The next 50 years of Operational Research in Health in the UK

(with some lessons from the last 50)

Dr Geoff Royston
Former Head of Strategic Analysis and Operational Research, Department of Health
Two health warnings

1. Prediction is very difficult, especially if it's about the future."
   (Neils Bohr)

2. A practitioner’s perspective, and not a comprehensive overview

But it does draw on thirty years of personal experience, various shades of white and grey literature, and views recently sought from a range of prominent UK health analysts (for which grateful thanks)
1. What are coming challenges for health or healthcare where OR analysts should seek to make a significant impact – and how could we could best contribute?

2. What lessons should OR analysts working in health take from the past to help make a bigger impact in the future – and what should we do today to prepare the path?
Yesterday’s World
Today’s World
Tomorrow’s World?
We can hope for continuing improvements in the health of the UK population

Mortality from the major killers has fallen

Life expectancy has risen dramatically

Source: Office for National Statistics / Government Actuaries Department (GAD)
Health care is a likely major growth area

The proportion of UK GDP spent on healthcare has steadily risen

And this rise is expected to continue

The Wanless report estimated that in fifteen years time between 10.5% and 13% of GDP would be required to fund the UK health system
NHS reform will continue, aiming at improving quality, choice, diversity, and efficiency

**TRANSACTIONAL REFORM**
Money following the patients, rewarding the best and most efficient providers, giving others the incentive to improve

** DEMAND-SIDE REFORM**
More choice and a much stronger voice for patients

**SUPPLY-SIDE REFORM**
More diverse providers, with more freedom to innovate and improve services

**SYSTEM MANAGEMENT AND REGULATION**
A framework of system management, regulation and decision making which guarantees safety and quality, fairness, equity and value for money

**Better health**
**Better care**
**Better value**
More care should be safely and cost-effectively delivered “upstream” - in or closer to home

Technology can support integrated care at home

Dramatic improvements in home care are being achieved with technological support

- Care cost reductions per patient from £21,000 to £7,000 per annum (Telecare pilot UK)
- £3,000 saving per emergency admission in England (CFH)
Better chronic disease management should bring major gains

- Much stronger support for **self-care**, through personalised information and local peer groups
- **Universal case management** for those with greater need
- Requirement for **multi-disciplinary teams** across health and social care
- **GPs held accountable** for the care of their registered population

**‘Our Health, Our Care, Our Say’ strengthened approach to long term conditions**

**Predicting likely future use at individual level is becoming easier**

**Risk factors/diagnosis**

- High
  - Active recall and review
- Medium
  - “Routine plus”
- Low
  - Routine check-ups only

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**Inverting the traditional pyramid of care by supporting self care and co-production**

**20th Century Health Care?**

- Individual self care
- Support of family and friends
- Support of community networks

**21st Century Health Care?**

- Complex cases with co-morbidities
- Equal share of care
- Self care
Better health promotion and prevention could produce a real primary care-led NHS

Current Preventative and Public Health Care Spend is relatively low

Key “Choosing Health” allocations
- Action on diet, activity & obesity: £34 million
- NHS Stop Smoking Services: £5 million
- Alcohol interventions: £15 million

‘Choosing Health’ and ‘OHOCOS’ white papers re-prioritised public health and prevention
- Reduce the numbers who smoke
- Tackle obesity – with a focus on children
- Increase physical activity – more opportunities
- Support sensible drinking
- Improve sexual health
- Improve mental health and well being
- NHS Life Check targeted at key life stages
- Health & social care working together
- Better information, more support for self care
- Tackle health inequalities
Improvements need to be supported by modern IT and good financial management

**National Programme for IT**

- The ultimate goal is better integration of electronic patient records, e-prescribing, and electronic appointment scheduling with an underlying principle of patient choice.
- To truly realise productivity gains, this IT investment will need to be accompanied by profound service transformation – learn from Wal-Mart or Ryanair

**Financial Management**

- Solid financial forecasting coupled with effective budget-setting and monitoring procedures
- Trusts need to ensure their own financial systems are collecting the correct and accurate financial data in a timely fashion.
There remains much scope for improvement in efficiency and productivity

### Huge variations in activity exist:

- Internationally: e.g. the UK does twice as many surgical procedures as in Spain.
- At the local level: e.g. activity levels of endoscopy operations can vary by as much as 800% (on stomach & intestine, 2003/04) by primary care trust.
- A significant fraction of A&E presentations and emergency admissions are unnecessary.

### There is wide variation in length of hospital stay:

- Varies enormously across 72 large acute trusts – driven by discharge rounds, adverse events, hospital acquired infection, etc… Up to £2bn direct cost of additional bed days.

### There is wide variation in use of day case surgery:

- Healthcare Commission calculate at least 74,000 operations could be moved to day surgery.
And in addressing persisting inequalities in health status

Life expectancy varies considerably across the country

Poverty and poor health tend to go together

Minority groups often have worse health

[Maps and graphs showing life expectancy, prevalence of mental disorders, and maternal death rates by ethnic group]
Change will not be problem free!

For example - the changes threaten the traditional acute hospital

- Working Time Directive
- Specialisation
- New technology

- Shorter hospital stays
- Cheaper technology
- More anticipatory care
- More drug treatments
- Near-patient testing
- Expert patients
Looking further ahead, there are many possible health futures.

- **“NORDIC HEAVEN”**
- **HEALTHY LIFESTYLE**
- **ECONOMIC GROWTH**
- **“AMERICAN NIGHTMARE”**
- **UNHEALTHY LIFESTYLE**
- **“EQUALITY IN ADVERSITY”**
- **ECONOMIC COLLAPSE**
- **“NASTY, BRUTISH AND FAT”**
We need to watch for trends and for discontinuities—white sails and black swans

health trends
-e.g. ageing population, obesity, telecare

health discontinuities
-e.g. AIDS, Viagra, Avian Flu
We have to live in an unpredictable world that we don’t understand very well

A turkey is fed for a 1000 days—every day confirms that the human race cares about its welfare “with increased statistical significance”. On the 1001st day, the turkey has a surprise.
Our uncertainty about the future increases with time

There are only a few entirely robust forecasting methods*

*illustration thanks to Philip Hadridge
Although the track record is not too bad

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
</table>
| 2000 | Artificial blood  
          Full medical records stored on smart cards |
| 2005 | Personal wearable health monitors  
          Determination of whole human DNA base sequence |
| 2010 | Artificial heart  
          Robots extensively used for routine hospital tasks |
| 2015 | Genetic links to all diseases identified  
          Individual’s genome is part of medical record  
          Artificial lungs and kidneys |
| 2020 | Artificial liver  
          Extension of average human life span to 100 years |

Source: BT Technology Calendar 1997 - 2045
We need to scan a range of major external factors influencing future health and care.
Their combined effect on the health and care system is likely to be profound
An ageing population will put increasing pressure on NHS care

The ratio of the working age population to 65+ age group is set to drop rapidly

There will be zoomers and zimmers – and some who are both

People with long term conditions already account for about 70% of total health & social care spend. We may have 2 million more people with Long Term Conditions (LTCs) by 2020

Source: Government Actuary Department

Source: Department of Health

Source: Wanless Report
Our lifestyles are offsetting the gains made in public and personal health care

Obesity is projected to rise—though smoking shows trends can be shifted

- There are already more obese than normal weight adult males, by 2050 60% of men and 50% of women are forecast to be obese
- Similar trends can be seen with drinking; however, smoking is set to decline, albeit with a hardcore of remaining smokers

These lifestyle factors are having a very significant impact on the incidence of disease

Estimated impact of the increasing trend in obesity by 2023 (% change)

Source: Choosing Health: Making Healthy Choices Easier, DH, 2004
The public will expect far more from public services, tailored to their individual needs.

Consumer expectations now apply to public services

Areas of public services that need improvement

- Keeping me informed on the services they provide
- Making it easy to get in touch when you have an enquiry
- Quickly responding to an enquiry
- Being able to contact them at weekends and in the evening

People will look for “soft” factors - a more personal and sensitive approach to care

- Patient experience
- Medical treatment & outcome
- Other factors
- Patient/locaton factors (age/sex health status)

The overall “utility” or satisfaction indicator that a patient gives the service received

Around 50% of patient satisfaction with hospital treatment is related to non-medical factors

Source: Marion Nestle, NYU, Nutrition Action Healthletter, 2002; PMSU policy review of public services; Motivations, mindsets and the NHS-SHM research 2007; Understanding drivers of patient satisfaction DH 2005; What the citizen wants - Henley Centre 2007
Medical technology holds out the prospect of a new era in personalised care

Genomics is transforming the pharmaceutical industry

Trastuzumab (Herceptin) is the most well known drug to result from pharmacogenomic design. There has been extensive debate about its cost-effectiveness, affordability and the initial lack of NICE approval for its widespread use.

Robots and nanotechnology will play an increasing role in food and medicine.

Personal Robotics Market ($000s)

The medical robotics market is forecast to quadruple from $1.3bn in 2006 to $5.7bn in 2011

Nanotechnology could manipulate molecules of foods to modify taste and change the nutritional values.

However the Soil Association have already adopted a “no-nano” position on organic certification.
The next 50 years of OR in Health in the UK

Information will become ever more accessible

- For most patients the first and most trusted source of information is their doctor, however faith in doctors’ expertise if beginning to erode – especially the younger patients (MORI 2001)

- In USA, many patients with chronic disease have rated their online support group as a more important resource than their health professional for many aspects of their health care.

Source: Usage and Attitude survey DH; Mori; Technorati, April 2007

People increasingly access health information from the internet

<table>
<thead>
<tr>
<th>Sources of health information</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor</td>
<td>73%</td>
</tr>
<tr>
<td>Internet/website</td>
<td>30%</td>
</tr>
<tr>
<td>Leaflets or books</td>
<td>23%</td>
</tr>
<tr>
<td>Nurse/other health professional</td>
<td>22%</td>
</tr>
<tr>
<td>Family &amp; Friends</td>
<td>19%</td>
</tr>
<tr>
<td>Newspaper/magazines</td>
<td>18%</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>7%</td>
</tr>
<tr>
<td>Patient organisations</td>
<td>6%</td>
</tr>
<tr>
<td>TV/Radio</td>
<td>4%</td>
</tr>
<tr>
<td>Advertisements</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>1%</td>
</tr>
</tbody>
</table>

Ubiquitous connectivity will promote remote monitoring of conditions

- Wireless sensors will allow diagnostic information to be monitored continuously from a distance by health professionals with a patient being almost unaware

- However, this raises confidentiality issues since there is also a risk that such data could be hacked into by other wireless devices

Smart Shirt

Vital Monitoring System
The workforce is likely to become increasingly diverse

Driven by demographics the workforce will age and depend more on women and immigrants

This will impact the health and care workforce

- Females now constitute 40% of GPs, and 60% of medical students. This will mean a greater requirement for part-time working and more flexible hours
- Similarly the NHS is already disproportionately dependent on staff from overseas (14% of the workforce vs 8% of UK population), and it is likely that this will continue
- Retaining older healthcare workers will also be crucial

The health and care workforce could also increasingly draw on the 3rd sector

Source: ONS; DH
The worldwide economic downturn may slow growth in health care spend

Health care behaves as a “luxury good” – the % of GDP spent on it increases with GDP

Source: WHO 2006
Climate change is expected to increasingly impact on health and care. World food supplies are also emerging as a key issue.

The impacts effects of climate change on health and care could be significant:

- Climate change, if it is not halted, will lead to more extremes of weather that will impact on health and care.
- For instance, hot weather will cause problems for COPD patients, and flooding could lead to public health outbreaks.

Food crisis will take hold before climate change:

- It has been predicted that price rises in staples such as rice, maize and wheat would continue because of increased demand caused by population growth and increasing wealth in developing nations.
- The biofuel industry, has delivered a "major shock" to world food prices. Wheat prices in the UK have doubled in 12 months. Biofuel production is due to increase hugely in the next 15 years.

Source: IPCC Global Climate Predictions 4th Report; DTI Foresight; Maplecroft, 2007; Prof John Beddington Guardian 7th March.
Emerging diseases can come from abroad, but the UK is also susceptible to home grown diseases.

Global travel is forecast to continue rising, easing spread of infections - & health tourism

But the density of humans and wildlife make the UK too a global hotspot for emerging infectious diseases.

Map of world's Emerging Infectious Diseases hotspots

**Global Risk of Human Influenza**

- **Extreme (0.0-2.5)**
- **High (2.5-5.0)**
- **Medium (5.0-7.5)**
- **Low (7.5-10.0)**
- **No data**

- **Hotspots**
- Countries with confirmed human cases of H1N1

**Sources:**

Infectious diseases transmissible between animals & humans

Higher levels
Middle levels
Lower levels

**Source:** Nature
How will OR meet these future challenges of change?

**Changes – e.g.**
- Aging ‘Baby Boomer’ Generation
- Rising expectations
- Changing lifestyles

**Challenges – e.g.**
- Ensuring provision for older people is more joined up – hospital and social care working together
- Changing services to allow care to be tailored to individual needs - more choice and responsiveness
- Promoting healthy lifestyles - shifting care upstream from treatment to prevention
We do have a significant contribution to offer - e.g.

<table>
<thead>
<tr>
<th>Challenges</th>
<th>OR Contribution</th>
<th>Analytical Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital and community services working together</td>
<td>Helping understand and manage the interface between health and social care</td>
<td>&quot;whole system&quot; mapping and modelling</td>
</tr>
<tr>
<td>Greater choice and responsiveness</td>
<td>Helping to set, implement and monitor standards for customer service</td>
<td>Waiting time and capacity modelling</td>
</tr>
<tr>
<td>Shifting care upstream from treatment to prevention</td>
<td>Exploring balance and timing of impact for treatment and prevention options</td>
<td>System dynamics modelling, decision analysis</td>
</tr>
</tbody>
</table>
An effective response will depend on generic factors too - we should remember wise words from the past

Some of Blackett’s principles for effective OR

**Collaborative** “An OR section should be an integral part of a command and should work in the closest collaboration with the various departments at the command”

**Grounded** “All members of an OR section should spend part of their time at operational stations in close touch with the personnel actually on the job”

**Pathfinding** “An OR section which contents itself with the routine production of statistical reports and narratives will be of very limited value”

Three of Tomlinson’s six principles for effective OR

**Catholic** – OR should not be hide bound in techniques but should be wide ranging in the problems it addresses and the methods it is prepared to use

**Balanced** – the programme of the OR group should be balanced between long and short projects, tactical and strategic work and between old and new work

**Catalytic** – OR is an agent of change within the organisation
It’s *not* rocket science – in health care we are dealing with complex adaptive human activity systems!

Technical advance is important but this is not the crucial challenge facing OR in health – or most other areas - today

<table>
<thead>
<tr>
<th>Factors affecting project success</th>
<th>Factors leading to project failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management support/involvement</td>
<td>Too technical/abstract approach</td>
</tr>
<tr>
<td>Verifiable and useful results</td>
<td>Customer not sold on the project</td>
</tr>
<tr>
<td>Well organised/communicated/presented</td>
<td>Poor communication</td>
</tr>
<tr>
<td>Economic benefits/business results</td>
<td>Poor problem definition/planning</td>
</tr>
<tr>
<td>Understanding true spirit of request</td>
<td>Lack of professional competence</td>
</tr>
<tr>
<td>User support/involvement</td>
<td>Over budget, not timely</td>
</tr>
<tr>
<td>Timeliness</td>
<td></td>
</tr>
</tbody>
</table>

OR Practice: survey results and reflections of practising INFORMS members

L Abdel-Malek¹, C Wolf², F Johnson² and T Spencer III²
There are many possible futures for health OR—depending on its impact and its visibility.

- High recognition
  - Bright star

- Low recognition
  - Glitter without gold
  - Decline and fall

- High impact
  - Future?

- Low impact
  - Now?

  - Secret Service
What do we need to do today so health OR is equipped to make a strong contribution tomorrow?

Five key investment areas for UK health OR

1. Identifying and focusing on the key emerging challenges for the UK health and care system at local, national and global levels so we work on the right problems at the right time

2. Equipping ourselves to help tackle them with the right skills, positioned in the right places

3. Gaining powerful champions who own the problems so we work with the right people who can embed solutions in their organization

4. Making success visible to and recognised by our users – so we get the right messages to the right audiences

5. Understanding better what we need to do- keep learning about how to enhance our impact!
Draw on our spectrum of methods to scan for and to assess challenges on the horizon.

1. Identify and focus on the key emerging challenges

<table>
<thead>
<tr>
<th>GROUP</th>
<th>QUALITATIVE</th>
<th>QUANTITATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIVIDUAL</td>
<td><strong>accepting uncertainty</strong></td>
<td><strong>seeking certainty</strong></td>
</tr>
<tr>
<td></td>
<td>• brainstorming</td>
<td>• systems dynamics</td>
</tr>
<tr>
<td></td>
<td>• behavioural simulation</td>
<td>• discrete event simulation</td>
</tr>
<tr>
<td></td>
<td>• scenario analysis</td>
<td>• mathematical modelling</td>
</tr>
<tr>
<td></td>
<td>• soft systems</td>
<td>• statistical analysis</td>
</tr>
</tbody>
</table>

The next 50 years of OR in Health in the UK
Look at health managers’ hot topics e.g. see the HSJ 2008 awards categories

1. Identify and focus on the key emerging challenges
## Build strength in key problem solving areas

### Survey of DH OR Analysts, 2006

<table>
<thead>
<tr>
<th>Rank</th>
<th>TOP TEN</th>
<th>Mean score</th>
<th>Rank</th>
<th>BOTTOM TEN</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spreadsheet modelling</td>
<td>4.83</td>
<td>1</td>
<td>Heuristics</td>
<td>2.92</td>
</tr>
<tr>
<td>2</td>
<td>Statistics (introductory)</td>
<td>4.54</td>
<td>2</td>
<td>Mathematical programming</td>
<td>2.79</td>
</tr>
<tr>
<td>3</td>
<td>Problem structuring</td>
<td>4.46</td>
<td>3</td>
<td>Game theory</td>
<td>2.63</td>
</tr>
<tr>
<td>4</td>
<td>Consulting skills</td>
<td>4.25</td>
<td>4</td>
<td>Logistics</td>
<td>2.58</td>
</tr>
<tr>
<td>5</td>
<td>Project management</td>
<td>4.17</td>
<td>5</td>
<td>Accounting &amp; financial management</td>
<td>2.33</td>
</tr>
<tr>
<td>6</td>
<td>Public sector applications</td>
<td>4.08</td>
<td>6</td>
<td>Expert systems</td>
<td>2.33</td>
</tr>
<tr>
<td>7</td>
<td>Forecasting</td>
<td>3.88</td>
<td>7</td>
<td>Data envelopment analysis</td>
<td>2.25</td>
</tr>
<tr>
<td>8</td>
<td>Risk analysis</td>
<td>3.79</td>
<td>8</td>
<td>Marketing</td>
<td>2.08</td>
</tr>
<tr>
<td>9</td>
<td>Performance measurement</td>
<td>3.79</td>
<td>9</td>
<td>Credit scoring &amp; data mining</td>
<td>2.04</td>
</tr>
<tr>
<td>10</td>
<td>Systems dynamics modelling</td>
<td>3.75</td>
<td>10</td>
<td>Manufacturing management</td>
<td>1.79</td>
</tr>
</tbody>
</table>

**Key to scores** 1=low importance  5=high importance

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2. Equip ourselves to help tackle the key challenges

The next 50 years of OR in Health in the UK
The next 50 years of OR in Health in the UK

Develop a networked presence at all levels to allow both tactical and strategic work

In a more devolved and decentralised care system OR needs a stronger grass roots presence

Availability of analysts in the Health Authorities in England (2003)*

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Supply</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR analysts</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Economists</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Statisticians</td>
<td>29</td>
<td>34</td>
</tr>
<tr>
<td>Other e.g Accountants</td>
<td>37</td>
<td>28</td>
</tr>
</tbody>
</table>

While retaining a strong central presence

“If, instead of sending the observations of able seamen to able mathematicians on land, the land would send able mathematicians to sea, it would signify much more to the improvement of navigation and to the safety of men’s lives and estates on that element.” — Sir Isaac Newton, 1694

2. Equip ourselves to help tackle the key challenges
Focus on adding crucial value for key problem owners

1. Know the customer’s business
2. Focus on problem owners needs
3. Appreciate the customer’s environment
4. Offer something distinctive
   
   3. Gain powerful champions
Offer something distinctive – e.g. OR as the science of better!

OR analysts’ value to any business depends on being able to help with a number of thorny problem areas

- Understanding how systems work
- Clarifying complex and messy problems
- Coping with uncertainty and risk
- Creating, developing and appraising options for change

And working closely with customers in building solutions

OR as a promoter of evidence–based management

Is OR in health care linking enough to the US “science of improvement “ movement?
Relentlessly focus on implementation

Making success visible requires successes!

1981 review of 200 simulation projects in health care found only 16 (8%) reported successful implementation

JCT Wilson, Implementation of computer simulation projects in health care
JORS, 32: 825-832, 1981

2004 review found 182 papers on simulation in health (1980-99) but only a few reported on implementation so their “value could not be assessed”.

Fone D et al, Systematic review of the use and value of computer simulation modelling in population health and health care delivery

“Compared with many other organizations, hospitals have been slow in adopting operational research as a means to improve their performance.

Applications are scattered and the results not always used, even if they are relevant and reliable.

The implication is that, so far, hospitals have largely failed to use one of the most potent methods currently available for improving the performance of complex organizations”

Publish and publicise in the right way to the right audiences in the right places

Search of 2007 publications for:

<table>
<thead>
<tr>
<th>Area</th>
<th>All publications (search on discipline + health)</th>
<th>BMJ (search on discipline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR and health</td>
<td>1.7k</td>
<td>9</td>
</tr>
<tr>
<td>Health Services Research</td>
<td>7.7k</td>
<td>105</td>
</tr>
<tr>
<td>Economics and health</td>
<td>48k</td>
<td>183</td>
</tr>
<tr>
<td>Statistics and health</td>
<td>68k</td>
<td>966</td>
</tr>
</tbody>
</table>

A study of queues and appointment systems in hospital outpatient departments, N T Bailey, J R Stat Soc, 1952

Appointment systems in hospital outpatient departments J D Welch, N T Bailey, Lancet 1952

4. Make success visible to and recognised by our users
Look for simple but powerful messages that will stick in users’ minds

Hospital admission refusals rise exponentially with occupancy

NHS Direct staffing rises exponentially as approach response time target (and similar results for A&E waiting)

Analysis and modelling results on demand variation were distilled into two simple messages:
- you can’t run a hospital at 100% occupancy without turning people away
- you can’t achieve 100% performance targets without an unlimited budget
Continuously seek to learn about how to enhance our impact!

Hope MASHnet will be able to follow up its pilot survey on the questions posed at the beginning of this talk:

What are coming challenges for health or healthcare where OR analysts should seek to make a significant impact and how could we could best contribute?

What lessons should OR analysts working in health take from the past to help make a bigger impact in the future and what should we do today to prepare the path?

5. Understand better what we need to do!
These investments should position us for success in the analysts’ hurdle race.
The future is not a land to be discovered but a world to be created!

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