Brain Injury
MedTech Co-operative

NHS
National Institute for
Health Research

Multimodality Monitoring

MIC Theme 3

Professor Peter Hutchinson

Background

Multimodality Monitoring

National Institute for Health Research

'it is not monitoring per se that affects outcomes; rather, it is using the information from monitoring to direct treatment.'

Brain Trauma Foundation Guidelines (4th Edition, 2016)

Strategy

Multimodality Monitoring

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Yr 1

Short term

Find:

1. Revisit unmet needs with patients and carers and other sectors (sports, industry, etc).
2. Technology Showcase to establish gaps to inform year 2-3

Yr 2-3

Medium term

Facilitate:

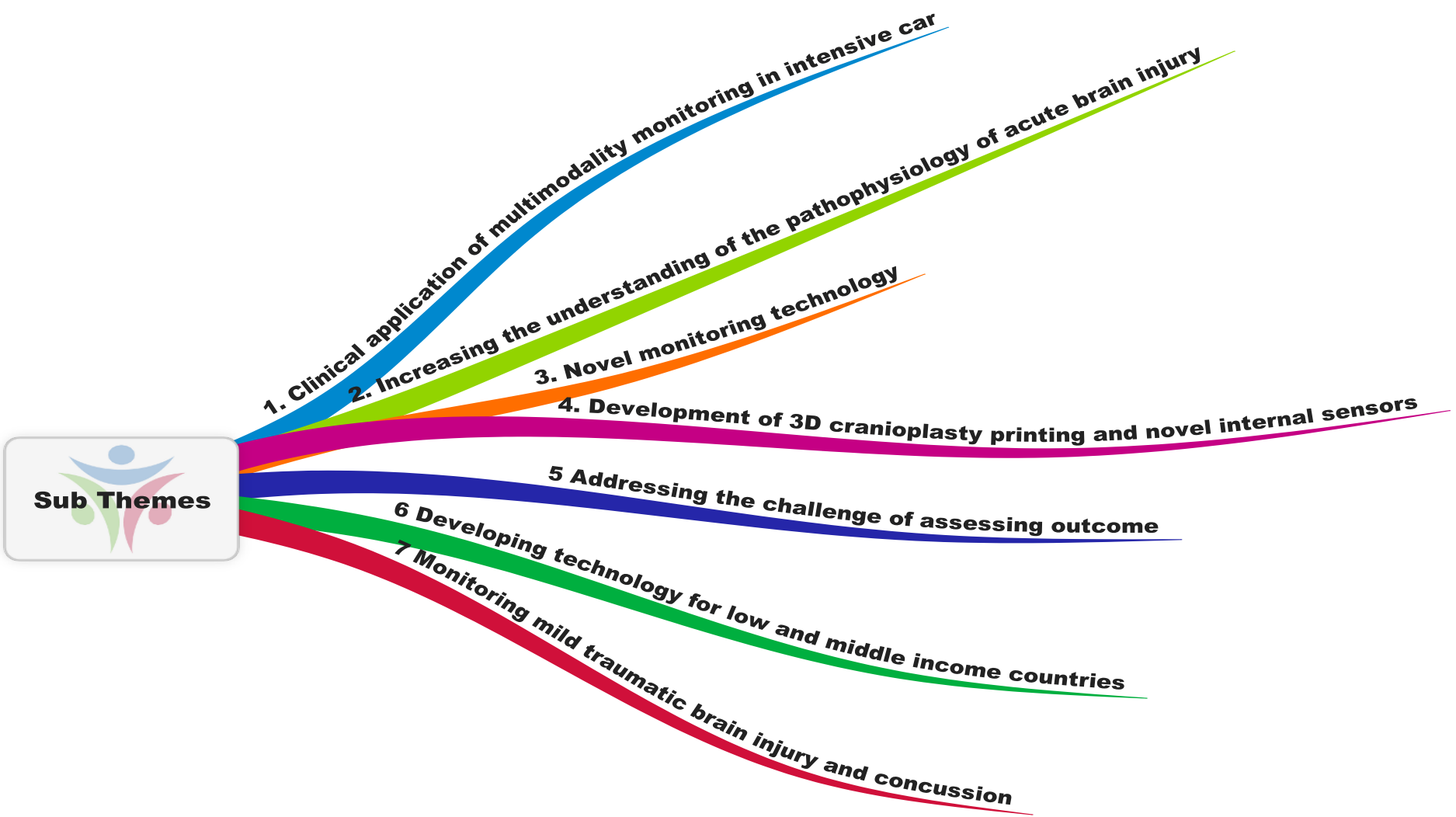
Focus pilot competition in areas identified in year 1, and follow projects and build further collaborations.

Yr 4-5

Long term

Foster:

Work with wider-innovation landscape to leverage further funding.


Sub Themes
1. Clinical application of multimodality monitoring in intensive car
2. Increasing the understanding of the pathophysiology of acute brain injury
3. Novel monitoring technology
4. Development of 3D cranioplasty printing and novel internal sensors
5 Addressing the challenge of assessing outcome
6 Developing technology for low and middle income countries
7 Monitoring mild traumatic brain injury and concussion

Sub Theme 1: Clinical application of multimodality monitoring in intensive care

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APTITUDE:
Novel aptamer technology for measuring interleukin at the bedside

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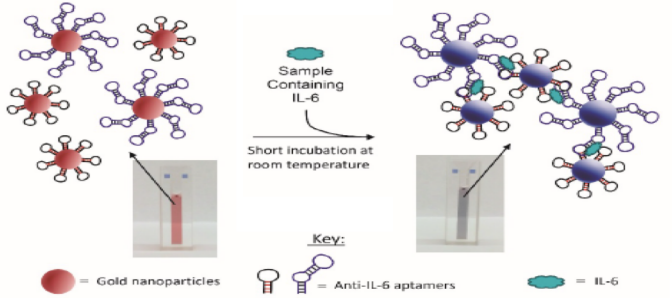
Susan Giorgi-Coll,[1] Maria Jose Marin,[2] Olajumoke Sule,[3] Keri Carpenter,[1] Peter Hutchinson[1]

Proof of concept project: Using mouse IL-6 aptamers to demonstrate the applicability of aptamer-gold nanoparticles for detection.

- Current state-of-the-art bedside testing relies on antibodies to bind the target molecule
  - Produced in animals or bacteria - Expensive - Batch variability -Temperature & moisture sensitive
- ✓ **Aptamers: DNA alternatives to antibodies**
  - Highly sensitive and specific - Synthetically produced - Cheaper, more consistent - Resistant to changes in temperature and moisture



- **Rapid, low-cost, easy-to-use point-of-care clinical test for improving diagnosis of acute infection.**
- **Assay targets immune signalling molecules such as interleukin-6 (IL-6) as a marker of the acute inflammation characteristic of infection.**
- **Multi-purpose - different infections, including sepsis and meningitis.**
- **Range of patient samples (e.g. serum & CSF). Robust, sensitive and highly specific.**

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1 Division of Neurosurgery, Dept. of Clinical Neurosciences, University of Cambridge.
2 School of Chemistry, University of East Anglia, 3 Clinical Microbiology and Public Health Laboratory, Cambridge University Hospitals NHS Trust.
Cambridge Neurochemistry

Sub Theme 2: Increasing the understanding of the pathophysiology of acute brain injury

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See Clinical Theme 5 – Functional Neuroimaging & Neurophysiology (Professor Franklin Aigbirhio

Sub Theme 3: Novel Monitoring Technologies

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Development of microdialysis online sensor technology for use in critical care of acute brain trauma patients

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NIHR i4i

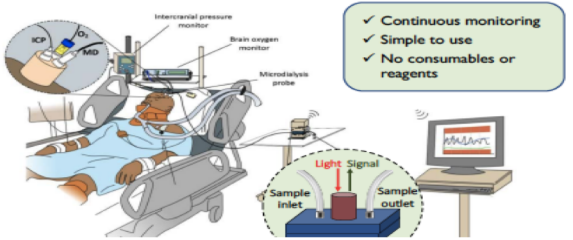
Peter Hutchinson[1], Stephen Elliott[2], Tanya Hutter[2], Keri Carpenter[1], Susan Giorgi-Coll[1], Adam Young[1]

Clinical need

- Every 90 seconds an individual in the UK sustains a traumatic brain injury
- Management of the injured brain: close monitoring to guide intervention

Current bedside analyser

✓ New sensor technology



- ✓ Continuous monitoring
- ✓ Simple to use
- ✓ No consumables or reagents

- **Brain injury monitoring of glucose, lactate, pyruvate.**
- Also for sensing of similar chemical molecules in biological fluids.
- Other organs and tissues, e.g. skin grafts in plastic (reconstructive) surgery, liver and kidney transplantation, gastrointestinal surgery, muscle, adipose tissue, diabetic patients and critically ill septic patients.

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[1] Division of Neurosurgery, Dept. of Clinical Neurosciences, University of Cambridge [2] Dept. of Chemistry, University of Cambridge

Sub Theme 4 Development of 3D cranioplasty printing and novel internal sensors

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SmartSkull: Sensor-Integrated Smart Wireless Skull-Monitoring System

Collaborative: Cambridge University Hospitals NHS Foundation Trust & University of Cambridge

Sub Theme 5: Addressing the challenge of assessing outcome

National Institute for Health Research

See Core Activity 3 Clinical Informatics and Registries (Dr Alexis Joannides)

Incl. Small Feasibility Study: National Cranioplasty Registry

ORION

Sub Theme 6: Developing technology for low and middle income countries (Themes)

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1: Mapping traumatic brain injury care

2: Understanding traumatic brain injury care

3: Innovation in traumatic brain injury care

4: Traumatic brain injury research capacity

Sub Theme 6: Developing technology for low and middle income countries (Innovations)

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1. Portable, non-invasive technologies to detect TBI

Infra-scanner - evaluating rapid access to TBI detection in areas where access to CT is limited

2. Non-invasive technologies for assessment of ICP

USS - use of optic nerve sheath diameter as surrogate of ICP on ITU
TCD based fully non-invasive ICP assessment technology

3. Automated detection of papilloedema

PEEKretina - smartphone based technology. Development of machine learning algorithms for automated detection

4. Long term follow – up

Telemedicine/online clinic - bringing neurosurgeons to rural communities and district hospitals

Sub Theme 7 Monitoring mild traumatic brain injury and concussion

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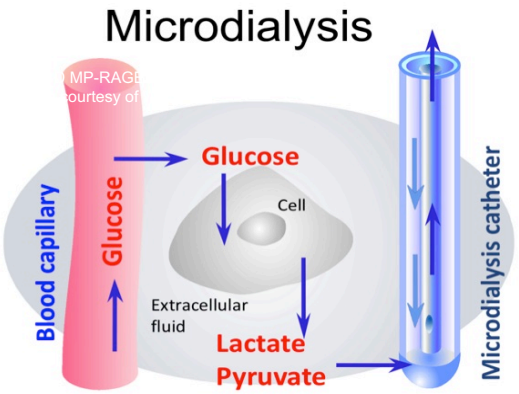
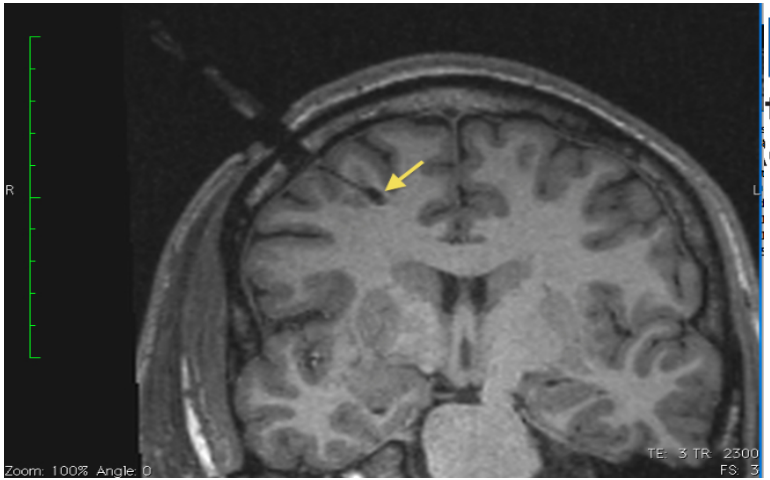
Concussion can occur from: contact sports such as **rugby;** a **clinical diagnosis; motorsport** where drivers returning to early.

Journal of Concussion found that **motorsport** has a high rate of **concussion** compared to other high risk sports and its incidence may be increasing.

'a complex pathophysiological process affecting the brain induced by biomechanical forces' [1]





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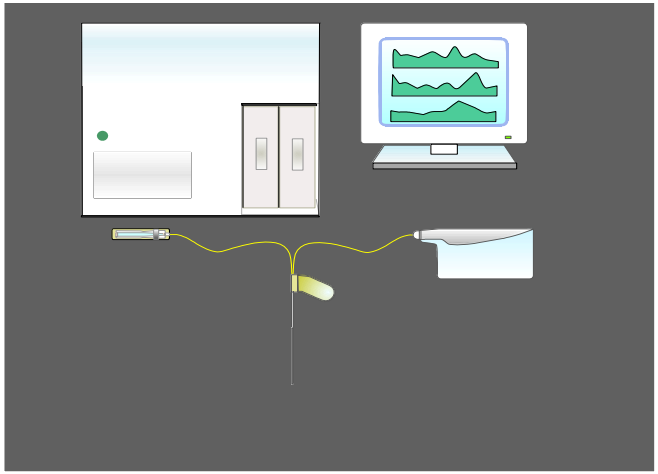

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