
This version is available at https://strathprints.strath.ac.uk/45485/

Strathprints is designed to allow users to access the research output of the University of Strathclyde. Unless otherwise explicitly stated on the manuscript, Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Please check the manuscript for details of any other licences that may have been applied. You may not engage in further distribution of the material for any profitmaking activities or any commercial gain. You may freely distribute both the url (https://strathprints.strath.ac.uk/) and the content of this paper for research or private study, educational, or not-for-profit purposes without prior permission or charge.

Any correspondence concerning this service should be sent to the Strathprints administrator: strathprints@strath.ac.uk

The Strathprints institutional repository (https://strathprints.strath.ac.uk) is a digital archive of University of Strathclyde research outputs. It has been developed to disseminate open access research outputs, expose data about those outputs, and enable the management and persistent access to Strathclyde's intellectual output.
DGHPSim: Performance modelling of general hospitals

Murat Günal & Mike Pidd
Department of Management Science
Lancaster University Management School
m.Gunal | m.pidd@lancaster.ac.uk
01524 593870
Why smart thinking is needed

Many hospitals are like balloons....

squeeze them hard in one place and ....

... or ...

MASHNet Conference, 23.Apr.08, London
What sort of smart thinking?

- Important to meet targets (e.g. 18-week RTT)
  - But beware the side effects
- Important to understand how one decision affects another
  - E.g. Meet 18-week RTT but this could worsen other PIs or degrade service quality
- Explore the decision space
- Need tools that support holistic thinking
DGHPSim Project

- EPSRC funded
- Objectives
  - To evaluate feasibility of English NHS performance targets and their interactions
  - To build a whole hospital simulation model with generic features
  - Change parameter values to fit individual hospitals
- Approach: model individual patient flows

If you squeeze hard in one place, what happens elsewhere?

MASHNet Conference, 23.Apr.08, London
Locating DGHPSim on a model use spectrum

Gives direction of travel
Contains complete route

Compass or GPS?

MASHNet Conference, 23.Apr.08, London
DGHPSim suite: 4 linked models

1. Emergencies to A&E → A&E model → Admit?
   - No specialties → Discharged

2. Emergency GP referrals → Inpatient model

3. By specialty
   - GP elective referrals → Diagnostics
   - Outpatient model
   - Admit?
     - Inpatient waiting list model
     - Inpatient model

MASHNet Conference, 23.Apr.08, London
DGHPSim patient flows: e.g. A&E model

Patient flows
• Individual
• Consume resources as they occur (e.g. doctor time)
• Based on statistical models
• Provide much more than just average values
Inpatient Model – schematic

- Emergencies have priority
- Electives taken from lists
- HES length of stay data
- Ward transition matrix

GP emergencies

Emergencies from A&E

Assessment wards

‘Normal’ wards

Discharge?

Elective admissions from outpatients

WTM mention here!
Elective inpatient waiting list model

From outpatients

Admit? Yes

Assign priority

Prioritise queue

To inpatients

Bed Avail? Yes

No

As patient waits, increase her priority

Different system for patients that can only wait very short-times, e.g. cancer

MASHNet Conference, 23.Apr.08, London
Outpatients: 18-week RTT

1: GP to OPI
   Max 4 weeks?
   INACTIVE TIME

2: OPI to I/P or exit
   Max 4 weeks?
   ACTIVE TIME

3: Wait to admit
   Max 10 weeks?
   INACTIVE TIME

Likely to be relaxed from 100%
Distinguish between admitted & non-admitted?

MASHNet Conference, 23.Apr.08, London
Hospital Activity Data Analyzer (HADA)

Data Sources

- Hospital’s Patient Administration System (PAS)
- National Hospital Episode Statistics (HES)
Some example DGHPSim experiments

- Examine 3 separate options for change, across all specialties
  - Reduce average LoS by 20%
  - Keep bed total constant, allocate 30% more to electives
    (Total beds: 427, Elective beds: 128 (up from 96))
  - 1100 Extra day-cases (12% increase), hence fewer standard admissions

- Based on old 04/05 data

- Today, focus only on stage 3 elective waits (wait to admit)
  - Model actually copes with all 3 stages
  - Could also look at
    - Emergency/elective interactions
    - Resource swapping (e.g. beds)
    - Combined options for change
    - Individual specialties
Base model: as-was 2004/05

SIMULATION OUTPUT

- %'age of patients waited
  - >5 weeks: 72.6
  - >8 weeks: 58.4
  - >10 weeks: 46.8
  - >18 weeks: 28.5

Elect Cancel.  Emerg Outliers

<table>
<thead>
<tr>
<th>Count</th>
<th>90</th>
<th>469</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Patients</td>
<td>2880</td>
<td>15713</td>
</tr>
<tr>
<td>%'age</td>
<td>3.1</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Scenario 1: 20% reduced LoS

SIMULATION OUTPUT

%'age of patients waited

- >5 weeks: 58.7%
- >8 weeks: 43.8%
- >10 weeks: 33.1%
- >18 weeks: 17.6%

<table>
<thead>
<tr>
<th>Elect Cancel.</th>
<th>Emerg Outliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>73</td>
</tr>
<tr>
<td>Total Patients</td>
<td>3396</td>
</tr>
<tr>
<td>%'age</td>
<td>2.1</td>
</tr>
</tbody>
</table>
Scenario 2: Keep bed total constant, allocate 30% more to electives

SIMULATION OUTPUT

<table>
<thead>
<tr>
<th>%'age of patients waited</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;5 weeks</td>
<td>48.1</td>
</tr>
<tr>
<td>&gt;8 weeks</td>
<td>34.7</td>
</tr>
<tr>
<td>&gt;10 weeks</td>
<td>25.5</td>
</tr>
<tr>
<td>&gt;18 weeks</td>
<td>13.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Elect Cancel.</th>
<th>Emerg Outliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>114</td>
<td>505</td>
</tr>
<tr>
<td>Total Patients</td>
<td>3490</td>
<td>15693</td>
</tr>
<tr>
<td>%'age</td>
<td>3.9</td>
<td>4.0</td>
</tr>
</tbody>
</table>
Scenario 3: 12% increase in day-cases (1100 extra)

Simulation Output

<table>
<thead>
<tr>
<th>%'age of patients waited</th>
<th>&gt;5 weeks</th>
<th>&gt;8 weeks</th>
<th>&gt;10 weeks</th>
<th>&gt;18 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>62.4</td>
<td>48.2</td>
<td>37.4</td>
<td>22.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Elect Cancel.</th>
<th>Emerg Outliers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Count</strong></td>
<td>51</td>
<td>469</td>
</tr>
<tr>
<td><strong>Total Patients</strong></td>
<td>2654</td>
<td>15711</td>
</tr>
<tr>
<td><strong>%'age</strong></td>
<td>2.5</td>
<td>3.2</td>
</tr>
</tbody>
</table>
Looking across the experiments

<table>
<thead>
<tr>
<th>% wait &gt; 5 wks</th>
<th>Base</th>
<th>LoS down 20%</th>
<th>30% more elect.beds</th>
<th>12% increase day-cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>% wait &gt; 8 wks</td>
<td>58.2</td>
<td>43.8</td>
<td>34.7</td>
<td>48.2</td>
</tr>
<tr>
<td>% wait &gt; 10 wks</td>
<td>46.8</td>
<td>33.1</td>
<td>25.5</td>
<td>37.4</td>
</tr>
<tr>
<td>% wait &gt; 18 wks</td>
<td>28.5</td>
<td>17.6</td>
<td>13.4</td>
<td>22.2</td>
</tr>
<tr>
<td>Elect patients</td>
<td>2880</td>
<td>3396</td>
<td>3490</td>
<td>2654</td>
</tr>
<tr>
<td>Elect cancelled</td>
<td>90 (3.1%)</td>
<td>73 (2.1%)</td>
<td>114 (3.9%)</td>
<td>51 (2.5%)</td>
</tr>
<tr>
<td>Emerg outliers</td>
<td>469 (3%)</td>
<td>405 (2.7%)</td>
<td>505 (4%)</td>
<td>469 (3.2%)</td>
</tr>
</tbody>
</table>
Uses for the DGHPSim suite

- Resources needed to meet target
  - e.g. 18 week RTT
- Waiting times achievable given specific resources
- Effect of trading elective admissions against emergencies
- Waits for admitted v/s non-admitted patients
- Testing proposals for change
  - E.g. from Modernisation Agency/NHS III
- Commissioning acute care with changing demands
Acknowledgements

- Gwyn Bevan, Alec Morton (LSE), Peter Smith (University of York)
- Funded by EPSRC
- NHS Trusts
  - University Hospitals of Morecambe Bay NHS Trust
  - Royal Preston Hospital
  - Salford Royal NHS Foundation Trust
  - Worthing and Southlands Hospitals NHS Trust
  - Barts and The London NHS Trust
  - Central Manchester & Manchester Children's University Hospitals NHS Trust