Systems Modelling and Simulation in Healthcare

A psychologist's reflections on the use of modelling in developing a new service

Dr. Fergus Gracey
NIHR CLAHRC for Cambridgeshire and Peterborough
Cambridge Centre for Paediatric Neuropsychological Rehabilitation (CCPNR)
Oliver Zangwill Centre, Cambridgeshire

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This presentation is about

1. A new community rehabilitation service for children with acquired brain injury
2. The challenges we faced and our collaborations with systems engineers
3. The evolving dialogue between a systems engineer and a neuropsychologist
4. Developing a psychological understanding of systems modelling
What do clinical (neuro)psychologists do?

• Clinical psychology is about the use of psychological methods (e.g. cognitive testing) and models (e.g. cognitive behavioural model of depression) to solve clinical problems in the NHS (e.g. how to reduce someone’s risk of suicide after their brain injury)
• At senior levels also expected to address team and service level problems
Formulation

“Patients come to psychotherapy because they are demoralised by the menacing meanings of their symptoms. The therapist collaborates with the patient in formulating a plausible story that makes the meanings of the symptoms more benign and provides procedures for combating them thereby enabling the patient to regain his morale”

(Frank, 1986: cited by Butler, 1998)
Formulation

“A formulation is essentially a hypothesis about the causes, precipitants, and maintaining influences of a person’s problems. A case formulation helps organise often complex and contradictory information. It should serve as a blueprint guiding treatment, as a marker for change, and as a structure enabling the therapist to understand the patient better ... help the therapist anticipate any therapy interfering events and experience greater empathy ...

(Eells, 1997: p1-2)
• CCPNR was set up to meet the needs of children and families affected by brain injury living in the East of England Region
In order to help children with

- ‘hidden disability’
  - Cognitive, emotional and social communication
  - Impacting on home, community and school
  - Requiring intensive neuropsychological intervention
  - Delivered directly with the child and via consultation and training of parents, teaching assistants, others
  - 13 funded full packages of assessment and rehab to break even
  - Case-by-case funding
<table>
<thead>
<tr>
<th>Initial Assessment</th>
<th>Detailed assessment and consultation</th>
<th>Individualised programme</th>
<th>Follow-up and review</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘1 day’ 4 hrs face to face</td>
<td>‘5 days’ 20 hours face to face</td>
<td>12 days 60 hours face to face</td>
<td>Repeat assessment and consultation</td>
</tr>
<tr>
<td>Individual assessment of child and family members</td>
<td>Targeted assessment and consultation</td>
<td>Intensive intervention</td>
<td>Readmission to programme</td>
</tr>
<tr>
<td>Consultation and advice</td>
<td>Limited or brief interventions</td>
<td>Group, individual; child, family or school focus</td>
<td></td>
</tr>
</tbody>
</table>
Challenges # 1

• Decisions about how to (re)structure programme to improve financial and clinical processes

• Still building up referrals
  – Number of assessments to complete in order to progress to full rehabilitation programme
  – Significant delays to funding
Modelling approach: CCPNR Conceptual Model

Referrals → 0

Screening → 1

Funding IA → 2

IA → 3

Funding Bundle → 4

Discharged @ DA

Rejected @ Funding DA

Rejected @ Funding Bun.

Rejected @ Funding FP

Rejected @ Funding IA

Rejected @ Screening

DAs @ T=0

IAs @ T=0

FPs @ T=0

Exit service

Cambs clients flow

General flow

Sources of clients

Client exit points

Processes

Decision points

Summing points

T = Simulation time

Alex Komashie, EDC
Modelling results

- Funding requests lead time 1 week – 6 months
- 3 requests per service user required to move to full programme of rehabilitation
- Decision made to move to offering ‘bundled’ package – 2 funding requests only required
- Modelling experiment confirmed viability of this option
Outcome

• More confident with decision making about changes to service structure
• Developing a ‘feel’ for how the service works from seeing the service ‘engine’ running
Challenge #2

- Difficulty understanding and conveying the complex service model to Trust managers
- Pressure from managers to reduce team size
Service modelling: Profit

Model of service showing profit over 1 year starting from 0 service users with full clinical team in place
Shifted perspective of Trust managers

Before:
• Number of referrals = £
• Not enough £ = not enough referrals
• Cut staff

After:
• X number of referrals may convert to Y assessments in order to do Z rehab programmes ...
• It’s a complicated service model ... how can we make it work?
Challenge # 3

- Number of referrals increases
  - Team needs to get more organised, improve mechanisms, get more efficient
- Travel becoming a real problem
Modelling approach

• OASIS project - Cecily Morrison
  – Issues mapping session
  – Driving the team to really explore the initial question
Question: how to reduce travel time?
Answer: how can we work together more closely?
Further outcomes

• Team adopted the idea of ‘redesigning the aircraft in flight’ (Sterman, 2000) that Alex introduced
• Facilitated team reflection on service organisation
• However, potential for modelling to help identify solutions still unclear to the team
Ongoing Challenges

• NHS timescale for action vs time taken to do modelling
• Team members’ urgency to address concerns, make changes
  – Impossible to stick to a ‘design’ timetable
  – Culture in healthcare of responding to needs with actions
  – A design approach may be anxiety provoking
• Service users, team members and service managers also within systems that impact upon each other
Understanding systemic complexity

- **Family context**
  - Disruption - adaptation

- **Service context**
  - Disruption - adaptation
  - Rehabilitation professional

- **Organisational context**
  - Disruption - adaptation
  - Supervisor or manager

“Complex” service user
Understanding systemic complexity

- Family context
  - Disruption - adaptation

- Service context
  - Disruption - adaptation

“Complex” service user

Rehabilitation professional

- Service context
  - Disruption - adaptation

- Organisational context
  - Disruption - adaptation

Supervisor or manager

Modelling provided additional capacity for reflection and problem solving
Neuropsychology and systems engineering
An evolving dialogue ...

• Modelling a helpful tool in the face of complexity

• Comparable with
  – formulation in clinical psychology: shared understanding, empathy, ‘attunement’
  – ‘compensatory strategies’ in cognitive rehabilitation

• Modelling as ‘distributed cognition’
  – “Cognitive activity is sometimes situated in the material world in such a way that the environment is a computational medium” (Hutchins, 1998, p. 7)
Formulation

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A case formulation helps organise often complex and contradictory information.

It should serve as a blueprint guiding treatment, as a marker for change, and as a structure enabling the therapist to understand the patient better ... help the therapist anticipate any therapy interfering events and experience greater empathy ...

(Eells, 1997: p1-2)
Modelling to support ‘distributed cognition’ in a service

- Shared ideas about complex service system
- Static models
- Dynamic simulation
- Team shared language for service complexity
- Ideas about service system
- Understanding of service system
- Team member’s behaviour

Service

Team members
Healthcare systems modelling: an integrated account

Group culture: Shared beliefs and practices

Interpersonal ‘scaffolding’: Relationship development

Metacognitive ‘scaffolding’: Model as shared representation

RESOURCES → MECHANISMS → GOALS

NIHR CLAHRC for Cambridgeshire & Peterborough
Design for Better Mental Health Care

National Institute for Health Research

Collaborations for Leadership in Applied Health Research and Care

University of Cambridge
Cambridgeshire and Peterborough NHS Foundation Trust
Final reflections

• Systems modelling approaches have been an important aspect of CCPNR service development

• Convergence of approaches between systems engineering and clinical psychology
  – A range of specific systems engineering tools for exploring and representing complexity
  – Specific psychological methods for understanding modelling in terms of cognitive and interpersonal processes
  – Research into implementation vs implementation of research?
"All Models Are Wrong But Some Are Useful"