Diagnostic Imaging
Demand and Capacity
Model User Guide
1. Introduction

The Intensive Support Team (IST) has developed a series of demand and capacity models designed to help organisations achieve an appropriate balance between demand and capacity, and to ensure that waiting lists are of an appropriate size. These models can act as a helpful starting point for organisations to better understand demand and plan capacity accordingly. The models are freely available via the NHS IMAS website using the following link: www.nhsimas.nhs.uk/ist

The IST recommends operational managers work with information colleagues to pull together the various data items required to complete the models. It is important to agree a standard dataset for each model, including, where possible, a standard data source so the models are consistent across the Trust.

This user guide is aimed primarily at users new to the Diagnostic Imaging Demand and Capacity Model and should be read alongside the information and instructions contained in the model. The guide follows the same structure as the model with a section for each of the tabs included in the model.

The model can be used at modality, procedure, geographical site or consultant level. The level at which it is appropriate to model will need to be determined by what is most suitable and useful for the service.

The model is Excel based and requires as a minimum Excel 2010 to operate correctly.

2. Welcome tab

This tab includes an overall introduction to the model and an overview of the data required to populate the model.

You are advised to complete a separate model for each modality. The model allows you to model up to five different length investigations.

3. Data tab

- Select the Trust name from the drop down box

3.1 Waiting list and emergency data

- Enter 52 weeks’ worth of request data in date order i.e. week one longest ago and week 52 most recent for a maximum of five different types of investigation within the modality. This data relates to the number of requests for investigations received and not the number of patients for whom a request is received i.e. if a request is received for a scan of the abdomen and head of the same patient this should be recorded as two requests, not one and should be included in each of the relevant columns.
- The 52 week period selected should be the most recent 52 week period where a full set of data is available. It is important to note the date range for this 52 week period, as other parameters within the model should be calculated based on this 52 week period where possible. Data is required separately for urgent and routine procedures.
- It may be helpful to look at the different procedure codes within the radiology system and group those with the same or similar procedure time together. Alternatively the procedures could be grouped into five categories based on the body part being scanned – the procedures will need to have the same or similar scan times.
- The investigation name can be edited. The scan time for each group of investigations should be added to the top of the ‘waiting list and emergency data’ table in the model.
• Enter the number of waiting list removals, by week and by investigation type, where the request was removed without the investigation being done. This may include patients who decline to attend or requests which are found to be inappropriate when vetted. Do not include DNAs in this section as they are accounted for separately elsewhere in the model.
• Enter the number of emergency procedures undertaken for each investigation type each week – only where the emergency activity impacts upon elective capacity. Emergency investigations done which do not impact on elective capacity should not be included.
• Sense check request data as you enter it – does it look right and reflect operational reality? Are there any unexpected peaks or troughs or patterns in the data? If so these need to be checked to ensure the data is accurate. Request data is presented graphically on the graph and SPC tabs where it may be easier to identify any anomalies or unexpected patterns in the data (see SPC section below).
• The model assumes the same demand profile in the future as that in the request data entered, i.e. it does not include growth in demand. If growth is anticipated this will need to be calculated outside of the model, and the number of mean requests per week adjusted in the parameter tab.

3.2 Waiting list minutes calculator
• Enter the number of patients waiting for each of the five investigation types being modelled. The model calculates the total approximate waiting list size by multiplying the number of investigations by the number of minutes the investigation will take to come up with the total demand in minutes. Include all patients waiting i.e. those both with and without an appointment date
• The total waiting list size in minutes will also be displayed in the slider box at the top right of the sheet if the slider is at the far right of the box.

4. Planned tab

4.1 Planned diagnostic patients due each week
• Enter the number of patients whose planned (surveillance) procedure is due by week for the coming year for each of the five investigation types being modelled. For patients due to come in next week enter under week one, for patients coming in two weeks' time enter under week two, etc.
• The SPC chart below the table shows this planned demand visually. It may not be possible to accurately predict planned demand for the whole 52 weeks going forward. If this is the case you can use historical planned activity as a proxy for future planned demand as long as this is expected to continue at the same level.
• The slider box at the top of the sheet displays the ‘mean planned minutes due each week’ calculated from the data entered.

5. Capacity tab

This section of the model is concerned with what capacity is expected to be available for this modality for the year going forward not what capacity has been available in the past. However, if there is a difference between these capacity levels, it could potentially explain any significant capacity gaps that may be identified later in the model. Core capacity can be defined as that which is included in consultant job plans and is therefore regularly available. Ad hoc capacity might typically be waiting list initiative sessions that are planned or capacity provided by locums.
5.1 Emergency reduction
If the slider is across to the far right of the box the number of minutes of emergency demand which impacts upon elective capacity is displayed on either a per week or per list basis. The model excludes capacity used for emergency patients from the calculation of sustainable capacity.

5.2 Surveillance reduction
If the slider is across to the far right of the box the number of minutes of planned demand / surveillance demand is displayed on either a weekly or per list basis. The model excludes capacity used for planned / surveillance patients from the calculation of sustainable capacity.

5.3 Mean core capacity per week
If the slider is across at the far right of the box the mean (average) capacity available calculated from the data you enter in the core capacity table is displayed.

5.4 Core capacity
- Enter core capacity i.e. what is in job plans / staff rotas on the table in minutes. Only enter data for when the imaging equipment is available and staffed to undertake elective investigations, i.e. although the equipment will be available overnight and on call staff may be available this should not be included as it is capacity for emergencies not elective patients.
- Critical data to enter is the number of minutes available per session and the number of weeks per year the session takes place. It is unlikely that the number of weeks per year will be the same for all elements of capacity. Remember that where sessions fall on a Monday a number will be lost due to bank holidays – this should be reflected in the number of weeks per year the clinic operates.
- Adjust capacity to account for planned downtime for maintenance and calibration.

5.5 Additional capacity
- Enter additional ad hoc capacity in the table in minutes. Only enter data for when the imaging equipment is available and staffed to undertake elective investigations.

5.6 Capacity calculator / historical data
- If the capacity calculator is selected the model calculates capacity from the data entered in the core capacity and additional capacity tables.
- Capacity data is best entered in the two tables as it is easy to review and sense check against operational reality. If however this level of detail is not available for additional ad hoc capacity it can be entered manually using the ‘mean additional capacity per week’ slider above the additional capacity table.
- Where there is regular overbooking of capacity and this is expected to continue in the year going forward, this can be accounted for in the ad hoc capacity table.
- The two tables at the bottom of the spread sheet page do not need to be completed as these are a look back at capacity delivered in the previous 52 week period and are not used by the model to determine capacity requirements. However, if populated the tables can be used to cross check previous activity against capacity, in which case the ‘toggle’ at the top of the sheet should be moved to select ‘historical data’ rather than ‘capacity calculator’.
6. Parameters tab

- The 'mean requests per week', 'proportion of urgent admissions' and 'ROTT rate' boxes are populated from data entered elsewhere in the model if the slider is across to the far right of the box. The ROTT rate should be checked against operational reality – typical ROTT rates for diagnostic imaging are around 5% – 10%.
- The DNA rate for the modality being modelled should be entered using the slider – this is important as it impacts on the capacity calculations. The DNA rate should be sense checked against operational reality and any anomalies identified and checked.
- The percentage of ‘DNAs removed from the waiting list’ should be entered for the modality being modelled. This is important as those not removed will be reappointed and require further capacity. The percentage of DNAs removed may vary by modality and should be checked against the Trust Access Policy.
- Given that the guidance around the diagnostic standard states that if a patient DNA’s their procedure, the six week diagnostic waiting time can be reset providing the patient has been given appropriate notice and choice of their appointment, it is likely that this percentage will be fairly high as the majority of PAS system capture this by ‘re-registering’ the request to test.
- In the ‘add planned diagnostic patients to demand or remove them from capacity’ box select ‘add’. The model will include capacity required for planned patients in the calculation of capacity requirements.
- The model allows you to model two priorities of investigation; urgent and routine. Cancer patients should be included in ‘urgent’ along with other clinically urgent patients.
- Data has to be entered manually into the three ‘target waiting time’ boxes using the sliders. The number of weeks entered should be what the service aspires to achieve not what is currently being delivered.
- Target waiting time for urgent patients will usually be two weeks, although many organisations are aspiring to a waiting time of one week.
- Maximum routine waiting time would typically be four weeks to allow time for images to be reported and support delivery of overall patient pathways within 18 weeks.
- The ‘week routine appointments commence’ and ‘maximum routine waiting time’ affect the calculation of sustainable waiting list size not the capacity calculation.

7. Summary tab

You are able to view the summary in minutes or approximate patients by selecting the appropriate option at the top of the spread sheet.

7.1 Indicator box

The ‘indicator’ box summarises data entered elsewhere in the model. The graph in this section shows demand for the modality for the 52 week period and shows visually the amount of variation in demand. A larger version of this graph is included on the SPC tab within the model.

7.2 Current capacity

- This summarises the core, ad hoc and total capacity available as entered elsewhere in the model and summarises capacity used for emergencies and planned patients.
- The model assumes that capacity will be used in the following priority order:
  - Emergencies
  - Planned
  - Elective / waiting list
- The box identifies the mean capacity available for elective investigations when that required for emergency and planned investigations is removed.
7.3 Required capacity

- If capacity is set at the mean all patients will get seen across the year but waiting times will vary and some patients will experience a long wait as the Trust will only have enough capacity half the time on a weekly basis to meet demand. A sustainable capacity is somewhere between the 65th and 85th percentiles meaning the service will have enough capacity in place to meet demand between 65% and 85% of the time.
- The model highlights in red type where current core capacity for elective / waiting list investigations is less than that required at the mean, 65th and 85th percentiles.
- It is for services to determine where it is appropriate to set capacity within the approximate sustainable range. This will depend on the flexibility required of the service i.e. if there are a lot of urgent requests then the service will need to have more choice of appointment available in order to offer patients a suitable appointment within the short waiting time.
- If there is a large degree of variation in demand for the service, greater flexibility will be required in order to effectively manage peaks in demand.

7.4 Clearing a backlog

- The ‘waiting list consistent with delivery’ is calculated on the number of weeks which the Trust want the service to see people within – therefore adjusting capacity has no impact on the calculated sustainable waiting list size.
- In the model the term ‘backlog’ refers to the number of patients waiting over the sustainable waiting list size not those waiting over the six week diagnostic standard.
- The model estimates the maximum (not target) waiting list size which will allow you to offer patients a range of dates and still achieve the median wait target.
- The ‘required reduction in backlog’ is calculated from the difference between the estimated sustainable waiting list size and the size of the current elective waiting list.
- The model calculates the time which will be taken in weeks, to clear the backlog of patients if the service continues with current capacity. If there is a backlog and this box says N/A this means that the backlog cannot be cleared within existing capacity.

7.5 Sustainable waiting list

- This graph shows how patients would be appointed over the course of the appointment period selected in the parameters tab and summarised in the table in this section.

8. Graphs tab

8.1 Variation in demand

- The ‘range of distribution’ graph shows visually the amount of variation in demand (requests) for the modality. The less variation there is the more confident you can be to set capacity at the 65th percentile. If there is a lot of variation it may be better to plan capacity on the 85th percentile. This graph is only useful if there are at least 8 - 10 data points (requests) per week otherwise the low number distorts the distribution.

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1Percentile - measure used in statistics indicating the value below which a given percentage of observations in a group of observations fall, e.g. a score in the 86th percentile is higher than 85% of the other scores - this means that if capacity is set at the 85th percentile the service will have enough capacity in place to meet demand 85% of the time.

2Median - lying at the midpoint of a frequency distribution of observed values or quantities, such that there is an equal probability of falling above or below it.
- The same information is showed in a different graphical form in the ‘your demand’ graph below. Use the drop down box to select one or all of the five different investigation types of data to be displayed in the graph.

8.2 Actual activity against plan
- The blue data point on the vertical axis is the current waiting list (both dated and undated). The purple line shows what will happen to the waiting list with the current capacity. The green and red lines on the graph indicate the 65th and 85th percentiles of estimated sustainable waiting list. Ideally the purple line would be between the green and red lines.
- The graph can be used to show the impact on the backlog of any changes made in the scenario planning section on the planning tab (see planning section below).
- The graphs can be cut and pasted into other documents such as business cases.

8.3 Your capacity versus your demand
- The graph shows the level of demand the service currently has against the capacity provision for the service (both core and ad hoc capacity), and the ROTT adjustment for the service. The ROTT is those requested that are added to the waiting list but where the procedure does not take place and therefore capacity is not required for these patients.
- The blue line (Demand (Requests)) shows the level of demand for the service with the appropriate weekly variation.
- The light blue line (DNA’s Rebooked) shows the level of demand defined above plus the adjustment for the patients who DNA’d the service but who have a further appointment booked for them. These patients require two appointment slots for every request.
- The orange area demonstrates the level of core capacity currently being provided for the service based on the information that has been entered into the core capacity template.
- The green area demonstrates the level of additional capacity currently being provided for the service based in the information that has been entered into the additional capacity template within the model.
- The red area demonstrates the ROTT adjustment for the service. This is for those requests who are referred but where the request did not result in a procedure being completed. The volume of these can be removed from the service capacity requirement given that capacity is not required for these patients.
- The sum of all these ‘capacity’ types demonstrates the total available capacity for the service.
- If the demand lines lie within the coloured area, the service generally has enough capacity to meet demand. Where the demand line moves outside the coloured area, capacity will be a constraint for the service.

8.4 Your past activity versus your past demand
- If the user enters the levels of core and additional activity completed in the previous year (at the bottom of the capacity sheet), this will visually demonstrate the level of activity provided last year for the service versus the level of demand and ROTT for the service.

9. Calculations tab
This section summarises key elements of data entered in the model and shows the methodology behind the calculations. It is included for information only and cannot be edited.
10. Planning tab

10.1 Planned activity

- Data can be entered into the tables in the planning tab to model the impact of changes in capacity (increases and decreases) on the service.
- The model allows you to model two different capacity scenarios, each with up to four different elements.
- If additional capacity is to be modelled the number of extra minutes per week should be entered within the scenario with a description of what the additional capacity is. If capacity is being removed the number minutes should be entered with a minus symbol in the scenario section.
- The impact of the scenarios on the waiting list size can be seen in the RAG rated waiting list size at the bottom of each of the two scenarios.
- The scenario start date should be entered into the ‘plan start date’ cell above the scenarios. Changes to capacity do not have to be for the entire 52 week period – if a shorter period is required the change should be entered into the relevant weeks only rather than all the weeks within the table.

10.2 Actual activity

- This table can be used to monitor progress against the planned scenarios. Data should be entered manually.
- The impact of the scenarios and actual progress can be seen in the ‘actual activity against plan’ graph in the graph tab.

11. SPC (statistical process control) tab

- The graph shows total request demand for the modality plotted on an SPC chart. The chart includes Upper Control Limit (UCL) and Lower Control Limit (LCL) lines and the average (mean) of requests. This graph again shows the level of variation in demand for the service but also identifies what is normal variation for the service and what is special cause variation (statistically significant unexpected data points).
- Generally speaking most data points within the UCL and LCL are part of the normal variation to be expected in demand for the service.
- Where there are unexpected data points or unusual patterns in the data these are identified on the graph by a red flag and an explanation is included under the graph.
- If there is a step change in the level of request demand this can be seen on the SPC chart. If the step change in the level of requests is expected to remain at the new level the data in the SPC chart can be split to reflect the new level of demand. In this case the data should be split at the first data point of the new pattern using the ‘split chart at week’ drop down box under the chart.
- It would not be appropriate to split the data at less than a quarter of a year as there would be insufficient data points to calculate accurately. If a split is applied the model recalculates using the latest part of the data (after the split) and the changes can be seen in the summary tab.

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3 The upper and lower control limits are statistically calculated numbers that define the range of normal variation within the data. Typically they are set at 3 standard deviations from the mean value.
12. Model outputs

Key outputs from the model include:

- Weekly waiting list net change - the variation that will be seen on a weekly basis in the waiting list size
- Capacity requirement – presented as a range at the 65th and 85th percentile
- Weekly capacity surplus / deficit - presented as a range.
- Backlog and clearance times - based on the sustainable waiting list size for the modality.

It is important to sense check model outputs against operational reality and with clinicians, including consultants. It may take a couple of iterations of the data before you are satisfied that it is accurate. This may be particularly challenging if data quality is poor.

13. Reviewing the models

The IST recommends that:

- A note is kept of data sources and any assumptions or exclusions applied through the modelling to inform future iterations of the model – a blank tab within the model can be used for this purpose.
- Trends in demand are monitored and capacity plans reviewed if required.
- The model is reviewed quarterly or sooner if things change.
- Data in the model is completely refreshed at least annually or sooner if things change.

14. Using the models

Further information on demand and capacity modelling is contained within the Elective Care Guide - ‘Referral to Treatment Pathways: A Guide for Managing Efficient Elective Care’ which is available from the following link:

http://www.nhsimas.nhs.uk/what-we-can-offer/intensive-support-team/rtt-pathways-guide/

If you have any questions regarding the IST demand and capacity models or would like support to use them within your organisation contact us by email to:

nhsimas.ist@nhs.net