Precision Imaging – Business Engagement Webinar 18 June 2020

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About us

**Vision**
- Become the international centre for precision imaging to pioneer personalized healthcare for reduction of global burden of disability.

**Mission**
- Innovate and apply imaging tools for a step change in understanding, diagnosis and prediction of outcomes in mental health and chronic diseases.
A revolution in brain scanning

The new system has been used to make MEG measurements while subjects make natural movements, including head nodding, stretching, drinking and playing a ball game.

Mental and chronic physical health conditions cost the UK up to £150bn annually

Mathematical models of large-scale brain activity

Easing the impacts of depression

Economic costs of major depression
- £17bn to the NHS
- £5.7bn in England alone

A ‘magic’ new medical device for MRI assessment of gut transit in children with constipation

Constipation is common in young people. We invented a new medical device to assess gut transit time using MRI.

Fighting Fatty Liver – imaging world health
Added Value for Business

Solutions from internationally leading experts

- Expertise in next generation biomedical Imaging
- Expertise in biomedical sciences & experimental medicine
- Expertise in mathematical modelling and computational imaging
- Expertise in clinical medicine, biomarkers and clinical trials
- Expertise in neurosciences

- Over 5,000 volunteers scanned in the Sir Peter Mansfield Imaging Centre
- 4 patents approved (cumulative)
- 6 Precision Imaging Beacon Research Fellows recruited (cumulative)
- 40 new imaging PhD students (cumulative)
- 26 Beacon seminars (since 2018)
- 34 new projects funded (cumulative)
- More than 100 researchers and academics in our community (105)
- Over 850 publications by our academic community (since 2018)
Added Value for Business

Access to world class imaging facilities

- Upright MRI
- 1.5T/3T/3T
- 7 T
- Pre-clinical facilities

MRI and MRS (NMR spectroscopy)
Electrophysiology in brain and body
Ancillary equipment

- DNP
- MEG
- EEG and NIRS
- Patient friendly
Precision Imaging at Nottingham – working with companies

Prof Luca Marciani
Precision Imaging Beacon
Industrial Strategy and Business Engagement Lead
Zsofia Toth & Claire Bicknell

How to boost your business attractiveness

Live webinar
21 April 2020
He recently injected his head chef with a dangerously high dose of chilli oil, intravenously, and then slid him into a £5 million MRI scanner to see how the spices reacted with his brain. "I used the brain scanner at Nottingham University," he says.

“I wanted to see what parts of his brain my spices would affect so I could create the perfect chilli”

“You could see all his brain cells light up on the screen and it helped me understand how chilli works”
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Outline

➢ All you need to know about MRI imaging (in 3 slides !)
➢ “What about my business ?”
All you need to know about MRI imaging
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Put a sample in the magnetic field and transmit radio frequency

Add spatial information using magnetic fields

Receive the resulting signal with an aerial

Reconstruct the signal’s spatial information (simple maths)

MRI image!
All you need to know about MRI imaging
“What about my business ?”
Swedish company Maurten developed a new hydrogel technology whereby a liquid sports drink can convert to a hydrogel in the stomach environment, modulating the transportation of the nutrients and increasing tolerability.

- Tested the hypothesis that DRINK MIX 320 gels in the stomach
- Demonstrated intragastric gelling
Foods / ingredients / nutraceuticals
Alginate and HM-pectin in sports-drink give rise to intra-gastric gelation in vivo

Luca Marciani, Patricia Lopez-Sanchez, Stefan Pettersson, Caroline Hoad, Nichola Abrehart, Martin Ahnoff and Anna Ström

The addition of gelling polysaccharides to sport-drinks may provide improved tolerability of drinks with high concentration of digestible carbohydrates (CHO), otherwise known to increase the risk of gastrointestinal complaints among athletes under prolonged exercise. The physico-chemical properties of a drink containing 14 wt% of digestible CHO (0.7:1 fructose and maltodextrin ratio), 0.2 wt% of HM-pectin/alginate and 0.06 wt%, sodium chloride were examined under in vitro gastric conditions using rheology and large deformation testing. The in vivo geling behaviour of the drink was studied using magnetic resonance imaging of subjects at rest together with blood glucose measurements. The in vivo results confirm gelation of the test drink, with no gel remaining in the stomach at 60 min and blood glucose values were similar to control. The physico-chemical characterisation of the acidified test drink confirms the formation of a weak gel through which low $M_w$ CHO can diffuse.
Global healthcare/nutrition company Fresenius Kabi developed new preoperative energy drinks to help recovery after surgery. These must clear the stomach before anaesthesia but gastric emptying time unknown.

- Compared gastric emptying of market product with 2 new formulations in clinical trial
- Determined gastric emptying time

Global food/personal care company Unilever developed new aerated drinks (foams) to increase gastric distension and reduce appetite. *In vivo* performance unknown.

- Tested two aerated formulations against an isocaloric control drink
- Demonstrated increased gastric distension and reduced appetite for the aerated drinks

Health, hygiene and nutrition company Reckitt Benckiser developed a new formulation of heartburn relief product Gaviscon and wanted to investigate performance *in vivo*.

- Tested old and new formulation
- Demonstrated intragastric raft formation for both and demonstrated performance
- Our images featured in the marketing brochure

Multimodal Biomarkers of Brain Health

Brain structure
- Development
- Resilience
- Prodromal disease

Brain metabolites
- Neurotransmitter
- Metabolism
- Anti-oxidative markers

Brain function
- Cognitive Health
- Emotional Health
- Pharmacodynamic and mechanistic effects

Brain blood flow
- Neurovascular health
- Disease pattern
- Response pattern

Precision Imaging provides added value for
- Experimental medicine studies
- Phase 2a pharmaceutical / nutraceutical trials
Flavonoids have beneficial physiologic and antioxidant effects. Food products company Mars Incorporated interested in understanding potential effects on the human brain, particularly blood flow.

- Tested effect of high and low flavanol content cocoa drink
- Showed high flavanol can increase cerebral blood flow – potential to aid treatment of vascular impairment

Next generation imaging-guided therapy

**Stratification**
- Response prediction
- Radiomics/AI

**Target selection**
- Brain stimulation
- Surgical/Radiotherapy planning

From CT of brain haemorrhage to outcome prediction

MRI for neuronavigated depression therapy

Pszczolkowski et al, under review, Courtesy Prof Dineen

Iwabuchi et al., 2017,2019
Japanese pharma company Mitsubishi developed a new serotonin receptor agonist (gastrointestinal motility) drug. Effect in humans unknown.

- Run first-in-man MRI clinical trial of 3 escalating doses versus placebo
- Demonstrated delay in liquid gastric emptying in association with relaxation of the proximal stomach

Healthcare company McNeil interested in understanding mode of action of two anti-diarrhoea formulations of loperamide on intestinal water distribution.

- Tested both formulations versus placebo in clinical trial
- Demonstrated that both formulations reduced small bowel water content and delayed arrival of fluid in the colon

Some of the science behind drug dissolution modelling and bench apparatuses is 40 years old.

➢ Work to improve *in vitro-in vivo* relevance of drug dissolution science using MRI data of the fluid, motility and transit in the undisturbed bowel
➢ Studied novel dosage forms and looking at colon targeted delivery

DM Mudie et al. Molecular Pharmaceutics 11, 3039-3047, 2014
Partnership with medical device manufacturer JEB Technologies to develop a new MRI visible mini-capsule to measure gastrointestinal transit in children with constipation.

- Two NIHR i4i research grants (£1.8M)
- Made the device, run first-in-child trial
- Setting up multi-site clinical trial to demonstrate effectiveness and going towards CE marking

Medica expo Düsseldorf 2019
Our collaborative imaging work has helped to support regulatory claims by providing data that demonstrated mode of action and feasibility.

- One EFSA claim for health benefits of food produce
- One patent on a novel digestion bench machine
- One patent on a novel thermal gelling material
Conclusions

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