Dartford, Gravesham & Swanley

Local Care System Dynamics modelling

Feedback session

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Local Care System Dynamics modelling

Approach
Context and key issue

The key objective for the modelling is:

“To develop a system dynamics model that reflects current STP plans but applies local assumptions for the implementation of Local Care in order to inform local investment and the impact on the hospital ‘front-door’ in 19/20 and 20/21.”

Key requirements are that the model:

1. Reflects the Local Care system being developed across DGS.
2. Contextualises and calibrates the Kent-wide approach that underpins the STP to DGS data and assumptions, including a comparison of the available demand drivers underpinning the ‘do nothing’ scenario.
3. Produces outputs that scale the capacity requirements in Local Care.
4. Provides a basis on which to gauge the likely demand scenario in the coming winter to inform capacity planning.
Approach adopted

- Engagement with local stakeholders in order to:
  - Review and revise local demand drivers through an analysis of recent trends in A&E/Non-elective admissions working with DVH analysts;
  - Identification of implementation profiles for key elements of local care with CCG leads;
  - Holding a multi-stakeholder workshop to develop a consensus on the ‘opportunity’ to impact on urgent care pathways through the implementation of local care;
  - Briefings for the joint Executives of the CCG and DVH.
Project deliverables

• A System Dynamics model that explores the impact of local care on demand for A&E and unscheduled admissions has been calibrated for the DGS system and has been made available to project team members;

• Other supporting information has been made available in the form of:
  – A word document detailing the assumption building process and consensus arrived at through local engagement;
  – A spreadsheet that contains the underlying data that has been used to initialise the system dynamics model and the outputs that have been derived from the model as a basis for some of the material in this pack.

• The development of the modelling approach, and the links to the K&M STP, are being facilitated through the Advancing Applied Analytics Community of Practice.
Development of the assumptions

• The logic for the modelling is to combine in one system:
  – The underlying demand drivers for the four PODs giving rise to a growth in activity that needs to be addressed through developments in Local Care;
  – The care functions that local care will mobilize to impact on this growth, with a view to meet increased demand and meet overall STP goals;
  – The timescales or implementation profiles for each of the care functions.
Demand drivers

• The 2015/16 to 2020/21 demand projections using different sources are shown opposite:
  • The local view was to produce a blended demand driver based on the local Trend and local need (80:20 respectively);
  • The anticipated growth in A&E attendances and non-elective admissions using this assumptions are shown opposite.
Care functions that will impact on the urgent care pathway

Population health and demand drivers

Proactive/MDT working in GP clusters

Pre-hospital urgent care

A&E

Non-elective admissions, including changes in length of stay

Local care functions – impacting on the urgent care system

- Case finding
- Community Frailty Assessment
- Integrated Reactive Care
- GP Extended Access
- See & Treat
- Clinical Assessment Service
- Urgent Treatment Centres

‘Home to assess’ pathways including admissions avoidance & early discharge

Acute sector outputs: A&E/NEL/OBDs
In 2015/16 we had a flow of people to A&E, and subsequently to an unscheduled admission, who had **frail or complex needs**. The Home First pathways have been developed to represent the diversion for patients to achieve better outcomes subject to local care being put in place...

**Illustration of the model logic for Integrated Discharge...**

<table>
<thead>
<tr>
<th>Pathway 1</th>
<th>Pathway 2</th>
<th>Pathway 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>25%</td>
<td>0%</td>
</tr>
<tr>
<td>90%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>20%</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>10%</td>
<td>20%</td>
<td>70%</td>
</tr>
</tbody>
</table>

= required local care capacity
Local Care System Dynamics modelling

Model outputs
Model outputs

• Model outputs are a reflection of the assumption building already outlined;
• Changing an assumption for one part of the system has the potential to impact on other parts;
• Model granularity means that these are ‘high-level’ outputs expressed in a way that reflects STP annual plans;
• This section identifies an output for the default assumptions and a further output for a more cautious set of assumptions.
Headlines – default assumptions

• The challenges of achieving sufficient investment in local care to achieve a reduction in pressure on the acute system for this winter and beyond are significant when seen in the context of the last three years of growing demand;

• The mix of local care functions impacting on preventive, diversion and integrated discharge suggests that with the levels of local care development assumed in our modelling it is possible to reduce occupied bed days, but that the number of A&E attendances and non-electives admissions will continue to rise, although at a slower rate than without local care.
Capacity requirements in local care

• The capacity in each local care function over and above 15/16 levels has been modelled as:
  – 60 more rapid response referrals pw in 2019/20, rising to 74 pw up to 2029/30;
  – 33 more pathway 1 episodes of care a week in 2019/20, rising to 40 in 2020/21, but then reducing again to 33 due to upstream impact;
  – 70 more community rehabilitation beds/packages in 2019/20 rising to 77 by 2029/30;
  – 57 more complex care beds in 2019/20 rising to 66 by 2029/30.
Impact on A&E and NEL adms

The chart opposite illustrates the impact on A&E and unscheduled admissions and occupied beds if the full range of local care was implemented with the expected impact being realised:

1. The benefit from local care on A&E attendances has a longer tail to 22/23 due to case finding and a longer implementation profile for UTCs but remains above the 15/16 level and grows at c.1.30% from 22/23.

2. The benefit from local care on NEL admissions and occupied beds is more modest and does not continue past 20/21, rising at 1.25%pa from 20/21.

The number of hospital beds required for non-elective admissions remains below the level in 15/16, but the gap closes to 30 beds (equivalent to c.7% improved occupancy levels over the medium to longer term).
What does the model say about the impact on the acute front-door?

• The net impact of increased demand and the impact of local care on the acute sector, compared to 15/16 levels, would be:
  - 121 more A&E attendances a week in 2018/19, reducing to 81 more than in 15/16 by 2019/20;
  - 37 more non-elective admissions a week in 2018/19, staying largely the same at 38 more than in 15/16 in 2019/20;
  - 5 more occupied beds in 2018/19 but 41 less by 2019/20.
Headlines – ‘cautious’ scenario (example)

- Whilst the assumptions underpinning the above scenario are a reflection of the general consensus through initial model building we have generated a second scenario reflecting the following more cautious (worst case?) set of assumptions, for example:
  - By assuming 20% instead of 70% of patients being discharged after treatment to receive specialist rehab in the community; and
  - By assuming 50% instead of 100% of patients being discharged after hospital based rehabilitation.

A difference of c.25 occupied hospital beds
Implications for Elm Court

• The model suggests that Elm Court, if used and managed as part of the acute pathway, could be phased out during 2019/20 if progress in implementing all the elements of local care has been achieved and evidenced to have had the necessary impact;

• However, the capacity in Elm Court, appropriately re-focused, could form an important contribution in developing local care...
Model adoption

• The model provides an understanding of the impact on demand and capacity based on an initial set of assumptions for local care;
• Assumptions need to be refined over time as implementation of local care proceeds;
• Suggested priorities in adopting the model as a working tool, as well as for refining and including any new assumptions are as follows:
  − Agree model ‘holder(s)’ and a small group of people from each organisation who own the assumptions and progress any work to refine these;
  − Continue to update our understanding of trends in activity to triangulate with the model outputs and as a means of informing further assumption building;
  − Consider areas of the model where assumptions are least certain and the impact from these assumptions is material to model outputs and initiate work to refine these assumptions, for example for Integrated Discharge pathways.
Next steps

• Medway, North & West Kent context:
  − The same modelling approach has been applied in W Kent and Medway & Swale, which provides the opportunity to inform MN&W Kent demand and capacity work currently underway;
  − The next stages for this include the mapping of cross-boundary flows for different hospital systems to understand the impact on capacity for each from the different local care systems.

• Local DGS system:
  − The local assumptions for DGS should be the subject of monitoring and review for both implementation and impact, using the model to capture updates in our understanding and implementation plans.
Local Care System Dynamics modelling

Further background material
What is System Dynamics modelling?

• System Dynamics is a simulation and modelling approach used to help understand complex and dynamic systems using ‘stocks and flows’.
• The simulation software used is called Stella Architect and has two layers – ‘under the bonnet’ (the maths) and a model interface layer.
• The model is initialised by data inputted from a spreadsheet, and then simulated over time through the ‘stocks and flow’.
• Assumptions about the inter-relationships between parts of the model are generated from engagement events and used to influence the model behaviour.
• Various what-if scenarios can be generated by adjusting these assumptions and re-running the model.
• Models are designed to support learning through an iterative approach that involves human interaction with the model, rather than expecting the model to produce precise ‘answers’ for what in a health system is an inherently complex one.
The contribution of System Dynamics (SD)

- SD modelling is the ‘tool of choice’ when:
  - The scope of an issue is ‘strategic’ rather than operational or tactical;
  - The importance of variability or tracking individuals within a system is low;
  - The number of entities is large;
  - When control over the system is exerted through rates rather than queues;
  - When timescales are relatively long;
  - When the purpose is to inform policy making and to gain understanding about a system.

What makes a successful modelling project?

Evidence about what makes a successful simulation project (including but not exclusively System Dynamics) has identified the following 5 elements:

1. High levels of communication and interaction between the client and the modeler throughout the project.
2. Modeler skills, competence and understanding of the client context.
3. Responsiveness and flexibility in delivering on the project.
4. Involvement and engagement with the client and relevant stakeholders.
5. The customer or client organisation should be committed, supportive and engaged in the modelling work throughout.

Ref: Key Performance indicators for successful simulation projects. JOR (2017) 68, 747-765
For example – a description of a new intervention

• Proactive care/MDT working:
  – Case finding focussed on the severely frail;
  – MDT working wrapped around GP clusters;
  – Single point of access for routine or urgent needs.

• Impact:
  – That for those who have been identified, reviewed and who are being actively supported that there will be a 20% reduction in A&E attendances and a 10% reduction in non-elective admissions to hospital compared to historic levels for this client group.

• Model dynamic:
  – That case finding is put in place and captures all those who enter the severely frail cohort plus a number of those who are already frail, but on a reducing ratio over time.
1. Change in the frailty cohort.

2. New frailty cases enter the MDT supported cohort.

3. The % reduction per person in POD activity is applied to the growing MDT cohort, which impacts on the flows into hospital in another sector of the model.
The basic structure for unscheduled admissions

- Remaining *agnostic to specialities* below is a representation of the acute pathway using ‘stocks and flows’. The building blocks to System Dynamics.
- At each stage of the pathway each *Cohort* has a *specific length of stay (LOS)* derived through analysis from the KID.
- The point at which someone is safely and appropriate discharged is altered through the care functions of *integrated discharge*, and affects the level of *Occupied Bed Days (OBDs)*.

![Diagram](image_url)
The dynamic of the system is created through the model logic.
Example for A&E attendances:

Key:
1. The STP demand trajectory (‘do nothing’) applied to DGS.
2. The STP ‘do something’, i.e. achieving target set by benchmarks/best practice.
3. Modelled attendances, taking account of possible duplication of UTC and ED for any given patient after the implementation of local care.
4. Modelled A&E incidents removing overlap and as comparator to historic A&E attendance levels.

The growth in the number of rapid response referrals pw to achieve the above (other care functions also contribute to the impact):
Sample model outputs

‘Do nothing’ v’s ‘do everything’ for NEL adms

Comparison between SD model outputs and STP/CF projections for OBDs

Requirements/expectations on parts of the local care system
Do nothing

- The chosen demand profiles underpinning the model produce the following demand pressure on the acute system:

<table>
<thead>
<tr>
<th>Front-door demand projections - do nothing:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>NE admissions</td>
</tr>
<tr>
<td>Occupied NEL beds</td>
</tr>
</tbody>
</table>

- The cumulative pressure over 3 and 1 years respectively is shown below:

<table>
<thead>
<tr>
<th>Cumulative 'do nothing' pressure:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>A&amp;E attds</td>
</tr>
<tr>
<td>NE admissions</td>
</tr>
<tr>
<td>Occupied NEL beds</td>
</tr>
</tbody>
</table>
The implementation profiles for Local Care reflected in the model indicate the need for the following capacity or changed pathways to be in place (expressed as additional capacity from the 15/16 baseline):

<table>
<thead>
<tr>
<th>Description</th>
<th>For the winter of 18/19</th>
<th>For the winter of 19/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS referrals pw, with a proportion being diverted from attending A&amp;E</td>
<td>c.1,200</td>
<td>c.2,300</td>
</tr>
<tr>
<td>Rapid response referrals pw, with impact on both A&amp;E and NEL</td>
<td>28</td>
<td>60</td>
</tr>
<tr>
<td>Pathway 1 referrals pw with an impact on NEL</td>
<td>29</td>
<td>33</td>
</tr>
<tr>
<td>Capacity to support Pathway 2 discharges requiring community based rehabilitation</td>
<td>47</td>
<td>70</td>
</tr>
<tr>
<td>Capacity to support Pathway 3 discharges requiring complex assessment and support</td>
<td>42</td>
<td>57</td>
</tr>
</tbody>
</table>

Note: 19/20 figure is cumulative not additional.
Do everything - impact

- The revised demand profiles based on the ‘do everything’ set of assumptions are:

<table>
<thead>
<tr>
<th>Front-door demand projections with local care impact:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>A&amp;E attds</td>
</tr>
<tr>
<td>NE admissions</td>
</tr>
<tr>
<td>Occupied NEL beds</td>
</tr>
</tbody>
</table>

- The amended cumulative impact on the system is as follows:

<table>
<thead>
<tr>
<th>Cumulative change with local care impact:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>A&amp;E attds</td>
</tr>
<tr>
<td>NE admissions</td>
</tr>
<tr>
<td>Occupied NEL beds</td>
</tr>
</tbody>
</table>
Incremental impact from different local care functions

• For A&E attendances (18/19 do nothing of 106,100 attendances):
  – The CAS has an initial impact during 17/18 of c.800 attendances;
  – Integrated Reactive Care, Improved GP access, CAS and S&T all have an impact during 18/19 totalling 4,600 reduced attendances – with improved GP access making the largest contribution of c2,000 attendances;
  – Total impact from these four care functions grows further in 19/20 to a total of 8,300.

• ‘Pathway 1’ has the dominant impact on NEL admissions (18/19 do nothing level of 32,300), which starts in 17/18 and grows to 1,900 saved admissions a year by 19/20 – there is a small impact from Integrated Reactive Care of c.200 by 19/20;

• ‘Pathway 1’ also has the biggest impact on NEL OBDs and therefore bed requirements starting in 17/18 (13,500 OBDs = c.37 beds compared to do nothing) – by 19/20 P1 is saving c.22,100 OBDs; P2 c.15,600; and P3 c.4,100 OBDs compared to the do nothing plus a small contribution of c.1,400 OBDs from integrated reactive care.
Modelling acute bed requirements

• The local care model explores the impact on the acute system at a strategic level, consistent with the STP transformation framework;
• Outputs are generated on an annual basis without regard to natural variation or to weekly and seasonal patterns;
• A supplementary modelling exercise was therefore undertaken to translate the annual outputs from the local care system dynamics model into a pattern of expected acute bed requirements on a day-by-day basis when the variation and weekly/seasonal patterns are applied;
• Assumptions were derived from analysis of daily adult NEL admissions to DVH for DGS patients for the three years 15/16 to 17/18;
• The total number of NEL admissions and the expected length of stay expected for 18/19 was derived from the ’do everything’ scenario of the Local Care Model.
Observed variation

• Over the three year period there was an observed variation having a standard deviation (SD) of 9.2, around a mean of 51.7 admissions a day;
• Seasonal variation indicated levels of admission up to 4.5% higher than the average between November and March and up to 4.7% lower than the average between April and October;
• Weekly patterns for NEL admissions are illustrated below:
The acute bed model can be run using any of the chosen years below to test capacity requirements under the variation and admission patterns outlined above – 18/19 ‘do everything’ is used as the basis for the outputs in this material.

<table>
<thead>
<tr>
<th>NEL admissions</th>
<th>15/16</th>
<th>16/17</th>
<th>17/18</th>
<th>18/19</th>
<th>19/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do nothing</td>
<td>29,318</td>
<td>31,435</td>
<td>31,870</td>
<td>32,302</td>
<td>32,740</td>
</tr>
<tr>
<td>Do everything</td>
<td>29,318</td>
<td>31,435</td>
<td>30,608</td>
<td>30,828</td>
<td>30,649</td>
</tr>
<tr>
<td>Difference on do nothing</td>
<td>0</td>
<td>0</td>
<td>-1,262</td>
<td>-1,474</td>
<td>-2,091</td>
</tr>
<tr>
<td>Difference on previous year</td>
<td>2,117</td>
<td>-827</td>
<td>220</td>
<td>-179</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEL ALoS</th>
<th>15/16</th>
<th>16/17</th>
<th>17/18</th>
<th>18/19</th>
<th>19/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do nothing</td>
<td>4.91</td>
<td>4.89</td>
<td>4.90</td>
<td>4.89</td>
<td>4.89</td>
</tr>
<tr>
<td>Do everything</td>
<td>4.91</td>
<td>4.89</td>
<td>4.66</td>
<td>4.11</td>
<td>3.81</td>
</tr>
<tr>
<td>Difference on do nothing</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.24</td>
<td>-0.78</td>
<td>-1.08</td>
</tr>
<tr>
<td>Difference on previous year</td>
<td>-0.02</td>
<td>-0.23</td>
<td>-0.55</td>
<td>-0.30</td>
<td></td>
</tr>
</tbody>
</table>
What might 2018/19 winter look like?

The local care model produces an output for occupied beds based on the number of unscheduled admissions and lengths of stay after taking into account demand growth and the impact of Local Care...

30,828 NEL admissions at an ave. of 84 day with ALoS of 4.11 days = ave. occupied beds of 347

Three years worth of local data has identified:
1. Statistical variation on a day by day basis
2. A ‘typical’/average weekly pattern
3. A ‘typical’/average seasonal pattern

30% of occurrences lie outside the range above, split above and below the range – the top line therefore shows the number of beds such that 85% of days require less than or equal to that number.

c.380 beds required from October through to March, or c.30 more than April through to August.
Notes:

1. Achieving the reduced levels of occupied bed requirements is conditional on the effective implementation of local care to the extent identified in slide 5.

2. The potential reduction in occupied beds is greater in ‘summer’ (Apr-Aug = -59) that in ‘winter’ (Nov-Mar = -44).

3. The potential reduction generated by the implementation of local care is roughly equivalent to the cumulative demand growth between 15/16 to 18/19, i.e. 39 beds (see slide 4).

4. Therefore, without the level of local care development suggested by the modelling, the pressure on acute capacity will remain above the levels experienced in 15/16.