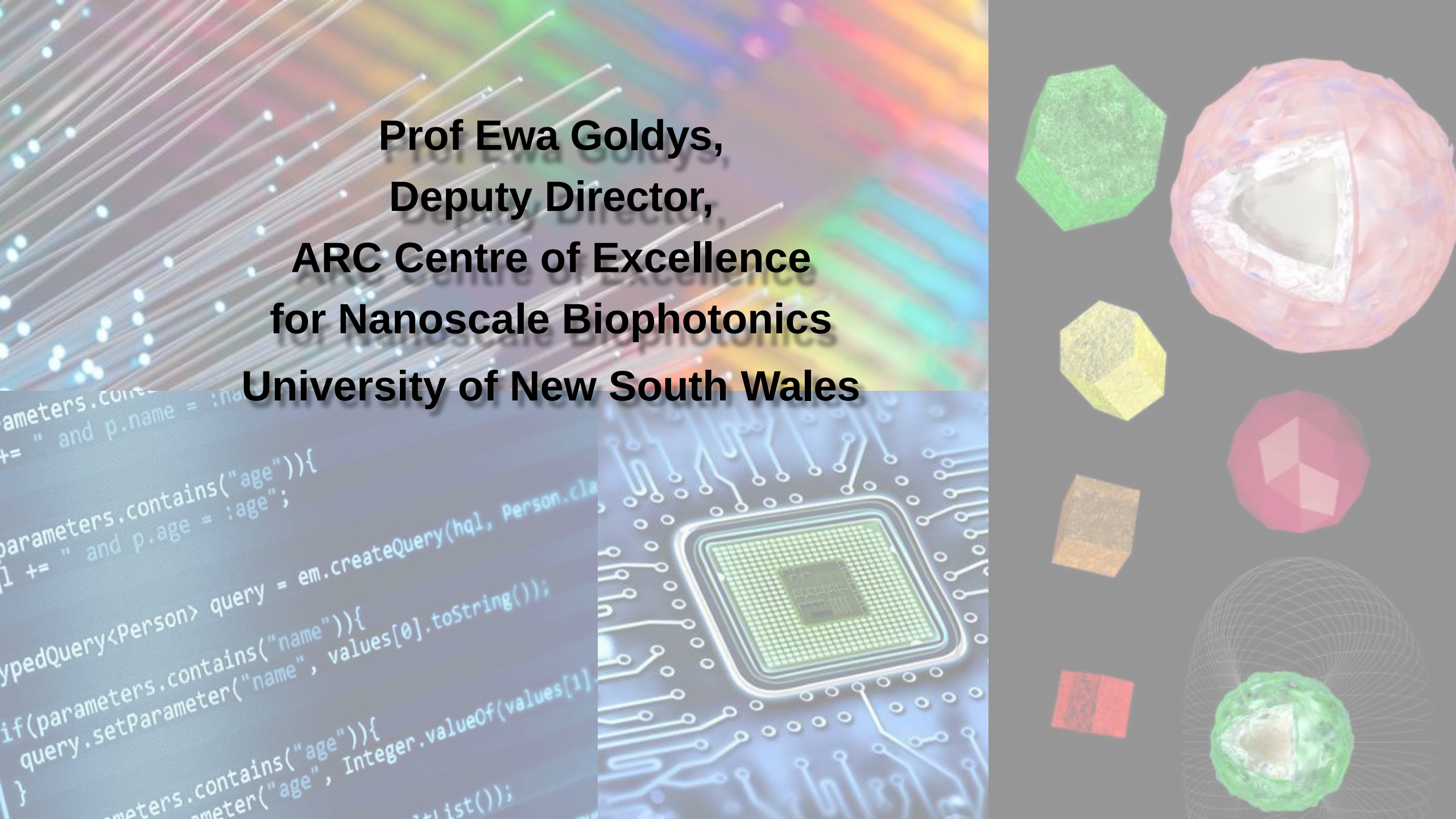
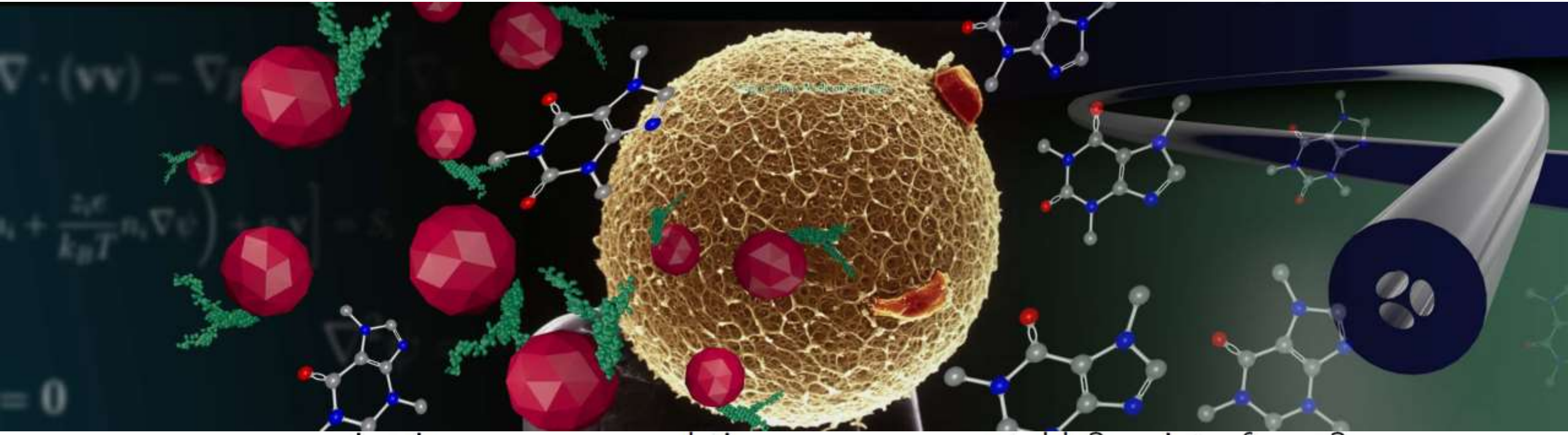


Prof Ewa Goldys,
Deputy Director,
ARC Centre of Excellence
for Nanoscale Biophotonics
University of New South Wales

Core aim of ARC Centre for Nanoscale Biophotonics

New approaches to measuring nano-scale dynamic phenomena

in living systems



in-vivo real-time portable? point-of-care?

BIOMOLECULAR ANALYSIS

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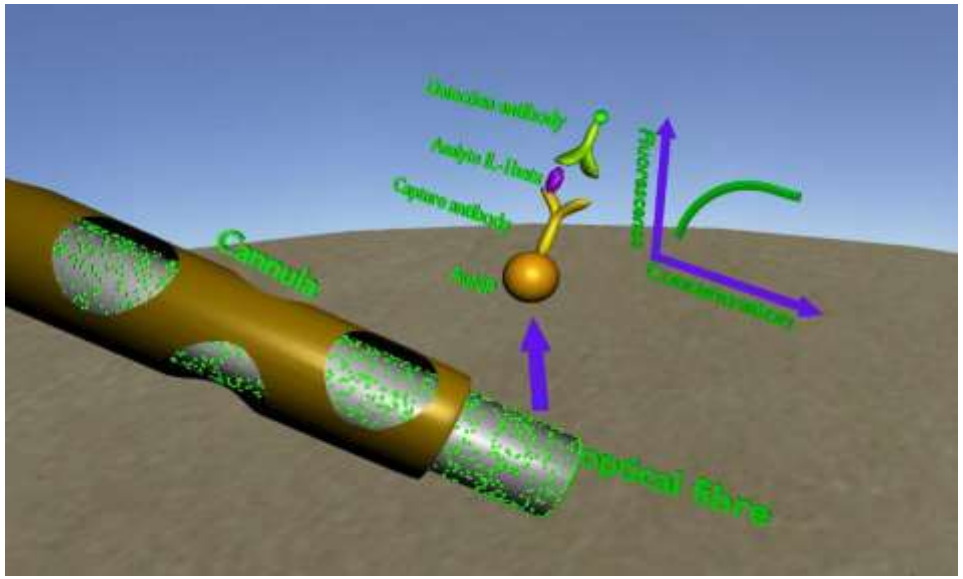
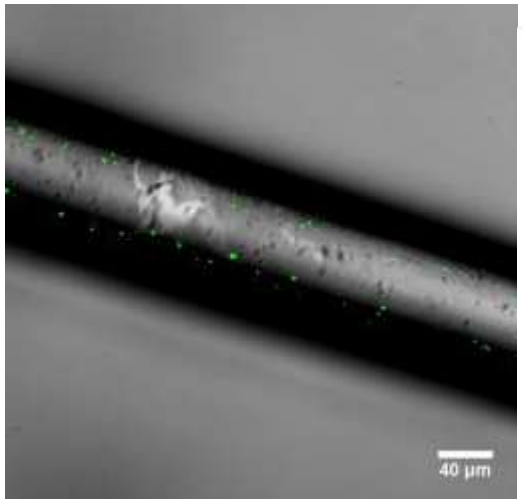
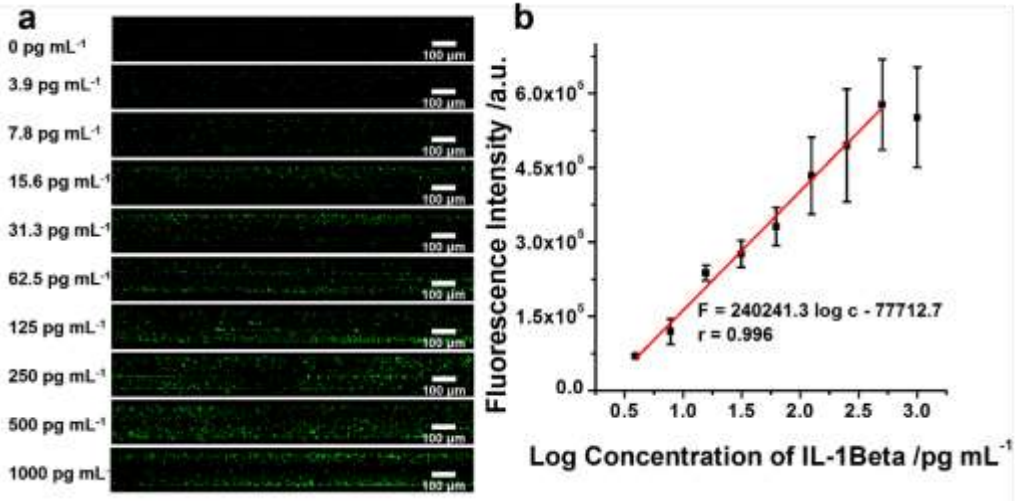
How to detect cytokines in specific locations



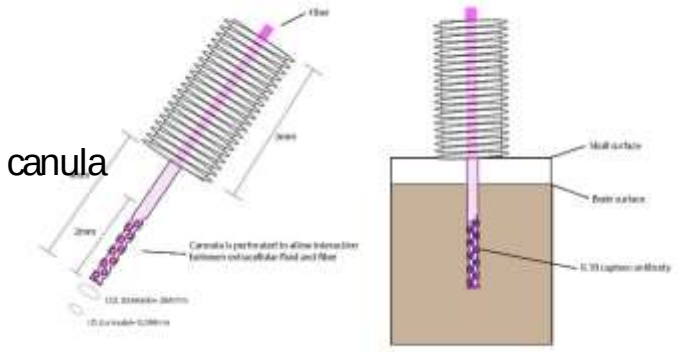




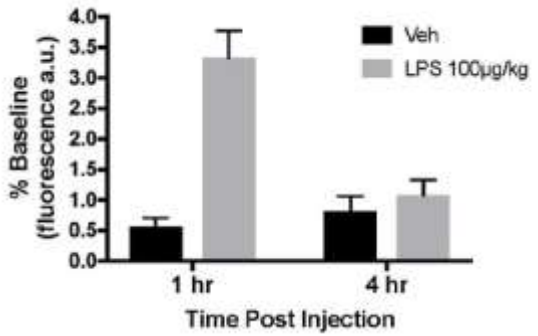
"sandwich immunoassay",

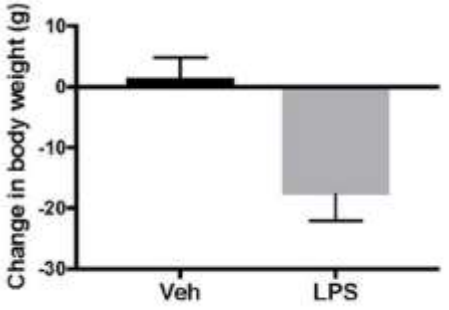
K. Zhang, Guozhen Liu
Macquarie U

Mike Baratta,
U Colorado



Living brain
(hippocampus)





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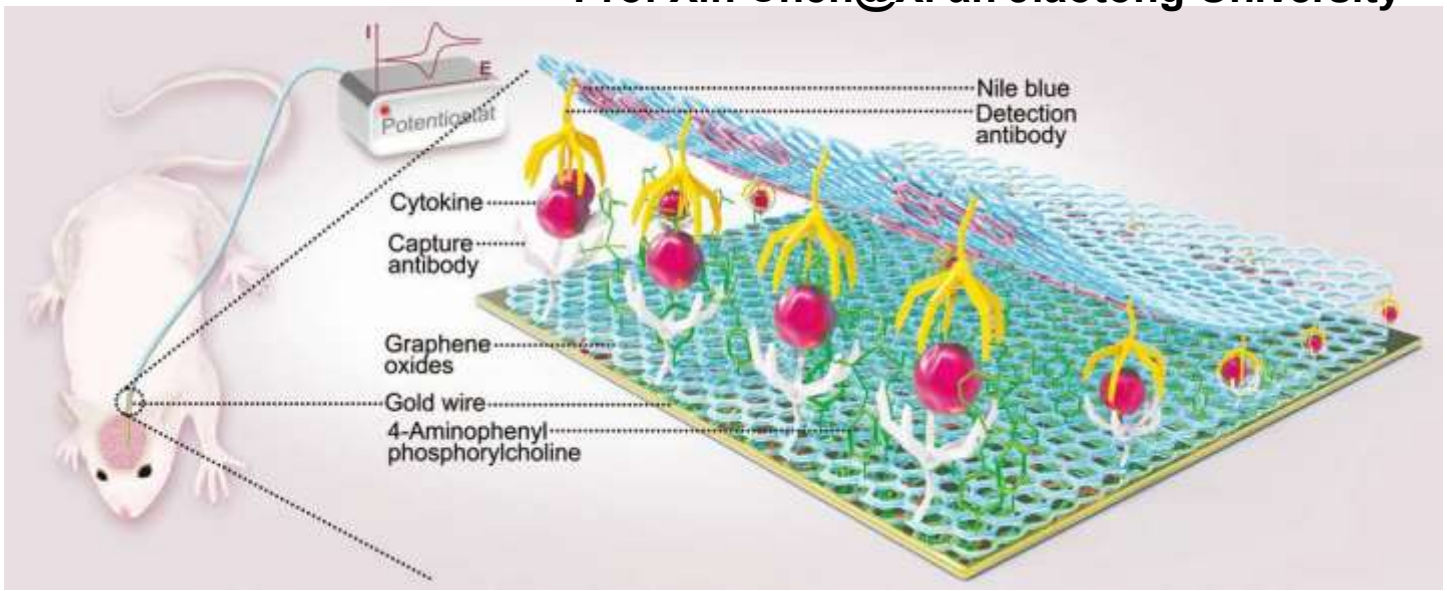
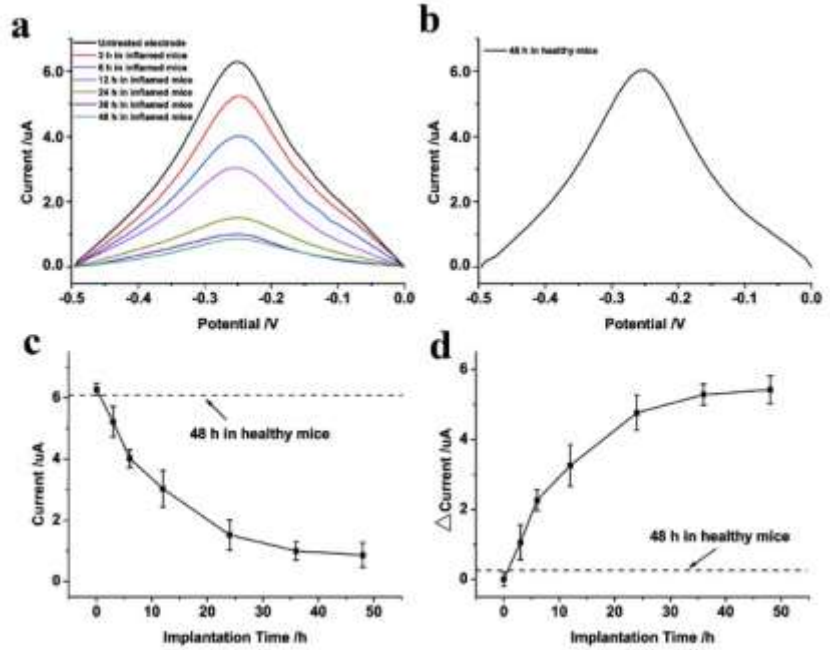
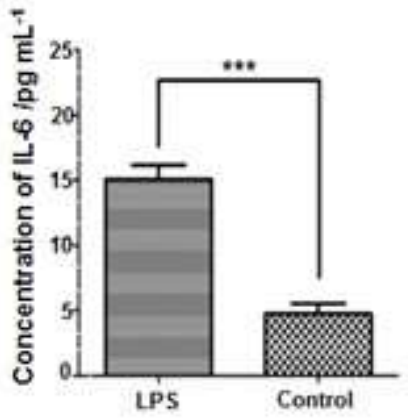
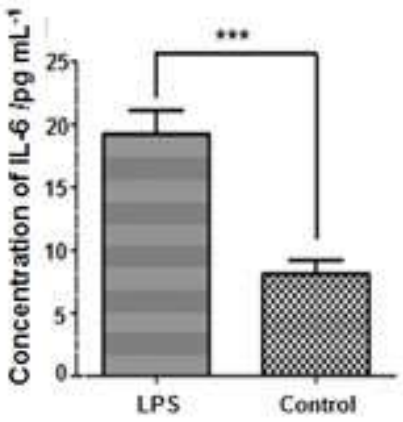
How to detect cytokines in specific locations

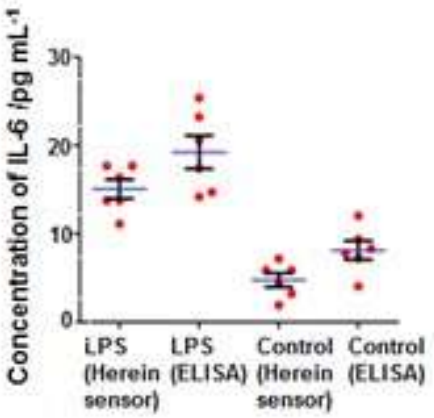
ARC Future Fellow, Dr Guozhen Liu, UNSW, A/Prof Rui Li@Centra China Normal University, Prof Xin Chen@Xi'an Jiaotong University











Real-time sensing of cytokines on a relevant time scale has been demonstrated

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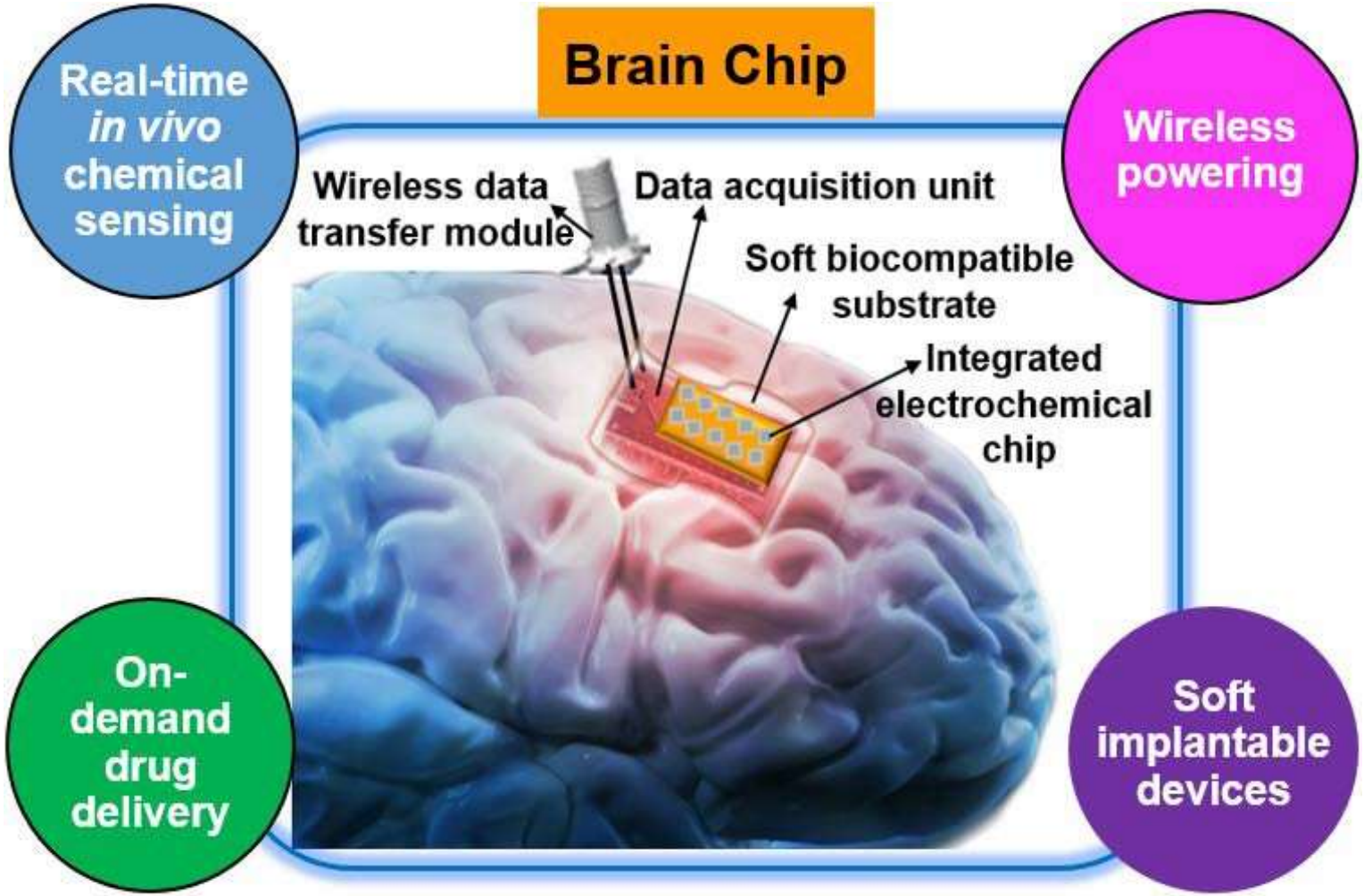
VISION: WIRELESS IMPLANTABLE REAL-TIME SENSORS



TARGETS: "Neuro" analytes – cytokines, neurotransmitters, metabolites

NEEDED:

- Switchable, shape changing capture molecules to dynamically respond to analyte variations
- Capture molecules for specific targets, and they must be working well on surfaces
- Non-degradable capture molecules
- Amplification strategies (FETs?)
- Technology integration
- Protect against fibrosis over the long term
- Usual biocompatibility, degradability,

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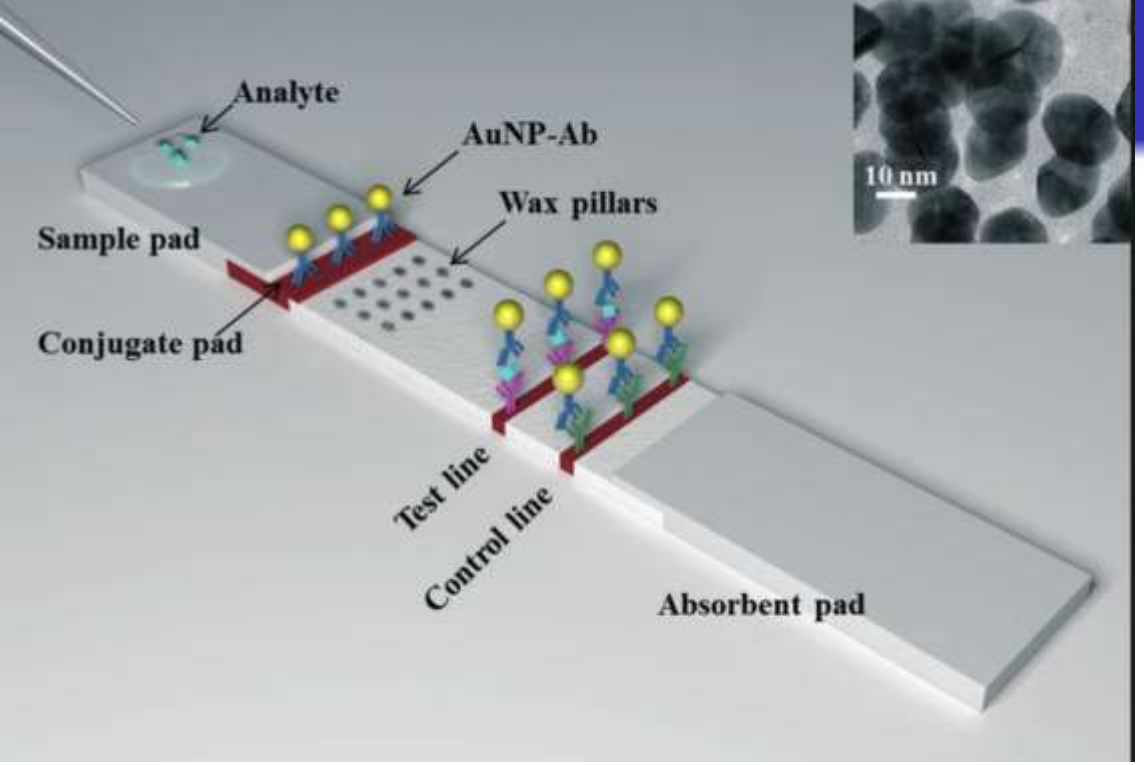
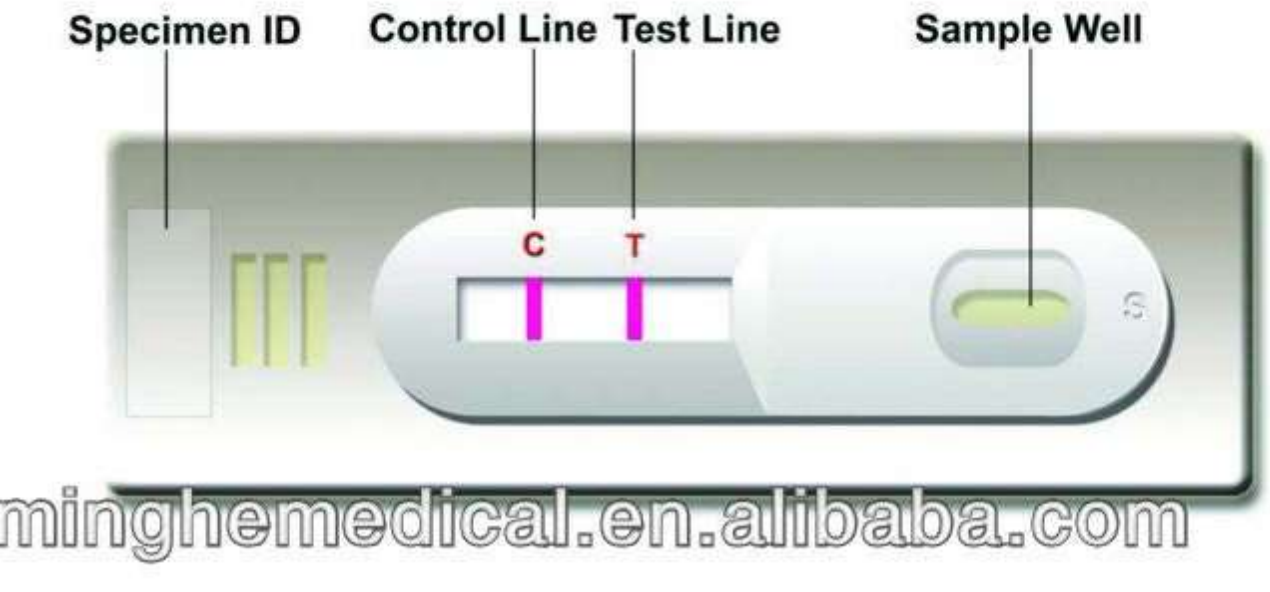
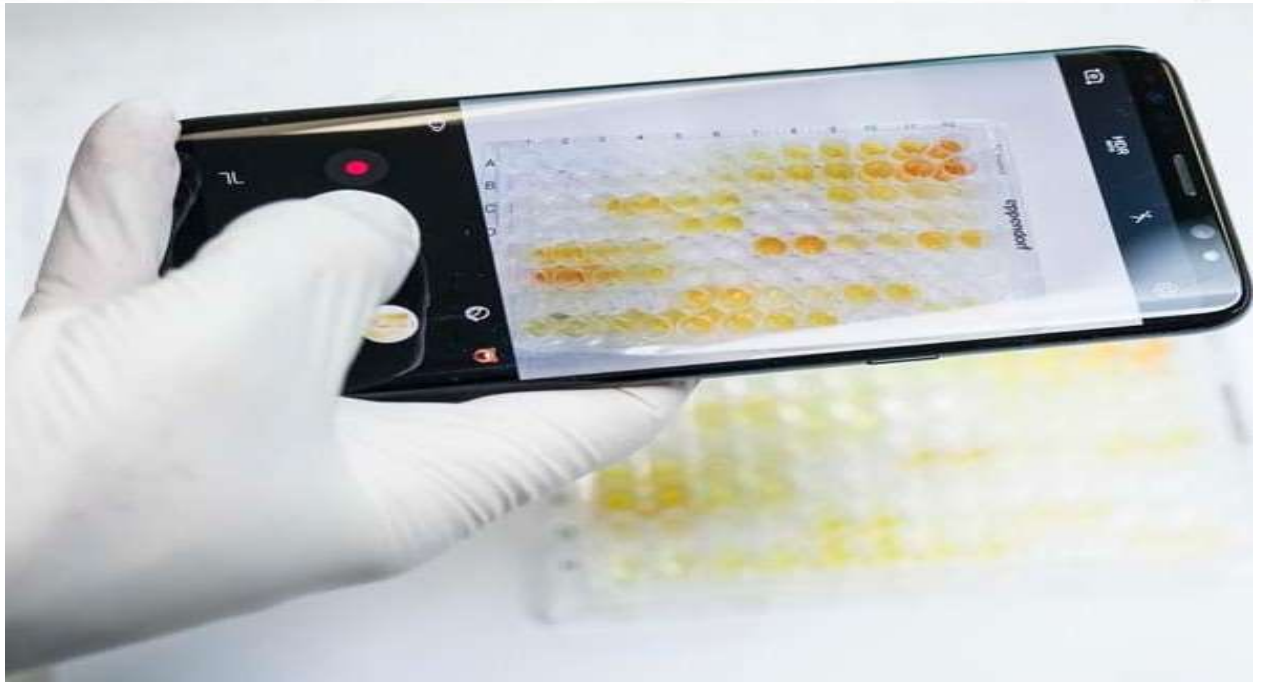
VISION: LATERAL FLOW ASSAYS







VISION: LATERAL FLOW ASSAYS

NEEDED:

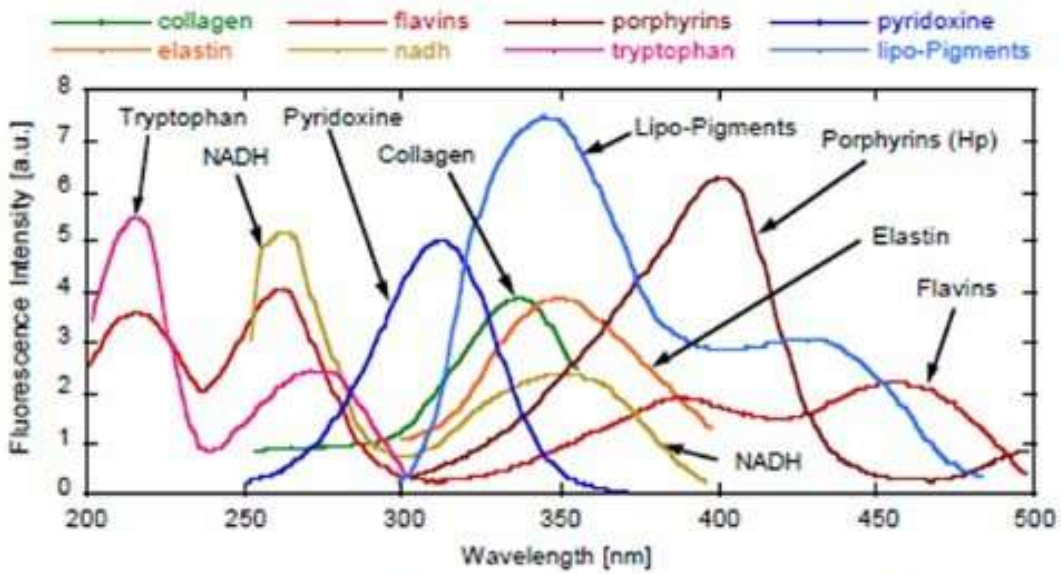
- Switchable, shape changing capture molecules to dynamically respond to analyte variations – may enable repetitive use of the same device
- Capture molecules for specific targets, and they must be working well on surfaces
- Non-degradable capture molecules
- **Amplification strategies** maybe based on nanomaterials
- Mobile phone readout (almost there)

TARGETS:

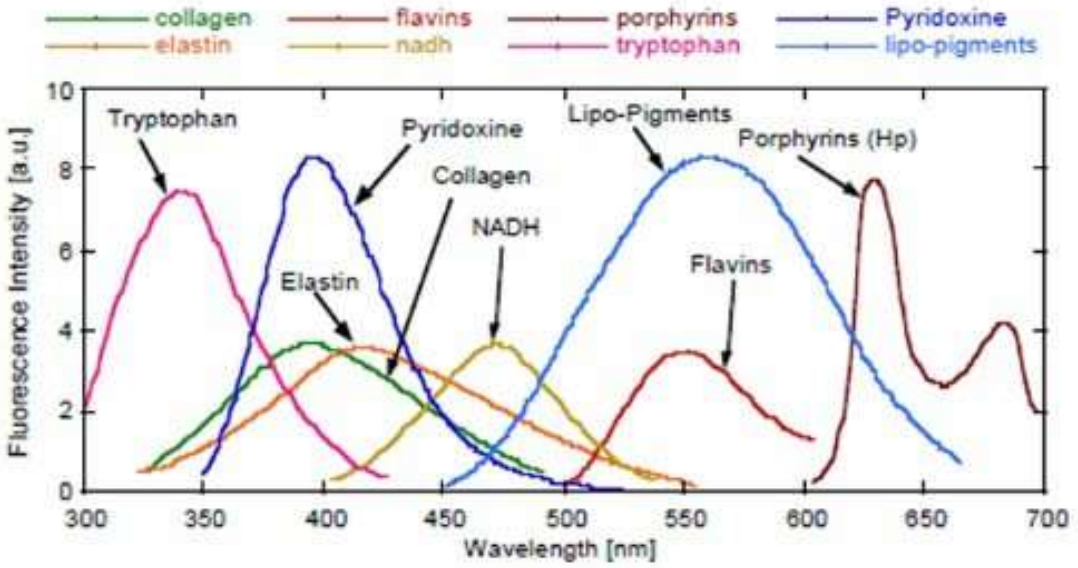
- "Neuro" analytes – cytokines, neurotransmitters, metabolites
- Bacteria and viruses
- DNA sequences
- Hormones
- Standard medical analytes, also those relevant to injury and acute conditions
- Warfare agents
- Toxins and contaminants
- Etc etc.

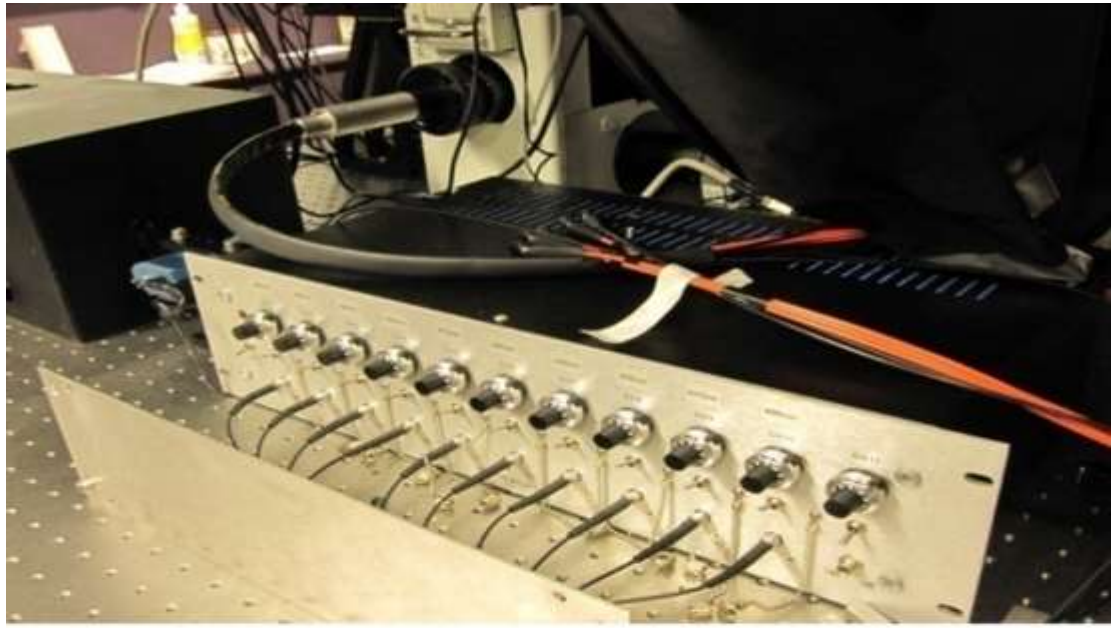
Autofluorescence analysis

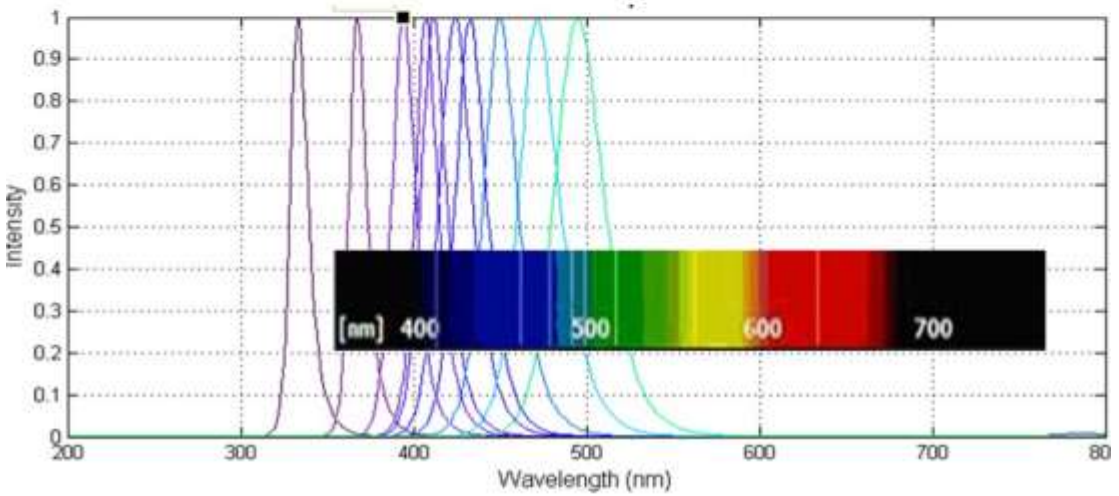
excitation



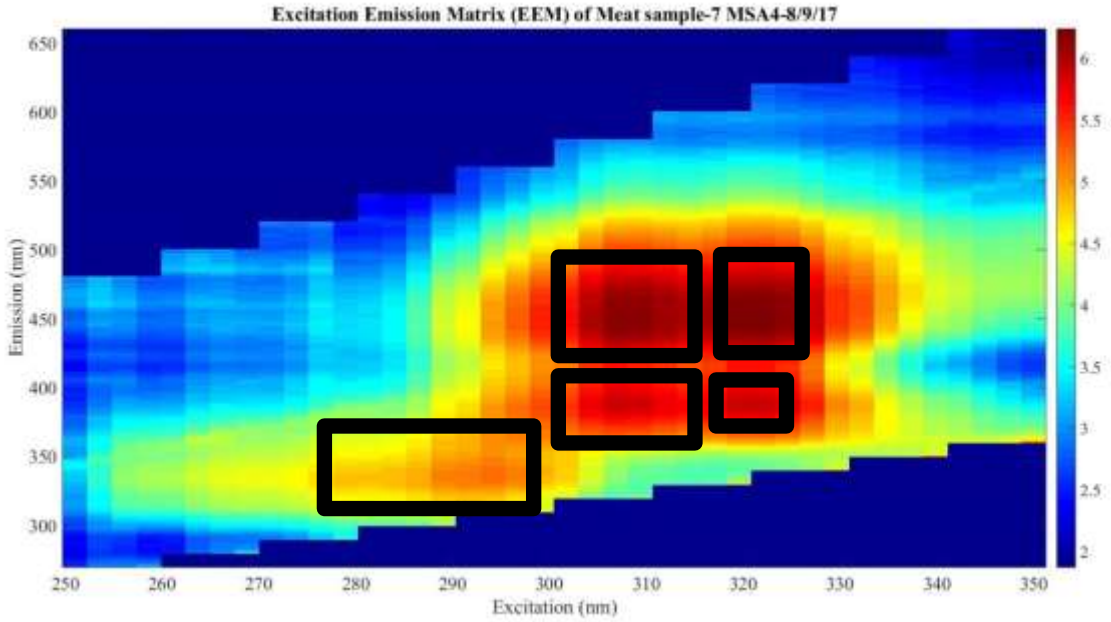
emission

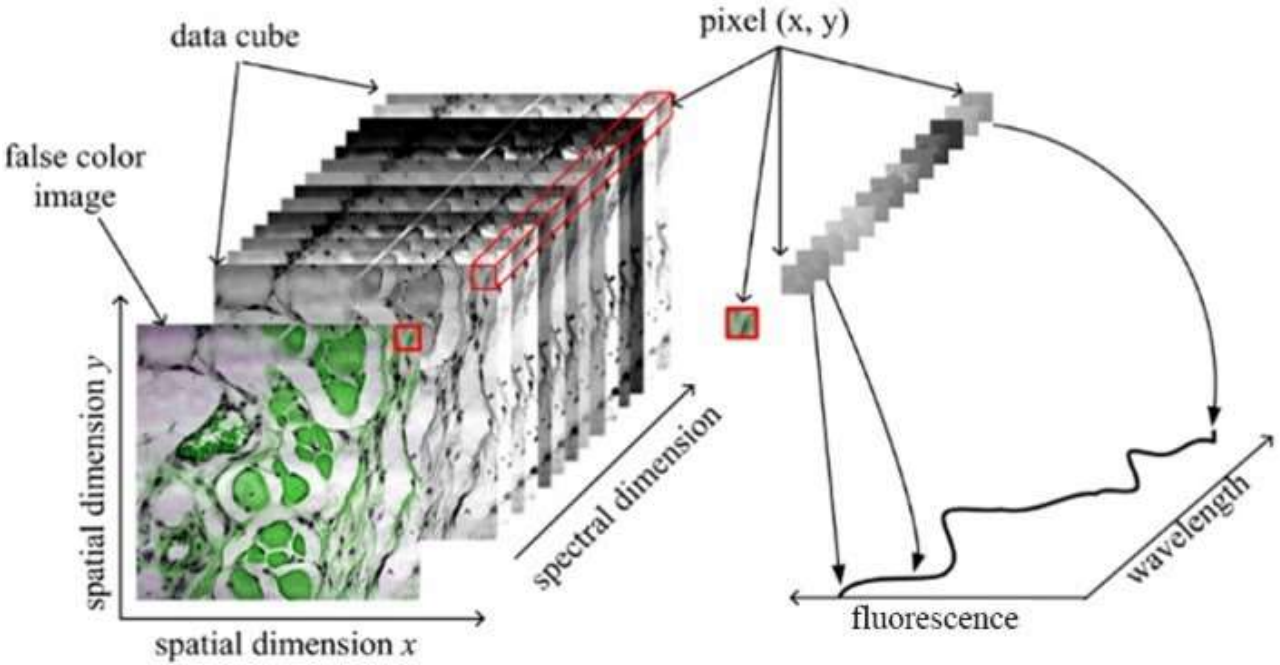






Hyperspectral image data set

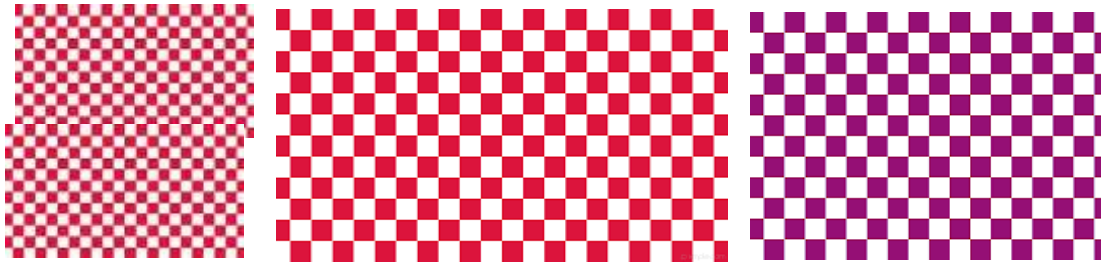




Cellular feature:
anything that can be calculated for a given cell

- average reading in that cell in a given spectral channel
- ratios of such readings for various channel pairs (channel ratios)
- Haralick textural features etc etc.

Example features: "squareness" – similarity to a square, length scale, colour



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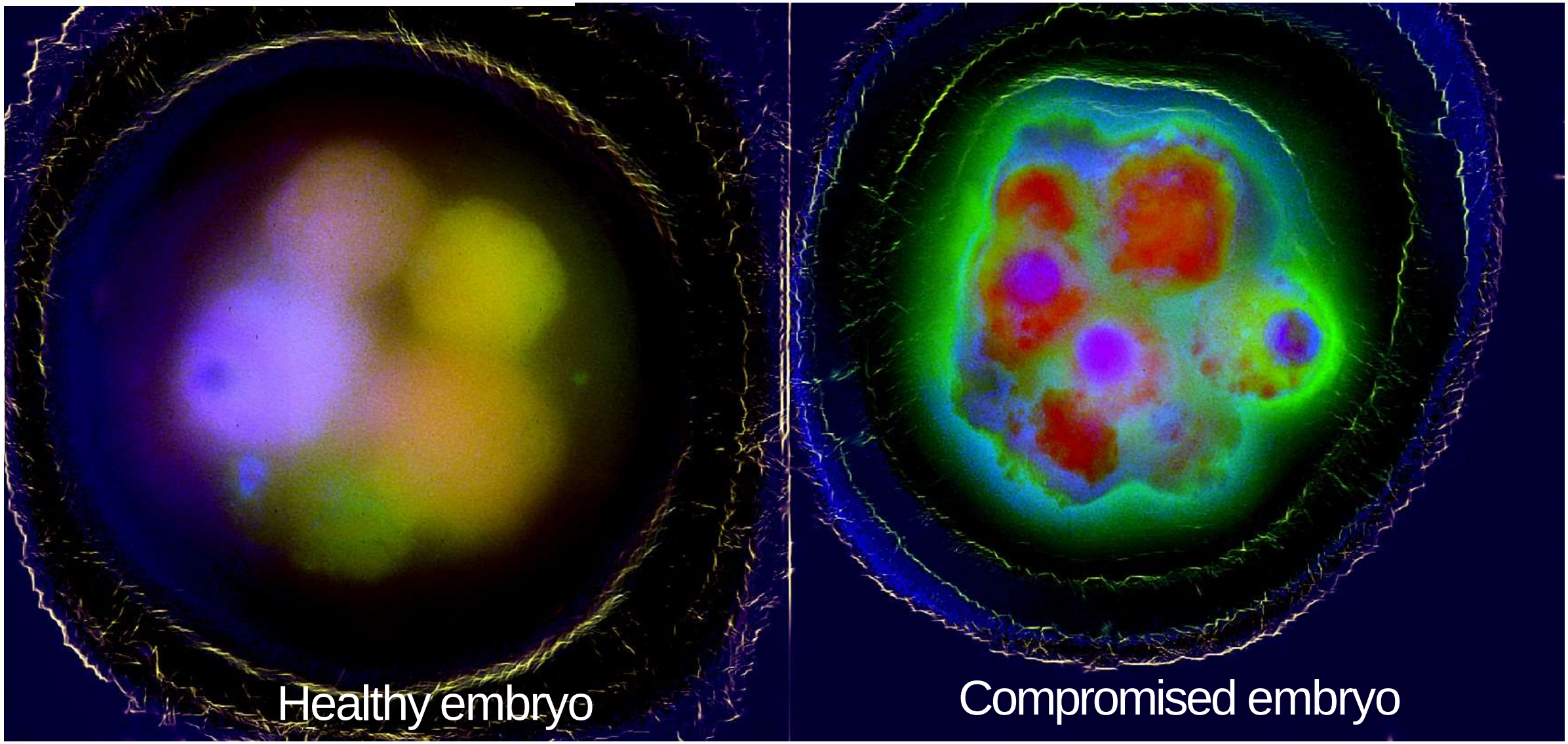
Healthy and compromised early bovine embryos



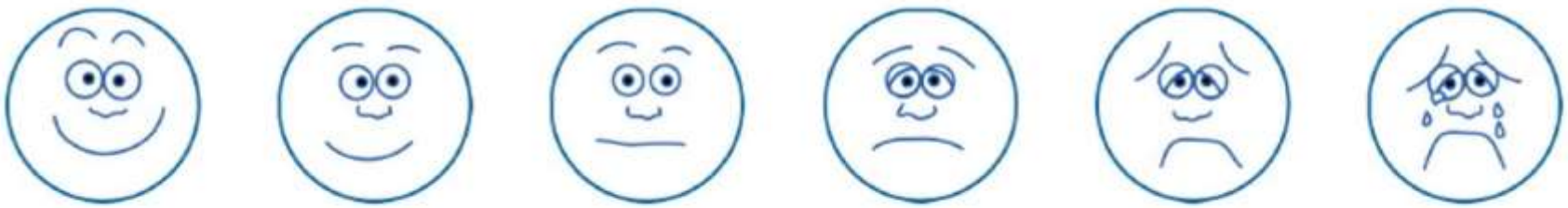
Measuring pain

Wong-Baker FACES™ Pain Rating Scale Instructions For Usage

Explain to the person that each face is for a person who has no pain (hurt) or some, or a lot of pain.

Face 0 doesn't hurt at all. Face 2 hurts just a little bit. Face 4 hurts a little bit more. Face 6 hurts even more. Face 8 hurts a whole lot. Face 10 hurts as much as you can imagine, although you don't have to be crying to have this worst pain.

Ask the person to choose the face that best describes how much pain he has.



< 5 = Panadol
>5 = Opiates

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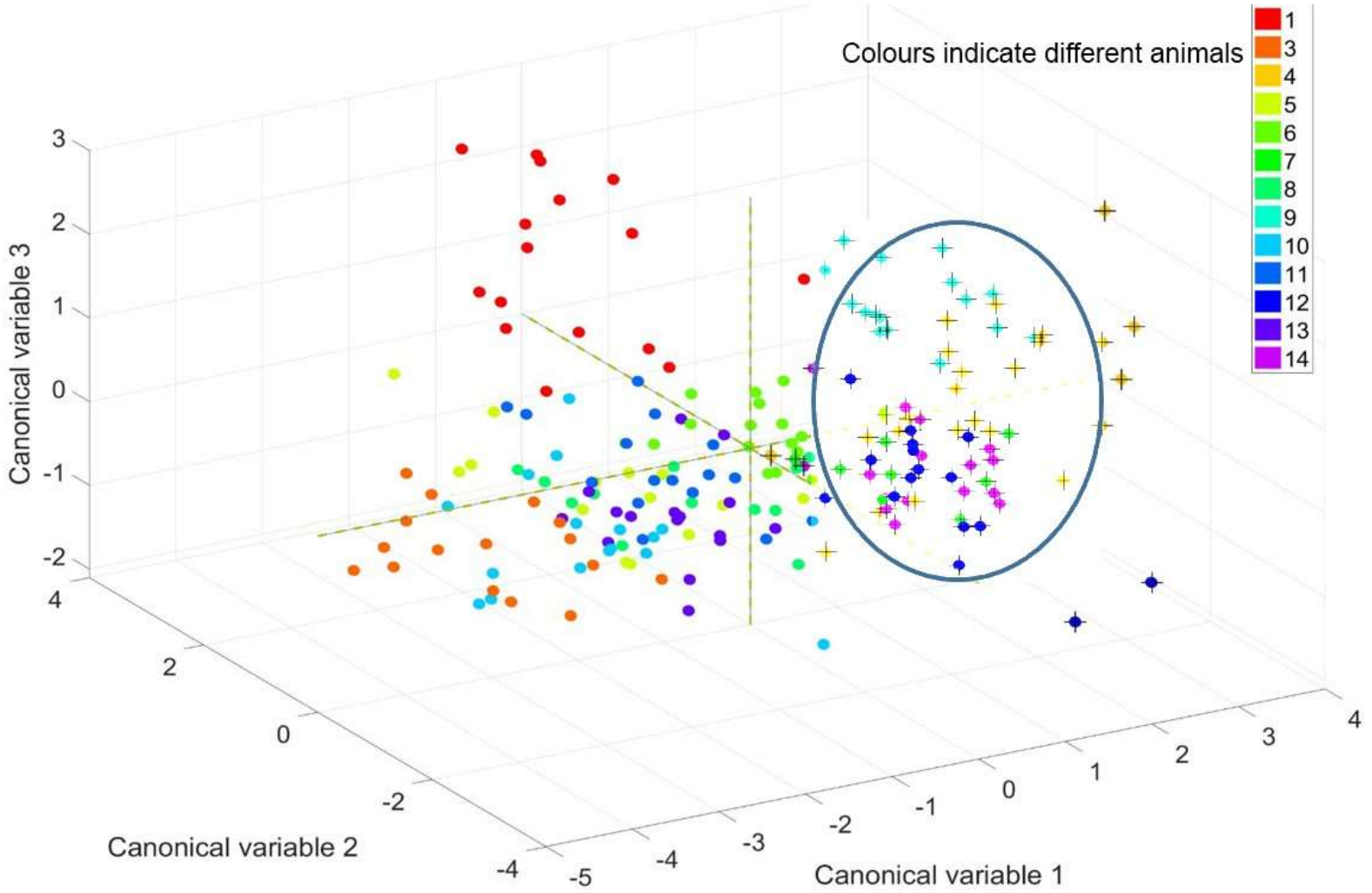
Molecular signatures of pain



Vicky Staikopoulos, Mark Hutchinson, U Adelaide, Martin Gosnell, Ayad Anwer, Macquarie U

"Hyperspectral imaging of endogenous fluorescent metabolic molecules to identify pain states in central nervous system tissue", Staikopoulos, V., et al., Proceedings Volume 10013, SPIE BioPhotonics Australasia; 1001306 (2016); doi: 10.1117/12.2243158

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VISION: HIGH CONTENT AUTOFLUORESCENCE IMAGING

NEEDED:

- Rapid multispectral imaging systems
- LED or laser based
- Improved ultrasensitive low noise cameras
- Mobile phone technologies
- Bespoke software (may need to be specific for each problem)
- Validation of methods

TARGETS:

-Characterisation of cells, tissues and underlying conditions (Cancer? Toxic exposure? Infection? Subtle immune effects? Sepsis? Microbial infection of wounds? Response to surgery? Transplantation? Pain?

"See right through" – autofluorescence in deep tissue (currently unexplored)

-Preparation-free histology

-Portable phone based devices for some of the above medical conditions

Acknowledgements

fertility SA

Medtronic
Alleviating Pain · Restoring Health · Extending Life

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TRANSLATIONAL CANCER RESEARCH

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