Keynote

**ProACT:** Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management

Dr. John Dinsmore
5 key Questions

Q1) Why bother?

Q2) Is it a National/EU/Global priority?

Q3) Is the solution already available?

Q4) Why are you the best person or people to deliver?

Q5) What would happen if you weren’t funded? (Would anyone Care?)
Acknowledgements

All research participants for their time, commitment and valuable input

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“Develop world-leading evidence based innovative research in the area of digital health”
Multimorbidity: clinical assessment and management

NICE guideline
Published: 21 September 2016
nice.org.uk/guidance/ng56
AIMS:

1- Challenge the EU focus on supporting a single disease framework of care to create a patient centric integrated care (IC) ecosystem to understand and manage multimorbidity.

2 - ProACT aims to develop and evaluate a cloud based open API to integrate a variety of new and existing technologies to advance ‘home based’ integrated care (IC) for multimorbidity self-management.
ProACT ICT-AT Platform

Person with Multimorbidity

Devices (e.g., Motivating, Withings, SmartThings, etc.)

CareApps

CABIE

InterACT

CareAnalytics

support networks
The people at the Heart of the Issue

Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management
C.O.P.D.
CHRONIC OBSTRUCTIVE PULMONARY DISEASE
Multi and co-morbidities
• Heart Disease = 16%
• Hypertension = 38%
• Diabetes = 6%
• High cholesterol = 22%
• Anxiety and depression = 31%
• Other 47%

n=32 (53% female)/Average age = 67

12.5% obtained info online
Combining science, politics and economics

The people at the heart of the Issue

Q1. Why Bother?

Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management
The Ageing Population

The number of people in the world aged 60 and older is expected to grow past 2 billion by the year 2050.

In Ireland...
Number of people aged 65+
12% → 22%
2012 → 2041

1 million people aged 75+

Cumulative percentage increase in population, all ages and aged 65+, Ireland and EU, 2003 - 2012
(Source: Eurostat)
Age = Risk of Multimorbidity

- Reduce QoL + functional decline
- More likely to die prematurely and be admitted to hospital, and have longer hospital stays.
- Correlated with socioeconomic deprivation
- 50m patients in EU – €700b cost per annum
  Rijken et al. (2013) - Eurohealth Incorporating Euro Observer
- US by 2030 171 million people with chronic disease – 50% with Multimorbidity. 65% of Medicare beneficiaries have multimorbidity

Barnet et al. (2012) – Lancet

Wolff JL et al. (2002) - Arch Intern Med
Conditions: Diabetes, COPD, CHF/CHD,
Politics: We do not deal with Multimorbidity

- **Inefficient**: Different clinicians, conflicting advice
- **Inconvenient**: Hospital appointments on many different days
- **Repetitive**: Multiple appointments; Repeating medical history
- **Burdensome**: Hospital appointments on many different days
- **Confusing**: Hospital appointments on many different days
- **Potentially Unsafe**: Medication interactions and negative polypharmacy

Empower the PwM and their care network to play an active role in managing multimorbidity
The people at the heart of the issue

Combining science, politics and economics

Q1. Why Bother?

Q2. Is it a strong National/EU/Global priority?

Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management

State of the Art
## Digital Health Research

<table>
<thead>
<tr>
<th>Healthy living</th>
<th>Prevention</th>
<th>Diagnosis</th>
<th>Treatment</th>
<th>Recovery</th>
<th>Home care</th>
</tr>
</thead>
</table>

### Convergence between Professional Healthcare and Consumer markets

- People wish to be engaged
- Need to improve quality + cost of care
- Focus on improving population health
- Costs shifting to the home

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### Improving Patient Engagement

To adopt new lifestyle changes by using online services to empower home-based care and ownership of their health.

### Advancing Home-based Healthcare and use of ICT-AT

The continuum of care now incorporates telehealth, remote monitoring applications, point of care treatment, health informatics, and analytics.

### Improving Workflow Management

And addressing organizational change to optimize and improve the efficiency and effectiveness of services and organizations to add value to patient care and increase revenue, while minimizing problems in care delivery.

### Advancing New Healthcare Models

To fit in line with flexible patient-centric service models being adopted by organizations, this includes business models, affordable healthcare etc.
1. Focus on theoretical and empirical work in the areas of prevention, addiction, and adherence to medical regimens for single-disease states.

2. Lack of detail regarding solutions for individuals, health care professionals and additional support actors on how to best support the self-management efforts of those with more than 1 chronic disease.
Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management

Q1. Why Bother?

Q2. Is it an EU/Global priority?

Q3. Is the solution already available?

State of the Art
Focus – Self-Management

• Self-management is a core activity

• Self-management of multimorbidity is challenging, requiring engagement in multiple tasks such as symptom monitoring, recognition of exacerbation, medication adherence and inter-stakeholder communication.

• A digital, integrated care approach is a critical part of the solution.

• The main objective of our work is to design a technology ecosystem to facilitate older adults to self-manage multimorbidity, with support from their care network.
1. Need to better understand data between care pathways to effectively support management of single diseases

2. Develop an data aggregator to collect data new or existing technologies (CABIE)

3. Develop an AI (InterACT) to analyse data to understand overlap in disease management and direct best practices in self-management, care support and training for multimorbidity

4. Ensure the system is open: new applications can be built into it from clinical, social or community care
Meet Sarah

Sarah is 85

**Conditions:** Diabetes and Heart Failure

Everyday for the last 5 years she has measured her:
- Weight
- Blood Pressure
- Blood sugar

She writes readings in notebooks and brings them with her to her GP and specialist clinics that she attends for her conditions.

Sarah is finding it hard to remember when to take measurements and to write down the different readings into separate notebooks every day.
How Can ProACT Help Sarah

Monitoring Symptoms

• Sarah’s GP recommended that she try a new technology to help her monitor her symptoms automatically.

• ProACT also help Sarah to keep track of other important parameters such as sleep, activity, mood and breathlessness.

Viewing Symptoms

• Her new devices now send her readings automatically to a tablet where she can view her symptoms over the last day, week or month.
Knowledge and Education:
• The system also provides Sarah with tips that might be useful for her to manage her conditions and stay as healthy as possible.

• ProACT gives Sarah trustworthy and clear information on managing diabetes and heart failure but also on general topics such as exercise and how to get off the floor safely after a fall.

Health and Care Network:
• Person driven modular ability to personalise care network

• Sarah’s daughter Mary can view the health readings that she chooses to share with her from her phone.
The people at the heart of the Issue

Combining science, politics and economics

Q1. Why Bother?

Q2. Is it an EU/Global priority?

Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management

Q3. Is the solution already available?

What the Solution?

Q4. Why are you the best people for the work?

Build your team (Do you have industry support?)

State of the Art
Combining science, politics and economics

The people at the heart of the issue

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Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management

Q3. Is the solution already available?

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Q5. What would happen if you weren’t funded? (Would anyone care?)

State of the Art

What the Solution?

Build your team (Do you have industry support?)

IMPACT: Design and implement to engage, sustain and scale
Project Outline (2016-2019)

• Phase 1: User Needs Research and Scoping (M1-9 complete)

• Phase 2: System Design, Development and Testing (M9 – M40)

• Phase 3: Pilot Trials and further co-design and development (M14 to M26)

• Phase 4: Main Proof of Concept Trial (2018: M26/27 to M37/38)
  • Ireland: 60 PwM and support actors
  • Belgium: 60 PwM and support actors
  • Conditions: Diabetes, COPD, CHF/CHD
  • Longitudinal Action Research Design (12 months)

• Phase 5: Transfer Feasibility Study (2018: M30 to M36)
  • Italy: 15 PwM and support actors
Engage, Sustain and Scale

Behavioural Change + Human Computer Interaction

User Needs and Requirements | Co-Design and Development | User Evaluation
1: User Requirements: Scoping

Significant desk research;
Literature and policy reviews on disease management, treatment and care pathways within national contexts
Person with Multimorbidity

- Pharmacy
- GP
- Informal carer
- Hospital-based clinicians
- Formal care
- Community-based clinicians
- Peers
User Requirements

- Qualitative study
- Interviews and focus groups – semi-structured; 45-120 minutes
- Demographic questionnaires (PwM and informal carer)
- 124 participants across Ireland and Belgium
- Thematic analysis
- Diabetes + CHF/CHD most prevalent
- 57% women
- 21% MCI

<table>
<thead>
<tr>
<th></th>
<th>Ireland</th>
<th>Belgium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person with Multimorbidity</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Informal carer</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Formal carer</td>
<td>11</td>
<td>10</td>
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<tr>
<td>GP</td>
<td>6</td>
<td>5</td>
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<tr>
<td>Community based healthcare</td>
<td></td>
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<tr>
<td>Public health nurse; care</td>
<td></td>
<td></td>
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<tr>
<td>coordinator</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Hospital based clinician</td>
<td></td>
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<tr>
<td>Geriatrician; Clinical</td>
<td></td>
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<tr>
<td>Nurse Specialists; Physio;</td>
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<tr>
<td>Occupational Therapist;</td>
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<tr>
<td>Dietician; Speech and</td>
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<tr>
<td>Language Therapist;</td>
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<tr>
<td>Cardiologist; Endocrinologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal care provider</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>124</strong></td>
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</table>
Key Outcomes - PwM

• **Hugely impacts on;** Lifestyle, relationships, psychological well-being

• **Lack of awareness of** strategies for self-management

• **Complexities of interactions** between conditions aren’t understood

• **Maintaining independence** - remaining at home - key motivator!

• **Barriers to self-management;** Lack of physical mobility; Limitations of conditions

• **Polypharmacy:** difficult keeping track of many medications; Paper-based lists managed by PwM

“If there was one thing I believe that would help people that end up going back into hospital, or end up being at home safer, is a much better pathway in minding their medications”

(Healthcare Professional interviewed in Ireland)
Key Outcomes – Support Actors

- Lack of info on **how to navigate the healthcare system** & absence of one unified care plan.

- **Most information** received verbally/ info leaflets

- Essential role played by **informal carers**

- Additional training needs among **formal carers**

- **Pharmacist** reliable/trusted source of info/support

- **GP** – essential coordinating role

- **Communication difficulties** between healthcare professionals

- Currently **limited technology use** among healthcare professionals; mixed response to use; need to ensure it is accessible; benefit to collate all data in one place.

  “It’s definitely a case of detective work linking into the community, the family, and any of the MDTs that the patient is linked with. God, it’s hard.” (Healthcare Professional interviewed in Ireland)
We employed traditional user-centred HCI techniques to help to translate this qualitative data into meaningful requirements for design:

47 key requirements across a number of categories:

1. Reducing impact of multimorbidity (3)
2. Self-management of multimorbidity (14)
3. Medication management (7)
4. Information, knowledge and education (7)
5. Sources of support (3)
6. Communication (2)
7. Technology use (11)
2: Designing ProACT as a BC intervention

• **What is the aim of the system?**
  
  To improve self management skills and support for PwMs using a digital rather than paper based system.

• **What is the behaviour that needs to change to do this?**
  
  PwM - needs to change their behaviour from managing their conditions using memory and paper based strategies to a digital self management tool.

• **Systematic approach to address this?**
  
  The Behavioural Change Wheel approach involves an 8-stage process for developing behavioural change diagnoses and targeted interventional strategies.

(Michie, Atkins and West, 2014)
Why apply the BCW model?

• Enabled us to design ProACT technology as a behaviour change intervention

• Understanding target behaviours within the framework of COM-B provides the first steps in selecting appropriate intervention strategies to bring about the desired change.

• Process allowed us to provide a framework for evaluation

• Behaviour change interventions may fail because the wrong assumptions have been made about what needs to change (Michie, Atkins and West, 2014).
BCW: Informed the UI Design

• Through the process of creating intervention strategies for each of the targets, we have translated intervention functions into additional application features.

• It has also helped us to understand the importance of features within the system that we may not have otherwise focused on (such as habit formation, social support etc.)

• Understand and pin-point BC functions and techniques in the system and helping us to define how to evaluate them and the system as a DBCI
### Target 1: Measure and view key symptom readings on ProACT (Person with Multimorbidity)

<table>
<thead>
<tr>
<th>Intervention functions</th>
<th>COM-B components served by intervention functions</th>
<th>BCTs to deliver intervention functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td>Psychological capability</td>
<td>5.1 Information about health consequences</td>
</tr>
<tr>
<td></td>
<td>Reflective motivation</td>
<td>1.2 Feedback on behaviour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.7 Feedback on outcome(s) of the behaviour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.1 Prompts/cues</td>
</tr>
<tr>
<td><strong>Training</strong></td>
<td>Psychological capability</td>
<td>4.1 Instruction on how to perform a behaviour</td>
</tr>
<tr>
<td></td>
<td>Automatic Motivation</td>
<td>6.1 Demonstration of the behaviour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.3 Habit Formation.</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td>Physical opportunity</td>
<td>12.5 Adding objects to the environment</td>
</tr>
<tr>
<td><strong>Restructuring</strong></td>
<td></td>
<td>12.1 Restructuring the physical environment.</td>
</tr>
<tr>
<td><strong>Persuasion</strong></td>
<td>Reflective motivation</td>
<td>9.1 Credible source</td>
</tr>
<tr>
<td><strong>Enablement</strong></td>
<td>Social opportunity</td>
<td>3.1 Social support</td>
</tr>
<tr>
<td><strong>Incentivisation</strong></td>
<td>Reflective motivation</td>
<td>10.4 Social reward</td>
</tr>
</tbody>
</table>
BCW: Implications for Analytics

• BCW has highlighted the importance of *User Engagement metrics and analytics* to help us to evaluate ProACT as a BC intervention

• The BCW has highlighted the need for the *personalisation* of behaviour change techniques and interventions which we have considered in the design of our CareAnalytics (PROACT Artificial Intelligence - IBM)
1. Data cleaner
2. Probabilistic Health and Wellness Profile Builder
3. Goal Recommender
4. Education Recommender
5. User Engagement Analyser
GOAL SETTING

- **Presents particular challenges and complexities** for multimorbidity. Due to link with age additional conditions impact on ability to achieve goals.

- **S.M.A.R.T goals (Doran, 1981)** were not common practice for PwM or care network. Goals were general and not measurable.

- **Issue**: Lack of awareness around types of realistic goals to set, lack of support from care network (time, not wanting to overload PwM, sense PwM should self direct, care network insufficient data to inform goals). Peer rather than clinical support a key motivator.
Evaluating ProACT as a BC Intervention

Each of the BC targets will be evaluated by:

- **Analysing system usage statistics** – how participants engage with specific features of the system i.e. measuring symptoms, recognising change, view education content

- **Quantitative trial assessment data (assessment measures)**

- **Qualitative interview data** – Thematic Analysis - Understand experiences

**23 key metrics including:** Session length, dashboard time, reflection screen time, view readings time, view reading screen responses health tips time, my info time, button presses on each screen, daily app opens etc.

**19 Assessments including:** Usability (T2;T3;T4), Burden (T2;T3;T4), technology proficiency (T1;T4), social connectedness (T1, T4), QoL (T1-T4), self efficacy (T1-T4, illness perceptions (T1-4), self-management (T1-T4), Demo (T1), med lists (T1;T4)

Interview schedules, reflect key assessment areas above.
3: Co-design Process

- A subset of participants were invited to take part in co-design activities

- **Goal**: ensure user involvement at all stages

- Validate findings from phase 1; further explore some areas; support design of ProACT ecosystem and CareApps;

- **Sessions used to**:
  - Inform the main features and concepts
  - Inform the interface design
  - Med Application and feedback on initial designs
Review, Confirm, Refine (Redesign)

Proof of Concept Study: Learn and confirm how it works
Conclusions

• Digital health **holds promise** but designing and delivering DBCI’s is **challenging**

• Key to our success is to design interventions based on a **strong theoretical foundation** – strong PoC

• **Technology advances rapidly** - Agile, iterative methodologies are needed to develop strong PoC’s before larger studies

• **Funding for larger studies** is required

• **Multimorbidity/Comorbidity** – May **unlock** how we can manage diseases on a single platform

• **AND FINALLY....**
Combining science, politics and economics
The people at the heart of the issue
Q1. Why Bother?
ARE YOU READY?
Q2. Is it a National/EU/Global priority?
Q3. Is the solution already available?
Q4. Why are you the best people for the work?
Q5. What would happen if you weren’t funded? (Would anyone care?)

Designing a Digital Behavioural Change Intervention for Multi-morbidity Self-Management

State of the Art
What the Solution?
Build your team (Do you have industry support?)

IMPACT: Design and implement to engage, sustain and scale
Thank You!

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