



HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI

ELÄINLÄÄKETIETEELLINEN TIEDEKUNTA  
VETERINÄRMEDICINSKA FAKULTETEN  
FACULTY OF VETERINARY MEDICINE



# Syöpähajukoirat

Inner Wheel Rally 2019  
27.10.2019



Anna Hielm-Björkman, ELT, Dosentti, tutkija (PI)  
Kliinisen hevos- ja pieneläinlääketieteen osasto  
Eläinlääketieteellinen Tiedekunta, HY

Susanna Paavilainen, Wise Nose:n eli Suomen  
hajuerotteluyhdistyksen toiminnanjohtaja

# Research group

## Study lead

- Dos. **Anna Hielm-Björkman** - Research leader
- **Susanna Paavilainen** – WiseNose CEO, Cancer project co-ordinator
- **DogRisk** research group
- Professor **Jouko Vepsäläinen** - University of Eastern Finland (UEF). The molecules of smell

## Students:

- **Heidi Pikkarainen** – DVM (use of dogs in medical scent work)
- **Johanna Loukola** – DVM student (human breast cancer)
- **Tuuli Katainen** – DVM student (problems with validating scent dogs)
- **Elina Heiskanen** – DVM student (Use of dogs to alarm for pain)
- **Soile Rummukainen** – PhD student, UEF (Naming the molecules that the dogs find)

## Wisnose dog trainers

- **Susanna Paavilainen**
- **Ilkka Hormila** – pääkouluttaja, tutkimusten suunnittelu
- **Ville Vihne**

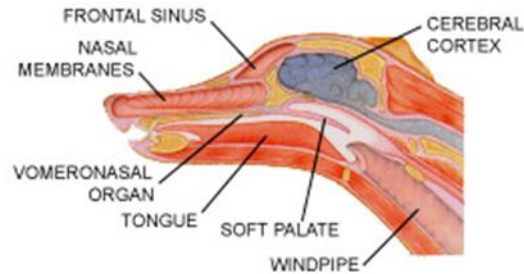
## Accreditation of Helsinki Scent Research Unit

- **Göran Wennquist** - Rikospoliisin Keskus rikospoliisin johtaja
- **Paul Karlsson** – Rikospoliisin Keskus rikospoliisin johtaja

**+co-operation** (HUS, FIMM, Orton, Turku. Oulu...) and E –nose, companies...

# The smelling sense of dogs and others

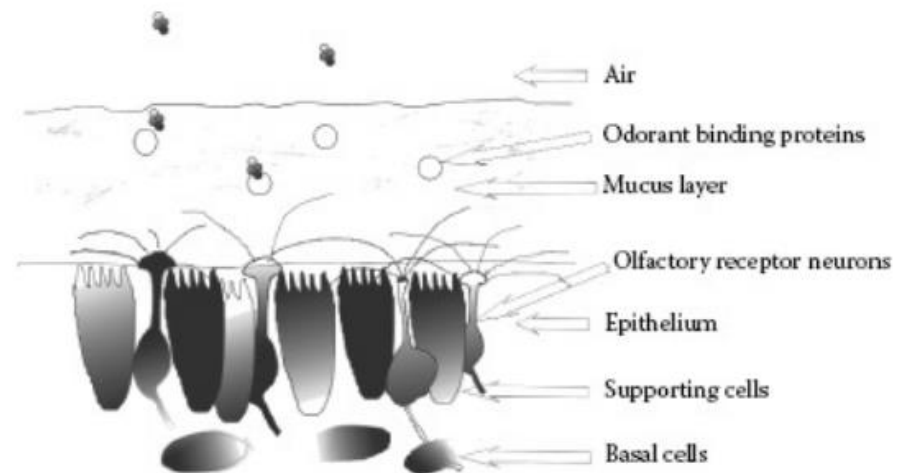
- First reported case 1989 (Lancet)



- The dog has ~200-250 milj. scent receptors,
- Humans have ~5-6 milj.

Also other animal species:

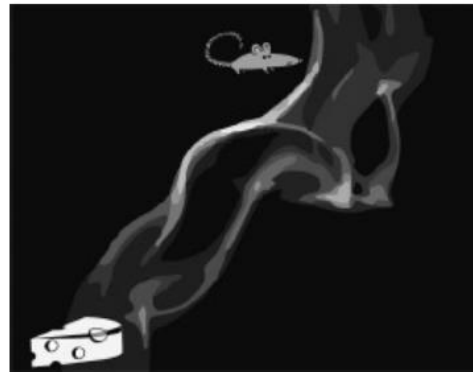
- African pouch rat
- <https://youtu.be/VrzpEfCUnc>
- Bee
- Pig ...





How specific is the dogs smell?

- The dog has ~1300 genes, that correlate with smell but only 18% of them are pseudogenes
- Man has ~660-900 genes, 64% pseudogenes (Quignon et al. 2003)



Odor plume

# “Assistant/working” dogs:

1. Police dogs
2. Custom dogs
  1. Finding money
  2. Finding drugs
  3. Finding explosives
  4. Finding people
3. “Voluntary” dogs
  1. Finding people in ruins
  2. Reading, school....
4. Patient assistant dog

## Cancer treatment dogs

- Tells us if the urine is from a cancer patient

## Diabetes dogs

- Tells someone when sugar goes up or down

## Epilepsy dogs

- Tells someone that there is an attack coming up

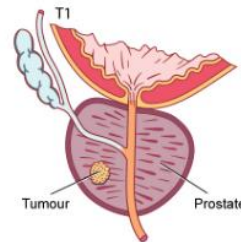
## Migraine dog / pain attack dog

- Tells someone that there is a pain attack coming up

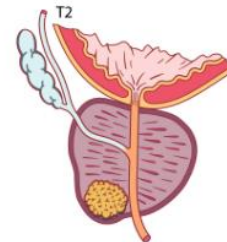
# The cancers we now are working with and will be working with...

In HUMANS: Cancers that are hard to diagnose early, that have non-specific tests (PSA) :

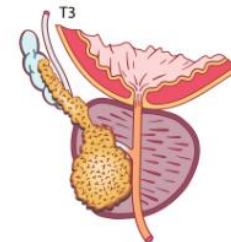
- **Breast cancer**
- **Prostate cancer**
- Pancreatic cancer
- GI cancers
- Liver cancer
- Kidney cancer
- Brain cancers....



The tumour or cancer cannot be felt by the doctor during examination



The cancer can be felt but it has not spread outside of the prostate



The cancer has spread outside of the prostate into nearby tissues



The cancer has spread into nearby organs such as the bladder



# ...and in the DOG



- **Mammary cancers**
- Melanomas
- Mast cell cancers
- ?...

Later?

- Lyme disease (Borreliosis)?
- Hypothyroidism?
- Chronic pain?

# What can the dogs smell?

Different samples:

- Urine, breath, tissue samples, whole blood, skin swabs, stools...



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Study	Cancer type	Number of dogs	Breed	Samples
McCulloch et al. (2006)	breast cancer	5	Labradors and Portuguese water dogs	Breath samples
Gordon et al. (2008)	breast cancer	7	Aussie cocker mix/Austin Collie mix, German shepherd, Rhodesian, Boxer, Italian greyhound, Chihuahua, Miniature golden doodle, Pembroke Welsh corgi, Border collie	Urine
Willis et al. (2004)	bladder cancer	6	Varying breeds	Urine
Sonoda 2010)	colorectal cancer	1	Labrador retriever	Watery stool samples for and breath samples
Gordon et al. (2008)	prostate cancer	4	Aussie cocker mix/Austin Collie mix, German shepherd, Rhodesian, Boxer, Italian greyhound, Chihuahua, Miniature golden doodle, Pembroke Welsh corgi, Border collie	Urine
Cornu et al. (2011)	prostate cancer	1	Belgian shepherd	Urine
Elliker et al. (2014)	prostate cancer	2	Dog A: Labrador retriever Dog B: Border Collie	Urine
McCulloch et al. (2006)	lung cancer	5	Labradors and Portuguese water dogs	Breath samples
Ehmann et al. (2012)	lung cancer	4	Australian shepherd, German shepherd and Labrador retriever	Breath samples
Horwath et al. (2008)	ovarian carcinoma	1	Riesenschнауzer	Tissue samples
Horwath et al. (2010)	ovarian carcinoma	2	black Giant Schnauzers	Tissue and blood samples



Study	Number of samples (training)	Number of samples (test)	Study design	Sensitivity	Specificity
McCulloch et al. (2006)	25 positives, 66 controls	6 positives, 17 controls	Double-blind test. 5 samples (1 positive, 4 controls) 1m apart on the floor in a straight line.	88 %	98 %
Gordon et al. (2008)	53 positives, 134 controls	9 positives, 54 controls (new samples)	Double-blind test 1 positive, 6 controls (two runs per each set)	No better than chance	No better than chance
Willis et al. (2004)	27 positives, 54 controls	9 positives, 54 controls	Double-blind test. 7 samples (1 positive and 6 controls) were placed on the floor at least 0.5m apart. Samples were on a Petri dishes under plastic pots.	41 %	?
Sonoda 2010)	breath samples: several hundreds positives, 500 controls	breath test: 33 positives, 132 controls watery stool test: 37 positives, 148 controls	Double-blind test. Five samples (1 colorectal cancer samples and 4 controls) were placed on the floor 52cm apart in a single straight line. Colorectal cancer sample was used as a standard sample.	breath test: 91% water stool test: 97%	breath test: 99% watery stool test: 99%
Gordon et al. (2008)	46 positives, 120 controls	11 positives, 66 controls (new samples)	Double-blind test 1 positive, 6 controls (three runs per each set)	No better than chance	No better than chance
Cornu et al. (2011)	26 positives, 16 controls	33 positives, 33 controls	Double-blind test 1 positive, 5 controls The false positives were retested with new set of control samples	91 %	91 %
Elliker et al. (2014)	50 positives, 67 controls	31 positives, 93 controls	Double-blind test. 1 positive, 3 controls Tests 1: dog A, the trainer rewarded the dog after the indication he thought was correct Test 2: dog A, the trainer was told after the indication whether the sample was positive or not Test 3: dog B, same set of samples as in the test 2	Test 1: 13% Test 2: 13% Test 3: 25%	Test 1: 71% Test 2: 71% Test 3: 75%
McCulloch et al. (2006)	25 positives, 66 controls	28 positives, 17 controls	Double-blind test. 5 samples (1 positive, 4 controls) 1m apart on the floor in a straight line.	99 %	99 %
Ehmann et	35 positives, 60	25 positives, 50	Double-blind test. 1 positive and four		

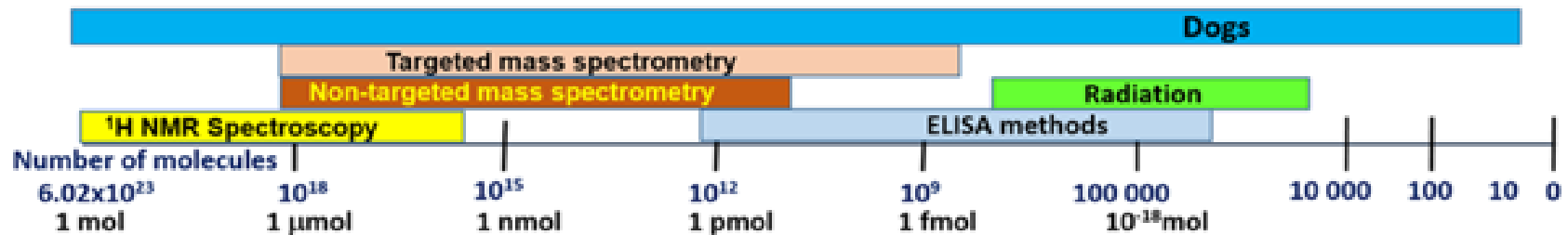
# Machines or dogs?



Sensor Devices: Example Technologies Used in Gas Sensor Arrays

Sensor Type	Transduction Principle
ChemFET, light addressable potentiometric sensors	Work function
Chemoresistors	Conductivity
Amperometric gas sensors	Ionic current
Chemocapacitors	Permittivity
Thermopile, pellistor catalytic sensor	Temperature
Colorimeter, spectrophotometer	Optical spectrum
Optical fibers	Fluorescence, absorption
Optical fibers, surface plasmon resonance	Refractive index
Cantilevers, surface acoustic wave, quartz crystal microbalance	Mass

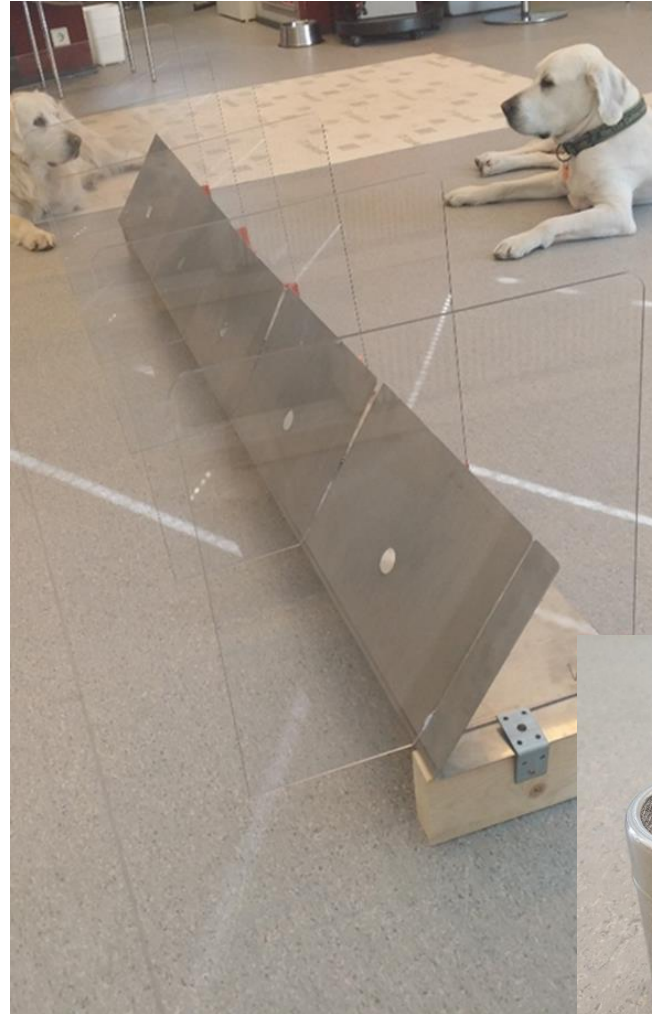
From: Chapter 1, Engineering Aspects of Olfaction. Cover of Neuromorphic Olfaction  
Neuromorphic Olfaction. Persaud KC, Marco S, Gutiérrez-Gálvez A, editors. Boca  
Raton (FL): CRC Press/Taylor & Francis; 2013. © 2013 by Taylor & Francis Group, LLC



**Figure 1.** Approximate detection limits and areas of some common analysis techniques compared to best scent dogs' detection limits.

# Lucky

- Kultainen noutaja
- 9 vuotias
- Kodinvaihtaja (sairaus)
- Asuu Nummisissa
- 2 muuta koira, 3 kissa, 2 lammasta, kanoja
- Treenannut 4,5 vuotta



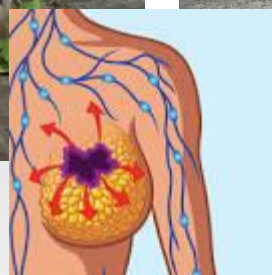
# Training scent detection - Kössi





# Thank You!

# Questions?



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