Diagnosing Long Waits in Radiology.

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Abstract

The common assumption is that long waits are due to the service 'demand' being greater than the 'capacity' but this is not necessarily true [1]. Making the diagnosis of the constraint is critical and requires managers to understand the flow through their service.

The Norfolk and Norwich University Hospital NHS Trust (N&N) is typical of many large acute organisations with long wait for Radiology. The CT team used the ISP Level 1 methodology to diagnose the constraint and found the following:

- The DNA rate was only 1.5% and 23.5% of requests were cancelled. The commonest reason was the appointment was not convenient for the patients, so must be re-booked.
- The real 'demand' and available 'capacity' of the CT service are masked by the complex schedule and the rework.
- The valid Vitals Chart® demonstrated the demand was only 15 requests per week greater than the activity, i.e. less than 0.5 scans per day for each of the 5 scanners.
- Comparing the 'workload' to the scheduled resource time showed that the resource time capacity is sufficient to cover this difference between demand and activity.
- The key to improving their lead-times will be to eliminate the constraint caused by their conflicting booking policies and to simplify the schedule so patients are scanned in order of their due dates.

(215 words).

Keywords

Healthcare; Improvement; Radiology; Healthcare Systems Engineering (HCSE); Foundations of Improvement Science (FISH); Improvement Science Practitioner ISP-level 1; Vitals Chart®; Demand; Activity; Work-in-progress; Lead-time; Capacity; Flow-Capacity; Cycle Times; Touch Times; Load;

Context

The Norfolk and Norwich University NHS Trust (N&N) is typical of many large acute organisations; recently out of special measures, with significant financial pressures and long waits in Radiology. Over the years, different approaches have been made to address the long waits including increasing the resources (scanners and staff time) and the classic waiting list initiative which addressed the problem for a short period, only for it to return.

Radiology staff are coping with a combination of workforce shortages and conflicting lead-time policies for different priorities of patients including: 4-hour Emergency care, 1-hour Stroke, 2-week wait for Cancer, 31/62 Cancer Pathway, new 28-day NICE Cancer Diagnosis, 6-week Diagnostics for 18-week pathway and the need to keep in-patient stays as short as possible. The consequences are a very complex schedule and that many patients, especially the 'less clinically urgent', experience long lead-times (waiting times) and are given very short and inconvenient notice of their appointments.

Keen to diagnose the underlying cause of the long waits, the Radiology department at N&N used the method taught in the Foundations of Improvement Science in Health care (FISH) and Improvement Science Practitioner (Level 1) courses (http://www.improvementscience.uk).

Purpose

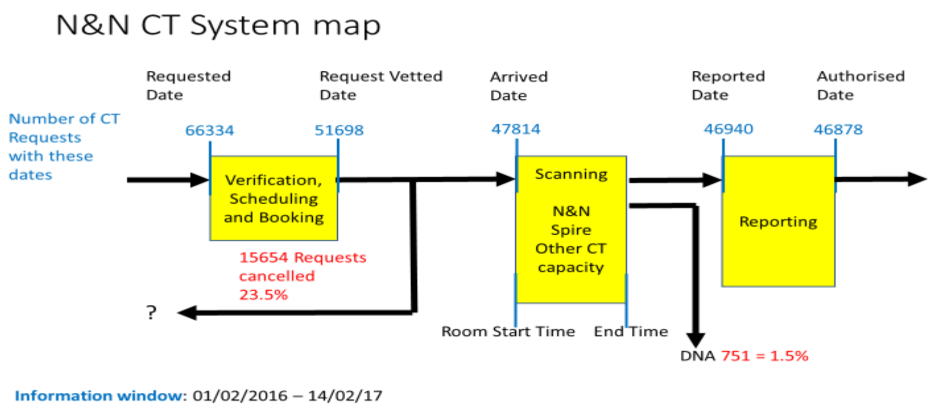
The purpose of this essay is to share our learning with others and to highlight the potential traps and pitfalls which could lead managers and trusts to make decisions based on an incorrect diagnosis, resulting from incorrect data and a lack of understanding about flow in a system [2].

Method

Based on our previous learning, we asked the RIS/PACS manager to extract 12-months of data using the correct, but counterintuitive, data extraction query [2]. This approach has been well documented in previous JOIS case studies, including, *Practical Application of Improvement Science to visualise the Queues and Flows within Radiology* by Jones and Markham [3].

The system flow map demonstrates the flow of CT requests over a 12-month period 01/01/2016 to 31/01/2017 (Fig 1).

Figure 1. CT System Flow Map



Using the validated approach to define the data query, a total of 66,334 data lines of patient CT requests were pulled from the RIS/PACS system.

Of the initial 66,334 requests: 23.5% are cancelled for a range of reasons, the commonest one being 'appointment not convenient for the patient'. These are then subsequently rebooked. Compared to this re-booking rework, the 1.5% DNA (Did Not Attend) rate is insignificant.

The first task is to measure the flow through the CT service and Fig 2 shows the correctly derived Vitals Chart® for the CT scanners at N&N.

Figure 2. Demand, Activity and WIP for N&N CT system between 01/01/2016 and 31/01/2017

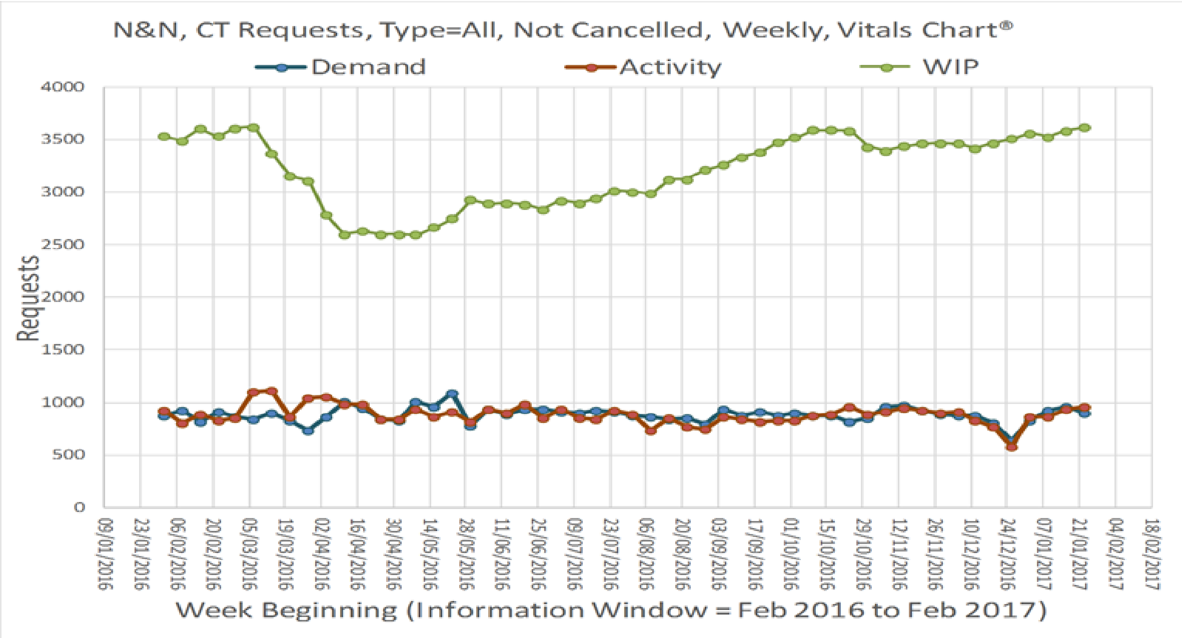


Fig 2 shows that the WIP (work-in-progress) has not been stable over time. The dip in WIP (green line) from 02/04/2016 corresponds with the increase in activity (red line) caused by a waiting list initiative. After the WLI, the activity falls to its original level and the work in progress (WIP) slowly rises back to its original value. There has been no significant change in the demand. Figs 3 and 4 show the weekly demand and activity in more detail.

Figure 3. CT Weekly demand between 01/02/2016 and 27/01/2017. Average = 900 requests per week.

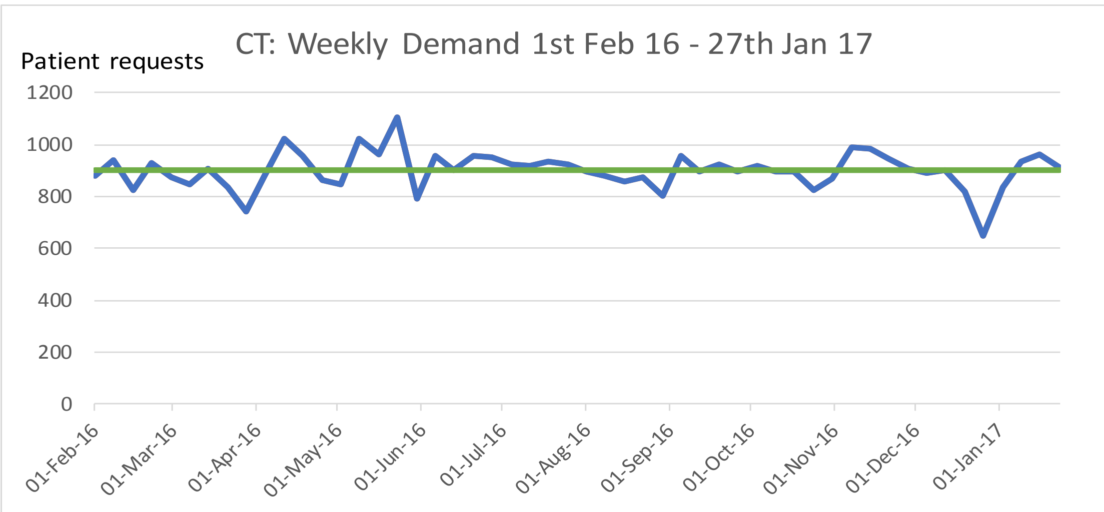
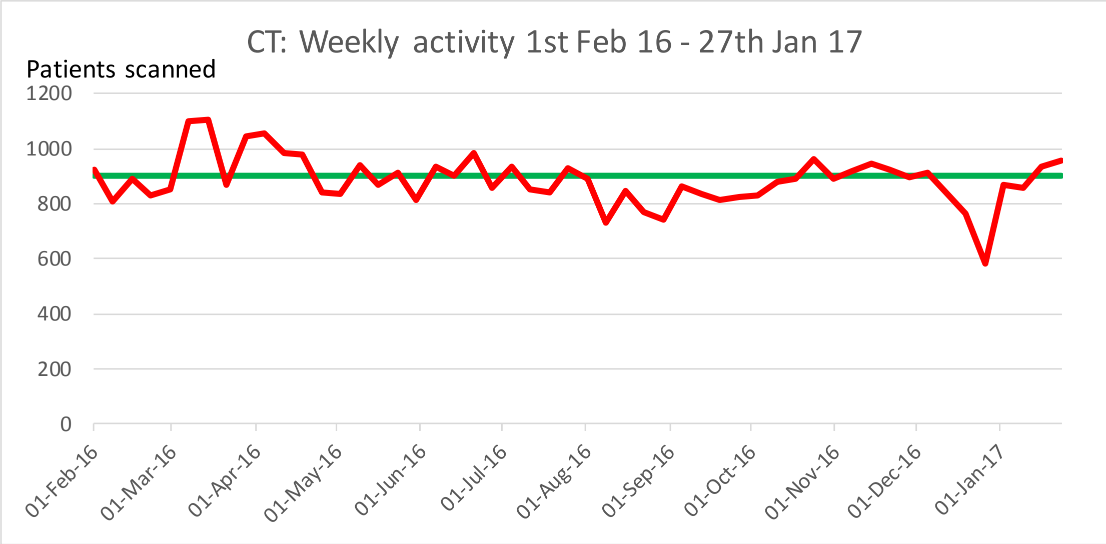


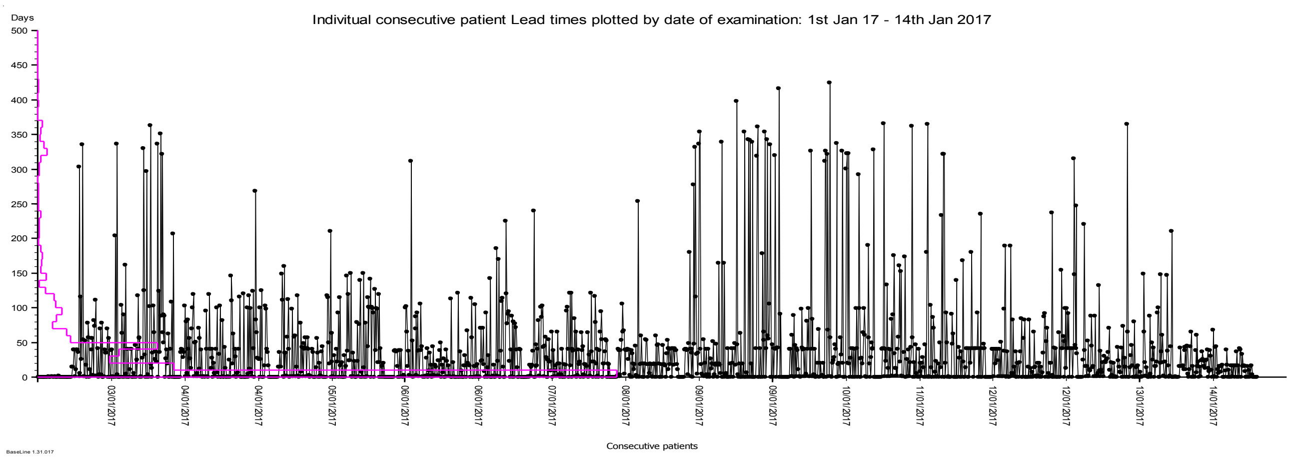
Figure 4. CT Weekly activity between 01/02/2016 and 27/01/2017. Average is 885 scans per week.



Diagnosis: On average, this CT service is only short of performing 15 CT scans per week.

Plotting 66,334 patients' lead-times is not possible in Excel so Fig 5 shows the lead times for the most recent patients scanned between 01/01/2017 and 14/01/2017.

Figure 5. CT Lead times (request date to date scanned) for consecutive patients



This chart shows individual patient lead times in days (Y-axis) plotted by their date of scan (X axis). The histogram (pink line) shows that many patients wait about a year (~360 days), some wait 6-months (~180 days), a larger group wait for 6 weeks (40-50 days) and the largest group who wait less than 14 days. The very long waits over 100 days are due to follow-up planned requests at 3 – 12 months so these lead times are consistent with the clinical protocols and waiting time targets.

Vitals Chart® summary:

1. The work in progress has not been stable over time.
2. The demand and activity are, on average, stable over time.
3. The average demand is greater than the average activity by only 15 patients per week (1.7%).

The question now is, has this service already got sufficient capacity (i.e. resource time) to meet the shortfall of 15 patients per week, rather than funding waiting list initiatives? To answer this question, we need to understand the workload.

Measuring workload

Workload is measured in man-hours / unit of time e.g. man-hours / day or week and is a measure of the amount of resource time that is required to service the demand i.e. demand x cycle time. The cycle time is the time taken for the resource (staff and machine) to process each patient request i.e. the time from when they start one patient to when they are ready to start the next patient.

The cycle time includes:

1. The 'touch time': the time the patient in the scan room.

2. The 'change over time': the time the staff require to finish the administration, clear the room after the has patient left and to adjust the equipment before the next patient comes into the scan room.

Measuring Cycle times

Radiology departments do not routinely measure cycle times or touch times. Some newer CT scanner software allows staff to record the touch times; i.e. time the patient is on the table or in the room.

It is important to remember that the touch time will underestimate the total amount of work required for each patient since it does not capture the change-over tasks (e.g. set-up, clearing rooms etc.). Experience and direct observation confirms the set up in CT is minimal so, in this case, the touch time is a reasonable estimate of the cycle time for CT.

The CT team used the 'touch times' recorded by the staff, as part of the post-scan data record, from their five CT Scanners for the period between 07/01/2017 and 27/01/2017. From this the calculated the total load per day for each CT scanner and compared it with the total time each scanner was available per day.

Figure 6. The difference between workload and resource time

In Fig 6, the X axis is the 21-days over which the touch times were measured. The Y axis shows the total touch times 'load' (grey line) and the available resource-time capacity (orange) for each of the five scanners. Each scanner is scheduled to work slightly different hours.

Diagnosis: While recognising it is important to measure cycle times, it is clear the scheduled resource time exceeds the workload on all five scanners.

Outcome

There is sufficient resource-time capacity to cover the difference between demand and activity of 15 patient requests per week i.e. 3 patients/scanner/week.

Now that the N&N's CT team know they have enough resource-time to meet their workload without waiting list initiatives, their challenge is to simplify their schedule so patients are scanned in order of their due dates.

Reflections

We make significant investment in continuous professional development to ensure staff have the most up to date training to diagnose a variety of conditions for our patients, but we do not invest enough into developing staff to diagnose the long waiting times in Radiology.

We need to treat our healthcare systems in the same scientific way we treat our patients. Firstly, to understand how patients flow through the service, then, based on an accurate diagnosis, develop an appropriate treatment plan as there may be more than one problem to solve.

There is a fundamental need for policy makers, healthcare executives, Radiology, RIS/PACS managers and lead radiographers, to develop their improvement science skills and understand how the 'policy constraints', both internal and external, are putting unnecessary pressure on their system.

Learning Points

The greatest learning points for me were:

- The need to have a multidisciplinary staff approach to diagnosing the cause of long waiting times, including executive support, before making any further investments in permanent or temporary (waiting list initiative) capacity.

- The vital role of the RIS/PACS manager who must understand the need to extract data in a counterintuitive manner [2].

The skills I have learnt from the ISP-1 training and ISP-2 training have taught me how to understand flow in a complex system like Radiology and the importance of getting the diagnosis right. Having started learning about Capacity and Demand as far back as 2000, as part of the Cancer Services Collaborative, I can now see there is a real science to flow in healthcare which is why I continue to learn and will develop my ISP Level 2 and 3 skills further.

References

1. Silvester K, Lendon R, Bevan H, Steyn R, Walley P. Reducing waiting times in the NHS: Is lack of capacity the problem? *Clinician in Management* 2014; **12 (3):** 105-9. http://www.internetgroup.ca/clientnet_new/docs/CIM12_3_Silvester.pdf

Abstract: This paper evaluates the causes of excessive queuing in the NHS, which results in patient backlogs and long waiting times. There has been a general call to increase the overall design capacity of many local health systems in the belief that there is insufficient capacity to meet patient demand. This paper suggests that lack of capacity is typically not the major issue. The primary cause of queuing in the NHS is the mismatch between demand and capacity, i.e. demand and capacity variation. Poor understanding of this variation, in particular variation in capacity, is compounded further by capacity loss through low yields of key resources and by increasing resources at parts of the process that are not bottlenecks. All this leads to ineffective capacity planning. As a result, some parts of the NHS are investing in additional capacity that will not increase the overall output from the service or may even make the situation worse. However, the knowledge exists to design health- care systems that deal with the variation in demand. Many hundreds of NHS teams are already using these principles with promising results. Given concerted leadership action, staff capability building and new systems to match demand and capacity on a daily basis, it would be possible to develop `low wait' or even `no wait' services across the NHS.

2. Silvester K. Diagnosing the Flow Constraint in an Endoscopy Service. Part 1: Recognising and Avoiding the Data Query Trap. *Journal of Improvement Science* 2016; **38:** 1-23. https://www.improvementscience.co.uk/jois/jois_view_abstract.php?volume=38

3. Jones C, Markham D. Practical Application of Improvement Science to Visualise the Queues and Flows within Radiology. *Journal of Improvement Science* 2017; **48:** 1-21. https://www.improvementscience.co.uk/jois/jois_view_abstract.php?volume=48

Acknowledgments

I would like to thank Mr Simon Dodds, MA MS FRCS and Dr Kate Silvester, BSC MBA FRCOphth, my ISP coaches for their expertise, advice and the encouragement to keep me pursuing new levels of improvement science. Thanks also to the staff at Norfolk and Norwich NHS Trust's Radiology and CT department who have started out on a journey of new learning with support from their Divisional Director, Sheila Glenn who has provided the essential executive support.

Author

Lesley qualified as a diagnostic radiographer with expertise in CT, MRI and Nuclear Medicine and trained as a black belt in Six Sigma. In 2002, Lesley established the national Radiology, Pathology and Endoscopy Service Improvement teams in her role as Director for Diagnostics Improvement, NHS Improvement. Developing and testing the improvement techniques required to redesign diagnostic services, facilitating clinical teams to implement changes and understand the importance of change management required for sustainability. Lesley has been able to demonstrate the value effective and efficient diagnostic services can have across the whole healthcare system and has published several improvement documents including 'How to guides' for Radiology, Pathology, and Cytology. She has written improvement articles and spoken at national and international Healthcare Quality Improvement forums in England, Ireland, Scandinavia and the USA and is a specialist advisor for CQC. Now working independently, Lesley continues to focus on facilitating improvements in diagnostics, training staff in the Science of Improvement and working towards an ISP Level 3 certification.

Sponsor

Kate Silvester originally trained and practiced as an ophthalmologist. In 1991, she retrained as a manufacturing system engineer and spent seven years in management consultancy transferring manufacturing principles to service industries such as banking, airlines and healthcare. In 1999, she re-joined the UK's National Health Service and worked on many national programmes improving the flow of patients through the system; addressing timeliness, cost and quality. Kate's specific area of expertise is in the management of organisational systems to address the variability in demand and capacity. In November 2007, she joined the EU-Japan World Class Manufacturing Programme to translate the Lean Thinking approach into Healthcare. She was appointed an Honorary Associate Professor, in the Health Sciences Research Institute at Warwick Medical School in January 2009. Between 2010 and 2012, she was sponsored by The Health Foundation to lead an *'Inquiry into Flow, Cost and Quality'* with South Warwickshire Hospitals NHS Trust and Sheffield Teaching Hospitals NHS Foundation Trust. Kate is co-founder of the Journal of Improvement Science.

Statement of Originality

Version

Reference	Version	Date	Document Owner
JOIS_2017_050	1.0	01/09/2017	lesley@lesleywrightimprovement.co.uk