Diagnostics and Therapeutics

Measure, Diagnose, Treat – Engineering Enabled Next-Generation Care

Geoff Chase and Martyn Nash
Definitions

• **Diagnostic**: Noun; (plural diagnostics)
  1. A technique etc. used in medical diagnosis
  2. Any tool or technique used to find the root of a problem

• **Therapeutic**: Noun; (plural therapeutics)
  1. Of, or relating to therapy or treatment
  2. Having a positive effect on the body or mind
Some Facts and “Facts”

• The medical device field is littered with various “facts”, real and imagined, that reflect on the goals of this CoRE and this theme

• **Fact 1:** “…a good-enough device is just that”
  • If it aint providing a step change, then it just aint (a realistic device)
  • Making money from the next increment is no longer on.

• **Fact 2:** “Providers are interested in novel technology **IF** it improves clinical outcomes, processes and financial returns.”
  • Improving quality and reducing cost simultaneously are imperatives. **Innovation in healthcare technology is increasingly difficult for manufacturers because the dimensions of a solution are multiplying** → Models/Informatics to reduce dimensions may be key!
  • Clinical capabilities need to be improved, but **compatibility with people, process, and technology** is also required. And a **high-enough reimbursement (to justify the change)** is needed. In robotic surgery solutions, for example, we see slow growth because of difficulty in overcoming these obstacles.”

• **Fact 3:** “Today is a good day to be in the medical device business”
  • Only if you can deliver on the outcomes from thinking about Facts 1-2
Medicine 101

- Three (3) main elements of medical care and thus device enabled medical care. They run in a cycle

- **Measure / Monitor**: Assessing patient status or condition, or a surrogate of patient status or condition
  - Poor measurements or surrogates make assessment variable/difficult

- **Diagnose**: Use of measurements (and/or other data) to define patient condition or status (i.e. the disease state)
  - Many possibilities can lead to difficulty choosing a “best” treatment

- **Treat**: Delivery of care in response to diagnosis
  - What is the “best” way to deliver care so there is good compliance and adherence (includes “role of design”)

[Diagram showing a cycle with arrows labeled Measure, Diagnose, and Treat]
The current approach

- Disconnected, costly, no feedback, minimal information
- Take measures to doctor, get dosing advice
- Not personalised, not optimal (seen by outcomes)

Patient gives care w/o any feedback or personalisation directly

Measure data

Leaves Home

Infrequent clinical feedback

Sliding Scales
Generic advice
Given Monthly or so
Not typically when struggling
Minimal data available
All typically one size fits all

Standard delivery
Low adherence = Poor outcomes

Return Home
Diagnostics and Therapeutics Theme

• Research under this theme will focus on improving care via:
  • Creating novel physiological sensors and measurement methods
  • Creating model-based or informatics based decision support to optimise diagnosis and therapy selection
  • Creating innovative treatments

• These outcomes may be standalone devices or systems, or mix computation and existing tools to create new, more powerful, next generation healthcare solutions.

• Targeted towards any form of medical problem where there are insufficient quality or availability of data to enable a big step forward.
  • Next-generation focused, rather than incremental improvement
A Platform Vision of the Future Part 1:

Personalised, Connected, at Home or in Hospital

Novel measurement tech for High Adherence

Patient Centered Management
Patient as “own doctor” where possible

Decision Support System

Identify and utilise patient-specific parameters

• Everything personalised and connected
• Cloud storage and informatics
A Platform Vision of the Future Part 2:

Personalised, Connected, at Home or in Hospital

- Informatics and warnings present **right** patients to clinical staff at the **right** time
- Better use of scarce and costly clinical time. Appts and meetings are when they can have best effect and are most needed, based on data and with far more information already available.
- Results feed back into improved care, models, use
Some Examples: from high cost and impact areas

Metabolic system:
- Glucose control, Insulin sensitivity testing, Needle free injection, Needle free sensing, Orthoses, Wound healing

Cardiovascular system:
- Model-based sensing, Model-based decision support, Monitoring of electro-mechanics, Perfusion monitoring

Lungs:
- Model-based ventilation, Monitoring of lung condition, Virtual patients for ventilator / therapy design, Novel inhalers

Imaging and Cancer
- Breast cancer screening using digital cameras, Models to enhance mammography, Image processing for diagnosis / screening
The main target then is actually ... ?
Or back to the beginning...

- **3P’s** = 3 inter-related issues and challenges of healthcare over the next 10-30 years:
  - *Productivity - Economic Sustainability*
  - *Personalisation (of care and delivery)*
  - *Priority – Equity of Access (for all)*

- Real target is managing the epidemic growth of chronic disease (diabetes, COPD/ Asthma, cardiovascular, ...) that debilitates people, communities, work forces, and thus economies
Questions???

A pathway to the future of medicine