A blueprint for streamlining patient pathways using a hybrid lean management approach

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TITLE: A blueprint for streamlining patient pathways using a hybrid lean-management approach

AUTHORS:

<table>
<thead>
<tr>
<th>Name</th>
<th>Email address</th>
<th>Number</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miss Chantelle Rizan</td>
<td><a href="mailto:Chantelle.rizan@nhs.net">Chantelle.rizan@nhs.net</a></td>
<td>012736969 55</td>
<td>Brighton and Sussex University Hospitals NHS Trust Royal Sussex County Hospital Eastern Road Brighton, UK BN2 5BE</td>
</tr>
<tr>
<td>Dr Rob Low</td>
<td><a href="mailto:Rob.Low@nhs.net">Rob.Low@nhs.net</a></td>
<td>012736969 55</td>
<td>Brighton and Sussex University Hospitals NHS Trust Royal Sussex County Hospital Eastern Road Brighton, UK BN2 5BE</td>
</tr>
<tr>
<td>Ms Saskia Harden</td>
<td><a href="mailto:Saskia.Harden@nhs.net">Saskia.Harden@nhs.net</a></td>
<td>012736969 55</td>
<td>Brighton and Sussex University Hospitals NHS Trust Royal Sussex County Hospital Eastern Road Brighton, UK BN2 5BE</td>
</tr>
<tr>
<td>Mr Nick Groves</td>
<td><a href="mailto:Nick.Groves@nhs.net">Nick.Groves@nhs.net</a></td>
<td>012736969 55</td>
<td>Brighton and Sussex University Hospitals NHS Trust Royal Sussex County Hospital Eastern Road Brighton, UK BN2 5BE</td>
</tr>
<tr>
<td>Ms Breda Flaherty</td>
<td><a href="mailto:B.Flaherty2@brighton.ac.uk">B.Flaherty2@brighton.ac.uk</a></td>
<td>01273 644128</td>
<td>Mayfield House, University of Brighton, Falmer, Brighton, BN1 9PH</td>
</tr>
<tr>
<td>Dr Trevor Welland</td>
<td><a href="mailto:T.Welland@bsms.ac.uk">T.Welland@bsms.ac.uk</a></td>
<td>01273 606755</td>
<td>Brighton and Sussex Medical School, University of Sussex, Falmer, Brighton BN1 9RH</td>
</tr>
<tr>
<td>Mr Prodip Das</td>
<td><a href="mailto:Prodi.Das@nhs.net">Prodi.Das@nhs.net</a></td>
<td>012736969 55</td>
<td>Brighton and Sussex University Hospitals NHS Trust Royal Sussex County Hospital Eastern Road Brighton, UK BN2 5BE</td>
</tr>
<tr>
<td>Professor Mahmood F Bhutta</td>
<td><a href="mailto:M.Bhutta@nhs.net">M.Bhutta@nhs.net</a></td>
<td>012736969 55</td>
<td>Brighton and Sussex University Hospitals NHS Trust Royal Sussex County Hospital Eastern Road Brighton, UK BN2 5BE</td>
</tr>
</tbody>
</table>
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CONTRIBUTORSHIP STATEMENT:
Miss Chantelle Rizan led on all aspects of this research including the design, acquisition, analysis and interpretation of data. Mr Prodip Das, conceived of the original streamlined patient pathway and oversaw the clinical governance of the research. Miss Saskia Harden and Dr Rob Low were involved in the design of the streamlined pathway and acquisition of data and now lead the clinical service provision of the streamlined pathway. Mr Nick Groves substantially contributed to the design and conception of the streamlined pathway. Dr Trevor Welland and Miss Breda Flaherty provided expertise on the analysis and interpretation of the data. Mr Mahmood Bhutta provided clinical input and guided the formulation of this paper. All authors were involved in the drafting of the work and approved the final version.
ABSTRACT: (275)

Background

Streamlining patient pathways within healthcare systems is a complex and challenging process. Whilst frontline clinicians often have an abundance of ideas, these rarely translate into real world change due to non-adoption or early abandonment.

Aims

The aim of this paper is to provide frontline clinicians with a blueprint for developing a business case for a streamlined pathway whilst guiding the practical implementation of this.

The blueprint

The key steps outlined in streamlining a patient pathway are as follows; step 1) identify problems with the patient pathway, step 2) identify the potential to streamline, step 3) forecast the benefits of the streamlined pathway, step 4) gain approvals, step 5) plan the practicalities, step 6) implement and monitor the streamlined pathway. Within these steps lean management techniques are introduced (including value stream mapping, Pareto charts, Ishikawa diagrams, demand and capacity calculations, role lane mapping) and strengthened by other methods (retrospective audit, systematic review, patient questionnaires and cost analysis). This roadmap is contextualised using a case study, demonstrating how streamlining pathways can result in statistically significant reductions in referral to treatment time, the number of steps in the pathway, lead time (pathway duration) and hand-off (transfer of patients between healthcare professionals). This can be achieved whilst increasing patient contact time, improving patient satisfaction and reducing costs.

Conclusion

This blueprint demonstrates a comprehensive method for streamlining patient pathways, using lean management techniques complemented by additional methods. This approach was developed by frontline clinicians and can be replicated by others, translating quality
improvement ideas into sustainable change in practice. It enables the design of streamlined pathways which confer significant benefits to patients, healthcare service providers and the health economy.
Introduction

Streamlining patient pathways in the context of complex healthcare systems is often a challenging process. (1) Doctors, nurses, and allied healthcare professionals are well placed to identify ways to improve pathway efficiency due to their deep understanding of healthcare processes. (2) Bottom up ‘distributive’ leadership from on the ground healthcare professionals (3) has been advocated by the King’s Fund ‘no more heroes’ model of shared leadership. (4) However, frontline healthcare professionals are rarely formally taught clinical leadership (5) and may not be aware of tools which can help develop and deliver a case for change. As such, only a small proportion of frontline staff’s ideas translate into real-world change, and reasons for this may include early abandonment of the idea, non-adoption by other stakeholders, or a lack of system readiness. (6, 7) This paper aims to empower frontline clinicians to lead pathway redesign in a ward-to-board manner by offering a blueprint for the development and implementation of patient pathway redesign.

Our approach is premised on lean management, a quality improvement method used to eliminate waste within systems (such as a patient pathway), through ensuring all process steps add value to the customer (patient). (8) Lean manufacturing was originally developed by Kiichiro Toyoda and Taicchi Ohno as part of the Toyota Production System in the 1930s, and subsequently described and popularized in the book *The Machine that Changed the World: The Story of Lean Production* by Womack et al. (9) Womack and Jones went on to specify five lean principles in their book *Lean Thinking: banish waste and create wealth in your corporation*. These principles encourage organisations to maximise the value of all activities to the customer, through identifying the value process stream, enabling continuous flow through supporting value-added steps and challenging non-value adding activities. Other lean principles included were the use of customer sales to ‘pull’ manufacturing processes, and the pursuit of perfection
through reduction of waste. (10) Examples of waste include unnecessary process steps, avoidable movement of people and goods, unnecessary waiting time (due to lack of co-ordination between processes), correcting mistakes, and the creation of goods in excess of customer demand. (9) Lean management has subsequently been used to underpin the concept of Total Quality Management (often used synonymously with the term Continuous Quality Improvement), as developed by W. Edwards Deming, Joseph Juran, Phillip Crosby, and Kaoru Ishikawa. (11)

In 1989, Donald Berwick proposed continuous improvement as an ideal in the healthcare setting, (12) and went on to co-found the Institute for Healthcare Improvement. Lean management has since been used to improve quality and flow in a variety of healthcare contexts, (1, 13, 14) most comprehensively and successfully at the Virginia Mason Medical Centre. (15) However, published case studies using lean management within healthcare settings often fail to define the practical steps taken, making the route to success difficult to replicate. (16-18) Other studies have identified factors for increasing the likelihood of success of lean quality improvement projects, such as creating a supportive culture, training, accurate data, physicians and team involvement; (19) or developing personal skills in organisation, persistence and resilience. (20) However, in our experience, the most helpful practical guides for using lean management to streamline patient pathways exist within the grey literature. (21-24)

Streamlining a patient pathway involves more than simply learning and applying lean management techniques, and must incorporate engagement with multiple clinical and non-clinical stakeholders. Each stakeholder has their own personal and departmental agenda and will be persuaded to support quality improvement projects on the basis of different, stakeholder
dependent merits. (25) It is therefore important to develop a comprehensive case for change, offering benefits across diverse domains.

Here we showcase a hybrid model for streamlining patient pathways, drawing upon lean management techniques alongside multiple additional methods. We believe that the model described can be adapted and emulated for streamlining patient pathways in a variety of settings. We illustrate the practical application of the pathway using a case study on streamlining the pathway for management of patients with unilateral tinnitus, which is published in more detail elsewhere. (26)

**A blueprint for streamlining a patient pathway**

Figure 1 provides a blueprint for streamlining a patient pathway, outlining seven key steps which should be followed sequentially. It may not be feasible or necessary to cover each subpoint in all instances, but this blueprint demonstrates the array of factors which can be included within a case for change and guides the process of pathway implementation.

**Step one: Identify the current patient pathway**

The first step in streamlining a patient pathway is to carefully define the problem with the existing pathway, formulating a precise problem statement. (27) All the steps in the pathway (both clinical and administrative) should be identified and visualised using value stream mapping (VSM). The term ‘value stream’ was coined by Womack, Jones and Roos, (28) and VSM is a lean management technique can be used to identify steps that do not add value to the customer (patient). (21, 22) The VSM based on the existing pathway is called the ‘current state’ VSM, and proposed streamlined pathway termed the ‘future state’ VSM. The key steps in the VSM can be time-stamped through a retrospective audit of patients on the existing pathway,
enabling calculation of average delays in the pathway. Variation in patient care can also be determined and incorporated into the VSM. A retrospective audit can also enable the scale of the problem (number of patients affected in a given timeframe) to be determined.

Using a VSM enables calculation of the average referral to treatment time, touch time (time the patient spends in contact with healthcare professionals) and lead time (total pathway duration). The average number of patient healthcare visits and number of steps in the patient pathway are also illustrated. The VSM can be used to highlight the ‘handoff’, which is the number of times a patient (or their data) is transferred from one healthcare professional to another.(23) High handoff increases potential for miscommunication, delays and duplication of work. Where feasible, the retrospective audit (and subsequent time-stamped VSM) should be appropriately powered, allowing detection of any statistically significant change in the referral to treatment time (or other salient endpoint(s)) following implementation of a streamlined pathway.

The VSM can also be used to help identify key stakeholders involved in the patient pathway. Early identification and engagement with such stakeholders is crucial. Departmental leads should be invited to identify missing steps within the VSM. Both clinical and non-clinical stakeholders should be consulted to identify problems in the existing patient pathway. Patients can also offer valuable insights into how a given pathway might be improved. This can be facilitated through patient questionnaires, focus groups or patient panels. The problems (collectively identified) can be summarised using an Ishikawa diagram, also known as fishbone diagrams, or cause and effect diagrams, and first described by Kaoru Ishikawa in the 1960s who used these to improve shipyard quality management processes.(29) Here the ‘head’ is the problem statement or ‘effect’, with each ‘bone’ along the spine referring to a different ‘cause’, encouraging lateral thinking and root cause analysis of problems.
Step one in practice

The problem statement was defined as follows; ‘there are inefficiencies and unnecessary steps which do not add value within the existing unilateral tinnitus pathway, causing distress to patients and frustration to staff members’. The retrospective audit indicated that 264 patients were referred and treated on this pathway each year locally. Figure 2 illustrates the current state VSM, formulated in collaboration with stakeholders and timestamped through retrospectively examining hospital databases. The VSM and associated measures were based upon a sample of 22 patients who received a Magnetic Resonance Imaging (MRI) scan for unilateral tinnitus (consecutively sampled from scans reported between 1/12/2014 and 9/1/2015). The key clinical stakeholders identified were ENT (Ear, Nose and Throat), Audiology, Neuroradiology and GPs. The non-clinical stakeholders were finance, communications and IT departments. Questionnaires were sent to the 22 pre-intervention patients, with a response rate of 72.7% (16 patients). Patient questionnaires indicated that two thirds of respondents would prefer fewer appointments that last longer (see Supplementary table 1 for full questionnaire results). When patients were asked what they thought about a potential streamlined process, 90% reported that this would be a little or much better. Within white space questions, common themes were unnecessary appointments, repeated visits and poor patient experience. The clinical team brainstormed further causes of pathway inefficiencies and ineffectiveness, summarised by an Ishikawa diagram (Supplementary figure 1).

Step two: Identify the potential to streamline

When seeking to improve a patient pathway it is important to identify any existing guidelines and also existing best practice. The latter should be ascertained through a formal systematic review, alongside discussion with colleagues at other sites. The purpose of doing this is to a)
determine whether local pathways reflect those within published (and grey) literature and b) highlight examples of streamlined pathways which can be built upon. The systematic review should preferably be conducted in accordance with PRISMA guidelines, for example searching The Cochrane Database, Embase, Ovid MEDLINE, PubMed and NICE Evidence Search.

The Pareto Principle is another useful tool to identify the most fruitful areas to focus upon when streamlining a pathway.(31) The 19th century Italian economist and sociologist Vilfredo Pareto estimated that 80% of wealth was held by 20% of the population, and this 80/20 rule was later named the ‘Pareto Principle’ and applied to defects by Joseph Juran in 1937.(32) This principle predicts that 80% of defects (here, pathway delays) will result from 20% of causes (i.e. a few key factors). A Pareto chart(24) can be constructed to identify the major causes of delay within the existing pathway. Each factor is ordered by the duration of the delay and the cumulative delay is then plotted. The key stakeholders should again be consulted to determine how best to streamline the pathway, taking into account the detailed analysis of the problem, existing alternative models of care and the greatest causes of delay in care.

**Step two in practice**

The systematic review and discussion with colleagues confirmed that the local patient pathway mirrored national pathways. It also highlighted that other units had piloted audiology led one-stop tinnitus clinics.(33, 34) The Pareto chart (Figure 3) demonstrated that 83% of the delays (i.e. number of days between the start and end of the pathway) in the existing unilateral tinnitus pathway were caused by just two steps. Following discussion with the clinical stakeholders it was determined that the unilateral tinnitus patient pathway could be optimally and appropriately streamlined through a) enabling GPs to directly request the relevant imaging investigation b)
setting up a one-stop tinnitus clinic (thus eliminating two ENT outpatient appointments) and c) making referrals electronic.

**Step three: Forecast the benefits of the streamlined pathway**

Having identified the most fruitful areas to target through an evidence-based approach, the streamlined pathway can be designed using a ‘future state’ VSM. The associated endpoints can be calculated and compared with the existing pathway. Streamlining patient pathways often involves maximising workforce capabilities and this should be emphasised within the business case. The shift in clinical responsibilities between healthcare professionals can be visualised using role lane mapping.(23) This involves listing all process activities and assigning these to relevant stakeholders, allowing easy identification of shifts in responsibility for a given task before and after an intervention.

When a pathway is streamlined, this invariably improves efficiency, both of limited workforce capacity, space and capital resources. Depending on the payment contract model for the pathway, this may translate into savings to the health economy, hospital trust or commissioners. These savings should be calculated in collaboration with hospital finance departments and commissioners, remembering to consider variation in care (as identified in the retrospective audit).

**Step three in practice**

Figure 4 demonstrates the unilateral tinnitus future state VSM. Under the proposed streamlined pathway, the referral to treatment time was projected to reduce from 139 to 42 days, and the number of patient healthcare visits from 4 to 3. The total number of steps in the VSM would be reduced from an average of 20.2 to 11 (considering variation in care), with the lead time (total
pathway duration) reducing from 222 to 42 days. The hand-off between healthcare professionals would also reduce from 12 to 6. Meanwhile the touch time (time where the patient receives face to face input from a healthcare professional) would increase, from 72 to 85 minutes. All these anticipated benefits were shown to hold statistical significance.

Role lane mapping (Table 1) indicated that the predominant shift in clinical responsibilities in this case study was away from ENT and towards Audiology and GP. This empowerment of non-ENT colleagues was in line with the tinnitus management Good Practice Guide.(35) The streamlined pathway provided an average saving to the health economy of £80.43 per patient (Supplementary table 2). An NHS Improvement publication(36) further predicted that implementing a direct access tinnitus clinic could save £5.9 million per year nationally in the UK, without the added benefit of the novel direct access imaging.

**Step four: Gain approvals**

Following the proposed steps helps to build a rich business case for change, identifying a clear problem, and well thought through solution demonstrating multi-faceted benefits to patients, NHS trusts, commissioning groups, and the wider health economy. It is critical at this stage to host a key stakeholder meeting to ensure that all relevant departments are in support of a given change. This offers a forum where any anticipated problems can be tackled. Where stakeholders are resistant to change, it can be helpful to do a ‘stakeholder analysis’. The concept of stakeholder theory takes its origins in work from Edward Freeman(37) and Max Clarkson,(38) and stakeholder analysis has since been widely used across industry and applied to healthcare settings.(39) A stakeholder evaluation matrix involves plotting all stakeholders on a grid depending on their influence or power over the success of the intervention (low to high), against their interest or allegiance towards the project (low to high).(40) This can be used to identify
those who are most important to the success of a streamlined pathway, but who are least engaged, and core frontline healthcare staff leading the project can then focus efforts on building relationships with these individuals.

*Step four in practice*

The streamlined pathway was approved by all relevant departments at a key stakeholder meeting and by commissioners following presentation of the business case. A snapshot stakeholder analysis is provided in *Supplementary figure 2*, highlighting that at one point there were stakeholders who held power over the success of the streamlined pathway but who were not engaged in the process. The challenge is finding ways to make the streamlined pathway a priority for these stakeholders, motivating them to become proactive in enabling the pathway’s success. Efforts were directed at understanding the perspectives and agendas of these stakeholders and aligning them with those of the streamlined pathway, demonstrating how introducing this could be mutually beneficial.

*Step five: Plan the practicalities*

Prior to implementing a streamlined patient pathway it is important to ensure that the demand is estimated and capacity built to meet this demand. The capacity required (number of hours allocated to the service per week) can be calculated using the takt time equation,(22) by multiplying the weekly demand (determined by the retrospective audit) by the time required to see one patient (‘takt time’). For example, if a factory needs to produce 100 widgets per day, and can operate for 10 hours continuously, a widget must be manufactured every 6 minutes. Takt time was used within the German aviation manufacturing industry during World War II to synchronise assembly processes, and is named after the German word for rhythm or musical beat, ‘takt’. This was subsequently used to underpin the Toyota Production System ‘Just in
Time’ concept to enable continuous flow. If takt time is overlooked, referral to treatment time targets may slip further and further. Conversely, over-capacity equates to inefficient use of resources.

Streamlining a patient pathway will usually require the design of new referral forms, algorithms and systems to support these (preferably electronic). This may involve collaborating with hospital communications and IT departments alongside commissioning groups. These referral processes should ideally be modelled and tested before use to ensure glitches are resolved. Referrers are most likely to use a streamlined pathway where processes are simplified and seamless, providing a path of least resistance. Systems should also be designed to capture inappropriate referrals.

**Step five in practice**

The takt equation was used to determine that a four hour one-stop tinnitus clinic per week would likely meet the local demand. New referral forms and algorithms were designed alongside electronic systems to support the streamlined pathway. Systems were also put in place to divert inappropriate referrals, capturing patients that should have been referred onto another clinical pathway, and also patients who were referred incorrectly via the old pathway. Standardised letters were sent to GPs making inappropriate referrals, to inform them of the new streamlined pathway, its benefits and how referral forms could be accessed.

**Step six: Implement the streamlined pathway**

Any given clinical pathway is likely to be dependent upon hundreds of individuals, from the clinical team through to administrative staff. It is important that efforts are made to inform as many of these individuals as possible about a planned change to a system prior to
implementation. According to the Roger’s Diffusion of Innovation model,(42) a streamlined pathway will only become embedded and self-sustaining once a critical mass of individuals have been convinced of the merits of change. Once the tipping point is reached, an innovation is likely to be adopted by the late majority, in part due to natural social communication channels.

Step six in practice
An educational campaign was developed in collaboration with the local commissioning groups to raise awareness of the streamlined pathway amongst GPs. Departmental leads were called upon to inform all staff members within relevant departments. Communication included presentations, emails and news bulletins.

Step seven: monitor the streamlined pathway
Once the pathway is live, it should be monitored and formally reviewed after a relatively short, pre-defined time period, with feedback encouraged from all stakeholders. This is vital to tackle problems arising in a timely manner. Plan-Do-Study-Act (PDSA) cycles(24) can be used as a framework to encourage the early identification of problems, prompting small iterative improvements. This encourages individuals to map out stages of an intervention including planning, implementation, evaluation of results, and acting upon those results (often linking to a new PDSA cycle). It is also possible to monitor for unwarranted variation in a given endpoint (such as referral to treatment time) through a statistical process control chart.(22) Where unwarranted variation is detected (for example a data-point lying more than three standard deviations from the mean) this may indicate a systemic problem and a root-cause analysis of the problem may be required. Both PDSA and statistical process control charts were popularized by W. Edwards Deming, adapted from work by Walter Shewart.(43) As part of the evaluation of the success of a streamlined pathway, an ‘actual state’ VSM should also be drawn.
and timestamped to determine whether projected improvements are reflected in the real world. Patients and staff should also be consulted to determine satisfaction with the streamlined service.

*Step seven in practice*

The actual state VSM of the streamlined pathway is shown in Supplementary figure 3, based upon a prospective audit of 22 patients with unilateral tinnitus treated consecutively at the one-stop tinnitus clinic (19/5/2017-15/12/2017). This demonstrated that the predicted benefits of the streamlined pathway translated into real world improvements in practice. There were statistically significant reductions in the referral received to treatment time, number of healthcare visits, number of steps in the VSM, lead time and hand off, whilst patient contact time increased. These results, based on the 22 pre-intervention patients, are summarised in Supplementary table 3. Patient questionnaires were re-distributed to the 22 patients, with 27.3% response rate (6 patients, see Supplementary table 4 for full results). The pre-intervention group most commonly reported that they were ‘neither satisfied or dissatisfied’ with their overall treatment, whilst the post-intervention group were most commonly ‘satisfied’. This failed to reach statistical significance (p=0.127).

Eleven patients treated at the one-stop tinnitus clinic were diverted from other referrals made to the ENT department (50%) via the traditional route. Where GPs had referred directly onto the new pathway (11 patients), the MRI scan was not requested in two cases (18.2%). Over half of patients seen at the one-stop tinnitus clinic during this pilot phase required further ENT input (12/22 patients, 54.5%). This indicates further GP and ENT education was required to ensure patients are referred appropriately.
PDSA cycles enabled timely identification of problems such as those arising where key staff members were on leave, or where not all reception staff were aware of the new pathway and associated arrangements. An example PDSA cycle is shown in Supplementary figure 4, where a review of patient outcomes at 4 months highlighted that two patients had not been sent their IAM MRI results. A system was implemented whereby an ENT secretary was given responsibility for ensuring MRI results were chased and sent to patients (and their GP).

The ongoing use of statistical process control charts provided reassurance that where potential outliers were present, they did not actually constitute unwarranted variation. The SPCC based on the 22 pre-intervention patients (Supplementary figure 5) indicated that regression to the mean (return to low referral to treatment times) was likely within the existing streamlined system and that further major changes were not required.

**Discussion**

This paper provides a robust and replicable approach for streamlining patient pathways, which can be adapted and adopted by frontline clinicians across other specialties and patient pathways. Lean management techniques have been introduced (including value stream mapping, Pareto charts, Ishikawa diagrams, demand and capacity calculations and role lane mapping) and strengthened by other methods (retrospective audit, systematic review, patient questionnaires and cost analysis), which can be used together to build a strong business case for change. Our novel blueprint also guides the practical implementation of streamlined patient pathways within complex health systems. The case study pathway was designed and successfully implemented within 18 months of the
problem being first identified, demonstrating that significant change can be achieved in a relatively short period of time. Over 200 patients have now been seen on the case study pathway and there are plans for expansion of the service.

We recognise that scaling and dissemination of streamlined pathways, both locally and distantly, is challenging and is a potential focus for further research.(7) Existing evidence suggests that replication of an innovation at other healthcare provider sites requires local champions,(44) in particular to gain approval from relevant stakeholders and adapt referral pathways in accordance with local systems. Potential challenges to widespread adoption include factors relating to staff, the environment, technology and finance.(45) Resistance to change may arise at a micro (individual), meso (organisation) and macro (policy) level.(7)

Additional quality improvement tools which could have been incorporated into this blueprint include Sigma Six, which uses the DMAIC improvement model (define, measure, analyse, improve, control),(46) the Kaizen approach (which focuses upon continuous, incremental improvement),(47) or other lean management techniques (for example A3 thinking, and 5S methodology).(21) Some healthcare practitioners may prefer to use other techniques due to personal preference or because they are better suited to the particular pathway being considered, and such techniques may also be used synergistically.

Limitations

The external validity of the case study is limited by sample size, and also risks temporal bias through including patients consecutively. There may have been confounding factors
specific to the short inclusion time period, such as staff annual leave or transient problems arising following introduction of the streamlined pathway. There was also risk of the Hawthorne effect,(48) whereby staff were more vigilant due to knowledge that pathway delays were being monitored. However, the aim of this paper was to provide frontline clinicians with a blueprint for developing a business case for a streamlined pathway, and the worked case example is sufficient to illustrate the use of the recommended strategy.

**Conclusion**

Our blueprint offers a robust and comprehensive method for streamlining patient pathways, using lean management techniques complemented by additional methods. This approach was developed by frontline clinicians and can be replicated by others, translating quality improvement ideas into sustainable change in practice, conferring benefit to patients, healthcare service providers and the health economy. We welcome feedback from healthcare staff who use our approach to confirm (or refute) its broad applicability and value.
References