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Agricultural Research Organization (ARO) Israel

Detection of early lactation ketosis by rumination and other sensors

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Outline

- Introduction
- Hypothesis
- Objectives
- Material & Methods
- Results
  - Basic statistics
  - Model Development - Calibration – Validation
- Discussion
- Conclusion

Introduction

- **Past**: livestock management decisions based only on human observation

Introduction

- **Last decades**: dairy farming
  → intensive production systems

Introduction

- Dairy farming in Israel
  - Israeli-Holstein
  - ~ 11500 kg milk/cow/year

Introduction

- Cow health
  - All cows: Routine check 5 to 12 days after calving
  - One main vet organization: 99 % cows
  - Records collected on national level

- Many sensors


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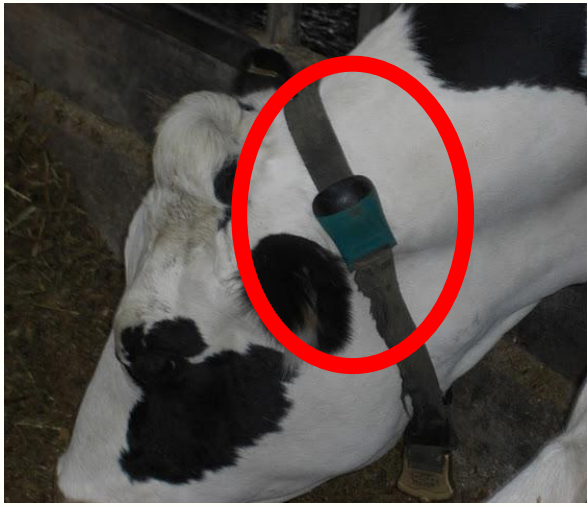


Introduction

- Large quantity of data signals in herd management software

- Many sensors - specific purposes

→ Give sensor data biological meaning

- GAP: combination sensor data hardly explored

Introduction

- Ketosis
  - Early lactation
  - 15 % of the cows in Israel

- Costs:
  - Veterinarian
  - Treatment
  - Lost milk yield
  - Labour

Hypothesis

- Ketosis= △ behaviour and performance
- Sensors
  - Ruminating time
  - Neck activity
  - Milk yield

Objectives

- Identifying post-calving ketosis by:
  - Behavioural data (ruminating time, neck activity)
  - Performance data (milk yield)
- Build model that can be applied in commercial farms as part of the herd management software

Material & Methods

- Sensor: HR-Tag (SCR Engineers Ltd)
  - Cow Identification
  - Ruminating time (min/2h)
  - Neck activity (activity index/2h)

Material & Methods

- Data collection:
  ~ 2000 cows – commercial herds
  - Big kibbutz farm: 1100 cows
  - 4 smaller kibbutz farms: ca. 300 cows/farm
- Daily data – 2h data
- Start in November 2010

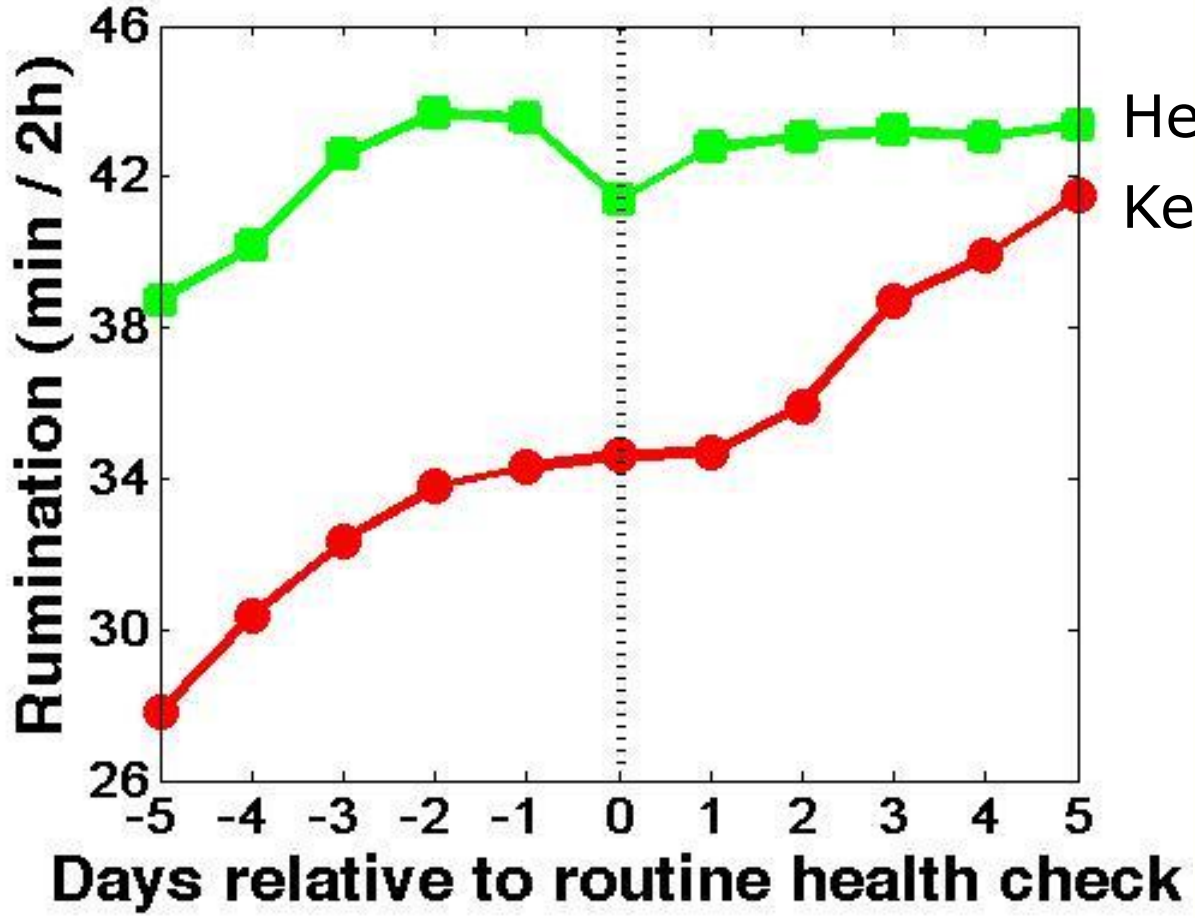
Material & Methods

- Golden standard: veterinarian
  - Routine check 5 to 12 days after calving
- Procedure
  - Ketosis → Ketostix test (measuring AcAc in urine)
- Treatment
  - Drenching with propylene glycol
  - Intravenous infusion in severe cases

Material & Methods

- Based on health reports and lactation curves:
  - Healthy cows
  - Ketotic cows
  - Excluded:
    - Cows with other health problems (metritis, mastitis, lameness, …)
    - Cows without Ketostix test results
    - Cows with unexplained drop in milk yield

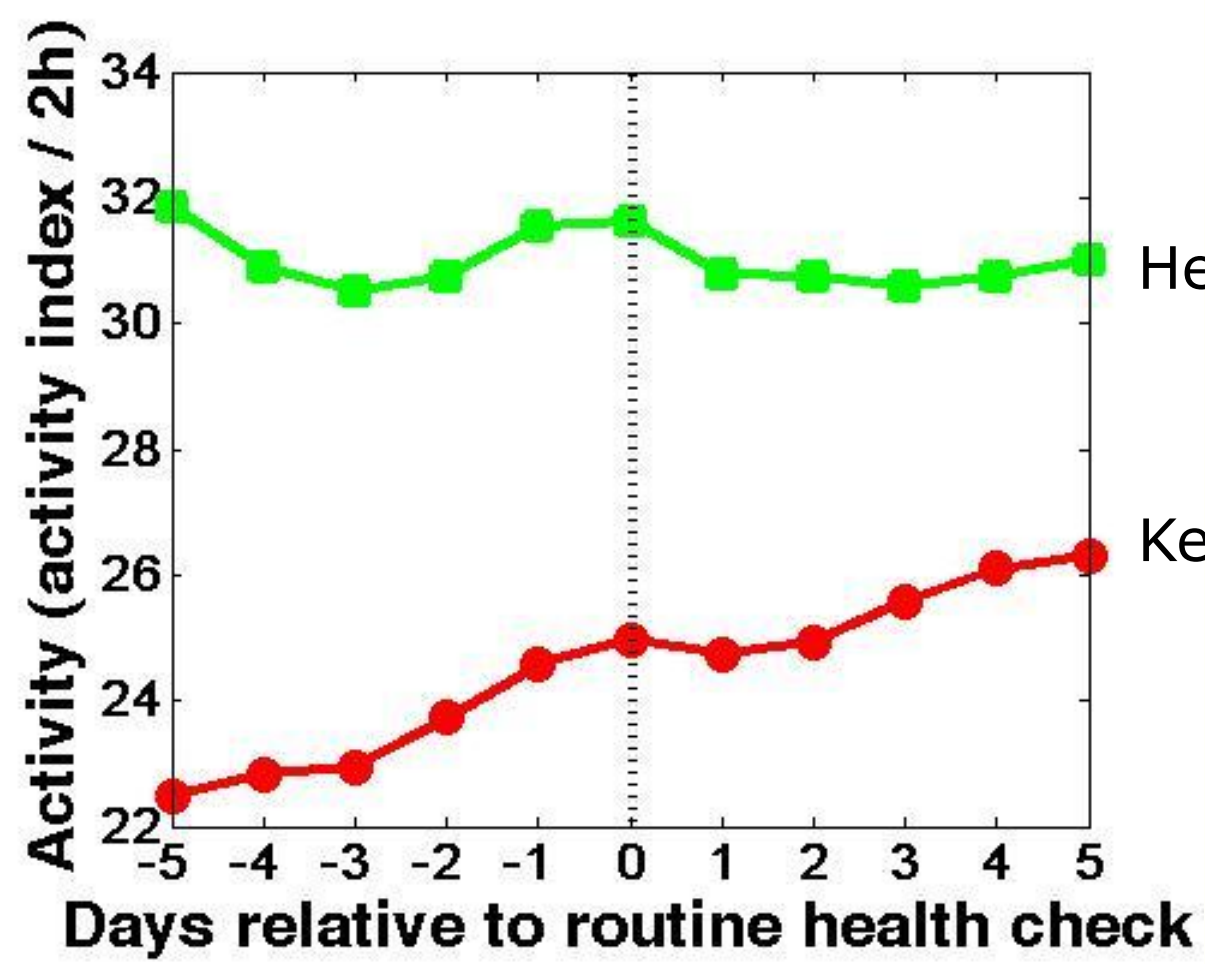
Preliminary Results – Rumination



Healthy: 45 cows

Ketotic: 45 cows

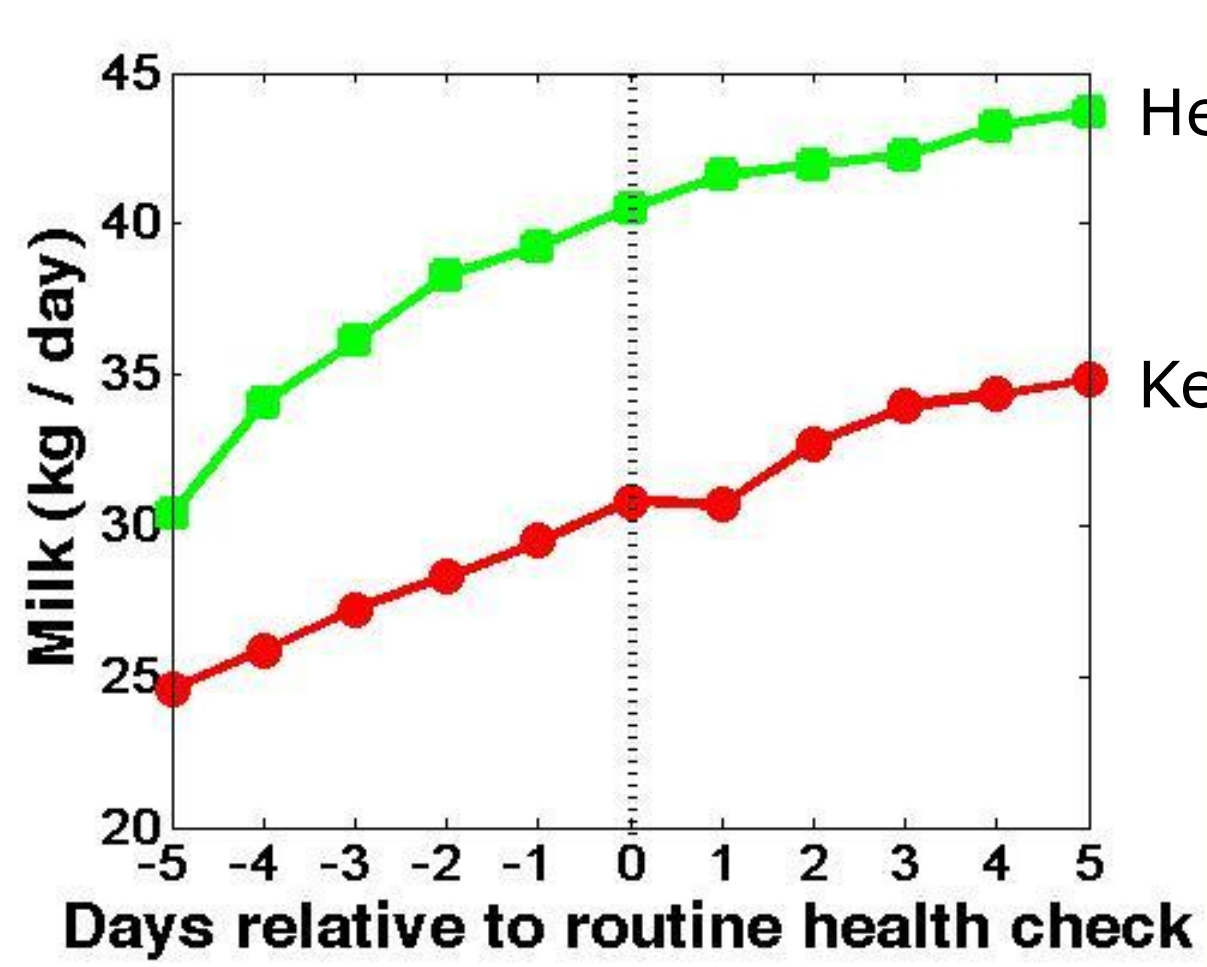
Preliminary Results - Neck Activity



Healthy: 45 cows

Ketotic: 45 cows

Preliminary Results – Milk yield



Healthy: 45 cows

Ketotic: 45 cows

Objectives

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Model: Development

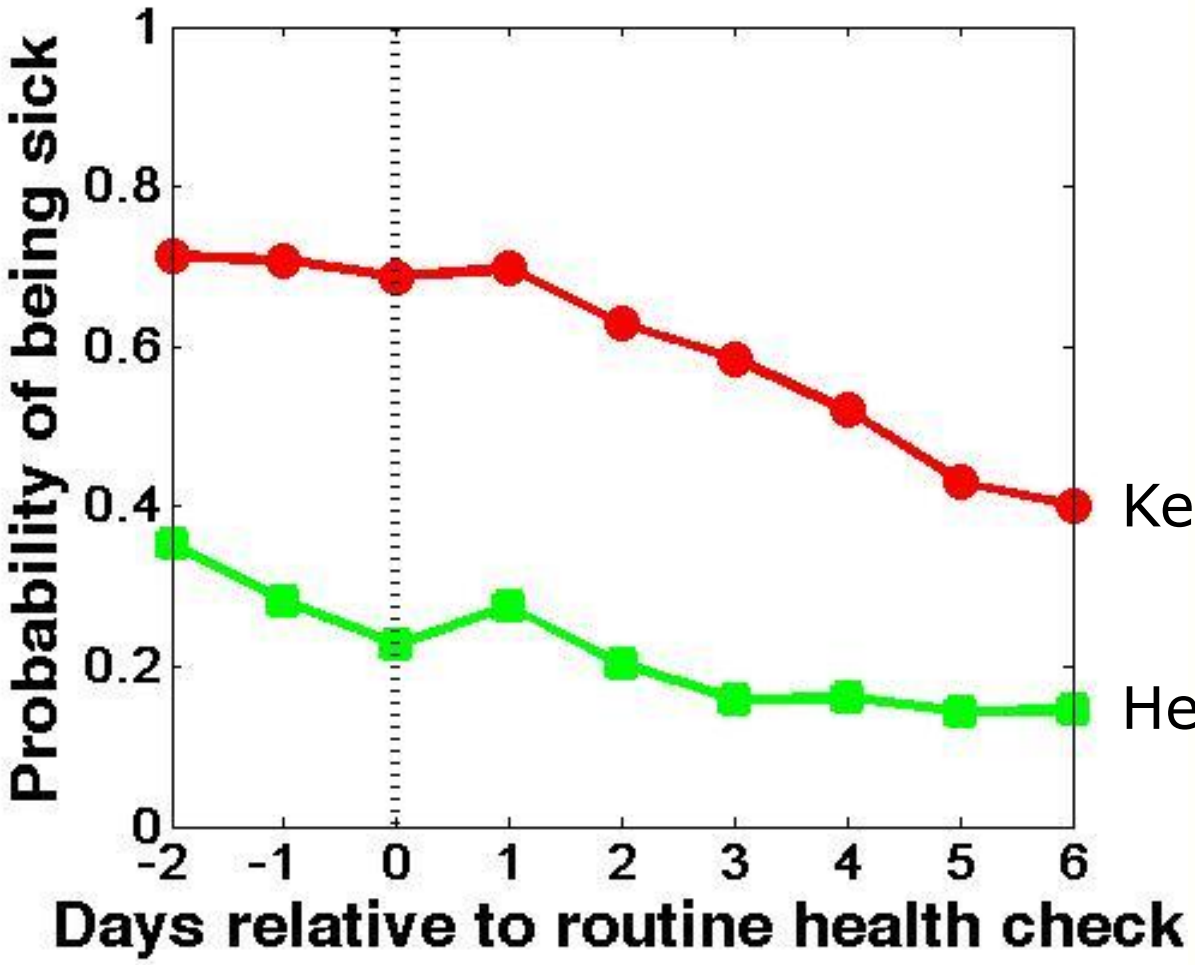
- Stepwise logistic regression model
  - Probability of being sick
    - $f(z) = (1 + e^{-z})^{-1}$
    - $z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k$
  - 2 model outcomes:
    - 0 – Healthy
    - 1 – Ketotic
- Variables: Ruminating Time, Neck Activity and Milk Yield

Model: Calibration

- 45 healthy and 45 ketotic cows

Detected value	Reference value		Correct
	Ketotic	**Healthy**	
Ketotic	37	5	**86 %**
Healthy	8	40	

Model: Validation



Ketotic: 89 cows

Healthy: 144 cows

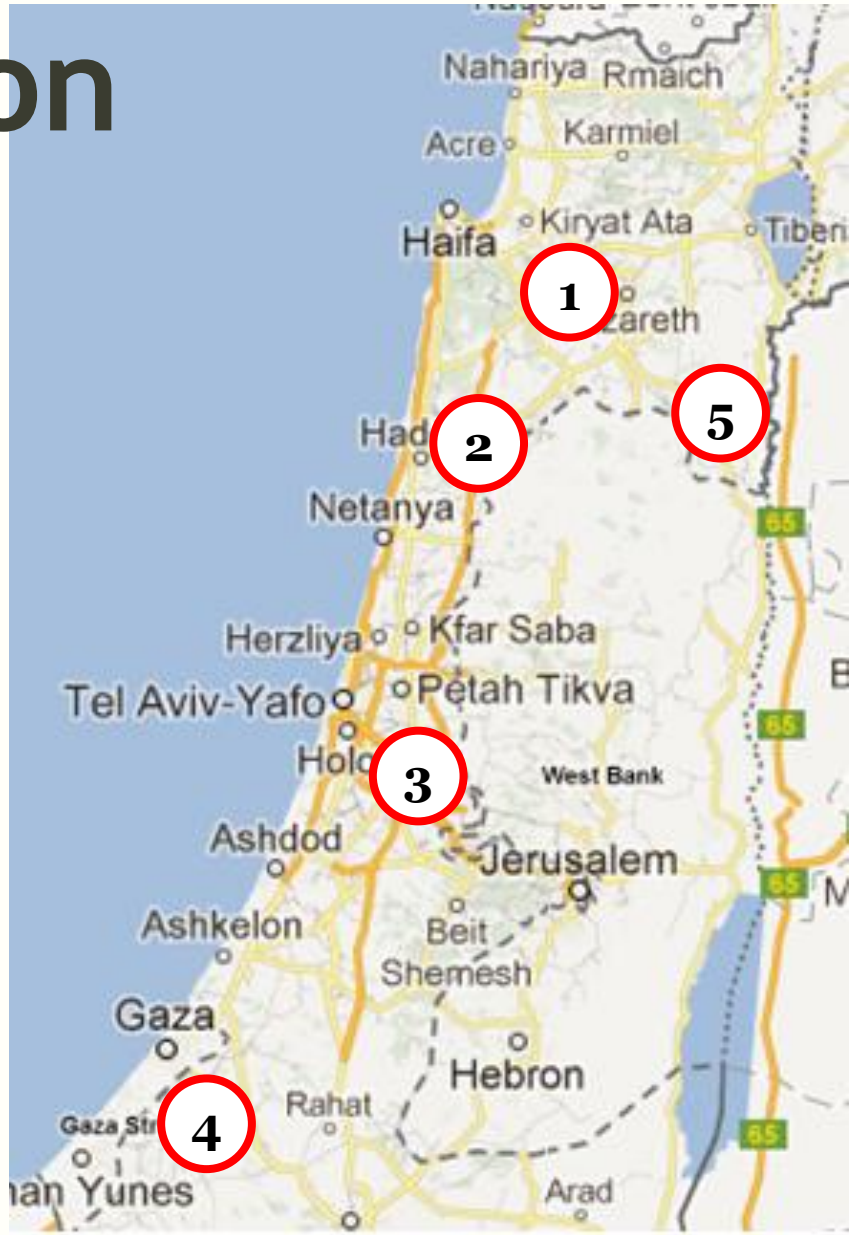
Model: Validation

- 144 healthy and 89 ketotic cows

Days to diagnosis	Detected value	Reference value		Correct
		Sick	Healthy	
-2	Ketotic	57	42	71 %
	Healthy	19	89	
-1	Ketotic	68	34	76 %
	Healthy	21	110	
0	Ketotic	64	20	81 %
	Healthy	25	124	

Model: Validation

Farm	Correct
1	83 %
2	70 %
3	91 %
4	67 %
5	77 %

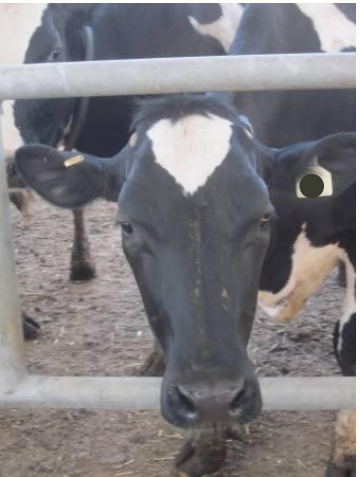


Discussion

- Existing farm data
- Exact timing of disease is unsure
- After diagnosis and treatment: recovery
- Misclassified cases ~
  - Subclinical ketosis (53 %)
  - Environmental conditions
  - Management practices
  - …
- Improvements
  - Other types of models (survival models, tree based models)
  - Other sensors

Conclusion

- Ketosis =△ behaviour and performance
- A model can be build
- Practical application: herd management software → automatic list of cows at risk for ketosis



Thank you!

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