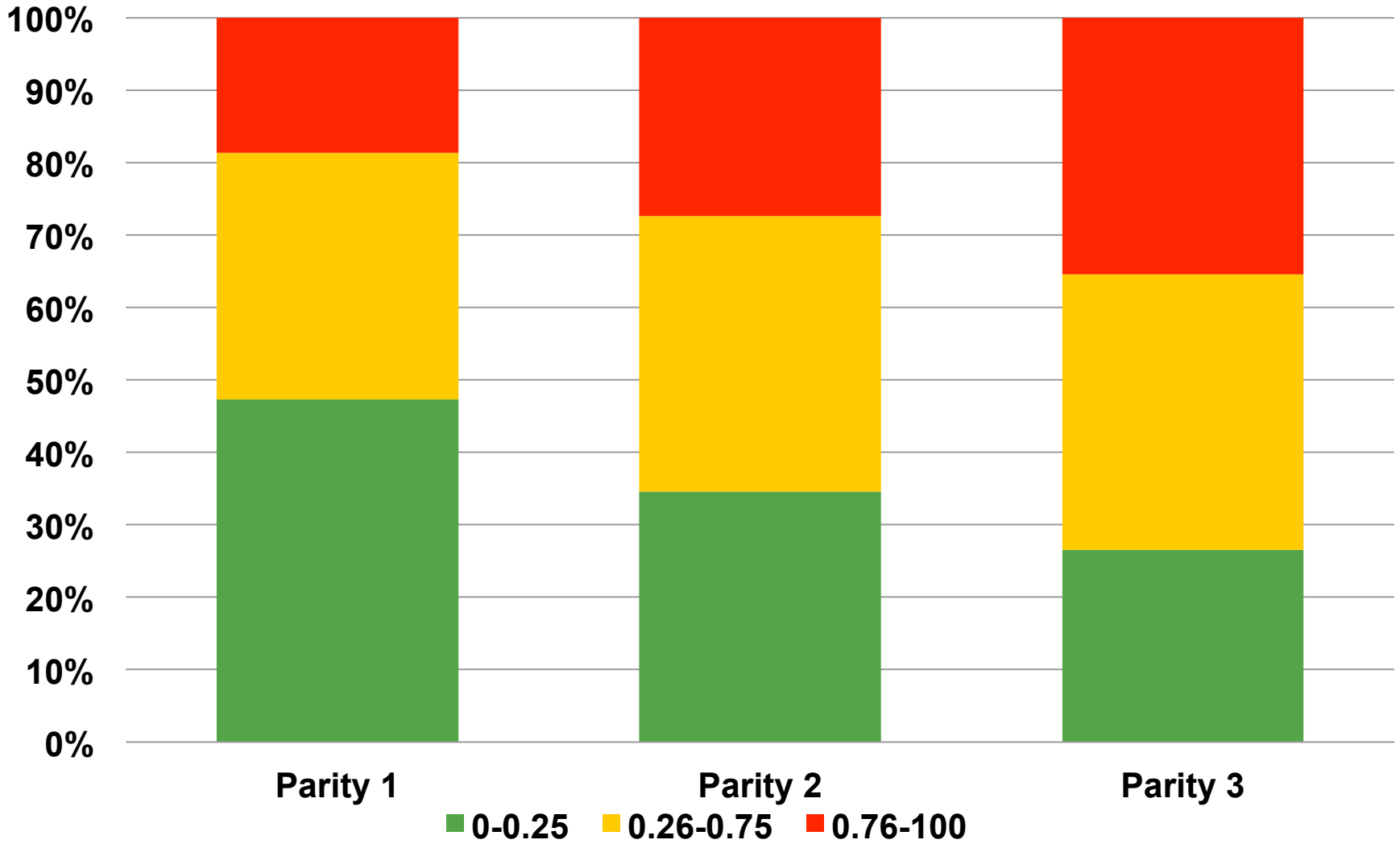
COMPARISONS WITH TDSCC_ORIGINAL

	TDscc_orig	SCS_150	SCS_305	SCS_total	Severity	SCS_new1	SCS_new2
TDscc_orig	1	0,46	0,47	0,49	**0,47**	**0,51**	**0,50**
SCS_150		1	0,71	0,89	0,78	0,91	0,85
SCS_305			1	0,92	0,77	0,90	0,84
SCS_total				1	0,78	0,94	0,87
Severity					1	0,93	0,99
SCS_new1						1	0,98
SCS_new2							1

COMPARISONS WITH TDSCC_ORIGINAL

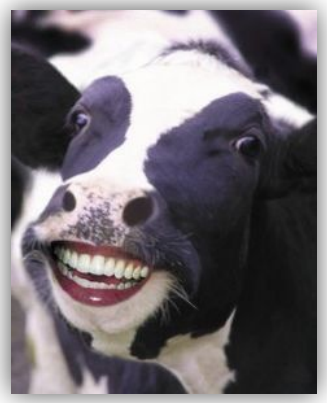


SEVERITY BY PARITY



CONCLUSIONS

- Many studies demonstrated that udder health can be improved by selection
  - TMI indices are working in this direction
- To select based on SCC pattern can reduce mastitis
- To use SCC traits is a rapid and economic approach
  - ANAFI will work in this direction and first results are showing that this is a feasible approach
- In general we need cows with low mastitis risk
  - For farmers
  - For community



THANKS FOR YOUR ATTENTION!