Quality Milk
Production Services

Using deep learning to assess teat-end condition in dairy cows

I. Porter, M. Wieland, P. S. Basran

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Background

"Mechanical forces during machine milking induce changes in teat tissue condition."

(Hillerton et al., 2000, Zwertvaegher et al., 2013, Guarin and Ruegg, 2016)

Background

EVALUATION OF BOVINE TEAT CONDITION IN COMMERCIAL DAIRY HERDS: 1. NON-INFECTIOUS FACTORS

G.A. Mein[1], F. Neijenhuis[3], W.F. Morgan[1], D.J. Reinemann[5], J.E. Hillerton[4], J.R. Baines[4], I. Ohnstad[4], M.D. Rasmussen[2], L. Timms[5], J.S. Britt[5], R. Farnsworth[5], N. Cook[5] , T. Hemling[5].

1. Short-term changes in teat condition
2. Medium-term changes in teat condition
3. Long-term changes in teat-end condition

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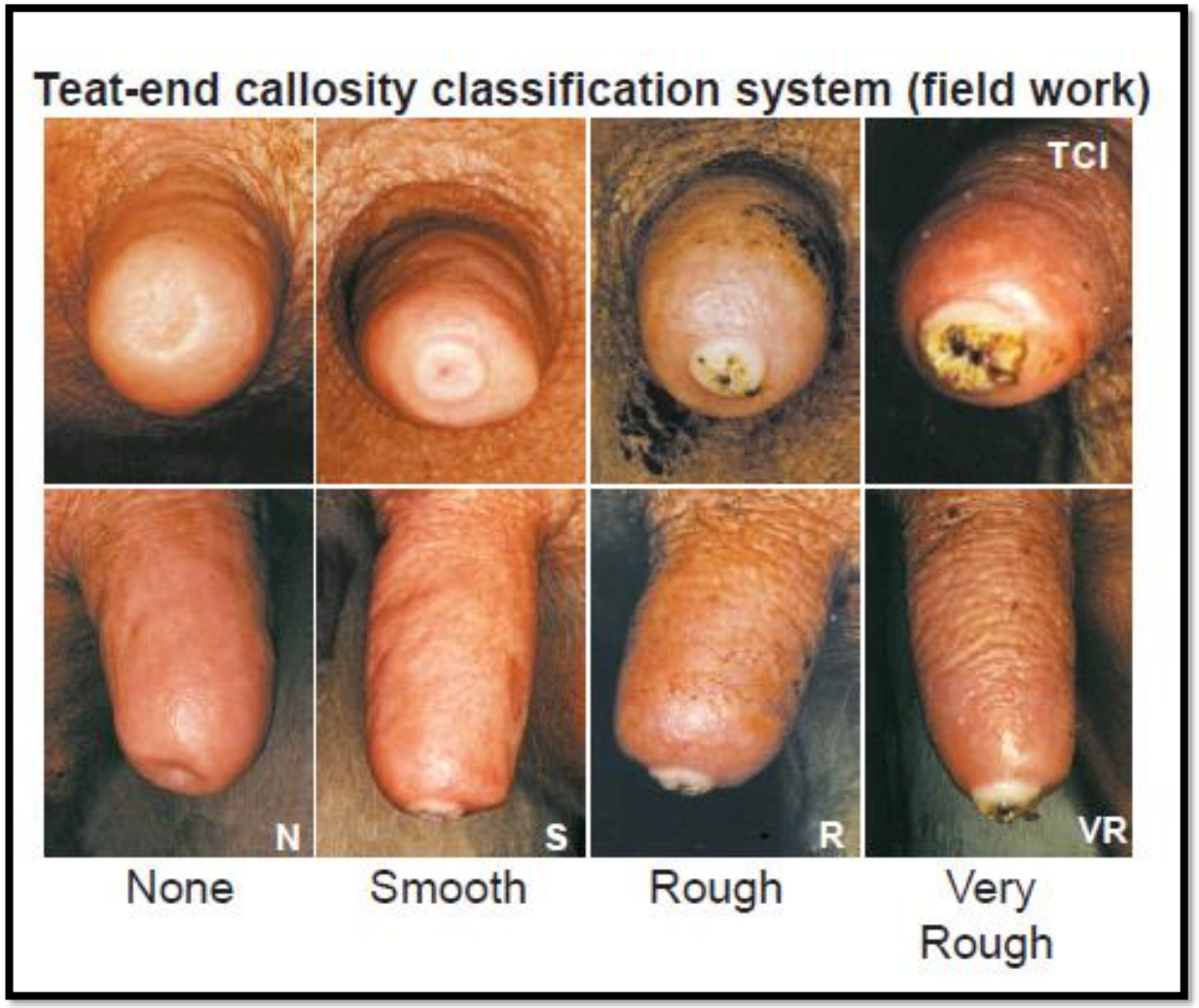
Background



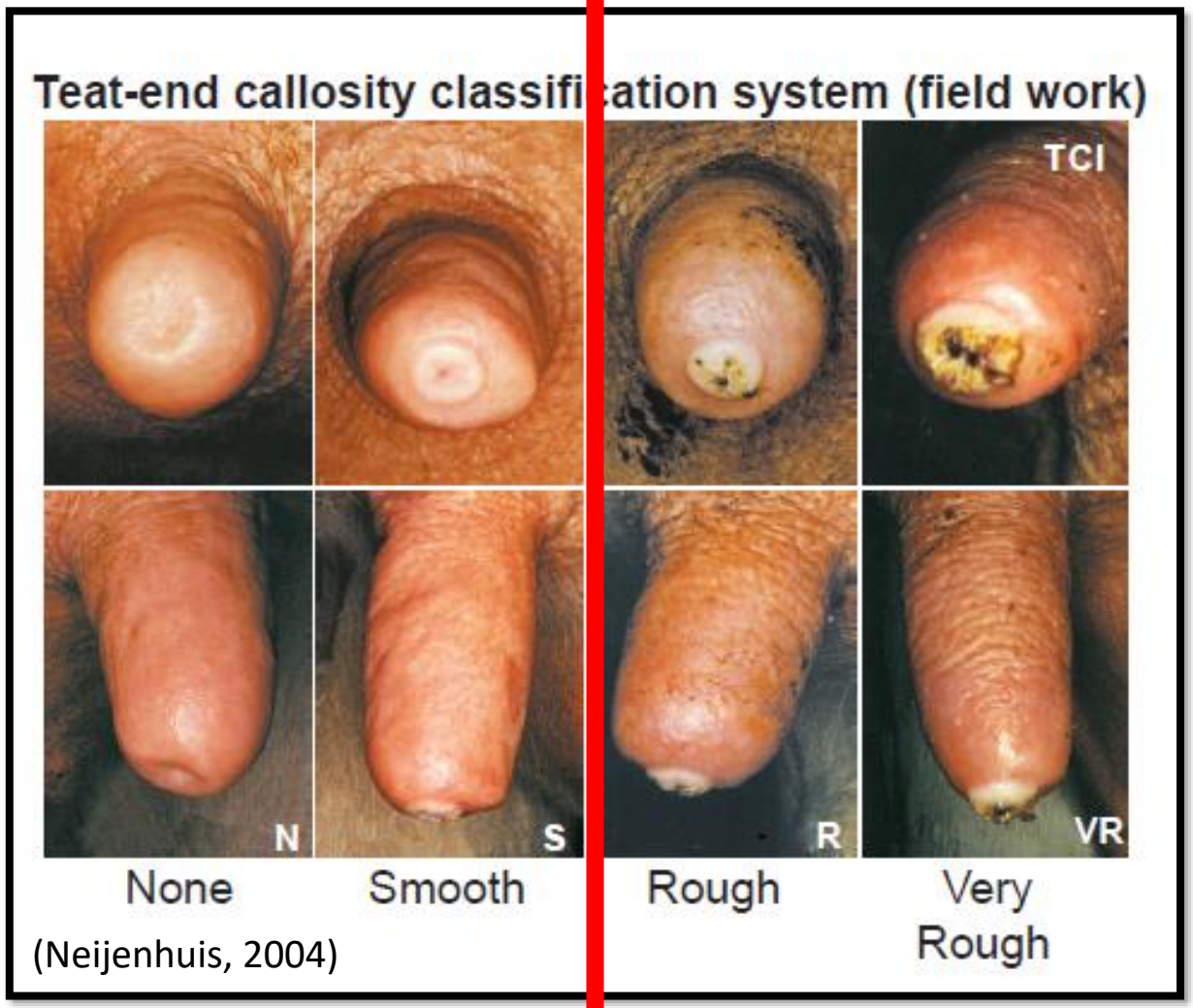
(Neijenhuis, 2004)

Background

"Clinical mastitis cows had more teat end callosity than their healthy herd mates." (Neijenhuis et al., 2001)

"Dairy consultants should focus on monitoring and minimizing occurrence of severe teat-end hyperkeratosis to prevent clinical mastitis and subclinical mastitis." (Pantoja et al., 2020)

Background



Industry goal:

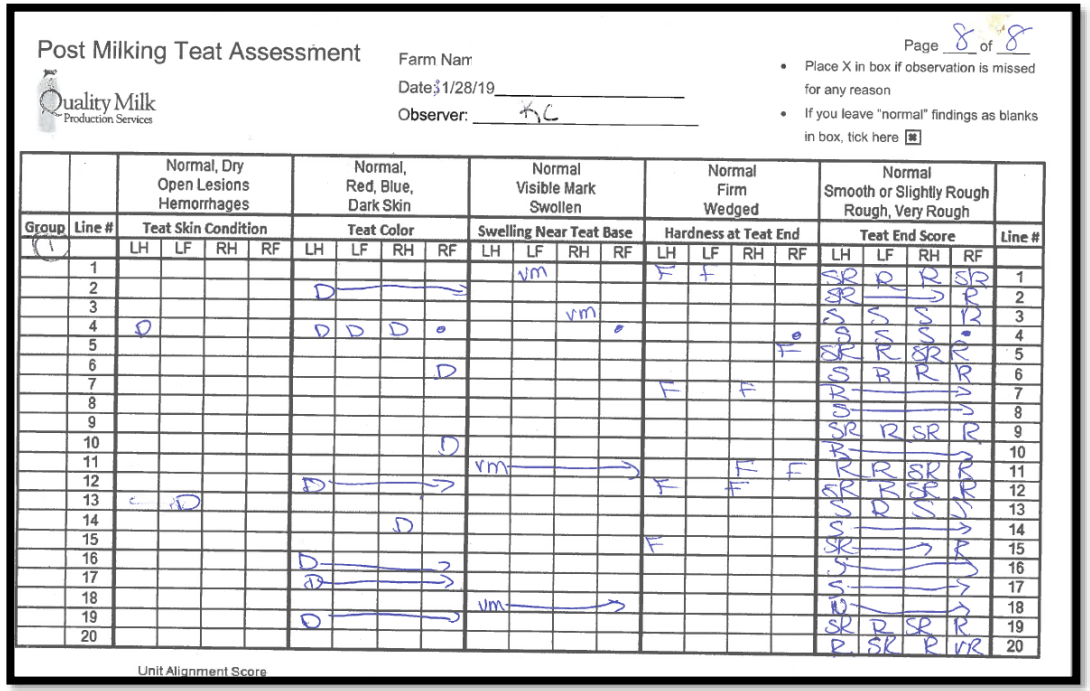
≤20% of cows (Mein et al. 2001)

Industry recommendation:

≥80 cows or 20% of the herd

(Reinemann et al. 2001)

Background



Post Milking Teat Assessment

Quality Milk Production Services

Farm Nam

Date: 1/28/19

Observer: KC

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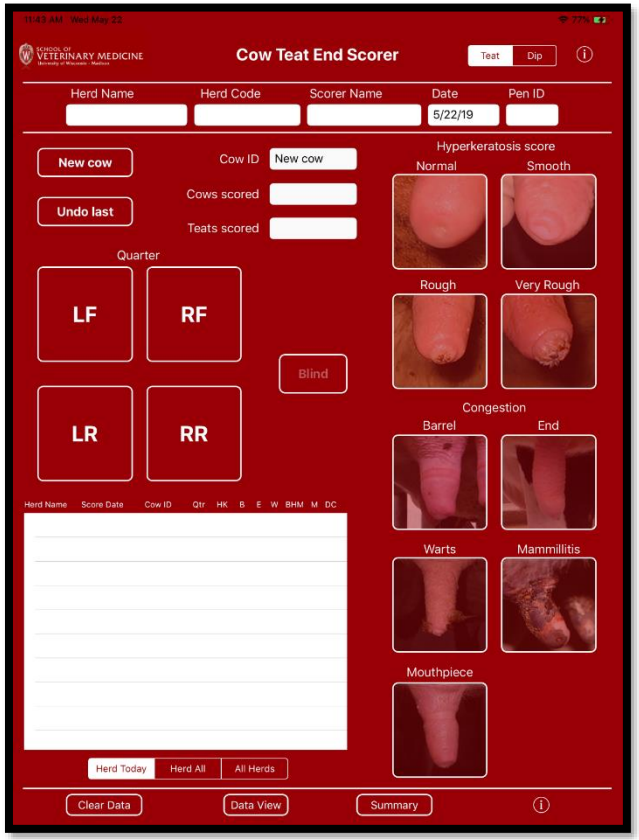
- Place X in box if observation is missed for any reason
- If you leave "normal" findings as blanks in box, tick here ☒

Group	Line #	Normal, Dry Open Lesions Hemorrhages — Teat Skin Condition LH	LF	RH	RF	Normal, Red, Blue, Dark Skin — Teat Color LH	LF	RH	RF	Normal Visible Mark Swollen — Swelling Near Teat Base LH	LF	RH	RF	Normal Firm Wedged — Hardness at Teat End LH	LF	RH	RF	Normal Smooth or Slightly Rough Rough, Very Rough — Teat End Score LH	LF	RH	RF	Line #
C	1										vm			F	F			SR	R	R	SR	1
	2					D												SR			R	2
	3											vm						S			R	3
	4	D				D	D	D	D				•					S			•	4
	5																F•	SR	R	SR	R	5
	6								D									S	R	R	R	6
	7													F		F		SR			V	7
	8																	SR			V	8
	9																	SR	R	SR	R	9
	10								D									SR			V	10
	11									vm	→					FF	F	R	R	SR	R	11
	12					D	→							F		FF		SR	R	SR	R	12
	13		D															SR	R	SR	R	13
	14							D										S			V	14
	15													F				SR			R	15
	16					D	→											SR			R	16
	17					D	→											S			V	17
	18									vm	→							SR			R	18
	19					D	→											SR	R	SR	R	19
	20																	R	SR	R	VR	20

Unit Alignment Score



Objective and Hypothesis

Objective:

- Investigate the feasibility of the use of a deep learning neural network for classification of teat-end condition in digital images

Hypothesis:

- Deep learning can be used to assess teat-end condition in dairy cows by means of digital imaging

Materials and Methods

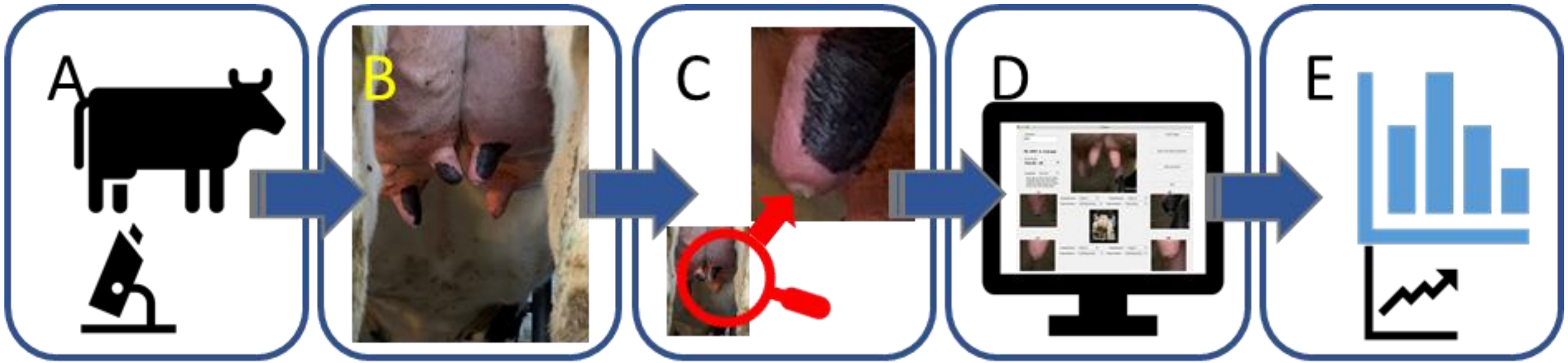
Study sites:

- Farm A: 1,600 cows; Farm B: 4,000 cows
- Milking schedule: 3X
- Farm A: 60 stall rotary; Farm B: 100 stall rotary parlor

Study period:

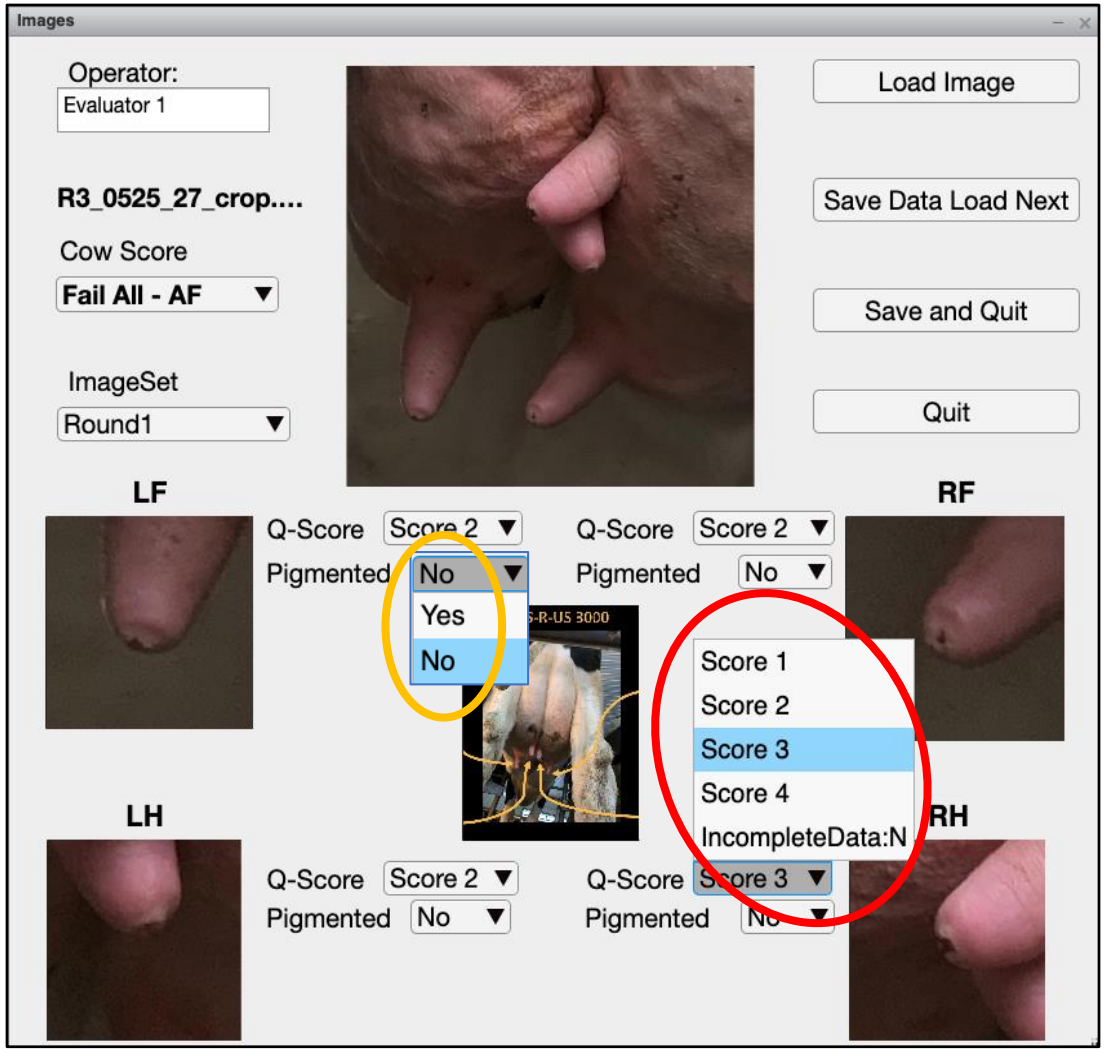
- Farm A: September 2019
- Farm B: July 2020

Materials and Methods



n = 398

Materials and Methods



Materials and Methods

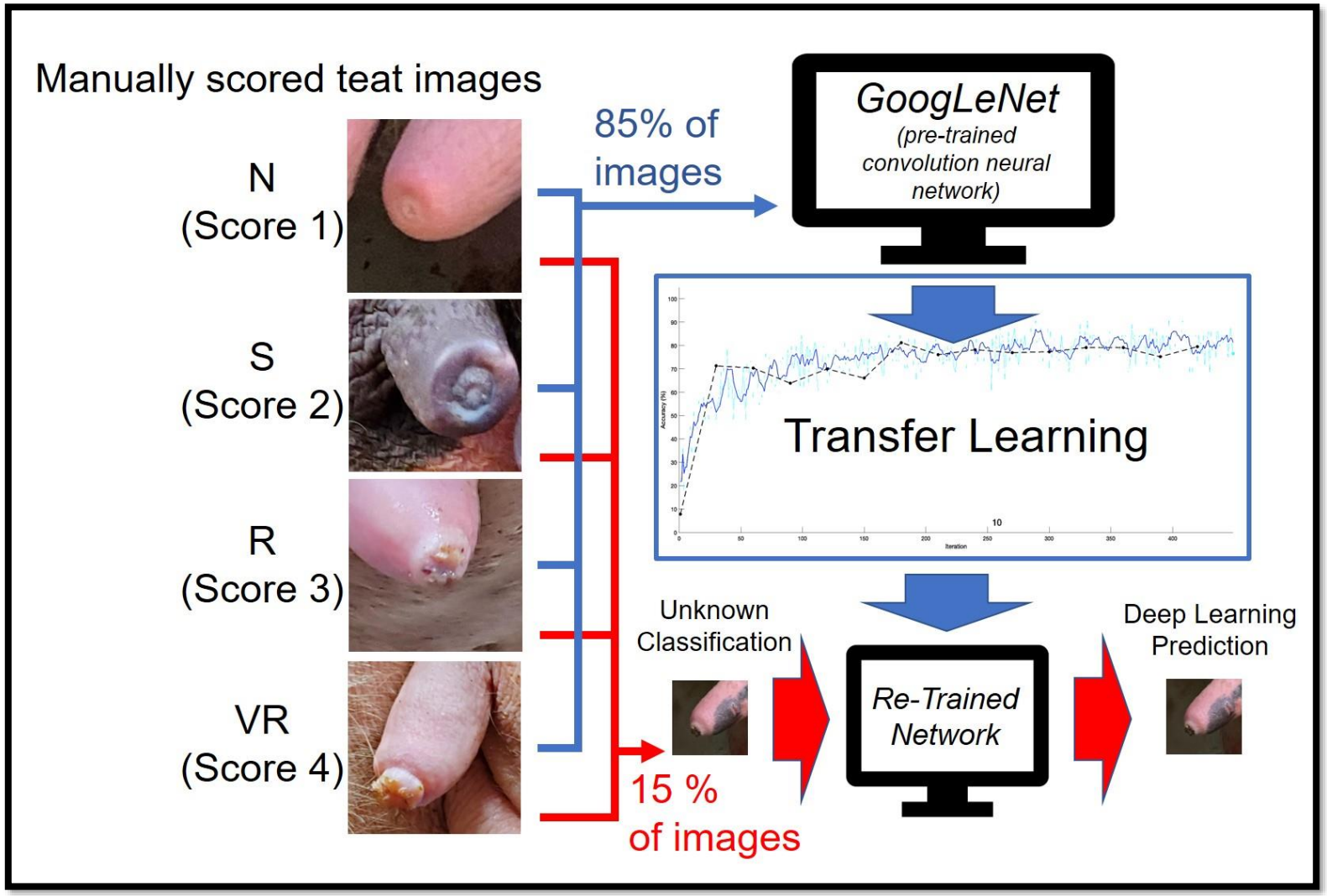
N (Score 1): 599 (39%)

S (Score 2): 654 (42%)

R (Score 3): 269 (17%)

VR (Score 4): 28 (2%)

Materials and Methods



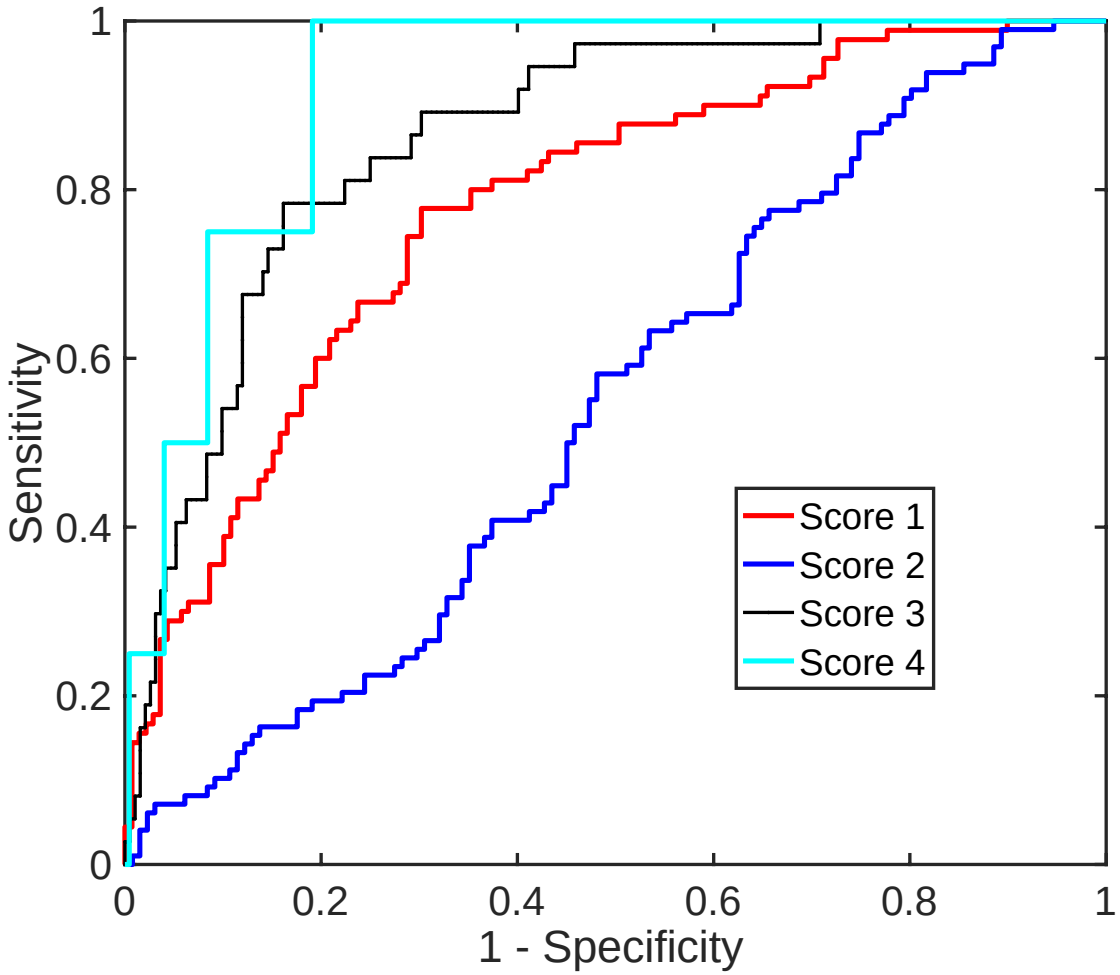
Results

Area under the curve:

- Score 1 (N): 0.78 (95% CI: 0.72-0.83)
- Score 2 (S): 0.54 (95% CI: 0.46-0.61)
- Score 3 (R): 0.86 (95% CI: 0.79-0.91)
- Score 4 (VR): 0.92 (95% CI: 0.80-0.99)

Overall accuracy:

- 47%



Discussion

Conclusion:

- Deep learning can be used to assess teat-end condition in dairy cows by means of digital imaging

Outlook:

- Improvement of deep learning network
- Automation of image aquisition
- Other teat tissue conditions

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