Syndromic Surveillance in veterinary medicine using laboratory submission data – lessons learned from two systems

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Information about the systems

- **Canada**
  - Animal Health Laboratory (AHL) in the province of Ontario
  - Laboratory of choice for livestock diagnostics
  - **Laboratory submissions (test orders) in cattle**

- **Sweden**
  - National Veterinary Institute
  - All testing of reportable diseases in animal in Sweden
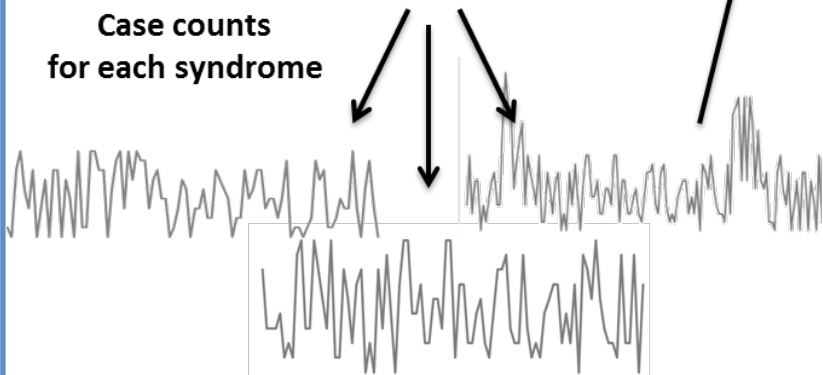 - **All laboratory submissions**

Records classification

Data extraction

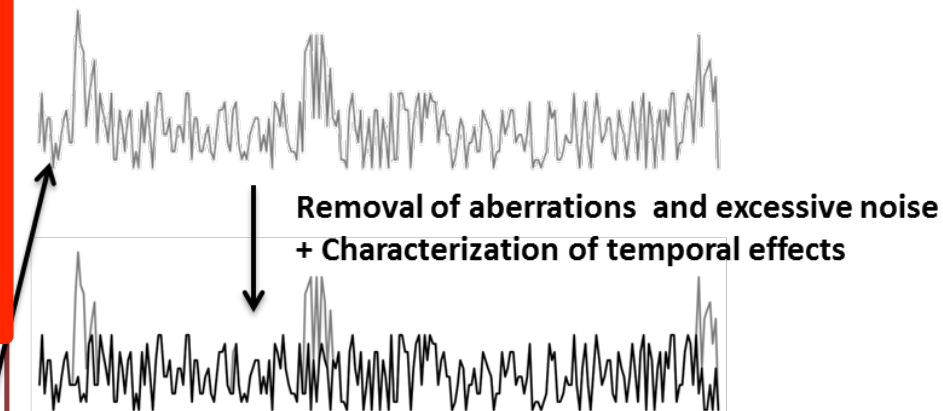| caseID	Source	Date	Sample	Test
2092814	clinical	2000-jan-01	Serum	BLV
2092814	clinical	2000-jan-01	Serum	BLV
2092582	clinical	2000-jan-01	Serum	BVD type 2
2092607	clinical	2000-jan-01	Serum	BVD type 2
2092607	clinical	2000-jan-01	Serum	BVD type 2
2000032	clinical	2000-jan-02	Liver	Bacterial culture
2000032	clinical	2000-jan-02	Lung	Bacterial culture
2000032	clinical	2000-jan-02	Spleen	Bacterial culture
2000032	clinical	2000-jan-02	Tissue_-_Fixed	Histopathology
2000128	clinical	2000-jan-02	Tissue_-_Fixed	Histopathology
2000055	clinical	2000-jan-02	Tissue_-_Fixed	BVD type 1
2008045	clinical	2000-jan-02	Brain	Bacterial culture
2008001	clinical	2000-jan-02	brain	Bacterial culture
2015705	clinical	2000-jan-02	Fetal_Tissue	Bacterial Culture
2015789	clinical	2000-jan-02	bone	Clostridia
2015789	clinical	2000-jan-02	joint	Clostridia
2015719	clinical	2000-jan-02	Lung	Bacterial culture
2015705	clinical	2000-jan-02	rumen	Bacterial culture
2015705	clinical	2000-jan-02	rumen	Bacterial culture
2015705	clinical	2000-jan-02	Bronchoalveolar_Lavage	Bacterial culture
2024811	clinical	2000-jan-02	large Int	Clostridium perfringens

Classification of records into syndromes

Syndrome	caseID	Source	Date	Sample	Test
BLV	2092814	clinical	2000-jan-01	Serum	BLV
BLV	2092814	clinical	2000-jan-01	Serum	BLV
BVDV	2092582	clinical	2000-jan-01	Serum	BVD type 2
BVDV	2092607	clinical	2000-jan-01	Serum	BVD type 2
BVDV	2092607	clinical	2000-jan-01	Serum	BVD type 2
Hepatic	2000032	clinical	2000-jan-02	Liver	Bacterial culture
Respiratory	2000032	clinical	2000-jan-02	Lung	Bacterial culture
Haematopoietic	2000032	clinical	2000-jan-02	Spleen	Bacterial culture
Nonspecific	2000032	clinical	2000-jan-02	Tissue_-_Fixed	Histopathology
Nonspecific	2000128	clinical	2000-jan-02	Tissue_-_Fixed	Histopathology
BVDV	2000055	clinical	2000-jan-02	Tissue_-_Fixed	BVD type 1
Nervous	2008045	clinical	2000-jan-02	Brain	Bacterial culture
Nervous	2008001	clinical	2000-jan-02	brain	Bacterial culture
Abortion	2015705	clinical	2000-jan-02	Fetal_Tissue	Bacterial Culture
Musculoeskeletal	2015789	clinical	2000-jan-02	bone	Clostridia
Musculoeskeletal	2015789	clinical	2000-jan-02	joint	Clostridia
Respiratory	2015719	clinical	2000-jan-02	Lung	Bacterial culture
GIT	2015705	clinical	2000-jan-02	rumen	Bacterial culture
GIT	2015705	clinical	2000-jan-02	rumen	Bacterial culture
Respiratory	2015705	clinical	2000-jan-02	Bronchoalveolar_Lavage	Bacterial culture
GIT	2024811	clinical	2000-jan-02	large Int	Clostridium perfringens
Respiratory	2024699	clinical	2000-jan-02	Lung	Virus isolation

Case counts for each syndrome

Retrospective analysis

Removal of aberrations and excessive noise + Characterization of temporal effects

Prospective analysis

Use historical data as a baseline to train algorithms for prospective detection of aberrations

Alarm detection + Automated correction of baseline

Real-time monitoring

Alarms of various magnitudes
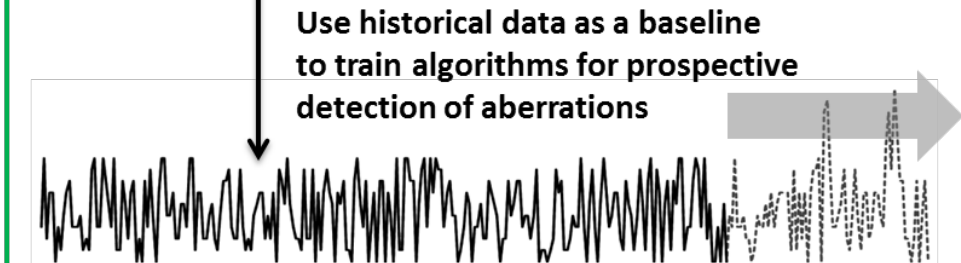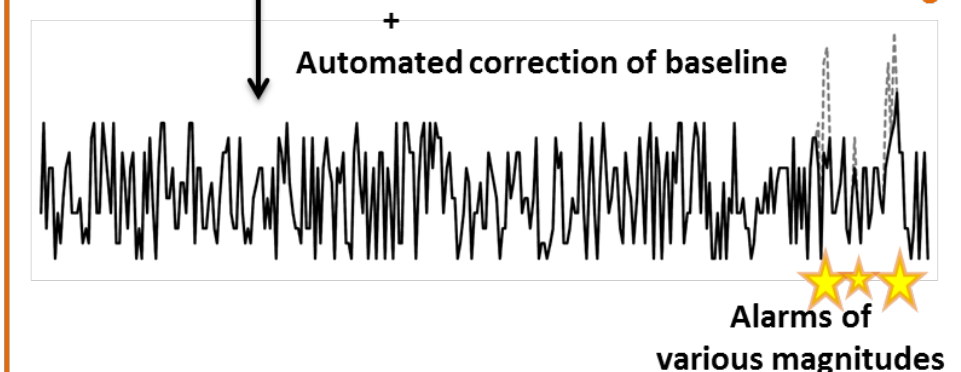
1. Classification:
records → syndrome counts

- *Lack of standardized coding systems*

- Challenges:
  - Limited clinical information
  - *Active versus passive activities*
  - Structured limited information + free-text
  - Missing or erroneous information

1. Classification:
records → syndrome counts

- *Exhaustive syndromic list*
- Methods
  - Direct mapping
  - Rule-based - 99.4% recall and 100% precision
    - Dictionary of relevant words
    - Direct relationships
    - Co-occurrences
    - Precedence

Animal groups
Cattle
Equine
Swine
Poultry
Cats
Dogs
Aquatic
Wild
Environmental
Feed

Syndromic groups
Abortion
Circulatory,Hepatic,Haematopoietic
Eyes,Ears and Others
Integumentary
GIT
MBS
Mastitis
Musculoskeletal
Nervous
Reproductive
Respiratory
Systemic
Urinary
AntimResistance
Fallen stock

2. Retrospective analysis
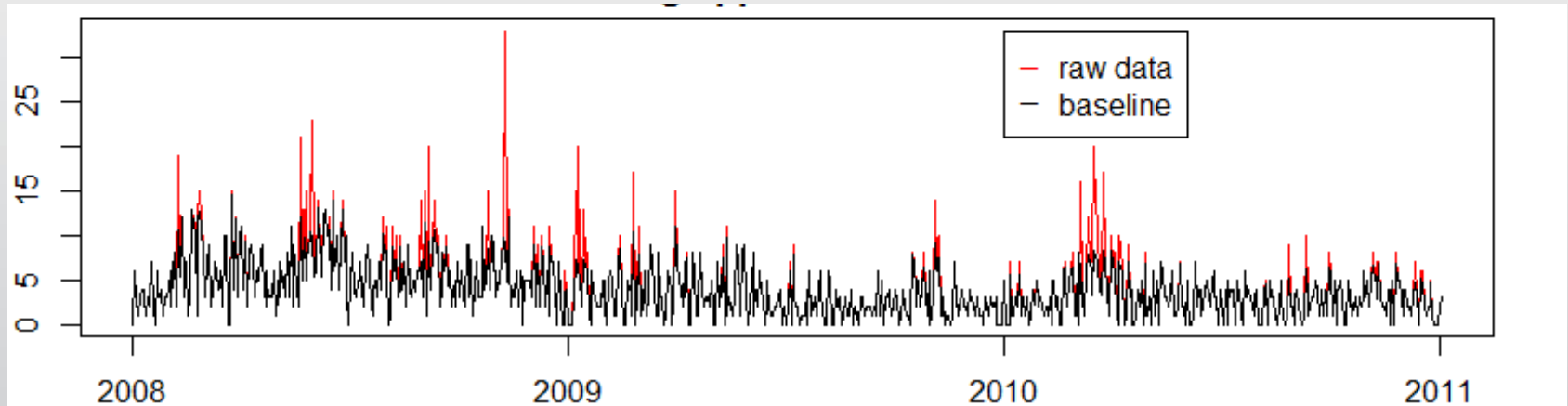
- Noise versus past outbreaks
- Temporal effects
- *Small counts per day*
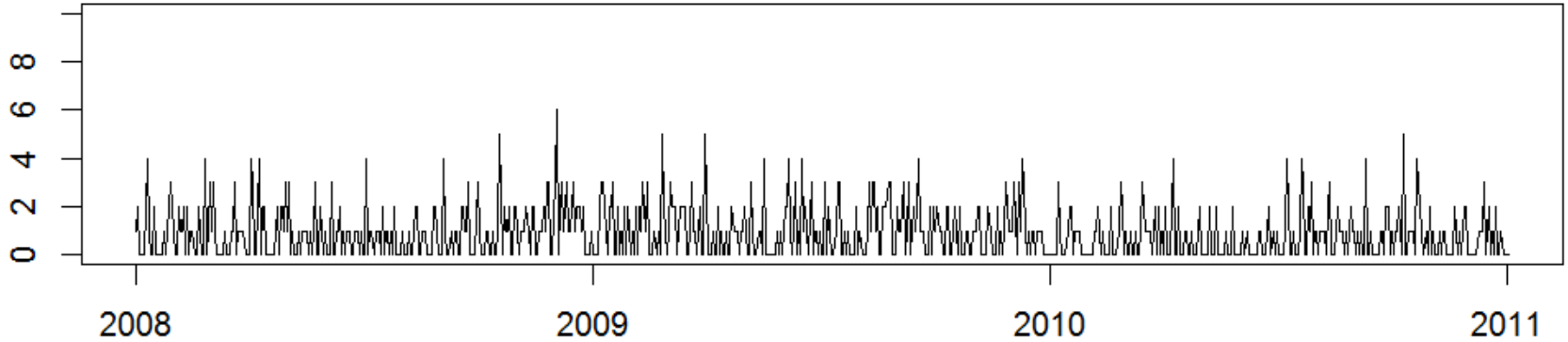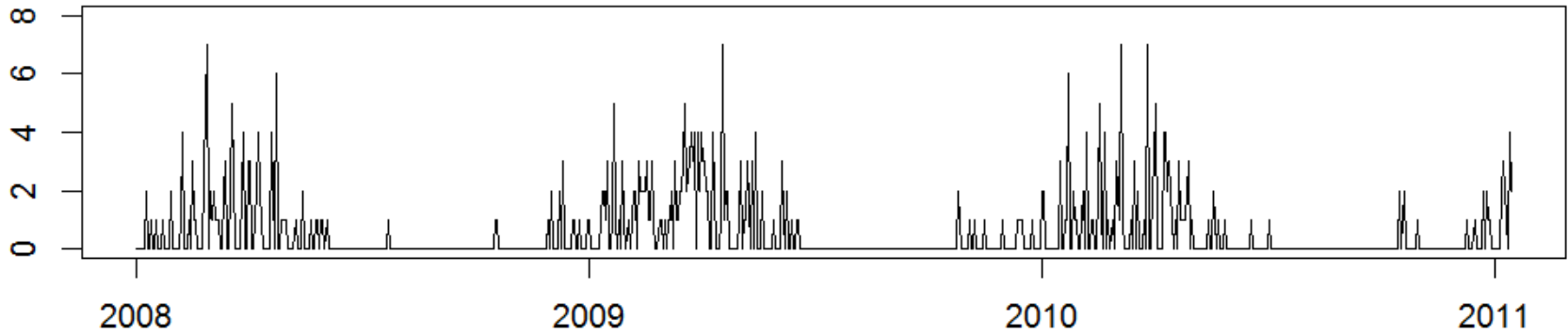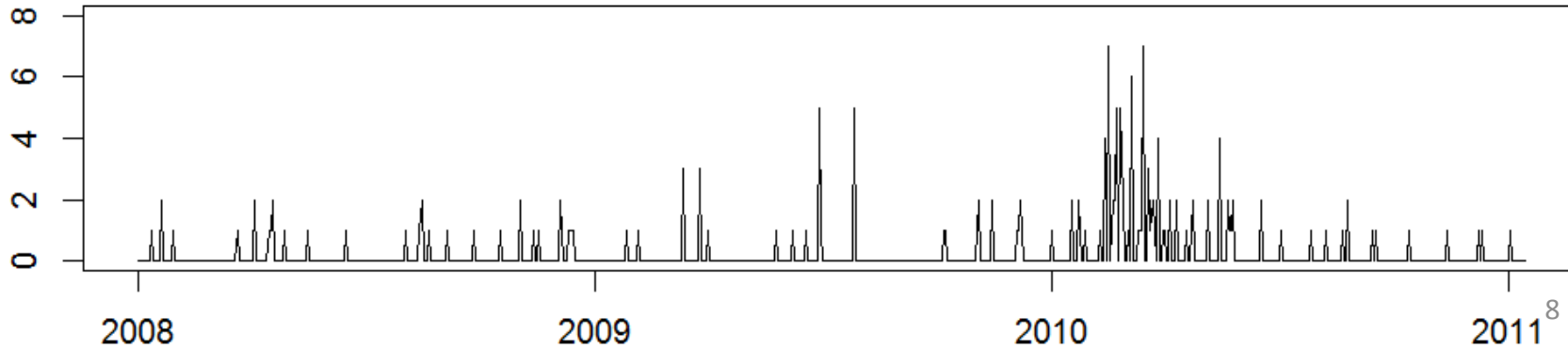
2. Retrospective analysis

3. Prospective analysis

baseline

Guard-band or range

Current data point

Alarm detected

00000001000001
Alarm Vector

NO Alarm detected

00000001000000
Alarm Vector
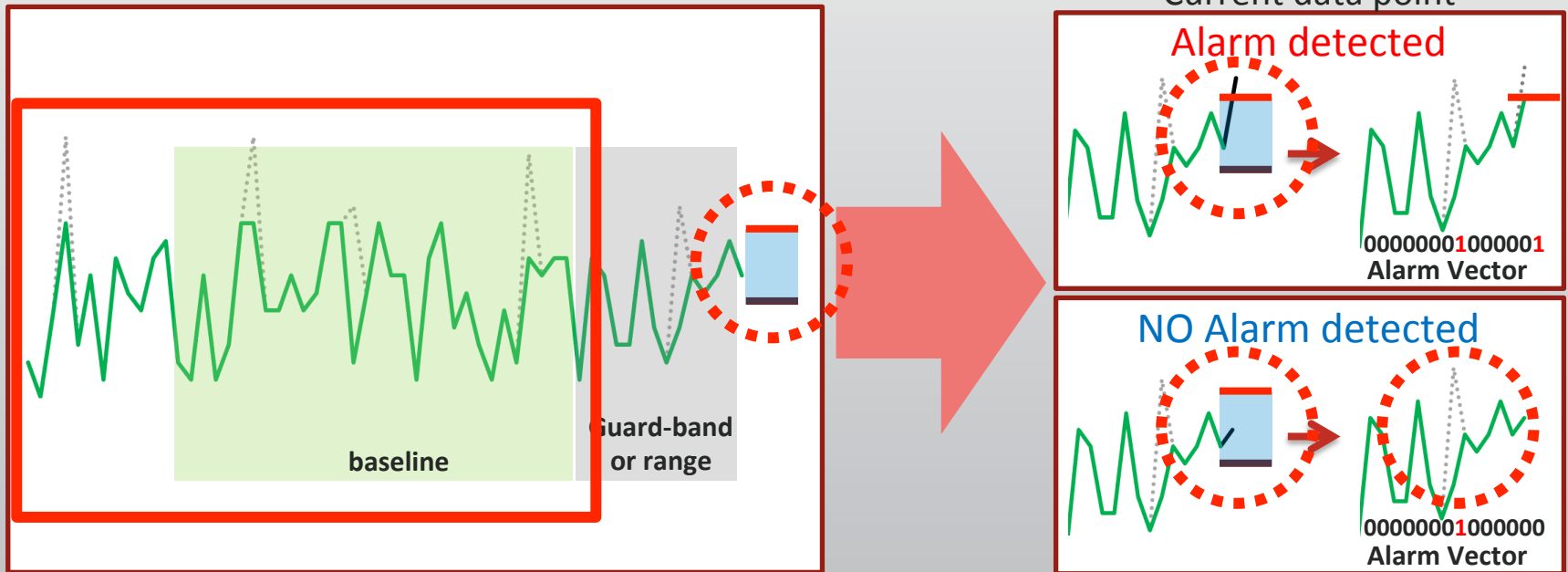
3. Prospective analysis

- What algorithms
  - Control charts (Shewhart + EWMA)
    - ***R:{qcc}***
    - Pre-processing: Differencing or Regression Models

  - Holt-Winters exponential smoothing
    - ***R:HoltWinters()***

Characteristics of the outbreak

Characteristics of the data stream

Respiratory - 2011-12-09

Algorithm	D-4	D-3	D-2	D-1	TODAY
HW	0	0	0	0	5
EWMA	0	0	0	0	2
Shewhart	0	3	0	0	5
SUM	0	3	0	0	12

Respiratory DAILY Alarm Score

Alarm Algorithm
- Holt-Winters
- EWMA
- Shewhart
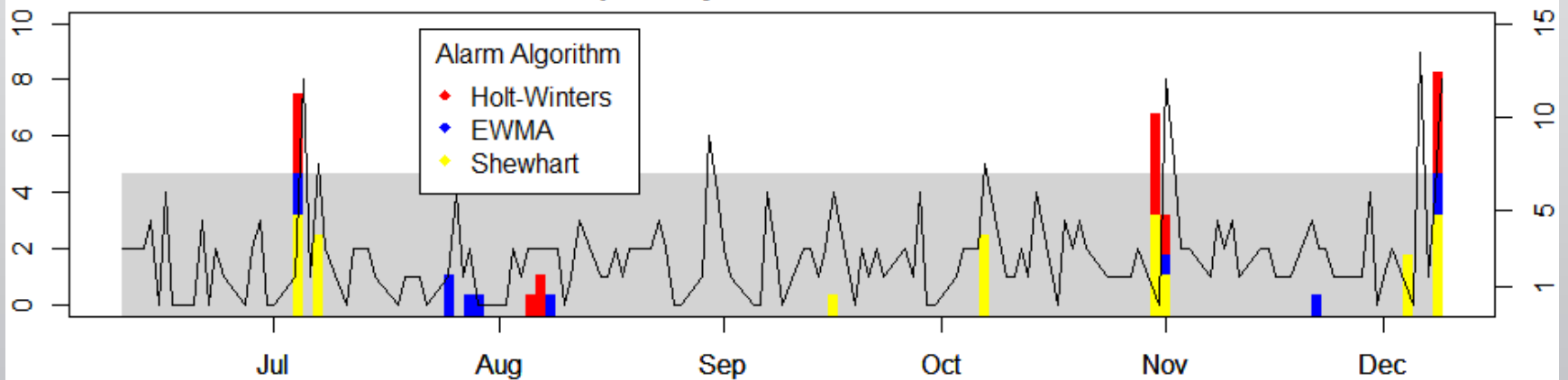
Respiratory Observed counts and Corrected Baseline

+ Original submisison counts
+ Corrected baseline

Syndromic surveillance at SVA
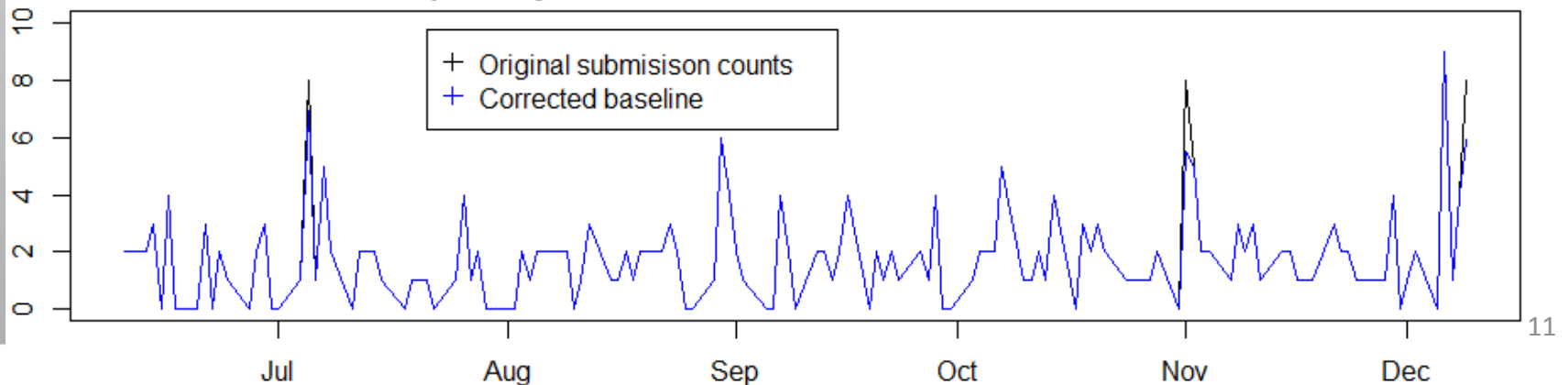
2013-07-27

Cats
Cattle
Dogs
Environm.
FOD
FSK
Horses
Poultry
Small Ruminants
Swine
VLT

Select a group on the navigation menu to the left to see results

System outputs are based on data up to the end of the PREVIOUS day.

Number of events per day correspond to the number of laboratory submissions, classified into syndromic groups by a computer system.

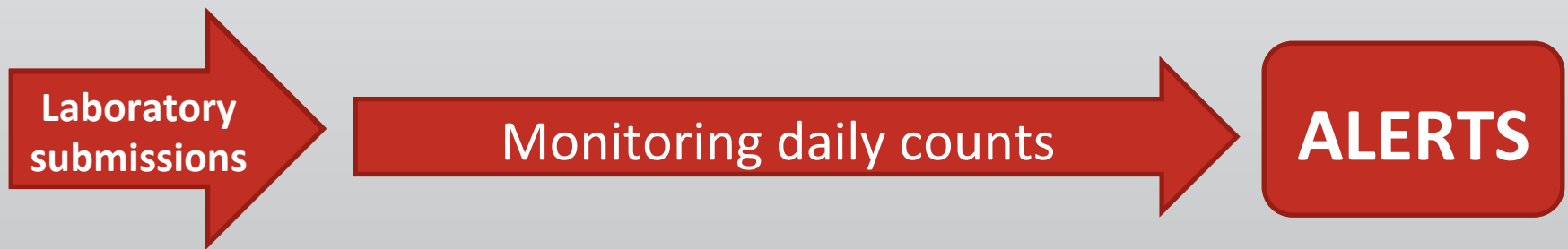They reflect the number of ANIMALS tested per day for CATS and DOGS, and the number of HERDS otherwise

For questions contact Fernanda Dorea (fernanda.dorea@sva.se)

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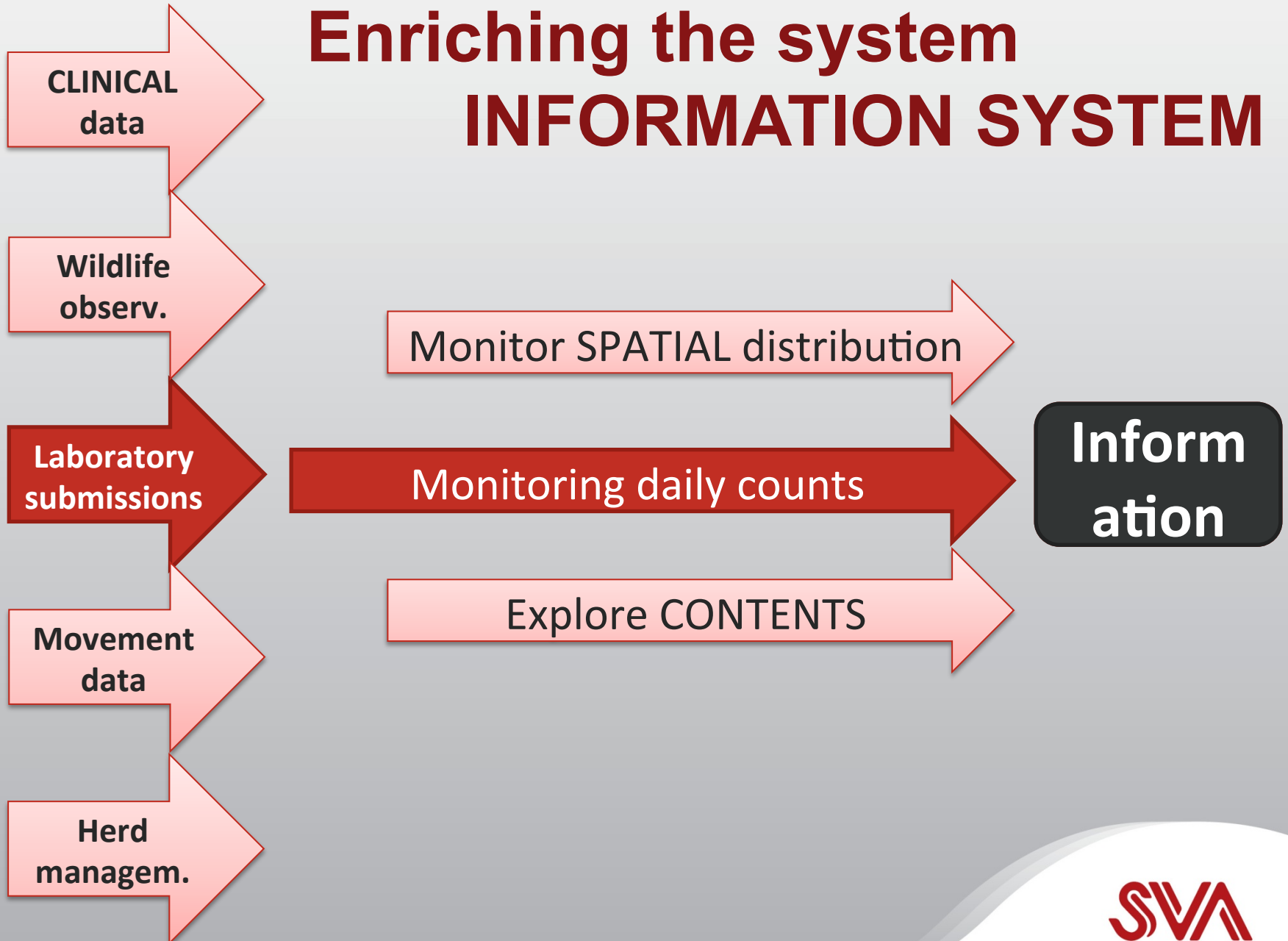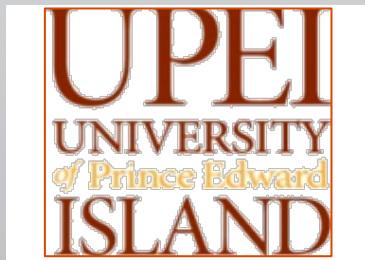# Free tools

Basic framework
SYNDROMIC SURVEILLANCE

Laboratory submissions → Monitoring daily counts → **ALERTS**

Enriching the system
INFORMATION SYSTEM

CLINICAL data

Wildlife observ.

Laboratory submissions

Movement data

Herd managem.

Monitor SPATIAL distribution

Monitoring daily counts

Explore CONTENTS

Inform ation

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Acknowledgments

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"IN GOD WE TRUST;
ALL OTHERS MUST
BRING DATA."
– W. EDWARDS DEMING

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