KidsBrainIT & IMPACT-ACE: Data Informatics Improvement Research in Pediatric Critical Care – Concept, Challenges, Co-ordination, & Future Collaborations

Dr. T.Y.M. Lo

Consultant Paediatric Intensivist /

NRS Career Research Clinician /

Research Lead in PCCM /

Hon. Reader

Royal Hospital for Sick Children,

Edinburgh

Concept:
Routine Physiological Monitoring

- Clinical use in PICU
- At least minute resolution
- Net-worked or non-networked monitors

Concept:
Physiological Data Beyond Clinical Care

Audit & Research

- Variable and unit dependent
  - High resolution data (at least minute resolution)
  - Lower resolution data (5 minutely resolution)
  - Low resolution data (e.g. end-hour recording)

Data archive & Storage

- Variable & unit dependent
- Forward planning required (e.g. High-resolution data compressed after 1 month)

Concept:
Closing the Data Loop

Making the best use of data generated through routine clinical care for research and quality improvement work

- Generate new research ideas
- Develop data-driven improvement interventions
- Improve patient care, outcome, and safety

Clinical Big Data, Data Science, Research, Innovation

Prof. JD Miller

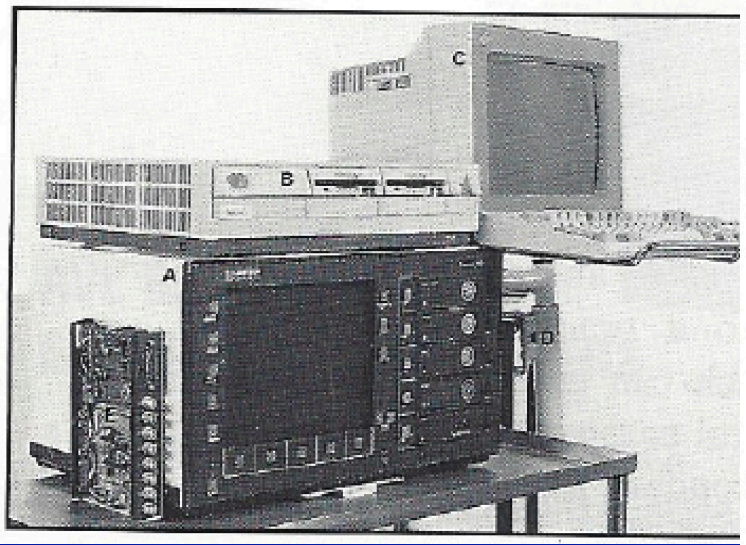
Brit J Intensive Care 1991, 1: 73 — 78.

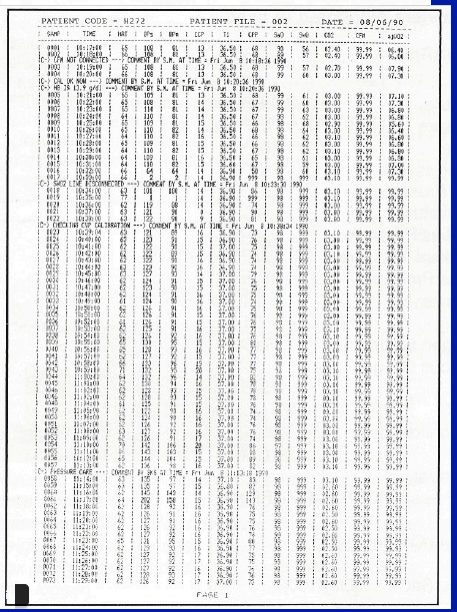
COVER FEATURE

Computerised data collection

A Microcomputer Data Collection System in Head Injury Intensive Care.

IR Piper, PhD, **A Lawson**, HND, **NM Dearden**, FFARCS, **JD Miller** MD, PhD, FRCSE. Department of Clinical Neurosciences, University of Edinburgh, Scotland.





BrainIT (Dr. Ian Piper)

Brain Monitoring with Information Technology

- Adult brain trauma research collaboration in UK + Europe
- Established in 1997
- Clinicians, basic scientists, engineers, industry collaborations
- Improve the intensive care management and outcome of brain injured adults.
- Openess & free collaboration (NOT competition)

A New Multi-centre, Multi-disciplinary, Multi-national Data Informatics Paediatric Brain Trauma Research Initiative

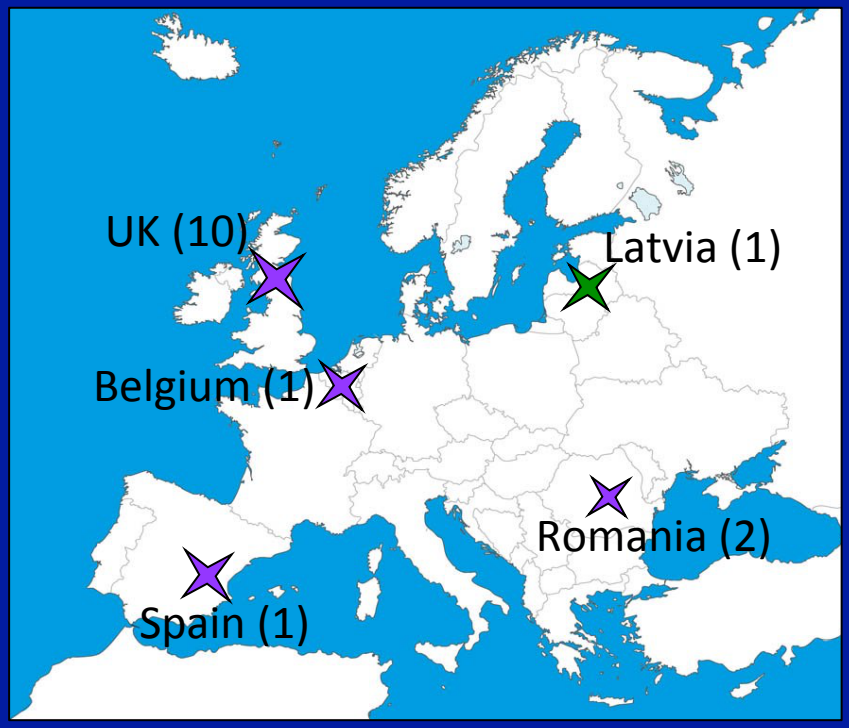
(est. 2013)

KidsBrainIT - Timeline

- Concept 2013 (Edinburgh led)
- KidsBrainIT launch, BrainIT meeting, Barcelona, Oct 2015
- Infrastructure development funding Sept 2016 (Neuroscience Foundation £11,220)
- Phase 1 funding secured Nov 2016
  - EU grant (ERA-NET NEURON)
    - 621,843 Euros

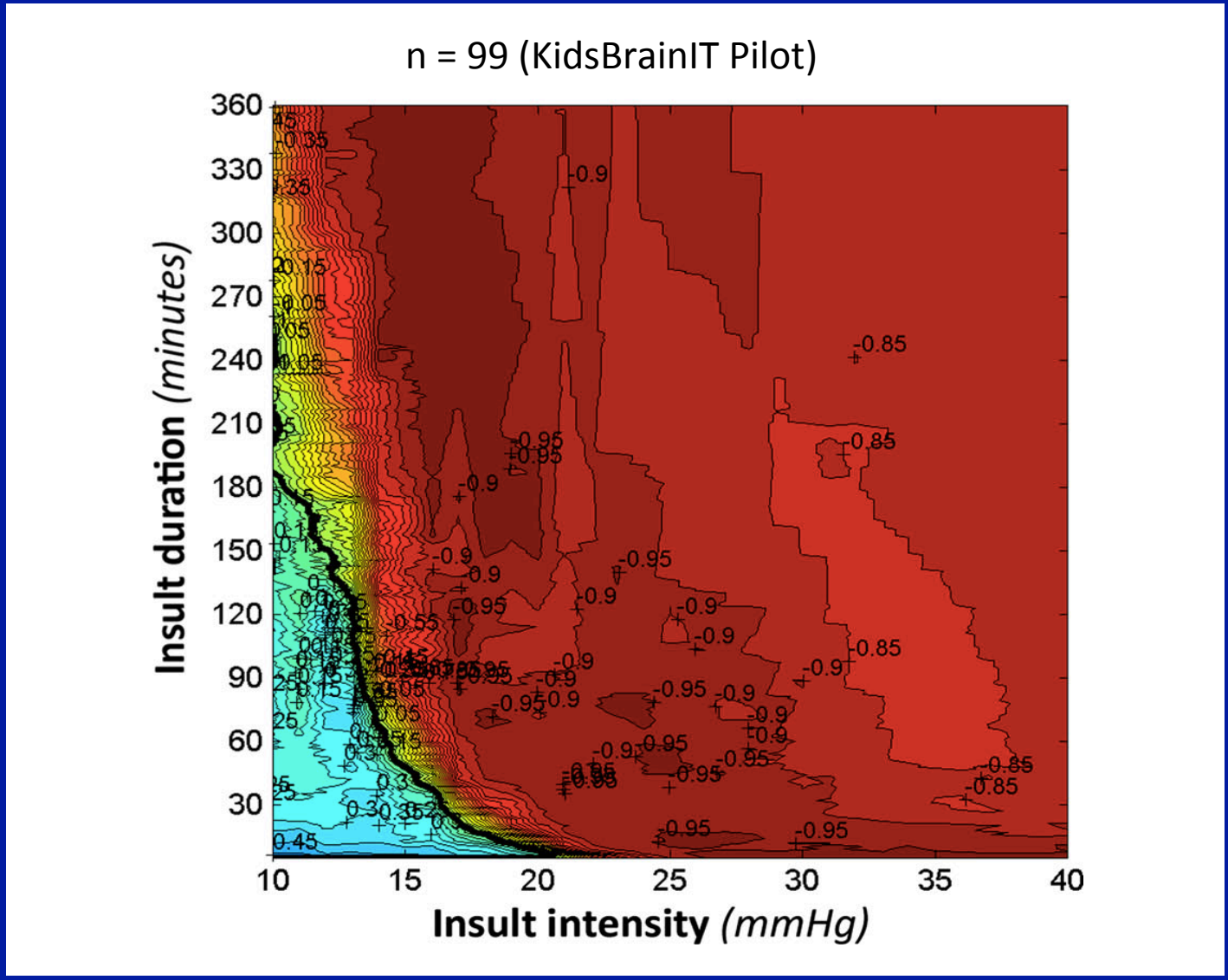
KidsBrainIT Phase 1

- Data collection started Nov 2017
- 15 PICU 5 countries



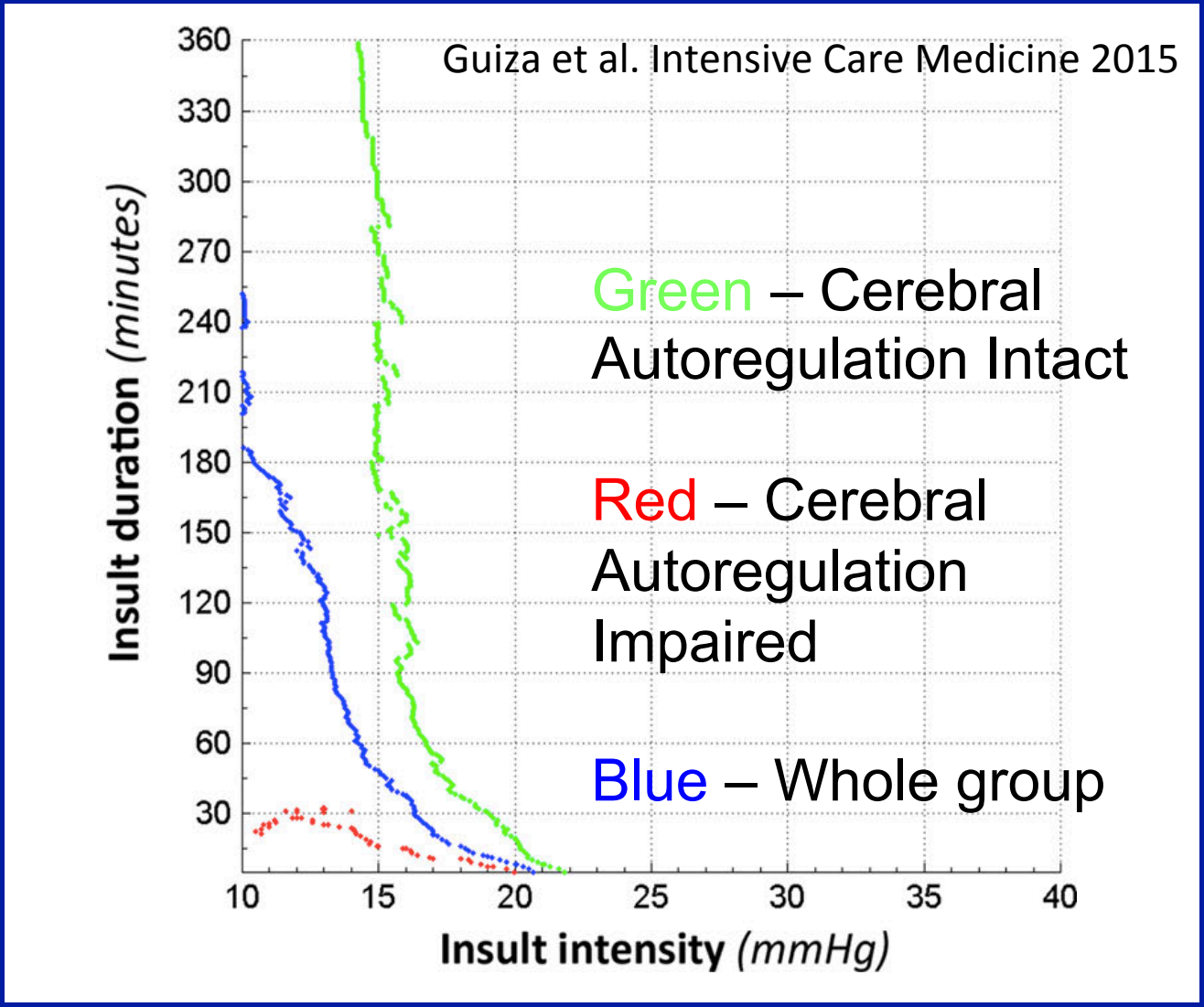
- Paediatric TBI (Clinical big data)
- Hypotheses testing (ICP dose response, cerebro-autoregulations & TBI recovery) (Data science & Research)
- Novel technology development sub-study (BCN & EDI) (Innovation)

ICP Dose-response Visualisation Plot



Guiza et al. Intensive Care Medicine 2015

ICP Dose-Response & Cerebral Autoregulation Status



Challenges

- Multiple regulatory bodies in different countries (Ethics / R&D / Management)
- Bedside monitor data extraction – different brands + configurations
- Multi-centre multi-national technical support for study specific java tool + computers
- Outcome follow-up (some families are lost to follow-up)
- Novel technology substudy equipment matching fund
- Hospital move (delayed novel technology substudy timeline in UK)

Co-Ordination

- Bespoke interface successfully developed for different monitor brands + configurations to extract beside monitor data
- KidsBrainIT Data-bank + infrastructure set-up within Usher Institute (Edinburgh)
- Novel technology substudy started in Spain, UK to join after hospital move
- Secured web-based data entry / transfer
- Further funding applications
- New collaborations (including industries)

IMPACT-ACE

NHS Lothian

MDT Clinical Notes

CIS

Rx Prescription

PICU

Data Informatics Improvement Research

Usher Institute Population Health Sciences & Informatics

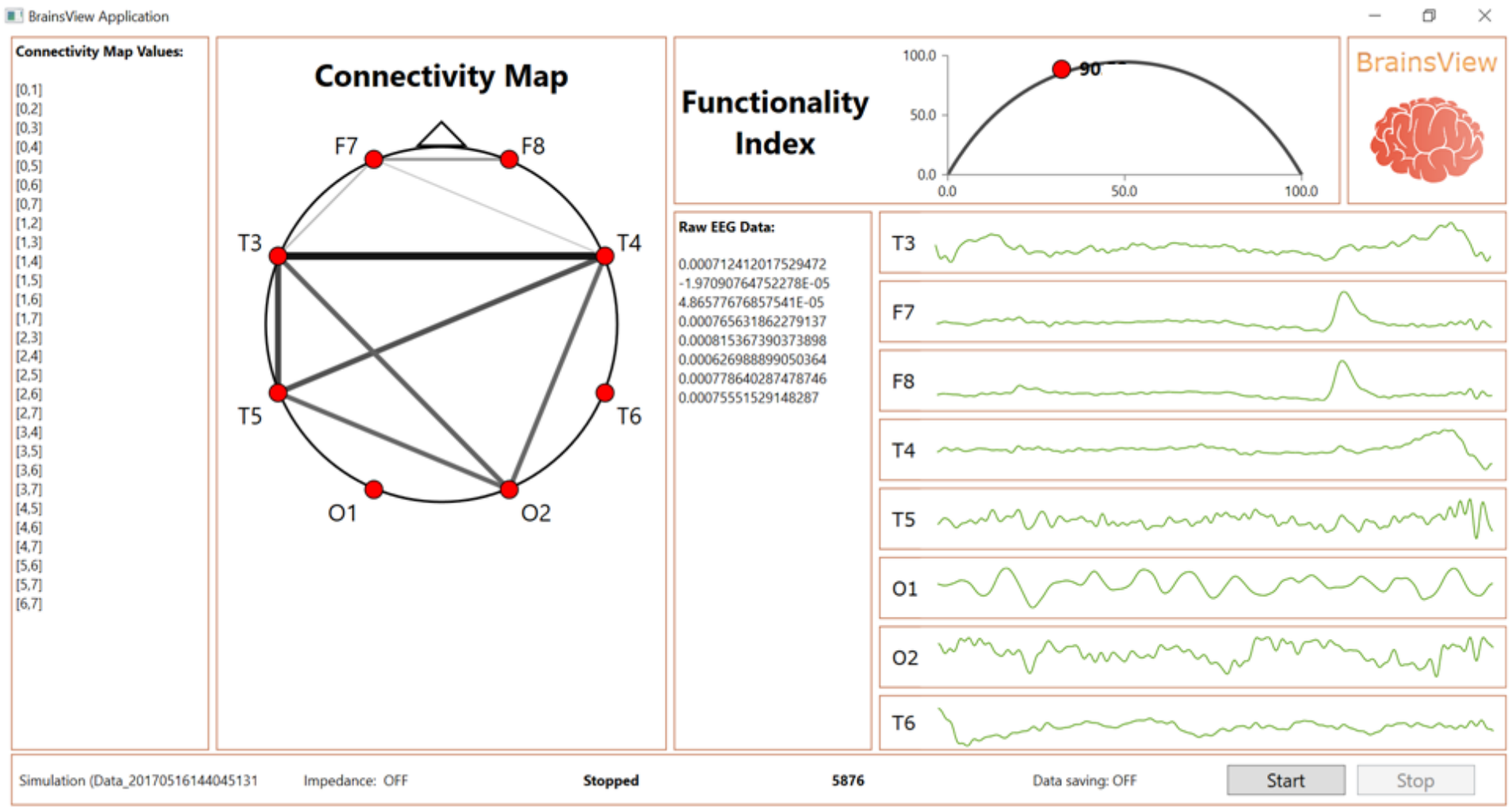
The University of Edinburgh

Future Collaborations

Clinical Big Data, Data Science, Research, Innovation

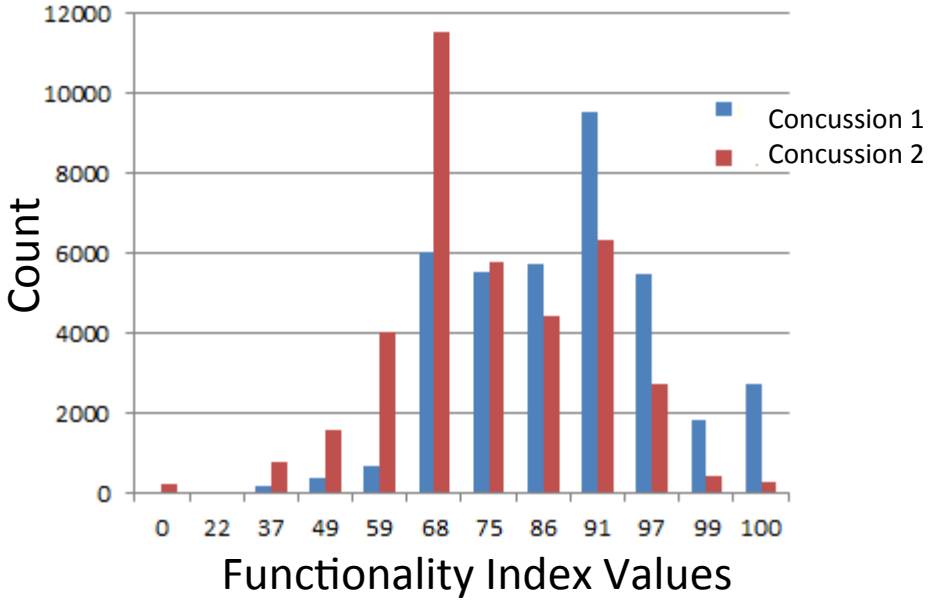
- MRC P2D grant
  - Academic – industry – clinical collaborations
  - Accelerate brain functional connectivity assessment & clinical translations
- IMPACT-ACE
  - National / International PICU Physiological data-bank for research + quality improvement
- MRC Precision Medicine PhD Studentship
  - Machine learning / AI / Data Linkage Collaborations
- KidsBrainIT Phase 2 (beyond UK + EU)

Analytic Software

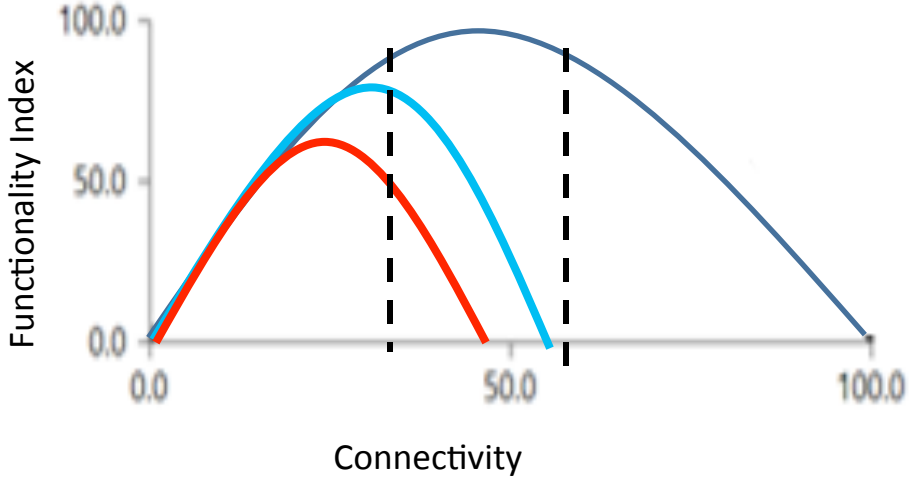


Functionality Index: x axis 0 to 100% connectivity, y axis 0 to 100% entropy of the system.

Concussion

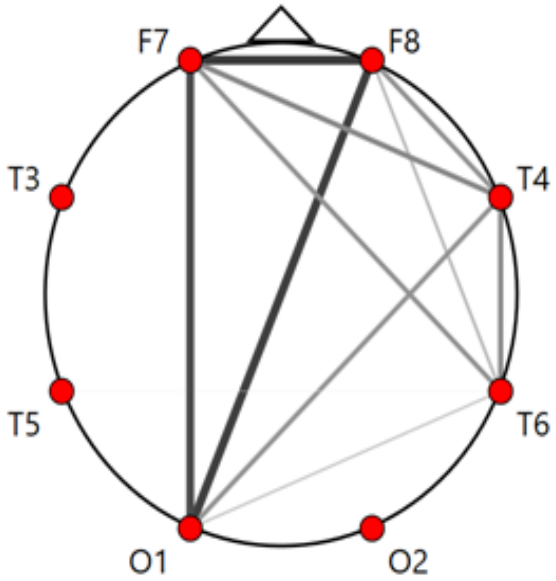


Maximal Functionality Index for Concussion patient 1: 91
Concussion patient 2: 68

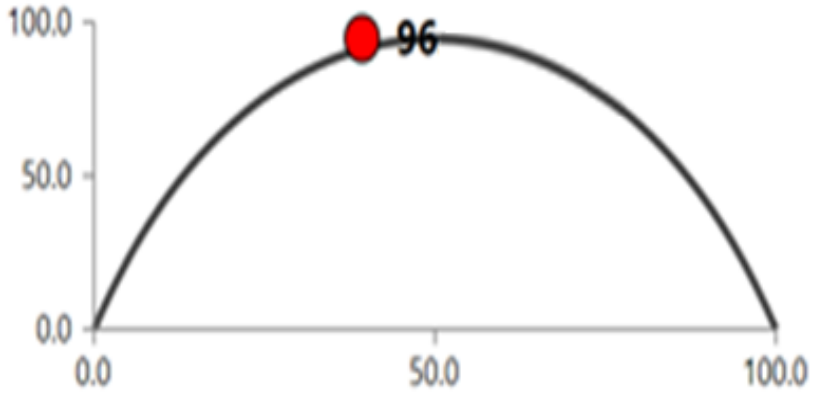


Maximal Functionality range values in normal, awake brain: 94 to 100

Connectivity Map



Functionality Index



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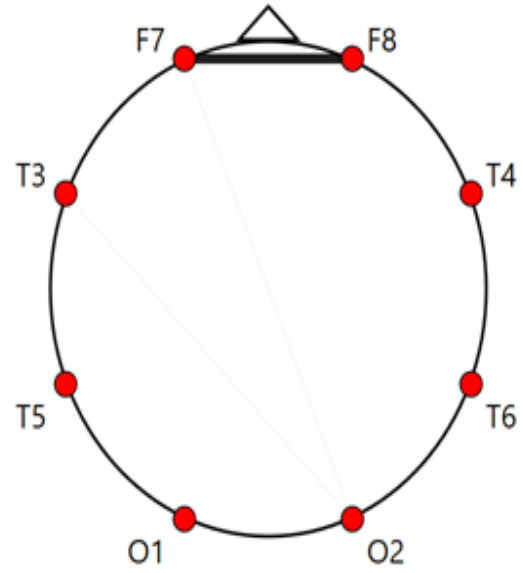

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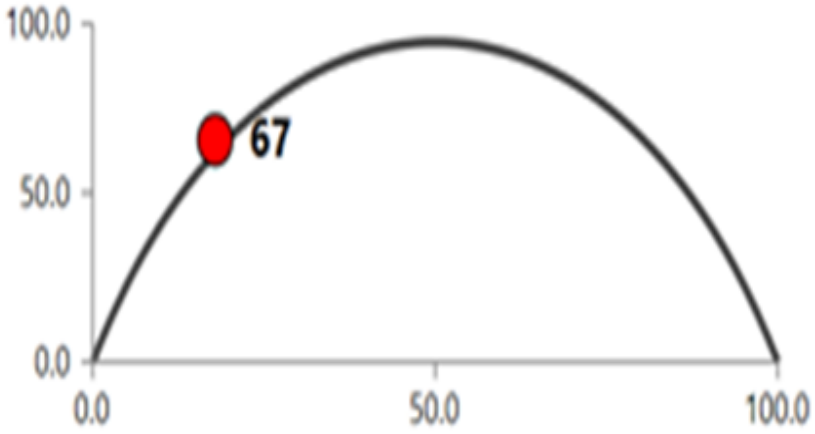

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Special thanks

- Ian Piper
- Patricia Jones
- R.A. Minns
- KidsBrainIT consortium partners (UK + EU)
- P2D Industry Partner (Brainsview Inc.)

- Funders:
  - CSO; NRS (Career Research Fellowship 2013) + NHS Lothian R&D (NRS Career Research Clinician since 2016)
  - ERA-NET NEURON
  - MRC
  - Neuroscience Foundation
  - Edinburgh Children's Hospital Charity