Combining physiological sensing and biomarkers with intelligent support surfaces for closed loop prevention of chronic wounds.

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Chronic Wounds

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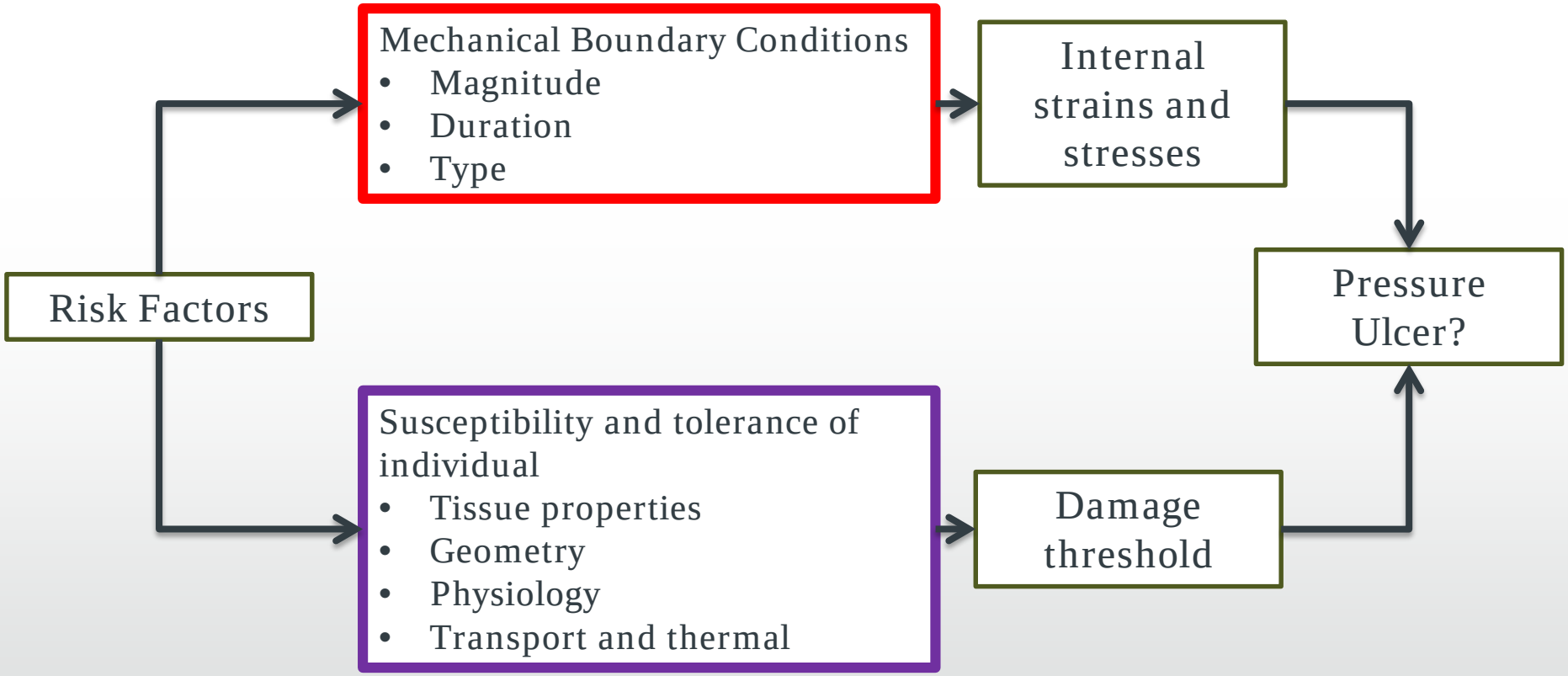
Clinical Challenge *(Guest et al,. 2015)*

- There were an estimated 2.2 million wounds managed by the NHS in 2012/2013.
- Resources attributable to managing these wounds included 18.6m practice nurse visits, 10.9m community nurse visits, 7.7 million GP visits and 3.4 million hospital visits.
- The annual NHS cost of managing these wounds and associated comorbidities was £5.3 billion.

Factors that influence susceptibility for pressure ulcer development



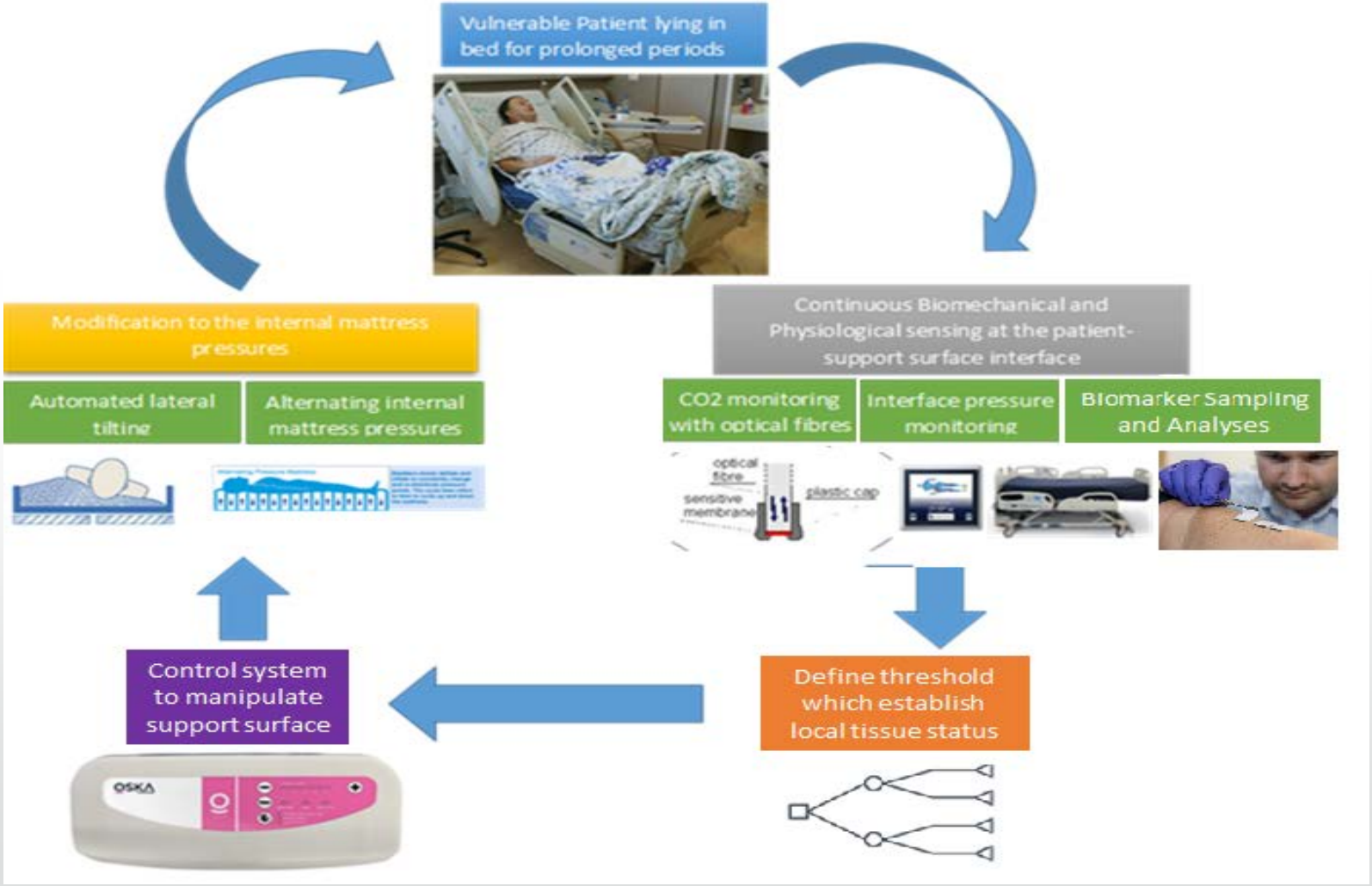
Coleman S, Nixon J, Keen J, et al. A new pressure ulcer conceptual framework. *Journal of Advanced Nursing*. 2014;70(10):2222-2234. doi:10.1111/jan.12405.

CYCLOPS PROJECT – UoS, UoN, BCU

Several monitoring technologies are available to detect changes in skin response to loading, involving an array of physical and biochemical markers, which can inform the effectiveness of intervention strategies for prevention *(Bader and Worsley 2018).*

The aim of this project is to provide an early detection system allied to an intelligent prevention strategy for pressure ulcer prevention

Closing the loop for wound prevention



Progress to date

Biomechanical and biophysical monitoring in lying postures

- Combined technologies have been used to measure interface pressure (ForeSitePT, Xsensor), microclimate (Sensiron) and transcutaneous O2 and CO2 (TCM5, Radiometer).
- A relationship between interface pressure and transcutaneous changes has been established.
- $TcPCO_2$ remains a critical parameter which is indicative of local ischemic stress in the mechanically loaded tissues.

Chai, Worsley, Bader (2017), Worsley et al (2018)

Example Data

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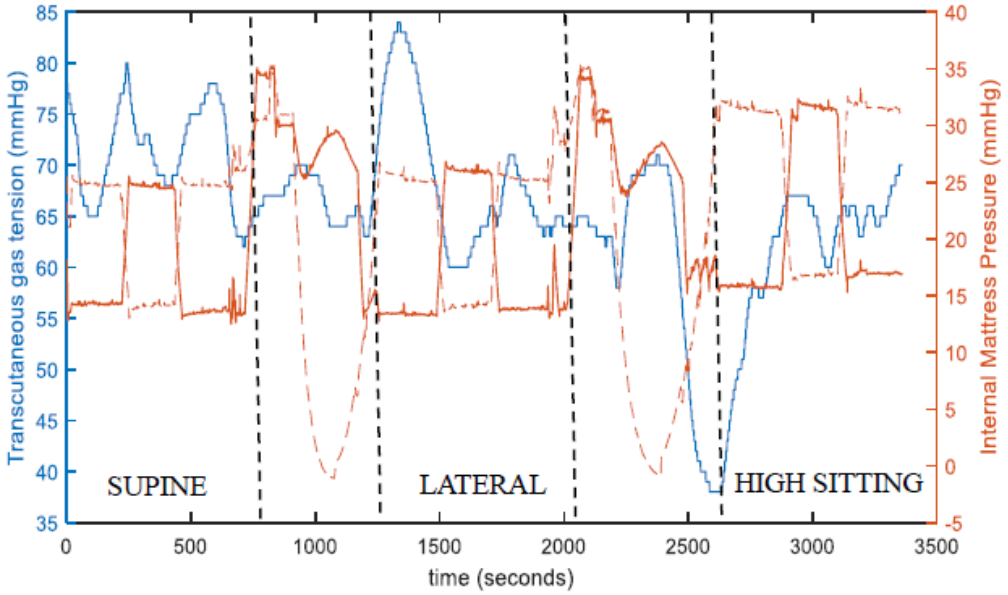
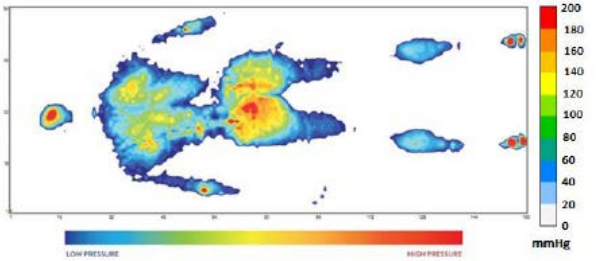
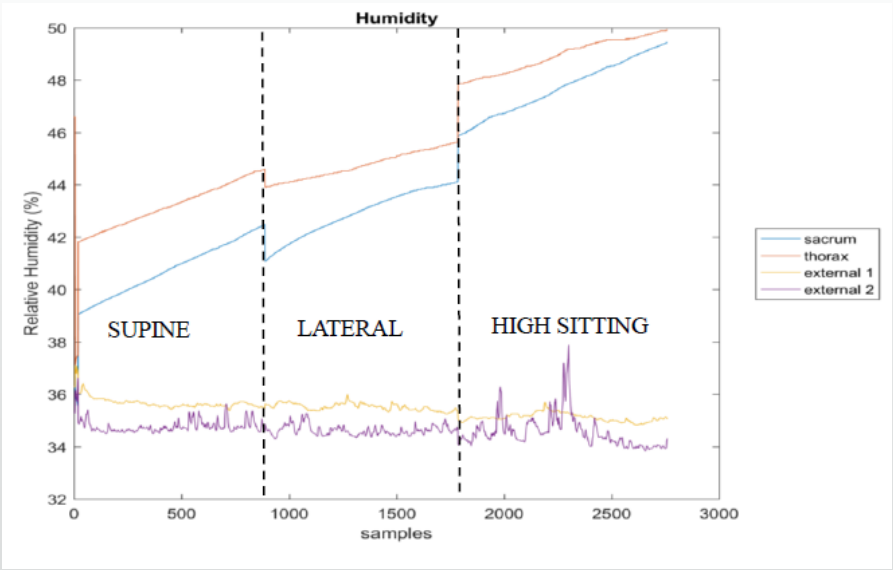
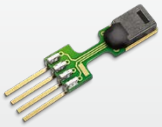




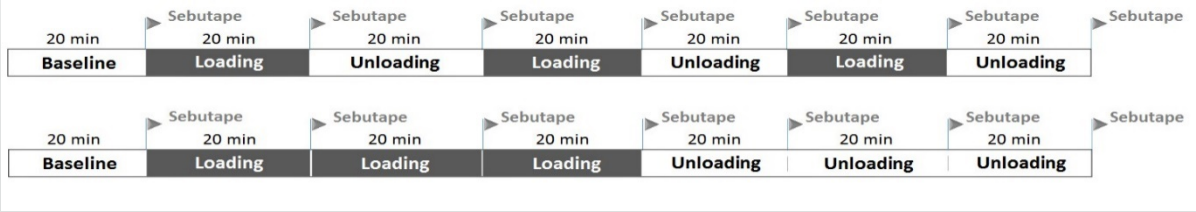




Progress to date

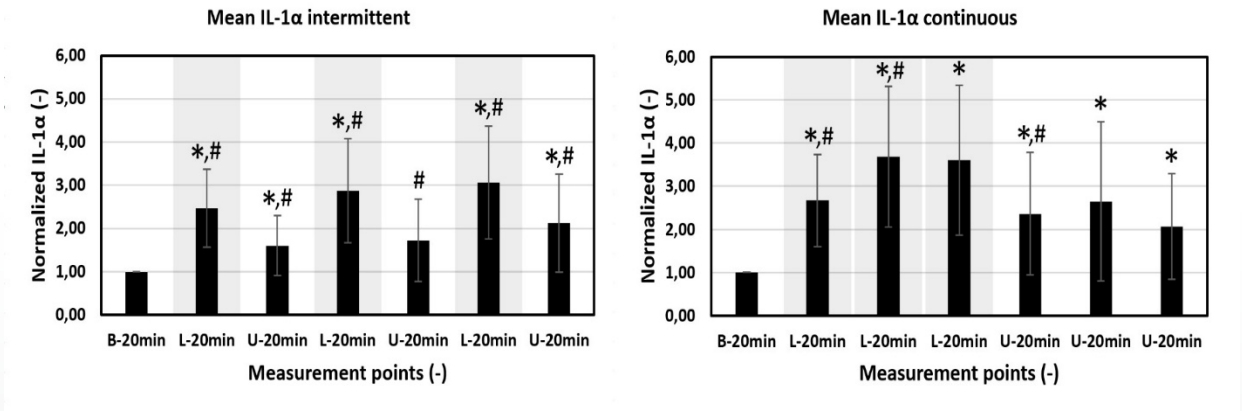
Biomarkers to detect changes in local physiology following mechanical loading

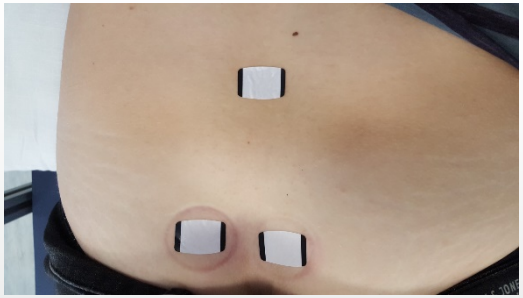
- Two key sets of Biomarkers
  1. *Inflammatory Cytokines*
  2. *Metabolites*
- These were samples from sweat and sebum non-invasively in a cohort of healthy participants.
- A standard loading protocol was used in each case to derive relative changes during periods of loading and off-loading.

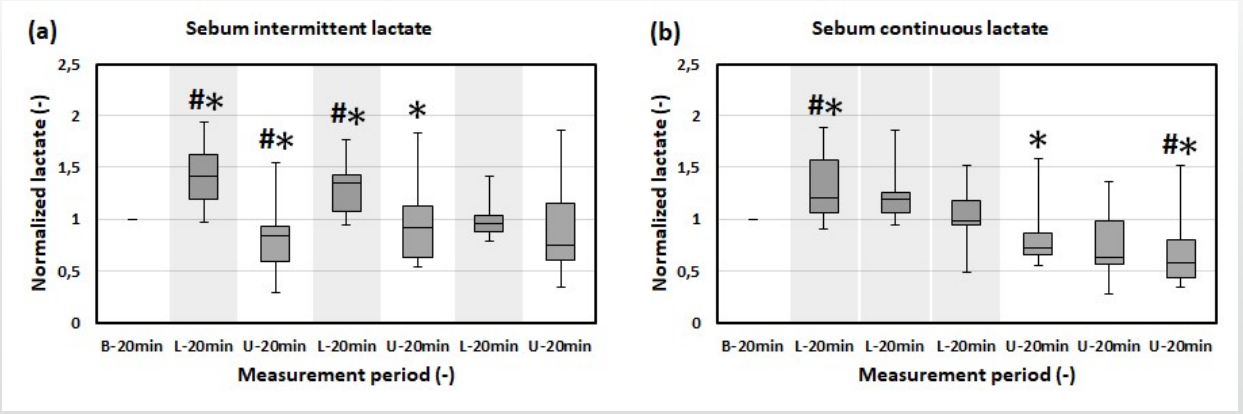


Soetens et al., (2019) Journal of Tissue Viability

Example Data - Biomarkers





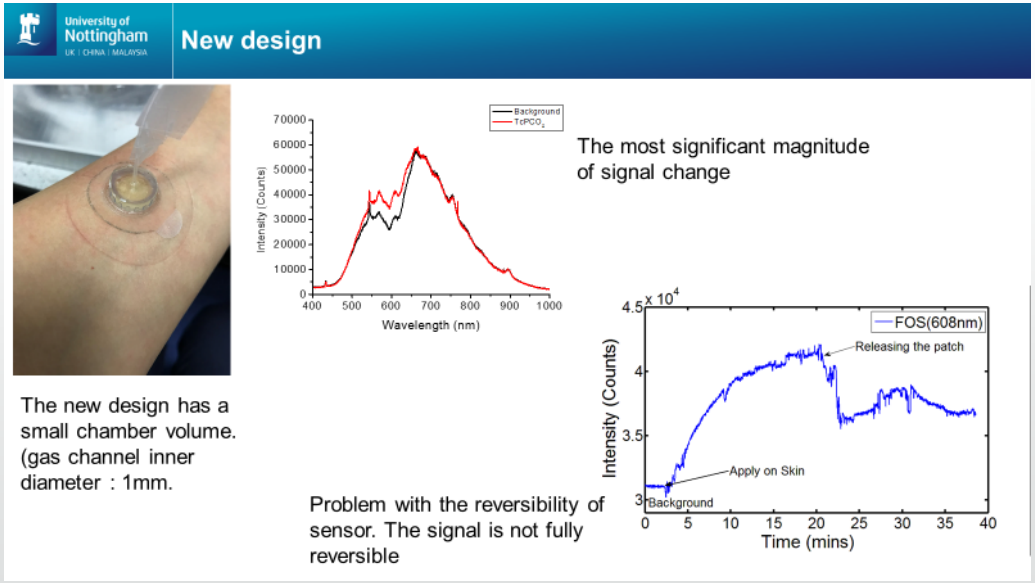


Future Studies

1. Evaluating the technologies on a sub-population known to be at risk – Amputees (Prof Jeffery)
   - Measuring biophysical and biomarker properties at the interface between the socket and residuum in amputees.
   - A/W final ethical approval.
- Closed loop evaluation of prolonged lying on a commercial support surface (OSKA).
   - Develop an algorithm which automatically changes the internal pressures of a mattress based on the biomechanical, microclimate and physiological conditions being monitored.

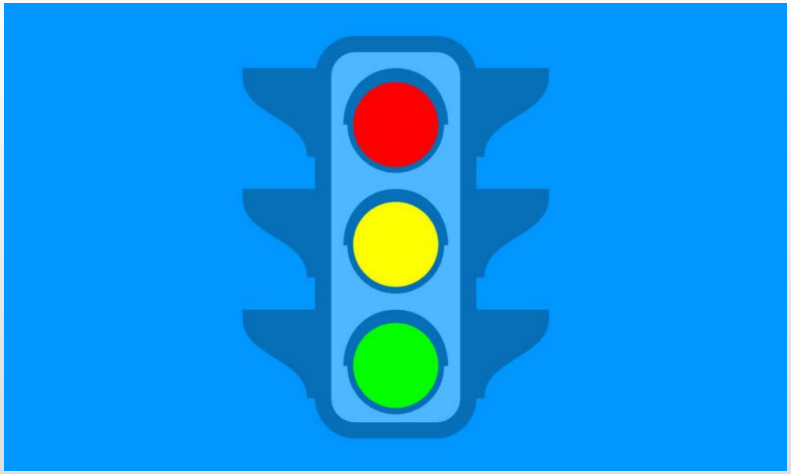
Future Studies

- Minimally invasive & cost effective sensing solutions – Optical Fibres
- Can optical fibres be used to measure
  - Pressure
  - Shear
  - Microclimate
  - CO2/O2



Future Translation

- Patient monitoring for chronic wound prevention (PUs, DFUs, LUs)
- Minimum data set required to monitor the health of vulnerable tissues
- Appropriate technologies for implementation
- Funding sources
  - MRC
  - NIHR
  - Innovate
  - EPSRC



Research Partners

The Team:

- Prof Dan Bader
- Dr Luciana Bostan
- Prof Steve Morgan
- Prof Steve Jeffery
- OSKA Ltd

- Thanks to all the participants in the studies

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Any Questions?