THE IMPACT OF DIGITAL INNOVATION IN HEALTH CARE:

A CASE STUDY OF HEALTH CARE ROBOTICS IN NHS GREATER GLASGOW & CLYDE

Dr. Robert van der Meer
Reader in Management Science
Strathclyde Business School
University of Strathclyde
Glasgow, Scotland, UK

© University of Strathclyde

Questions to the audience

1. In the short-term, the main risks of digital innovation (*robotics, AI*) in health care are caused by technical problems. ***YES/NO?***

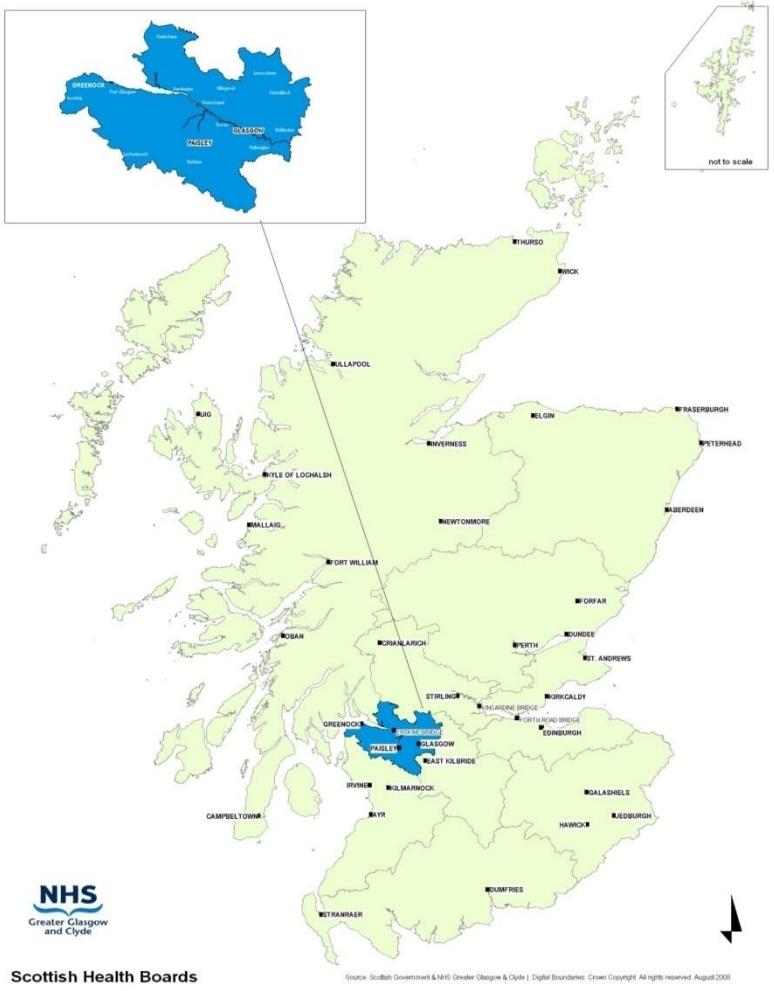
2. In the longer term, digital innovation improves the jobs of all health care staff. ***YES/NO?***

3. The main benefits of digital innovation in health care are related to efficiency gains (improvements in cost and speed). ***YES/NO?***

Content of the presentation

- The pharmacy service redesign project:
  - Making the Most of your Medicines (MMyM)
  - Pharmacy Distribution Centre (PDC)
- Research aim and methodology
- Findings from first stage of the research
- Findings from second stage of the research
- Overall benefits gained
- Conclusions

NHS Greater Glasgow & Clyde



- *€130m spend on Medicines (€25m Homecare)*
- *14 different Hospital sites (includes specialist mental health)*
- *534 Pharmacy Staff (headcount)*
- *€20m Pharmacy Staff Cost*
- *153 Pharmacists*
- *198 Pharmacy Technicians*
- *78 Other Staff*

Pharmacy service re-design

The re-design vision:

- to redefine the core service around ***'patients own medicines' (MMyM) medication management*** for hospital inpatients;
- to redesign, consolidate and automate hospital pharmacy medicines distribution, in order to ***release staff to near-patient tasks*** as part of integrated clinical teams;
- to adopt ***digital innovation*** as an integral part of this redesign.

PPSU Inpatient Medicines Management Future State Design

Brings Own Meds

Ward Medicine Cupboard

Hospital Dispensary

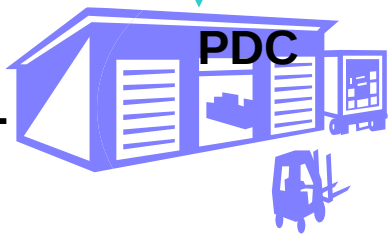
MMyM Locker

Takes Home Meds

Dispensary Order

Ward Order

GG&C



PDC

Making the Most of Your Medicines (MMyM)

Principles:

- re-design of inpatient medication systems;
- drug administration as a care episode, not a task;
- uses patients' own medicines and facilitates self-administration by patients;
- reduces need for discharge prescriptions;
- care shared with community pharmacists;
- forms a vital link in the patient pack cycle in NHS Scotland.

MMyM bedside locker

PPSU Inpatient Medicines Management Future State Design

Brings Own Meds

Ward Medicine Cupboard

Hospital Dispensary

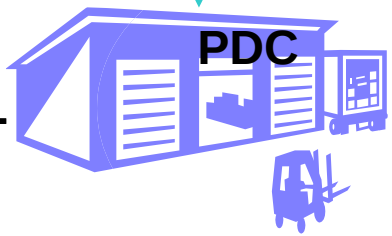
MMyM Locker

Takes Home Meds

Dispensary Order

Ward Order

GG&C



PDC

Pharmacy Distribution Centre (PDC) from spring 2010

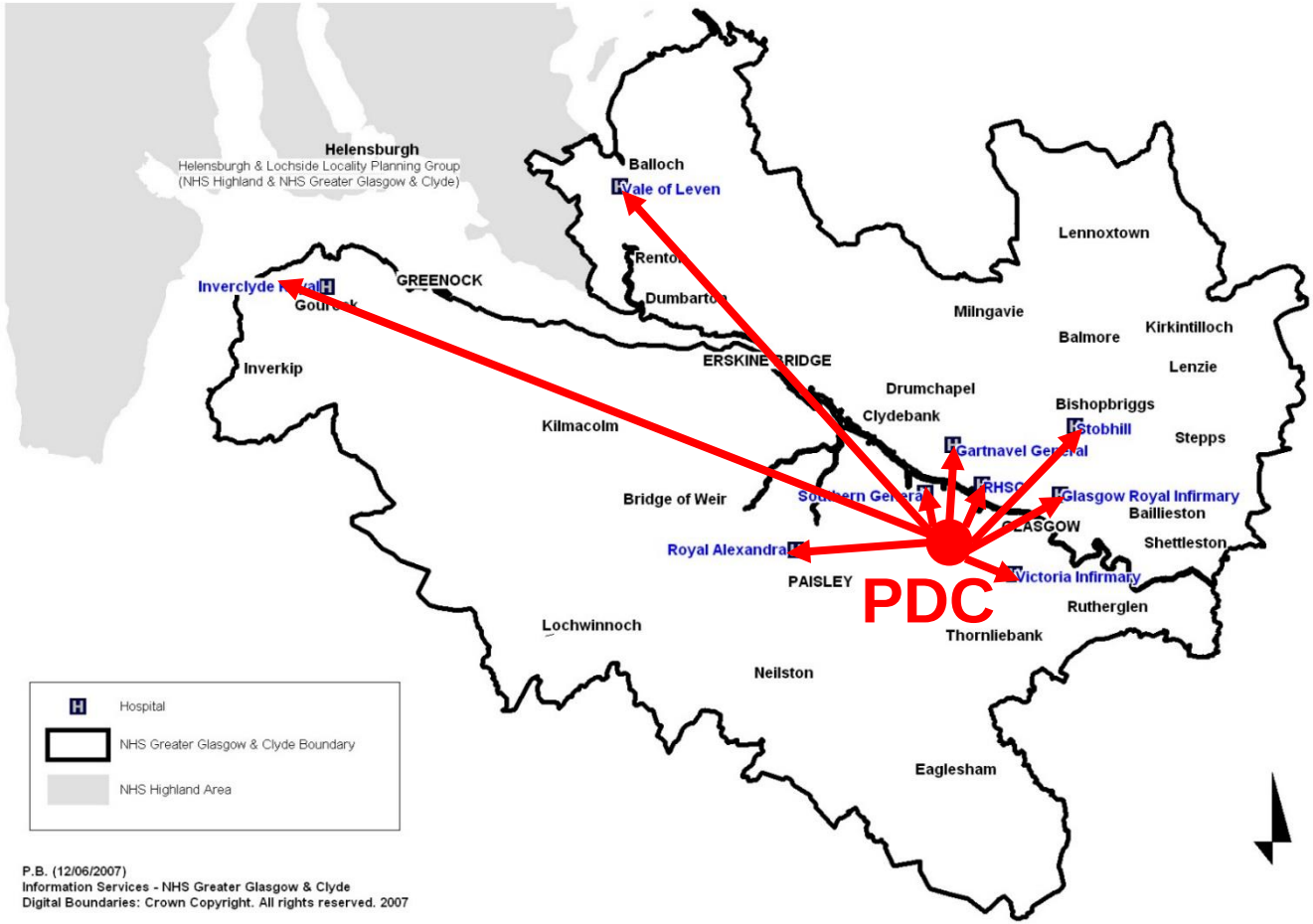
- Single facility responsible for the procurement and automated distribution of medicines to replenish ward and site pharmacy stocks for all hospitals and community clinics in the region.
- Eight robots (ROWA VMAX Extent2), with Prologs, working in tandem as an integrated storage and distribution system.
  - Vmax picking head for accuracy and speed.
  - Connected by conveyor systems.
  - Interfaced with Ascribe Pharmacy Management system.
  - Additional robot for safe handling of narcotic agents.

Pharmacy Distribution Centre (PDC)

Impact on work organisation

- Most pharmacists, many pharmacy technicians and some pharmacy support staff were relocated to ‘nearer the patient’, ward-based activities.
- Other pharmacy technicians and many members of support staff were redeployed to the PDC to manage the automated distribution processes.
- A minority of pharmacy staff were retained to deliver the remaining support services provided by hospital dispensaries.

Pharmacy service re-design, NHS Greater Glasgow & Clyde



- *PDC investment = €1.25m*
- *IT upgrade = €0.9m*
- *Automated dispensaries = €1.1m*
- *Staff training*
- *Total CAPEX over 3 years = €3.5m*

Research aim

- To analyse and assess the impact of the ***large-scale automation*** of medicines distribution – in both the initial stage of implementation and the longer term – on efficiency and safety in the supply network as well as staff satisfaction.
- The analysis is primarily set within a ***socio-technical systems*** framework, as this enables due attention to be paid to both the technical and the social dimensions of a technological innovation, as well as the interactions between these dimensions.

Findings from the academic and professional literature

- Most of the attention so far has focused on relatively small-scale dispensing systems rather than large-scale distribution systems (*Goundrey-Smith 2013)*.
- The severity of implementation problems is likely to increase disproportionately with the scale and complexity of a healthcare technology installation *(Greenhalgh & Stones 2010).*
- There are still important questions about the nature of interactions within a network of human actors and technological entities (such as IT systems or robots) in the longer term *(Cresswell et al. 2010).*

Research methodology

1. First stage of the research:
   - ***Action research:*** monthly project board meetings comprising senior pharmacy management, key pharmacy staff and university research team.
   - Interviews with thirty-six pharmacy staff from four hospital sites (700-900 inpatient beds per site) in the summer of 2010.
2. Second stage of the research:
   - Interviews with another thirty-six pharmacy staff in the second half of 2012.
   - 'Key stakeholder' interviews with management, employee partnership groups and trade unions.

Findings from the first stage of the research

- Three problem areas related to the technical dimensions of the newly redesigned system:
  1. the robotic storage and distribution system;
  2. the pharmacy management system;
  3. sourcing medicines unavailable from the pharmacy distribution centre.
- The other three problem areas related to its social or human dimensions:
  1. understanding staff roles within the new system;
  2. the importance of effective communication;
  3. the effect of the redesign on staff morale.

Discussion of findings from the first stage (1)

- Previous (legacy) design configuration of the storage and distribution system: ***decentralised*** in nature, in terms of both its technical and social dimensions.
- New configuration: ***technical*** dimension (large-scale robotic system in a separate location) strongly ***centralised***, but ***social*** dimension (responsibility for the dispensing of medicines to individual hospital patients) still ***decentralised***.
- Staff perception: centralised characteristics of the technical dimension no longer in step with decentralised characteristics of the social dimension.

Discussion of findings from the first stage (2)

- ***Two-way negative interaction*** between the technical dimension of the new system and its social dimension.
  - Negative impact of technical problems on the ability of local teams to provide an effective pharmacy service.
  - In response, local teams took 'defensive' action – thereby exacerbating technical problems even further.
- The implementation of a large and technically complex system is likely to result in ***unintended consequences*** that are almost impossible to specify beforehand.

Benefits gained after the first stage

- Early implementation problems, particularly those of technical nature, had been overcome by a combination of efforts directed from the centre and local learning.
- Reported benefits of redesign programme:
  - Release of floor space.
  - More effective use of pharmacy staff.
  - Patient safety improvements.
  - Stock rationalisation and order-processing efficiencies.
  - Pharmacy stock waste reduction.
  - Processing and administration enhancements.

Findings from the second stage of the research

- Mixed impact of the redesign project on training opportunities for staff.
- Different experiences between front-stage staff and back-stage staff.
  - More job satisfaction and control over their work for pharmacy technicians and support workers involved ward-based services.
  - Less opportunities for progression for pharmacy technicians redeployed in a back-stage capacity to the PDC.

Discussion of findings from the second stage

- Three recurring themes:
  1. Limited opportunity for staff engagement in shaping the initial decision-making process.
  2. Post-redesign opportunities for personal development differed between pharmacy staff groups.
  3. Positive impact on job quality for staff delivering ***front-stage*** services ‘nearer to patients’; more negative impact for staff redeployed to perform ***back-stage*** standardised tasks.

Overall benefits gained PDC

- *PDC operating 24 hours/day, 7 days/week*
  - Weekend support for ward based teams.
  - Out-of-hours emergency supply on video call remote authorisation of pharmacist.
- *PDC dashboard performance:*
  - Service level: 98.1%
  - Stock value held: €5.3m
  - Days stock: less than 8 days
  - Orders picked per week: 24,000 (90,000 packs)
  - Automated picks: 78% of packs

Overall benefits gained MMyM (1)

- *Access to MMyM service*
  - January 2015: **96%** of inpatient beds *(36% in 2008).*
- *Access to Clinical Pharmacist*
  - June 2014: **96%** of hospital inpatients *(60% in 2007).*
- *Improved patient safety through MMyM*
  - MMyM assists medicines reconciliation and highlights any patient non-compliance.
  - Nursing staff report improved patient safety.
  - Improves communication of information at inpatient discharge to community pharmacists.

Overall benefits gained MMyM (2)

- *MMyM quality and efficiency*
  - Compliance with requirement to include patient information leaflet with each dispensed item.
  - High level of patient satisfaction.
  - €8.50 saved per patient admitted through avoidance of needless destruction of patient's medicines brought with them in to hospital.
  - Avoidance of duplicate stock ordering: €400 per bed per annum.
  - Dispensing time for discharge reduced from 7 minutes per item to 3 minutes.

Conclusions

- New technology may lead to unintended first-order consequences, but can also generate potentially serious ***adverse feedback loops*** between the social and technical dimensions of the new system.
- The longer-term impact of new technology may be quite different for different groups of healthcare staff. ***Frontline staff*** are freed from more routine administrative activities, enabling them to spend more time directly with patients.
- If early-stage problems can be effectively overcome, then significant benefits are achievable in terms of ***patient safety, quality and efficiency***.

Questions to the audience - reprise

1. *In the short-term, the main risks of digital innovation (robotics, AI) in health care are caused by technical problems.*

- **NO.** Problems may occur in both the technical and the social dimensions of the new system. Of particular concern is the possibility of adverse feedback loops between the different dimensions of the system.

Questions to the audience - reprise

2. *In the longer term, digital innovation improves the jobs of all health care staff.*

- **NO.** Health care staff moved to back-stage activities (to manage automated processes away from patients) may experience a deterioration in job quality. Sufficient opportunities for progression should be created for staff in that position.

Questions to the audience - reprise

3. *The main benefits of digital innovation in health care are related to efficiency gains.*

- **NO.** Digital innovation can free up key resources and enable health care staff to focus on near-patient tasks – thereby improving patient safety and service quality as well as efficiency. But for new technology to be successful, it must be effectively integrated into the socio-technical system.