Automated detection of lameness in dairy cows compared with claw diagnosis and mobility score

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Lameness – Widespread & Unnoticed by Many

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- 37% (range 0-79%) lame cows in the UK (data collected 2006-07)

- Only 20-25% of lame cows are noticed by farmers

- Lame cows are estimated to be in severe pain for ~3 months

Archer et al, 2010 In Practice 32: 492-504
Barker et al 2009 Journal of Dairy Science 93: 932-941
Bruijnis et al 2012 Animal 6: 962-970

Lameness Reduces

- Yield: 270-857 l milk lost over a lactation

- Oestrus behaviour: mounting period shortened from 5.2 to 1.8 h

- Reproduction: first ovulatory oestrus delayed by 19 days

- Longevity: increased culling risk (HR=1.45 for MS$\geq$3, HR=1.74 for MS$\geq$4)

Bicalho et al, 2007 Journal of Dairy Science 90: 4586-91
Huxley, 2013, Livestock Science 156: 64-70
Petersson et al, 2006 Animal Reproduction Science 91: 201-214
Walker et al, 2010 Reproduction in Domestic Animals 45: 109-117

Lameness affects Behaviour

Lying time   119%
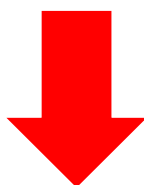
Number of steps   95%
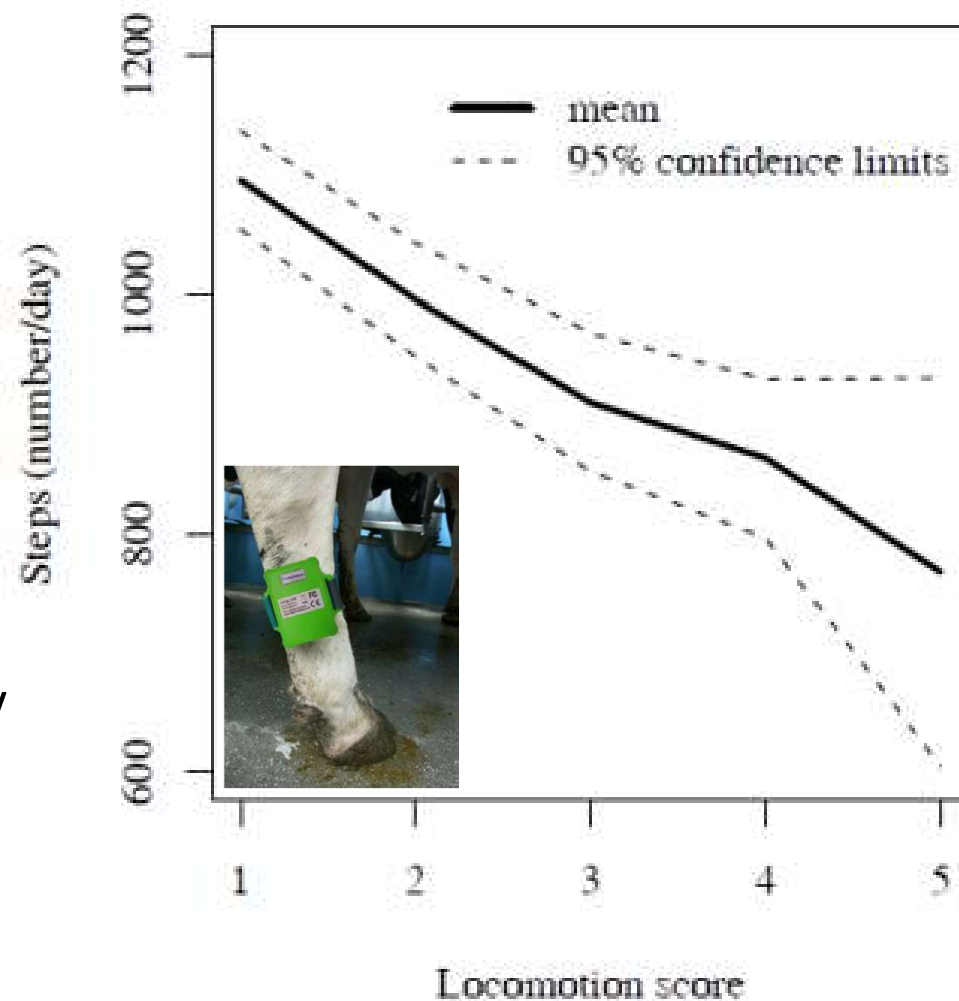
Leg activity   80%

And we can measure behaviour automatically

Blackie et al, 2011 Applied Animal Behavioral Science 134: 85-91
Thorup et al, 2015 Animal 9: 1704-12
Wadsworth et al, 2016 Proc. PDF Conference, Leeuwarden, NL: 315-19

The DASIE Project

- Dairy Animal Sensor Integrated Engineering
- August 2014 – 2017
- Budget 1.8 m £
- Supported by the UK government
- 4 partners
- Data from 6 commercial farms & 1 research herd

Lameness Model Development

- ➤ 7 farms visited in 2016, 1 farm bi-weekly
- ➤ 6755 visual mobility scores (MS)
- ➤ 1 of 2 trained observers
- ➤ Scale 1-5[1]

Lameness Detection model → One objective Automated Lameness Probability (ALP) per cow per day

[1]Chapinal et al, 2009 Journal of Dairy Science 92: 4365–74

Compare ALP & Claw Diagnosis

- 5 commercial farms visited in 2017
- MS-observer picked 50% lame and 50% non-lame cows (AHDB 0-3 scale) for trimming
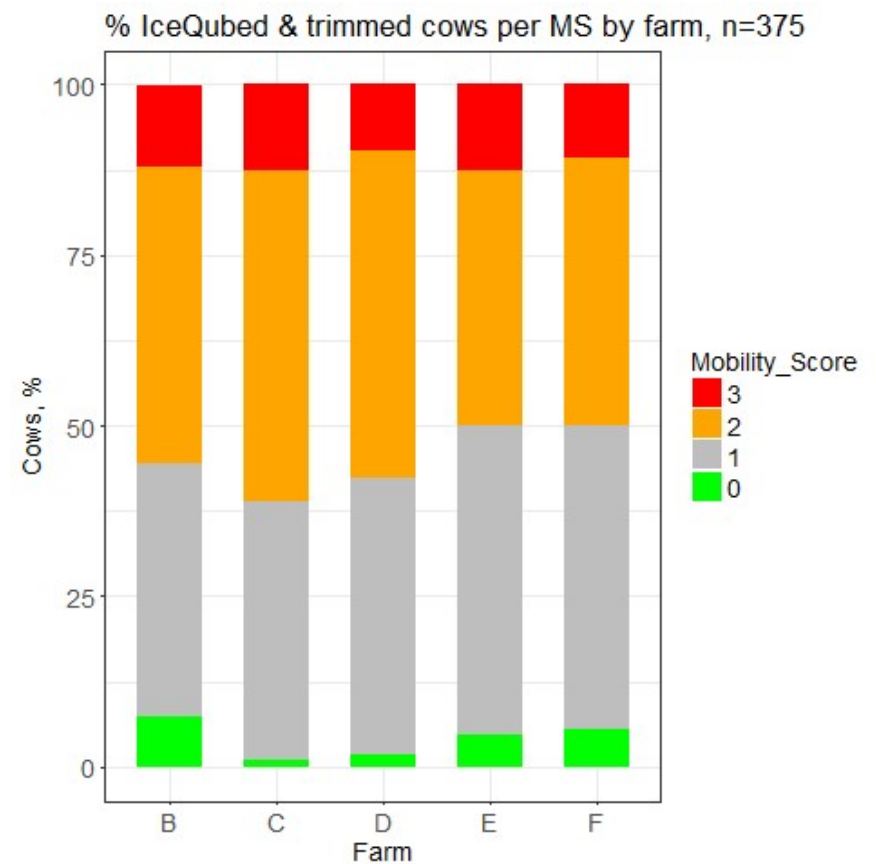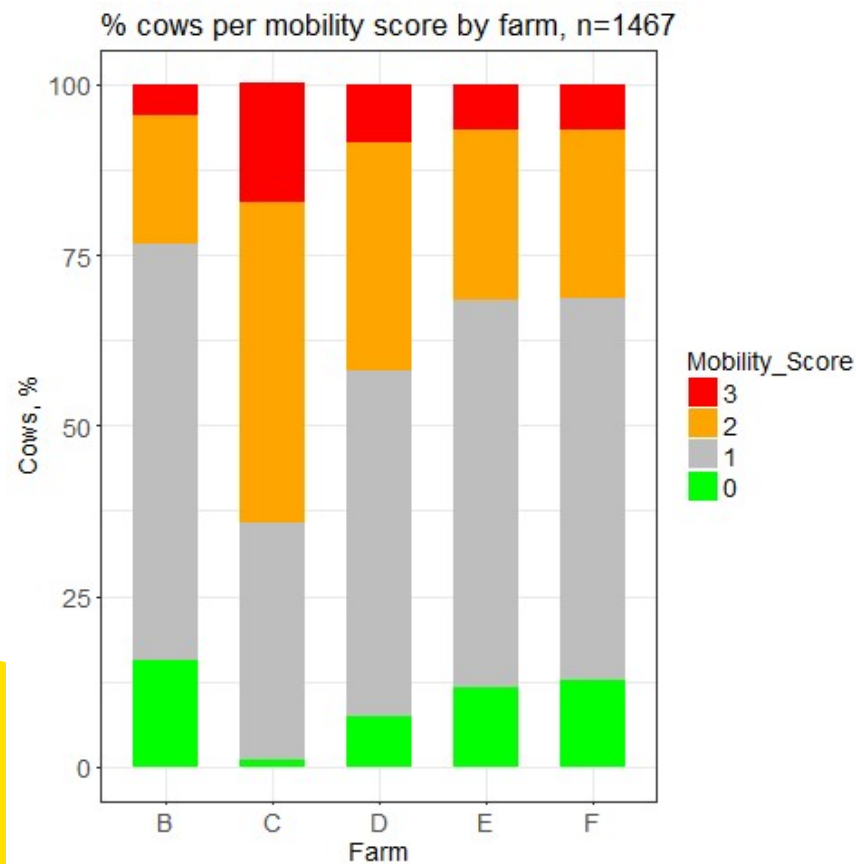- Vet performed claw diagnosis blind to MS and ALP

Farm	Herd size	IceQube cows	MS cows	IceQube, MS & trimmed
B	1,500	500	325	108
C	145	137	115	95
D	467	462	378	52
E	610	606	483	64
F	200	181	166	56
Total		**1,886**	**1,467**	**375**

Mobility Scores by Farm

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Farm lameness prevalence from 24 to 62%.

Aim: to trim 50% non-lame and 50% lame cows.

% cows per mobility score by farm, n=1467

% IceQubed & trimmed cows per MS by farm, n=375

Claw Diagnoses

| Severe diagnoses			Mild diagnoses	Healthy/not lameness causing
Major claw lesions	**Major skin lesions**	**Major other**	**Minor claw lesions**	**Other**
Sole ulcer 45	Digital dermatitis 63	Upper leg 7	Sole bruise 71	Good feet 121
Heel ulcer 5	Foul in the foot 1	Shackles 2	Sole overgrowth 3	DD (M3; M4*) 7
Claw necrosis 25		Unknown but lame 3	Thin sole 5	*low pain reaction
White line 12			Cut heel 1	
			Stone 3	
			Corkscrew claw 1	
87	**64**	**12**	**84**	**128**

Total = **375 cows** with complete data

Many cows with severe diagnoses

Detection Examples
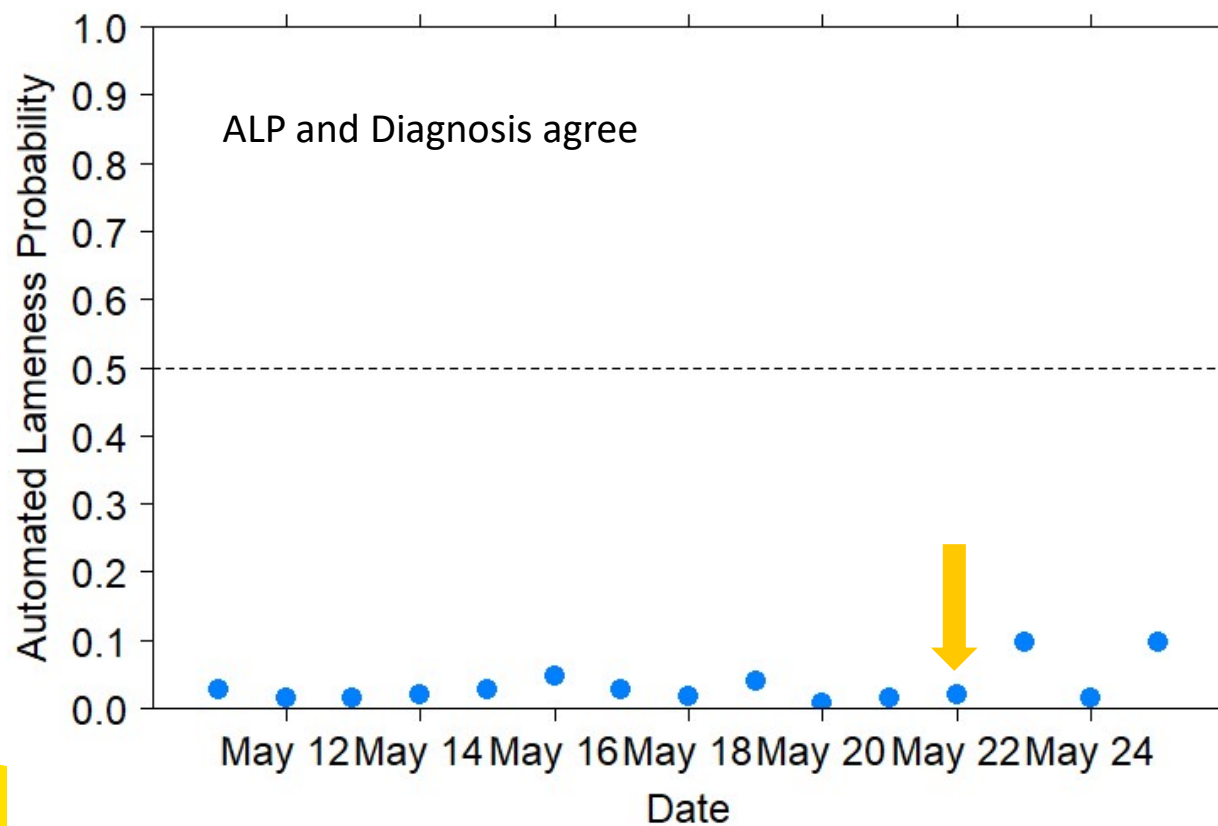

Cow #354.756. ALP 2 weeks prior to SU diagnosis, MS=3

All agree

MS
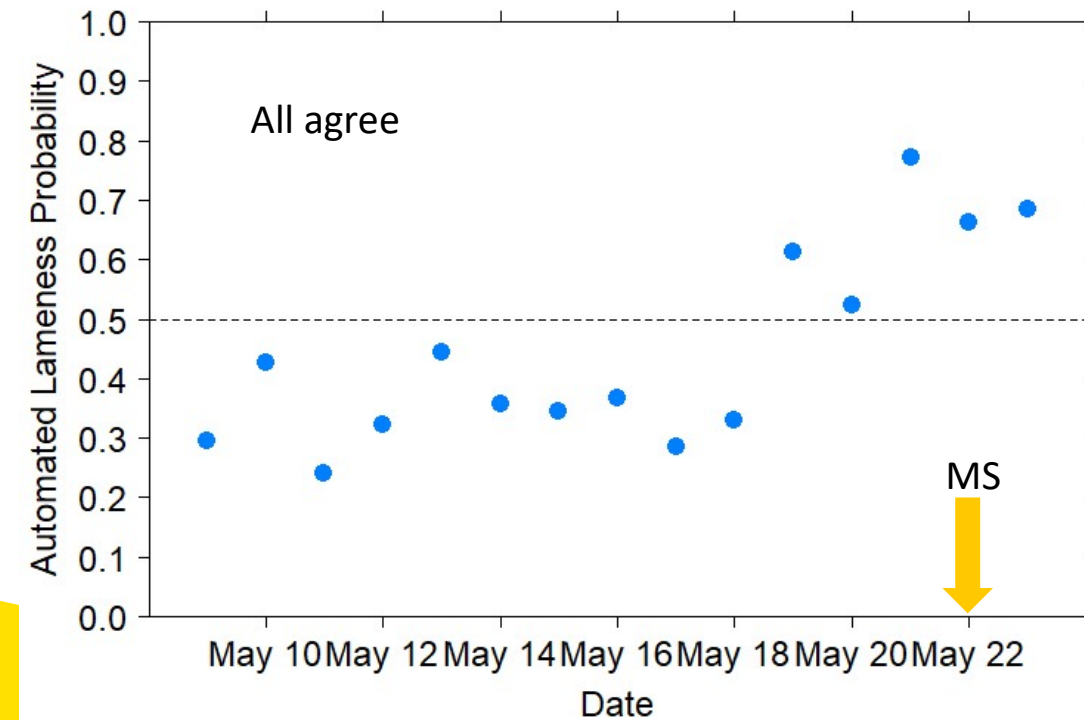
Cow #349.285. ALP 2 weeks prior to SU/CN diagnosis, MS=3

All agree
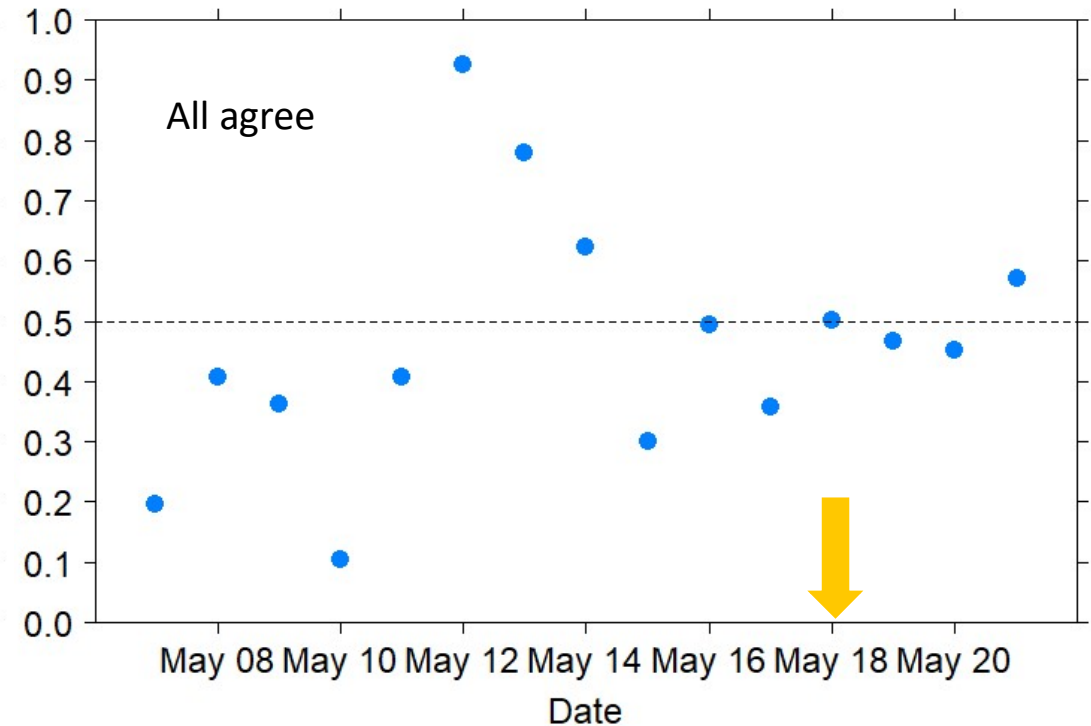
Detection Examples

Cow #348.766. ALP 2 weeks prior to Good Feet diagnosis, MS=2

ALP and Diagnosis agree

Conclusions

- Lameness remains a very severe welfare problem which MUST be addressed on every farm
- Behavior-based detection – some alerts due to other types of disease
- Develop appropriate filtering of alerts
- Ongoing validation on several farms
- PPV of ALP and MS are similar
- ALP is objective   potential as benchmarking tool
- ALP runs every day

– what do you use as gold standard when modelling?

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Further Development

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UK research herd, ~100 cows,
2 milkings/day
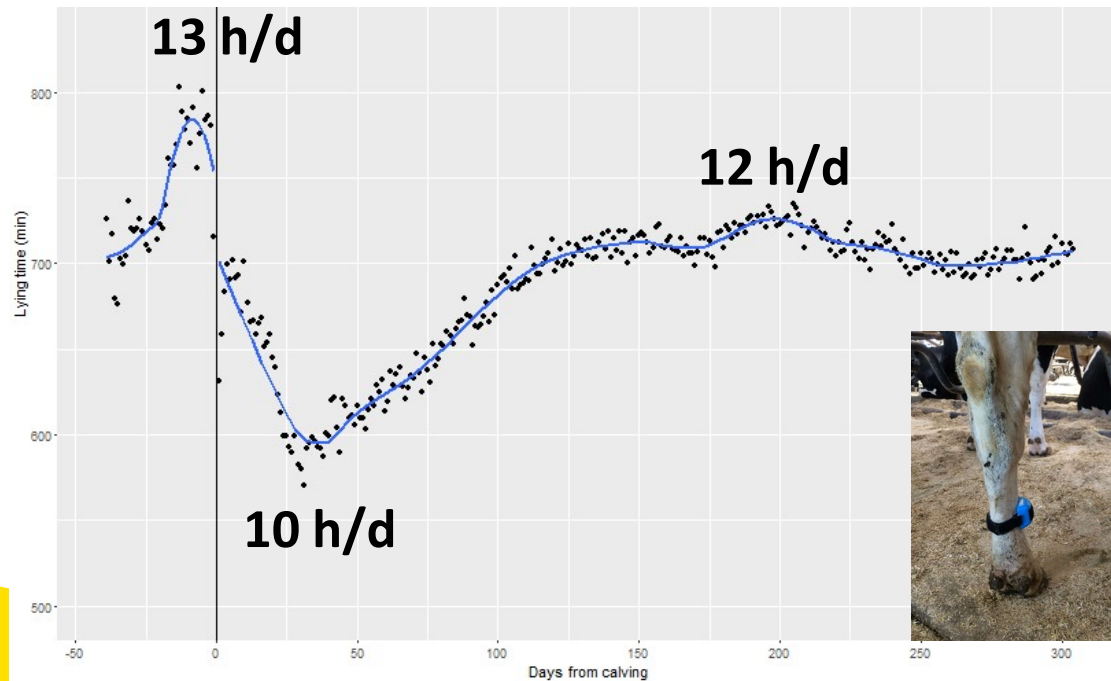
4 commercial Danish farms, 366 cows,
2 milkings/day
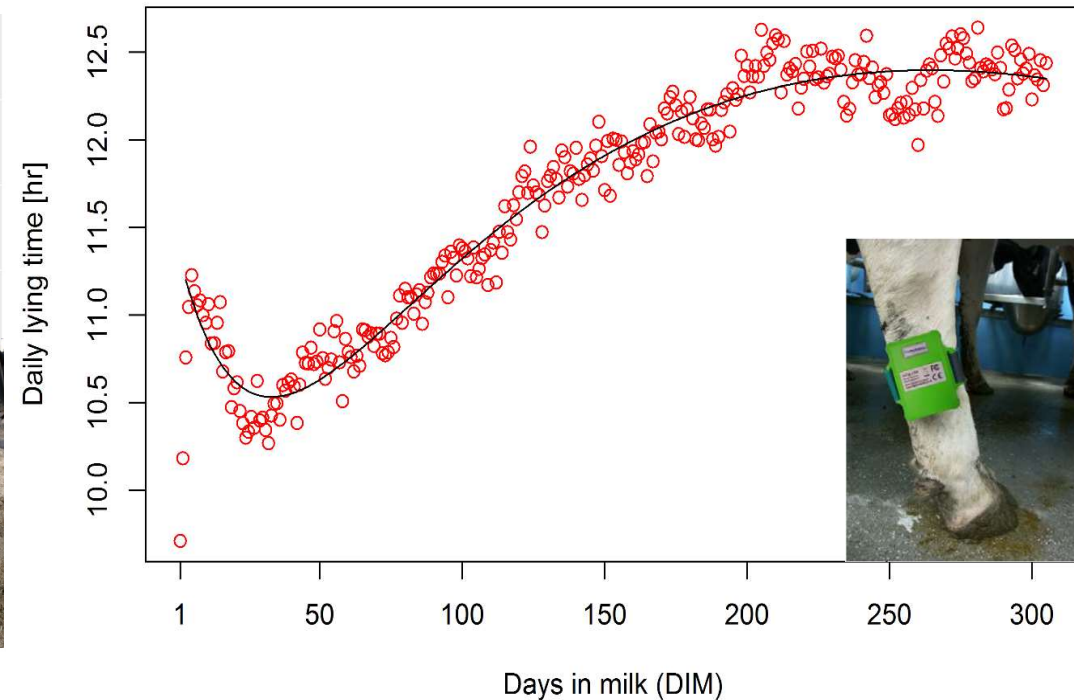
Thorup et al, 2016 Proc. 4th DairyCare Conference, Lisbon, p 16

Maselyne et al (2017) Res Vet Sci 110: 1-3 (DC STSM)

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Any questions

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