No. 19
Improving patient flow across organisations and pathways

Evidence scan
November 2013
Health Foundation evidence scans provide information to help those involved in improving the quality of healthcare understand what research is available on particular topics.

Evidence scans provide a rapid collation of empirical research about a topic relevant to the Health Foundation's work. Although all of the evidence is sourced and compiled systematically, they are not systematic reviews. They do not seek to summarise theoretical literature or to explore in any depth the concepts covered by the scan or those arising from it.
Key messages

This scan compiled research about the methods used to improve patient flow across organisations or pathways.

The Health Foundation’s work suggests that poor patient flow increases the likelihood of harm to patients and raises healthcare costs by failing to make the best use of skilled staff time. This evidence scan rapidly sourced examples of strategies to help improve patient flow across organisations or pathways of care to feed into the Health Foundation’s ongoing work in this area.

The evidence scan addressed the question:
– What empirical literature exists about methods to analyse or alter patient flow across organisations or pathways of care?

Ultimately the Health Foundation wanted to consider how methods for analysing or changing flow might best be applied to support unscheduled care. However, it was important not to focus on individual departments so the scan examined how flow could be improved across wider pathways, organisations or systems of care.

Five bibliographic databases were searched from their inception to the end of October 2013 and 280 studies were included about pathway, organisational or system-wide initiatives. More than 150 additional examples were included to illustrate potential applicability to unscheduled care, even if on a narrower basis.

Approaches to patient flow

The most commonly researched techniques for analysing patient flow across organisations, systems or pathways included:
– analysing routinely collected data about service usage
– capacity and workflow planning
– computer models using simulation and queuing theory
– failure mode and effects analysis
– systematic feedback from staff
– ethnography and observation.

After analysing data and identifying areas for change, organisations may implement flow improvement strategies such as:
– reducing variation using structured approaches such as ‘Lean’
– management based on real-time data
– matching demand and capacity, including workforce changes
– proactively planning discharge
– ‘pulling’ people through the system rather than relying on departments or services to ‘push’ people forwards.

The majority of published research focuses on patient flow in hospitals, though examples from primary care and other services are beginning to emerge.
**Potential benefits**

There is evidence that methods to improve patient flow can enhance throughput and continuity and reduce waiting time and length of stay. The size of the impact depends on the exact methodology used, but benefits have been found in both hospitals and care in the community across a wide range of pathways and specialisms.

The impact on patient satisfaction, safety and cost is less clear, due to few studies specifically investigating these outcomes. A small number of studies suggest that methods to reduce waiting time and length of stay are associated with improved patient satisfaction or cost.

However, it is important to bear in mind some caveats. The methods used to improve patient flow are heterogeneous so it is not possible to say that all flow-related methods result in similar outcomes. The outcomes will likely depend on the approach used. Few studies have explicitly compared whether one methodology is more effective than others.

Furthermore, a large proportion of studies provide examples of using various approaches in practice, but do not explore outcomes. The studies that do focus on outcomes have most commonly explored impacts on process measures such as throughput and length of stay, rather than issues such as cost or patient satisfaction. Therefore the evidence allows us to suggest that patient flow-related methods have potential when applied to pathways, organisations or systems of care, but further work is needed before unequivocal statements can be made about improved quality, experience and safety.

**Lessons learned**

Healthcare teams wanting to analyse and alter patient flow should note the following key learning points:

- Analysing patient flow and putting in place steps to address bottlenecks can have a measureable impact on throughput and length of stay.

- It is possible to transfer improvement techniques to a healthcare context, but it is essential to recognise contextual factors and adapt the methods.

- It is important to undertake detailed ‘diagnostic’ work to understand patient flow, rather than moving straight into redesigning services. Real-time demand and capacity management may be important.

- Flow issues may best be addressed by exploring processes across an entire hospital or a wider system comprising primary care, ambulance, hospital, social care and community services, rather than in specific departments.

- It can take time for new processes and systems to embed. Adequate time, resources and management support are needed to facilitate change.

- The most successful redesign initiatives include extensive staff engagement and training. If people are being asked to change the way they work, it is important that they understand why and what the benefits will be for themselves and patients.

- There is no ‘one size fits all’ approach. Many different methods have been used with the potential to improve healthcare.
1. Scope

Making sure that people can get the care they need quickly is a key component of providing safe and high quality healthcare. Ensuring that patients are flowing through healthcare systems is an important part of this. This scan examines research about how patient flow can be improved across organisations or pathways.

Purpose

Prompt access to healthcare is essential for safety and satisfaction. A growing number of people are using health services for scheduled and unscheduled care, so robust strategies are needed to deal with the high demand.1 If people are not moving through the system appropriately, it may mean that others experience delays in accessing care that can cause significant harm.2,3 This may also raise healthcare costs by failing to make the best use of skilled staff time and increasing the length of time that people are using services.4

It is therefore important to ensure that there is a match between capacity and demand in order to maintain patient safety, privacy and dignity. This can be done through ensuring timely availability of senior staff, access to diagnostics and investigations, good teamwork, adequate support from inpatient specialities and readily available hospital beds, for example.5

This is exemplified by The Health Foundation’s learning report, Improving patient flow, and associated case studies describing the work from two NHS trusts to address poor patient flow in unscheduled care.6,7

‘Patient flow-related methods’ refer to any methods seeking to identify the bottlenecks in services and how to address them effectively.

The Health Foundation was interested in further understanding how methodologies to address patient flow may help to improve outcomes in unscheduled (emergency) care. This is important because there are more than 100 million NHS calls or visits each year related to unscheduled care, representing one third of all NHS activity and accounting for more than half of the costs.8,9

For example, NHS England’s recent review of unscheduled care10 found that every year there are about 24 million calls to NHS urgent and emergency care telephone services,11–14 seven million emergency ambulance journeys,15 22 million visits to accident and emergency (A&E) departments, minor injury units and urgent care centres16 and five million emergency admissions to hospitals in England.17 This demonstrates the wide range of emergency services available and the extent of their use.18

However, an examination of research about using patient flow-related methods to improve outcomes in emergency care services found that much published literature about emergency care focused on specific departments rather than addressing wider systems, pathways or organisations.19 In the purest sense, methods to analyse and alter patient flow may be best applied across more than just one department or section. Therefore, to provide more robust examples of analysing and improving flow, the Health Foundation decided to compile research about applying these methods across organisations or pathways of care rather than concentrating only on unscheduled care. The learning can then be applied to emergency services as well as many other facets of healthcare.

This evidence scan thus addresses the question:

- What empirical literature exists about methods to analyse or alter patient flow across organisations or pathways of care?

Scanning research

The scan focused on readily available research published in journals in the UK and internationally. It was completed over a two-week period in November 2013.

To be eligible for inclusion in the scan, studies had to:

- include empirical data
- be published in a print or online journal
- be published in the English language.

There were no geographic restrictions.
Priority was given to studies exploring methods for analysing or addressing bottlenecks across pathways, organisations or wider systems rather than in individual departments or services. However, given that an aim was to apply the learning to unscheduled care, some specific examples from narrower studies in emergency services were also included.

To identify relevant research, two reviewers independently searched six bibliographic databases for studies of any design. The databases comprised Pubmed/Medline, Embase, Cinahl, the Cochrane Library and Controlled Trials Register, Google Scholar and the Health Management Information Consortium. All databases were searched from their inception to the end of October 2013. If only a small number of published studies were available, it was planned to extend the search to grey literature. However, the searches identified a large number of relevant published studies so the search strategy did not need to be extended.

Search terms included combinations of flow; patient flow; flow methodology; flow techniques; process redesign; logistics management; systems engineering; parallelisation; queuing theory; constraints; theory of constraints; Lean; Six Sigma; clinical systems improvement; patient demand patterns; demand and capacity; capacity variations; statistical process control; bottleneck; variation; smoothing variation; pull factors; streaming; reducing variation; reliability; Forrester/bullwhip effect; FIFO (first in first out); ‘carve out’; discharge planning; delays; waiting times; improving access; handoffs; transitions; process improvement; patient pathway; whole system; organisation and similes.

Abstract and title searches identified more than 5,000 studies about methods for analysing or altering flow in healthcare, though many were descriptive or did not report outcomes. 280 empirical articles met the inclusion criteria and more than 150 additional studies were also used to highlight how the wider findings may be applicable to unscheduled care.

Findings were extracted from all publications using a template. Studies were grouped according to key themes to provide a narrative summary. The studies were grouped according to whether they included methodologies to analyse patient flow or whether the approaches sought to make changes to flow.

All of the evidence was sourced and compiled systematically, but the scan is not a systematic review and does not seek to summarise every study about the impact of methods related to patient flow. Instead the aim is to provide examples of how these methods have been used to analyse and improve patient flow across organisations, pathways or systems of care, based on empirical evidence. There are many other studies examining flow-related methods within specific departments or units, but these were outside the scope of the review.
2. Assessing patient flow

This section provides examples of methods that have been used to assess patient flow across organisations or pathways (such as diagnostic analyses and models).

The main methods researched for assessing patient flow across organisations or pathways include:

- analysing basic routinely collected data about service usage
- capacity and workflow planning
- simulation and other forms of modelling
- queuing theory
- failure mode and effects analysis
- systematic feedback from staff
- structured observation and ethnography.

Examples of each of these methods and any research about their impacts is presented here. The next section focuses on methods to change patient flow, such as redesign activities.

It is important to note that these analysis methods may be used simultaneously and that they are often part of larger programmes to implement change. Examples of analysis approaches are presented here discretely solely to help clarify the range of methods used.

Analysing service use

Examples of use

There are many examples of health services, particularly hospitals, analysing routinely collected data to help understand how patients use services and whether there are trends based on particular times of the day or the types of staff or care involved.  

Retrospectively examining data over a set period of time is the most common approach. These analysis approaches can range from simple to very complex.

Analysis of routinely collected data to identify patterns in service usage has been done across hospitals, within specific subgroups or pathways of care and specifically for unscheduled care services.  

For instance, retrospective analysis of data from 23 Australian hospitals was undertaken by aggregating historic data into hourly intervals spanning a two-and-a-half-year period. The researchers examined admission and discharge rates, occupancy levels, length of stay for admitted and unscheduled care patients and access block. The study identified three stages of declining system performance or ‘choke points’ as hospital occupancy increased. Implementing strategies to support early discharge was predicted to improve patient flow. These researchers also compared differences between weekdays and weekends and looked at whether the findings were different from patient flow in hospitals across the region. Having something to compare to and benchmark against was seen as important, as was analysing patient flow at a service level as well as on a hospital-wide basis.

Another study from Australia used time-based clustering to visualise patient flow data from one hospital. Inpatient and A&E department patient episodes were clustered into hourly slots based on recorded timestamps and then grouped according to specific parameters. This was found to be a powerful tool for visualising and analysing interactions and interdependencies in patient flow factors across the entire organisation.

In another part of Australia, a hospital developed a user-friendly interface to distil routinely collected clinical data into patient flow information to aid bed management. Historical snapshots were used to allow flow to be visualised across a day, week, month or year. Flow information about occupancy, arrival and departure rates, length of stay and access block were included, and could be filtered by age, departure status, diagnosis, elective status, triage category and admission unit.

In the US, a children’s hospital undertook a detailed analysis of the reasons for delayed discharge. They found that, over a month-long period, almost one quarter of patients could have been discharged sooner.
than they were. The impact on length of stay and costs was substantial. The data was used to prioritise interventions such as improving discharge criteria, more efficient discharge planning and timely scheduling of consultations and diagnostic tests.44

The impacts of improvements made after analysing data about patient flow are described in section 3, 'Changing patient flow.'

Possible applicability for unscheduled care

There are many examples of how analysis of basic data has been useful for unscheduled care.45–52 For example, in one US hospital, the data used for A&E department redesign included the current status of the organisation, national trends, user profiles, types of long-term conditions, insurance distribution, proportion of inpatient admissions, readmission figures, outpatient services and charges.51 This is an illustration of how broader organisational data and data from outside the organisation were explored to understand the potential impacts on flow through unscheduled care. The study acknowledged that flow in A&E was a function of much wider system issues rather than solely related to an individual department.

There are many more examples of how analysing routinely collected data can help understand patient flow in unscheduled care. The most useful analyses tend to tailor the exploration to local needs, analyse data about a whole organisation or system rather than focusing on a specific department and build in an immediate strategy to make changes.54–57 Approaches which use visual tools, such as scatterplots, have been found to have some merit.58,59

Capacity planning

Examples of use

In addition to looking at data about service usage, another approach involves exploring data about workforce issues and the capacity available to meet such usage demands. A number of different models have been used to explore workflow and to plan resource needs across healthcare organisations or systems. Although the exact models used differ, they have in common a focus on compiling quantitative data about various patient, staffing and resource inputs in order to consider the staffing needs and the impact of any changes to processes or patient numbers.60–65

Examples of outcomes from capacity planning are included in the section 3, 'Changing patient flow.'

Possible applicability for unscheduled care

Mapping workflow capacity against demand is as potentially useful for unscheduled care as for other parts of the healthcare system. However, most examples of this approach in unscheduled care have focused on a specific department or service rather than exploring capacity across the broader spectrum of care and how this might impact on unscheduled care.

An example of application in a specific department comes from the UK where an A&E department undertook an in-depth analysis of demand and capacity, drawing on techniques from manufacturing and other industries. The team found that proper capacity planning is vital for improving patient flow, but this is often done poorly. The researchers argued that it is important to understand demand and the variation in demand in order to ensure effective workforce planning and process redesign. They suggest that planning using aggregated data may lead to inadequate capacity.66

Eight US hospitals attempted to take a broader approach by using a 'hospital capacity assessment tool' and applying it to unscheduled care services. The tool was available in paper and electronic form and drew on other emergency care assessment tools. Three hospitals found it difficult to complete the questions because they did not collect patient flow data regularly. The other hospitals found the tool easy to use and thought it was beneficial for evaluating community-wide emergency care.67

Another example is a model developed to predict surge capacity bottlenecks in response to a mass-casualty incident involving multiple burn victims. Commercial software was used to model patient flow and anticipated resource use based on principles of disaster management and historical data. The model input the age and weight distribution for casualties, severity of burns, rate of arrival of casualties to hospital, triage to ward or critical care settings, eligibility for early discharge, occupancy of intensive care unit, surgical step-down care and wards, staff availability, floor and operating room resources, and the average hospital length of stay and mortality rate for patients with inhalation injury and different sized burns. This helped predict the time to bottleneck for each limiting resource and the average waiting time to hospital bed availability. Knowing the time that it would take the hospital to reach capacity meant that alternative strategies could be developed to care for those waiting.68
Simulation and models

Examples of use

Healthcare managers may make decisions about patient flow, workflow and capacity based on subjective information, especially where ‘hard data’ are not available. Discrete event simulation is a computerised method of modelling how things work in real-world settings over time and can be used as an evidence-based tool to develop and prioritise potential operational changes prior to implementation. ⁶⁹,⁷⁰

There are a number of examples of using discrete event simulation or other forms of modelling to understand patient flow, manage bed capacity, schedule staff, manage admission and scheduling procedures, test the value of potential initiatives before they are implemented and use resources such as labs and pharmacies effectively. ⁷¹–⁸⁹

For example, a lack of intensive care unit (ICU) beds may cause ambulance diversion and surgery cancellation, thus affecting patient flow on a wider organisational or system-level. On the other hand, an excess of ICU beds may be a waste of resources. Researchers in Singapore used discrete event simulation to determine appropriate ICU bed capacity to balance service level, cost-effectiveness and patient flow. One year’s worth of operational data such as emergency arrivals, elective arrivals and length of stay were fed into the model to capture variations in the system. The model was used to test ‘what-if’ scenarios regarding growth in demand. ⁹⁰

Another example is a US ICU that used an advanced predictive model to ‘smooth flow’ based on analysis of need, occupancy and length of stay, coupled with an active daily strategy for demand/capacity matching of resources and needs. Key activities included patient flow models based on surgical predicted need for intensive care and predicted length of stay; scheduling the case and an ICU bed at the same time; capping and simulation models to identify the appropriate number of elective surgical cases to maximise occupancy without cancelling elective cases; and a morning huddle between senior staff from many departments to confirm that day’s plan and anticipate the next day’s needs. This approach helped to ensure there was always ICU bed capacity. ⁹¹

Elsewhere, a ‘stock and flow’ model was used to analyse the amount of blood stored in blood banks and hospitals in the US. The model simulated the potential impact on supply of using different blood management practices for transfusion such as first in-first out (FIFO), using the oldest stored red blood cell units first; preferentially selecting older blood; and preferentially selecting younger blood. ⁹²

Traditional discrete event computer simulation software can be quite complicated to use, expensive to purchase and require training. In Canada a simplified simulation platform was developed that ran using spreadsheets. Spreadsheets are low cost, popular to use and have good functionality, and these outputs may be just as reliable as those from traditional software. A comparison of commercial software versus simulation spreadsheets found that both were equally good at predicting patient flow characteristics but spreadsheets were easier to use, understand and implement. ⁹³

The impacts of improvements made after modelling patient flow data are described in section 3, ‘Changing patient flow.’ Most of these improvement studies do not explicitly state that models were used as a starting point, and instead focused on the change initiatives undertaken.

Possible applicability for unscheduled care

A number of studies have applied modelling tools to examine flow in unscheduled care, though most of these focus on specific departments rather than using hospital-wide or broader system-level data. ⁹⁴–¹⁰⁵

There are some exceptions, however. For instance, researchers from England used simulation to create a ‘perfect world model’ for A&E care, not as it is, but as it could be. Importantly, the ‘efficiency gap’ between the ‘perfect world’ and the ‘real world’ was used to identify the location of bottlenecks in the current ‘whole hospital’ patient pathway and brainstorm ideas for improvement. ¹⁰⁶ This shows that drawing on wider organisational-level data can lead to ideas for change in specific services.

Elsewhere in England, a primary care commissioning organisation focused on improving the use of unscheduled care and support efficiency gains in the local hospital. A model of the system was developed to help set usage targets at the micro-level of the hospital. The model drew on a small number of key readily available data items. The model emphasised that primary care had a key role in changing the culture, communication and care provided within A&E and other unscheduled services. ¹⁰⁷

US researchers used a model to test whether discharging people from inpatient hospital wards earlier in the day could affect crowding in A&E. The model suggested there was potential to reduce or eliminate the number of people admitted through A&E who had to be placed in temporary beds whilst awaiting an inpatient bed to become available. ¹⁰⁸
In Korea a simulation model was used to examine internal and external factors affecting patient flow and crowding at one unscheduled care department. Basic patient flow and process data were collected and computer simulations were used to evaluate diverting patient loads to another area as well as other improvement initiatives. Using simulation models allowed managers to think through the intricacy of the unscheduled care environment and how it related to other facets of the wider system. It also enabled experimentation to make inferences about how the real system might perform.109

Models have also been used to inform patient flow on a larger scale in unscheduled care. In Canada simulation was used to explore ‘crowdinforming’ as a method for controlling patient loads between six A&Es in one city. Six months’ worth of data were analysed to determine factors influencing flow and to develop a process control strategy. A&E arrival rates were the most useful measure of ‘busyness.’ The researchers concluded that making live data available may help to redirect paramedics and also encourage patients and their families to visit unscheduled care services that are less busy.110

Possible applicability for unscheduled care

Queuing theory is very applicable to urgent care, but has tended to be applied at the level of individual departments or units rather than across wider organisations or pathways.122–125

For example, researchers in the US developed a model based on queuing theory to predict the effect of various patient crowding scenarios on ‘left without being seen’ rates in A&E. One year’s worth of data from one hospital were analysed. A model previously used in a call centre was modified for use in healthcare. It was possible to use data about patient arrivals, treatment time, and non-availability of beds to predict the proportion of patients who left without being seen.126

At a broader level, a team from the UK used queuing theory to evaluate completion times in A&E departments. They suggested that flows through an A&E can be accurately represented as a queuing process, with visual aids helping to interpret data in a simple manner. The analysis suggested that government waiting time targets resulted in significant improvements due to better management and changes in the way patients are labelled and therefore counted through the system.127

Researchers in Canada used queuing theory on an organisational level to analyse the relationship between patient flow to A&E and patient flow to the inpatient unit. They then used the model to estimate the average waiting time for patients and the resources needed in unscheduled and inpatient care. The model was used to analyse the potential impacts on waiting time and resources of an alternative way of accessing unscheduled care and this helped managers plan the resources needed to enhance patient flow.128

Statistical process control

Examples of use

Statistical process control is a quality control method that was originally applied to manufacturing processes to ensure they operated within specific limits and eliminated waste. Control charts plotting the extent to which processes conform to standards are often used, along with rapid improvement changes.129 This approach has been applied in healthcare to assess where processes conform to specifications, including changes in patient flow.130

A systematic review of 57 studies explored how statistical process control, with control charts as a core tool, has been used to improve quality in healthcare. The review found that this approach has been applied in a wide range of settings and specialties and across organisations. The reviewers reported that statistical
process control helped different stakeholders manage change, but only if applied robustly with risk adjustment and data stratification. Another review of 34 studies found that control charts can be useful, but are not always developed and analysed robustly.

Studies have reported improved efficiencies in care, reduced variation and more streamlined pathways following the use of statistical process control. However this is merely an analysis approach and interventions need to be implemented to make changes (and monitored with ongoing analysis so adjustments are possible).

**Possible applicability for unscheduled care**

As an example of applying this approach to unscheduled care, researchers from the UK tested using statistical process control to monitor and provide prompt real-time feedback on strategies to reduce ‘door-to-balloon time’ for people suffering a heart attack. This spanned care across diagnosis, ambulance transfer, A&E assessment and immediate treatment. Median time to treatment fell significantly following changes in protocol. The team concluded that statistical process control provided a robust mechanism for assessing the effect of process redesign and gave a useful visual representation to support changes.

Other examples in unscheduled care have tended to focus on a departmental level but, as illustrated above, there is no reason why statistical process control cannot be applied spanning departments or pathways.

**Critical path analysis**

Critical path analysis is a modelling technique developed in the 1950s. It is used to examine relationships and interdependences in projects and has been used in construction, the military, IT and engineering contexts, as well as healthcare. The key steps are to develop a model or outline listing all activities required to complete the project, the time that each activity will take to complete, the dependencies between the activities and logical end points such as milestones or deliverable items. This can be used to visually identify areas that need to be prioritised, using Gantt charts or similar. The NHS Institute for Improvement and Innovation’s ‘Improving Time to Care'/Productive Ward programme uses critical path mapping, among many other tools.

**Possible applicability for unscheduled care**

The efficiency of unscheduled healthcare depends on interactions among the system structures, processes and outcomes so critical path analysis may be useful.

Examples of this approach in unscheduled care have focused at the level of individual departments however, rather than incorporating wider organisations or systems.

A department-specific example comes from Korea where researchers examined the effect of structural adjustment (change in floor plan or layout) and process improvement (critical pathway implementation) on A&E performance for people with stroke. One large hospital adopted structural changes and another large hospital used critical path analysis to support process improvements. Before and after analysis suggested that both redesign of the layout and implementation of critical pathways improved most of the performance measures. Overall, adopting critical pathways appeared to be more effective for reducing waiting time or time to treatment. This was purportedly mainly due to the extensive staff training required to implement new pathways. The researchers concluded that combining structure-oriented and process-oriented strategies may maximise the effectiveness of efforts to improve patient flow.

**Failure mode and effects analysis**

**Examples of use**

Failure mode and effects analysis is a systematic technique to identify potential errors or system failures. Originally developed in the 1950s by engineers studying malfunctions in military systems, this type of analysis tends to be qualitative in nature and involve reviewing as many components and subsystems as possible to identify possible failures and their causes and effects. Worksheets and templates are used to record the information. This approach has been used in healthcare, particularly to address aspects of patient safety.

**Possible applicability for unscheduled care**

Failure mode and effects analysis may be useful for unscheduled care. In the US, national targets state that people presenting with a heart attack should receive intensive treatment within 90 minutes or less, and there is some evidence that receiving care within one hour significantly decreases in-hospital mortality. One hospital used proactive risk assessment with the failure mode, effects, and criticality analysis method to evaluate ‘door-to-balloon time’ processes and investigate how each ‘failure’ may affect the performance of the system. A multidisciplinary group of staff described the door-to-balloon time process then created a map and table listing all process steps. This was used to identify process failures, including their frequency, consequence and causes. Fifty-one failure points were identified across four phases of care. Thus the process was able to reveal areas of potential delay and vulnerability in unscheduled care.
Time-motion analysis

Examples of use

Time-motion studies aim to directly and continuously observe tasks, in order to quantify activities and the time taken to do them and identify areas for improvement. A number of studies have used this technique or variations of it as part of patient flow analyses.144-147

An example of a sophisticated time-motion-type study comes from a US hospital that used real-time patient data from barcodes and local scanners to track the progress of patients throughout 17 points in the surgical care pathway. Data about timing between the activity points were used to identify inefficiencies such as bottlenecks and areas of high variation. The causes of variation were identified and multidisciplinary improvement teams then worked to create solutions.148

Elsewhere in the US a smartphone/iPad app has been developed to help collect information in healthcare time-motion studies.149

Possible applicability for unscheduled care

Time-motion studies may provide areas for further exploration in unscheduled care. To date, most published literature on this topic has focused on time-motion studies in individual unscheduled care services150,151 but it is possible to apply this technique to consider broader level systems changes.

For instance, a US A&E department observed the time taken to register, assess, triage, treat and discharge patients over the course of seven time-motion analysis cycles spanning a five year period. Rather than analysing the results only at department level, an interdepartmental continuous quality improvement committee planned changes. The analysis found that a lack of availability of both A&E and inpatient beds led to significant delays. The researchers concluded that time-motion studies are an effective method of identifying areas of delay in patient care and can help to plan targeted interventions.152

Staff feedback

Examples of use

Another method used to identify patient flow issues involves systematically collecting feedback from staff.153 Surveys appear to be most popular for this purpose and are often combined with other analysis and change methodologies.154–156

Possible applicability for unscheduled care

This method is equally applicable to unscheduled care as to other aspects of healthcare and a number of studies have documented how staff surveys or interviews have canvassed patient flow issues for specific unscheduled care services.157,158

In Australia researchers canvassed hospital doctors and nurses about difficulties assessing and managing people with mental health issues who attend A&E. More difficult or complex patients can impact on overall flow and throughput, so the aim was to understand the barriers and potential solutions from clinicians’ point of view. Interviews suggested that a range of resource, environmental, staff and patient factors contributed to difficulties managing people with mental health concerns. Suggested solutions included additional resources, further education about mental health, A&E redesign and improved links to resources outside A&E. Importantly, the researchers concluded that many of the issues are systems-based and thus require systems-based solutions rather focusing on individual departments.159

However, caution is advised when relying on staff feedback to prioritise patient flow initiatives. In Australia, hospital staff were surveyed about their perceptions of the causes of delay in patients’ journeys through A&E. This feedback was then compared with findings from an analysis of key constraints to patient flow using real-time diagnostic/decision support software. The researchers found that staff perceptions regarding patient flow issues did not correlate well with real-time analysis, suggesting that staff may not always have accurate insights into the most important areas for improvement.160

Observation

Examples of use

Observation is sometimes used as part of time-motion studies or may be part of detailed ethnography or more surface level assessments of patient flow. Ethnographies provide detailed descriptions and observations about environments and interactions. They aim to be holistic and include a history of the issue and an analysis of the terrain, habitat and relationships in a specific site.161

More simplistic structured observation is also possible. While this does not look in as much depth as ethnography, it can still provide valuable insights into how emergency care is operating and potential areas to improve patient flow.162
Although the evidence scan identified a number of studies about using observation to explore patient flow, the impact of this method on patient and process outcomes was not detailed.

**Possible applicability for unscheduled care**

There is no reason why observation cannot also be a useful tool in unscheduled care. However, most examples in this field have focused on individual departments rather than taking a broader pathway or organisational perspective.  

For instance, in Australia, a year’s worth of ethnographic observations of patient flow were undertaken in two A&E departments. This included detailed observation of the communication and activities of A&E doctors and nurses and semi-structured interviews. This resulted in the theoretical concept of an A&E ‘carousel,’ whereby staff need to diagnose and treat individual patients, alongside taking a higher level view in order to lead the department and manage the staff skill mix. Using ethnography helped to extend traditional representations of patient flow and allowed concepts to be displayed visually.  

As an example of how useful less in-depth observation can be, a team visited all health boards in New Zealand and followed up with a report noting the observed challenges, initiatives and successes in relation to reducing delays in unscheduled care. The reports were then used to collate information about significant challenges and promising initiatives across the country. Access to hospital beds, access to diagnostic tests and inpatient team delays were the most common challenges.

Observation is often part of broader redesign initiatives. In the UK, an action research approach was used to improve unscheduled care pathways and patient flow at one hospital. Three action / reflection cycles were conducted with hospital teams. Data were collected using patient record review, staff interviews, observation of patient pathways and a survey of team climate.

**Summary**

To summarise, this section has overviewed some of the most commonly researched approaches for analysing patient flow across organisations and pathways, as well as their potential applicability to unscheduled care. Although the scan describes each method separately, in practice many of these approaches may be used together and combined with the approaches for changing flow described in the next section. As an example, an outpatient clinic in the US used a structured approach to identify sources of variability and areas for improvement. A process map was developed to visualise the flow process at the clinic and sources of variability that may contribute to congestion in flow were identified. Data about task times were collected by observing the process with stopwatches or using historical records. A simulation model was then developed to test potential service changes before implementing them in practice. This is a good example of how many of the methods described in this section can be combined to examine flow from many angles.

Most of the studies examining ways to analyse flow were from North America, but examples from the UK, Europe and Australia were also available. What is striking is that in most cases the empirical literature focused on describing the approach used rather than exploring potential outcomes, such as the impact on patient satisfaction or safety. This is largely because the analysis approaches are not an end in themselves, but rather result in some type of redesign work to change systems and processes. Research about methods for changing patient flow in this way is described in the next section.
3. Changing patient flow

This section provides examples of methods that have been used to change, redesign and improve patient flow across organisations or pathways of care.

The main methods that have been researched about changing patient flow at an organisational, system-wide or pathway level include:

- addressing variation, often using systematic continuous quality improvement approaches such as Lean/Six Sigma
- real-time management by applying data and assessing priorities
- matching capacity and demand, including workforce initiatives such as adding capacity, changing skill mix and using new roles such as patient flow co-ordinators
- proactively planning discharge
- pulling rather than pushing people through the system, such that the next link in the chain is actively seeking to move people onwards.

These approaches are not mutually exclusive and often overlap in their definitions or are used together within initiatives to improve patient flow. They are outlined in separate sections here to facilitate the clarity of examples, but there is a great deal of overlap and one approach is not necessarily more effective or appropriate than others.

Addressing variation

Examples of use

The main ways to reduce variation in order to improve patient flow documented in the empirical literature are:

- applying Lean methodologies or other continuous quality improvement approaches
- ‘smoothing’ or scheduling care differently
- implementing integrated care pathways (described in ‘Pulling through systems’ on page 21).

Methods to address patient flow may strive to reduce variation in the care provided or in the number of people using services at different times. Structured continuous quality improvement programmes have been used to support this. For example, the Lean approach was originally developed for manufacturing and production methods in order to improve processes and eliminate waste.

Lean principles aim to help organisations enhance process steps that are necessary, relevant and valuable while eliminating those that do not add value. The focus is on creating value for the end user. Any activity not adding value in this way is thought to be ‘wasteful’ and thus a potential target for elimination. Essentially, the Lean model, which is closely associated with Toyota car manufacturing, aims to preserve value with less work. This approach analyses potential sources of waste and implements cycles of continuous quality improvement.

Lean is about a fundamental change in the way organisations think about delivering care, but the specific changes employed tend to be simple – such as small procedure modifications relevant to the unique staff, processes and environment.

The approach may include: ‘value mapping’ whereby the extent to which tasks and processes add value from the patient point of view is assessed; quality function deployment to assess causes and potential solutions; rapid cycles of improvement. This approach to reducing variation may also draw on the ‘theory of constraints,’ a management paradigm often used in conjunction with Lean that focuses on the concept that ‘a chain is no stronger than its weakest link.’ It views any system as being limited only by a small number of constraints, and seeks to identify these constraints and restructure organisations and work processes around them.
This methodology has been applied in healthcare with some success, although some argue that it is not always applied robustly.

In Australia, a number of hospitals have implemented Lean principles to improve efficiency and reduce waste, concluding that approaches that emerged in the manufacturing sector may be readily translated for healthcare. These redesign initiatives tend not to change the specifics of clinical practice, but rather focus on improving the flow of patients through clinical and other systems. The most successful examples redesign care on a hospital-wide basis.

### Impact on processes

There is evidence that applying Lean principles can improve throughput and process indicators without negatively impacting on safety.

In the UK, a hospital mapped the steps in an endoscopy pathway and used Lean thinking to attempt to add value and reduce variation. The minimum and maximum time per step, bottlenecks and between-staff interactions were recorded. A patient pathway template was created and rolled out to another unit. The pathway reduced patient and staff travelling distances, waiting times, paperwork and handovers and nursing staff requirements reduced by 25%. Other tests in the UK have found similar gains in pathway efficiency.

A hospital in Norway used Lean principles to improve flow across the system for people with lung cancer. Initially there was an average ‘work-up’ time of several months, due to potential patient delays, doctors’ delay and waiting times for x-rays and scans, referral to specialists, and waiting time for chemotherapy and radiotherapy or surgery. This was an organisation-wide approach because all levels of the institution were involved in focus groups and workshops to analyse data and suggest and implement improvements. Workup time decreased from an average of 64 days to 16 days and the median time from diagnosis to surgery reduced from 27 days to 15 days.

Other quality improvement initiatives aiming to reduce variation or standardise care have also been found to be useful. These often focus on scheduling or ‘smoothing’ variation. For example, a US study used data from 39 children's hospitals to explore ways to smooth inpatient occupancy and reduce crowding. Occupancy levels were calculated and the impact of changing the number of patients and patient-days was modelled based on different scheduling techniques. Weekday occupancy was higher than weekends. Smoothing (or reducing variation via scheduling on different days of the week) helped to reduce overcrowding. The researchers concluded that hospitals may have substantial unused capacity and smoothing occupancy over the course of a week could help to reduce crowding.

In Australia, a large-scale programme was undertaken to improve patient flow and efficiency at more than 60 hospitals. During a ‘diagnosis phase’, a number of disconnections and misalignments in the process of care delivery were uncovered. Solutions aimed to address the entire patient journey through the hospital, to produce smoother patient flow. The approach included redesign, additional bed capacity and more rigorous hospital performance management. There was an improvement in flow and performance which was sustained over a three-year follow-up period. A key lesson learned was that to achieve sustained improvement, numerous solutions should be simultaneously implemented in each hospital.

Another study reported how five hospitals in Australia redesigned hospital services, including emergency services. Two of the hospitals took part in an externally-facilitated redesign programme, two hospitals implemented ward-based innovations using standardised processes sourced externally and one hospital undertook internally-led redesign including a medical assessment and planning unit and new bed management processes. Results were measured using control charts. Only one externally-led redesign resulted in short-term reductions in A&E blockages, but this was not sustained over time. The internally-led redesign was associated with an average reduction in access blocks from 55% to 22%. The researchers concluded that internally-led redesign was associated with superior and sustained improvements in A&E access block because structural reforms were driven by committed clinicians and managers and cut across departmental boundaries.

A hospital in Spain standardised admission and discharge processes to improve patient flow. Over a two-year period, the proportion of patients admitted the same day as surgery increased from 65% to 86%, the number of cancelled interventions due to lack of beds decreased from 216 per annum to 42 per annum and the median number of planned discharges increased from 43% to 86%. Average length of inpatient stay reduced from 8.6 days to 7.9 days. The researchers concluded that standardising admission and discharge processes is something that is largely within the control of hospitals, so may be an opportunity to improve bed capacity and hospital throughput.
Impact on safety

There is some evidence to support claims of improved safety from Lean or similar approaches being used to address flow issues. For example, an emergency general surgery ward in the UK tested the impact of Lean process redesign on patient safety. Compliance with targeted process measures improved and good compliance continued for at least ten months after the active intervention ceased. The proportion of people requiring transfer to other wards fell from 27% to 20%. There were no major changes in rates of adverse events or potential adverse events. Most adverse events and potential adverse events were due to delays in investigation and treatment caused by factors outside the ward. The researchers concluded that Lean can improve compliance with safety related processes but this may not translate into improvements in safety outcomes unless a system-wide approach is adopted across the entire hospital.

Impact on patient satisfaction

Reductions in wait times as a result of applying Lean principles have been linked to greater patient satisfaction, though the evidence is sparse.

Impact on cost

Although a number of studies postulate that the improvements in processes and length of stay resulting from Lean approaches would translate to greater cost-efficiency, fewer articles actually quantify any cost savings.

There are some exceptions, however. For example, a US hospital saved US$5.3 million by adopting Lean principles across the organisation. There were improvements in unscheduled admission rates and overall patient flow.

Another example also comes from a US hospital. 'Integrated Facility Design' is an adaptation of the Toyota 3P (Production, Preparation, Process) programme. The goal is to accelerate development time and lower start-up costs. A children’s hospital in the US used this process to design a surgery centre with reduced variation and improved cost-effectiveness. Using this approach resulted in completion 3.5 months ahead of schedule, with estimated savings of US$30 million in project costs and improved patient throughput.

Variations in the flow of patients through surgical theatres impact on hospital performance and finances. Natural variation (uncontrollable, unscheduled surgery) and artificial variation (controllable, scheduled surgery) require different management. A hospital in the US used variability methodology to analyse surgeries over a three month period and construct mathematical models of the resources used for scheduled and unscheduled cases. Guidelines and capped use were implemented to smooth the daily schedule and minimise variation. There was an increase in productivity and effective use of resources. Overtime staffing decreased by 27%, staff turnover decreased by 41% and the number of elective scheduled same day changes decreased by 70%. There were significant financial savings.

Possible applicability for unscheduled care

These concepts have demonstrated applicability for unscheduled care, though in the past they have often been applied at a departmental level.

For instance, a review of 18 studies about applying Lean principles to A&E departments in the US, Australia and Canada identified many changes in processes. These were often accompanied by structural changes such as new technologies, communication systems, staffing changes and the reorganisation of physical space. Patient care usually improved after A&Es began using Lean principles, with many A&Es reporting reduced length of stay, waiting times and proportions of patients leaving without being seen. There were few negative patient care effects reported. Impacts on patient quality, satisfaction or safety were usually not reported. The effects of Lean on staff were rarely measured, though there was some indication of positive effects on the workforce and organisational culture. Success factors included staff involvement, management support and organisational readiness for change.

In Ireland, researchers used Lean principles and the theory of constraints to identify bottlenecks in patient journeys through A&E. For each stage of the patient journey, average times were compared and disproportionate delays were identified using a significance test. A Lean value-stream map and the five focusing steps of the theory of constraints were used to analyse these bottlenecks.

There are a smaller number of examples of how Lean and other continuous quality improvement processes have been applied across organisations or pathways to improve flow in unscheduled care.

In particular, Australian hospitals have implemented Lean on a large-scale, and found improved efficiency. One study described a process redesign based on task analysis and Lean thinking. Analysis of data from one year before and one year after implementation found a 55% reduction in episodes of ambulance bypass and a decrease in most waiting times.
A US hospital used Lean concepts to redesign A&E facilities. Even though the focus was a specific department, success factors included using the approach in an integrated manner across departments and having a large proportion of clinicians in the improvement teams. This approach was found to produce facility designs that were custom-fit to patient needs and professional work processes. There was also a reduction in operational costs.

In Israel, a continuous quality improvement process based on Lean principles aimed to address delays in thrombolytic therapy for people arriving at a high-volume A&E with heart attacks. The improvement team followed a seven-step protocol: problem definition; present-state screening; factors analysis; solution development; outcome evaluation; standardisation; conclusions. Average ‘door to needle time’ reduced from 62 minutes to 48 minutes.

Overall, the evidence suggests that quality improvement approaches that address variation such as Lean / Six Sigma, may help tackle patient flow issues across organisations or pathways of care. However, reviews suggest that the true impact of these approaches is difficult to judge and that there is a lack of rigorous evaluation or sustained improvements. This applies to both unscheduled care and wider care pathways.

Real-time management

Examples of use

Real-time management of demand and capacity involves proactively collecting and using data regularly to support decisions about care and transitions.

Some healthcare services have implemented IT systems to speed up access to information about patients or manage beds to improve patient flow. For example, a hospital in Scotland found that patient flow from acute admission units into hospital beds was not always efficient during peak periods. Real-time management tools such as wireless local area networks and handheld devices were used to support patient management and avoid unnecessary treatment delays in overcrowded admission areas.

Many other studies are available about novel technologies but examples were only included in the scan if they explicitly aimed to improve patient flow.

Impact on processes

In Australia, one health service district tested the value of using whiteboards as a tool to improve patient flow. Whiteboards were placed in three hospital inpatient wards and in a day clinic to help record real-time flow data. Data collected via observation, interviews and photographs over an 11-month period found that the content and levels of use by various professional groups varied. Whiteboards were most well integrated into the day clinic and became a key part of multidisciplinary rounds, being updated several times daily. Staff in the clinic and on the wards generally perceived the whiteboards to have supported more timely referrals, improved patient flow and enabled better discharge planning, but some nursing staff described them as being an imposition and a cause of conflict among team members.

A community hospital in the US used a traffic light system to provide real-time data about patient flow on wards. The tool was used to assess current capacity and provide a graded, colour-coded ‘workload tolerance’ for each hospital unit (such as red meaning ‘closed to new admissions’). Each unit could instantly update its own status and look at the status of other work environments in the hospital. Over a six-month period there was an increase in efficiency and staff satisfaction.

A US hospital tested capacity management approaches for improving patient flow. A four-step approach to ‘real-time demand capacity management’ was used: predicting capacity, predicting demand, developing a plan, and evaluating the plan. Standard structures for unit bed huddles and the hospital bed meetings were developed. The approach used was tested in various hospital departments as well as unscheduled care. Improvements in median length of stay and the proportion of people who left A&E without being seen were achieved and sustained over several years.

Impact on patient satisfaction

There is little information about the impact on patient satisfaction of flow-orientated IT systems or similar tools. An exception is where a US hospital installed an automated patient-flow management system throughout, from A&E to admissions and the inpatient area. The system helped the hospital better use capacity, decreased diversion rates, increased efficiency and productivity and improved nurse, doctor and patient satisfaction.

Possible applicability for unscheduled care

Unscheduled care services have also implemented IT systems or real-time data management systems to improve patient flow, though this tends to be within individual departments.
A number of redesign programmes have been implemented in unscheduled care services based on diagnostic data, staff feedback or the need to respond to surges in demand. For instance, a systematic review identified 33 articles about the causes of A&E crowding, 27 studies about effects and 40 studies about potential solutions such as adding extra staff, observation units, increasing access to inpatient beds, non-urgent referrals, ambulance diversion, destination control, crowding measures and queuing theory.

**Matching demand and capacity**

**Examples of use**
The three main ways to match demand and capacity in order to improve patient flow explored in the empirical literature are:

- scheduling and prioritisation (such as comparing first-in, first-out with advanced scheduling approaches)
- structural changes such as physical layout
- workforce planning and changes

Mechanisms to match the demand for services versus the capacity to provide them may be as simple as using appropriate patient scheduling systems for appointments and procedures. For instance, in Egypt, a new scheduling system was set up for procedures associated with the most severe bottlenecks in patient flow at one hospital. The intervention was associated with significant reductions in waiting time and patient crowdedness, with little financial investment.

During a military conflict in Israel, the government issued a directive to change patient flow to hospitals in a metropolitan area. Admissions were monitored to determine if any changes occurred after the policy change. The directive did help to change patient flow patterns, suggesting that it is possible to take a top-down approach to rationalise the use of resources on a geographic scale in the short-term.

Another example of an approach used to match demand and capacity comes from Italy, where three hospitals redesigned their physical layout, the capacity planning system and the organisation of wards in order to address flow issues. Here a focus on the physical environment was as important as technological and staffing solutions.

Other ways to match demand and capacity have often focused on changes to the healthcare workforce. According to the empirical literature, three main types of workforce changes have been used to enhance patient flow across organisations or pathways:

1. adding additional capacity or teams or asking people to work in different ways
2. testing different skill mix
3. setting up new liaison or patient flow co-ordination roles

A US hospital undertook a social network analysis to suggest that efficiency gains could be achieved by redesigning social network patterns alongside organisational changes and using an integrated information technology system to model workflow. Knowledge experts and coordinators to draw on in times of crisis were identified and a new communication structure was developed that was more conducive to trust and knowledge sharing.

Regardless of the exact intervention put in place, initiatives to match demand and capacity (or reduce ‘queues’) tend to include compiling information about how to improve accessibility, finding ways to monitor varying demand and capacity and improving patient processing by reducing variations. In other words, there are overlaps with methods outlined in many of the other subsections of this evidence scan.

**Possible applicability for unscheduled care**

Workforce-orientated initiatives have potential for unscheduled care, though they have largely been tested previously at a departmental level. However, there are some examples of drawing in a wider range of staff to work in particular unscheduled care departments.

A US hospital decided to locate a hospital inpatient doctor and an allied health professional in A&E during the day in order to facilitate patient flow and care for people waiting in beds in corridors. Using inpatient staff in this way reduced diversion by 27% and increased A&E discharges by 61%. A&E doctors said that having immediate access to an admitting team streamlined the admitting process and ensured that patients are sent to the most appropriate wards for care. The approach required commitment from inpatient staff, a willingness among A&E staff to have this type of team in the department and a productive rather than confrontational relationship between A&E doctors and inpatient staff.

A US hospital created a new position, an A&E ‘flow facilitator’ nurse, who assigned patients to the east and west zones of the department and who handled all ambulance calls. The role required highly competent nurses who were able to multi-task and handle high levels of stress. Before and after analysis found that despite increasing patient volumes, there was a
reduction in the proportion of people who left without being seen and a decrease in length of stay and door-to-bed times. 297

Another example involved modifying a paramedic position to act as an ‘A&E expediter’ between 1pm and 1am daily. Six months of data from before the intervention were compared with six months of data afterwards. Regardless of increased numbers of patient visits, length of stay decreased by 25 minutes, as did rates of ambulance diversion. 298

Two hospitals in the US tested using inpatient nurses in a novel way. When admitting people from A&E, inpatient nurses would come down from wards to meet the A&E team and family members. Following verbal handover, the nurse would accompany the patient to their designated ward. Before and after comparisons found improved patient satisfaction ratings. 299

A systematic review searched ten bibliographic databases and included three studies about the effects of introducing GPs to provide care to patients with non-urgent problems in A&E. Two of the included studies found that GPs used significantly less healthcare resources, including fewer blood tests, x-rays, admissions to hospital and referrals to specialists. There were marginal cost savings. The third study found no significant differences. No data were reported on patient wait-times, length of hospital stay, or patient outcomes such adverse effects or mortality. 300

An example of adding capacity comes from a hospital in Singapore that used capacity demand analysis to set up new rostering systems for unscheduled care. A demand-based rostering tool matched doctor–unit–hours to patient arrivals and severity. 301

In addition to interventions focused on matching demand and capacity through workforce changes, some studies have examined other options. For instance, a systematic review of ten studies into ways to reduce ambulance diversion without worsening A&E department crowding found that diversion only minimally improved A&E waiting room times. Adding holding units for those placed on beds in corridors, A&E-based fast tracks, improving laboratory turnaround times and smoothing elective surgery caseloads were all found to reduce diversion. Some studies suggested that it was important to have a cooperative agreement between hospitals to prevent defensive diversion behaviour by a hospital when a nearby hospital goes on diversion but regional bans on diversion were not recommended.

This is an example of how multiple interventions at different levels of the system may be important for addressing patient flow issues. 302

The other main area of applicability for unscheduled care is in terms of scheduling and prioritising patients. A large number of studies have examined the potential of different approaches to prioritisation within unscheduled care services, though this tends to be done at the level of individual departments rather than taking into account organisational or pathway factors. 303–316

Triageing is a way of determining the priority order in which patients will be seen and treated. The aim is either to see the most serious and urgent conditions first, since resources tend to be insufficient for everyone to be treated immediately, or to ‘fast track’ non-urgent cases to less senior staff, thus freeing up resources for use on more severe patients. A number of studies have explored the impact of triaging on patient flow. 317

For instance, a systematic review of 25 studies assessed the extent to which triage processes in unscheduled care impact on patient flow. There was moderate evidence from a range of health services that combining triage and initial treatment in less resource-intensive cases can have a positive effect on patient flow. Triage systems that only prioritise patients without providing any treatment may not improve overall patient flow, although tailoring triage criteria more specifically to the patient population or using triage to prioritise treatable cases may be useful. 318

Another systematic review of 33 studies of A&E triage included streaming, fast track, team triage, point-of-care testing (performing laboratory analysis in A&E) and nurse-requested x-ray. There was good evidence that fast track systems improved waiting time, length of stay, and rates of people leaving without being seen. Team triage was also found to have an impact on rates of people who left without being seen, but the evidence about all other interventions was limited or insufficient. The reviewers concluded that fast tracking patients with less severe symptoms results in shorter waiting time, shorter length of stay and fewer patients leaving without being seen. 319

Sometimes special units are set up to provide urgent care, or to take the pressure off emergency services. A hospital in the UK expanded its acute medical unit from 29 to 81 beds. Patients with expected length of stay of less than five days were managed by the acute medical team only. Doctors provided twice-daily ward rounds, supported by specialist teams, allied healthcare professionals and investigation facilities. Within three weeks, the admission process for urgent cases had become more efficient, average length of stay had decreased by 1.3 days and bed-occupancy was reduced from 98% to 91%. Readmission rates, mortality rates and numbers of complaints were not affected. 320
Planning discharge

Examples of use

Proactive discharge planning involves thinking about how to move people on from services safely and appropriately as early as possible in the care pathway. This involves work to prioritise discharge planning within organisations, but also improving the communication and co-ordination between services such as hospital and community care. It may also involve assigning staff especially to concentrate on discharge processes or having nurses rather than doctors undertake the majority of discharge work. Special ‘discharge rounds,’ rapid discharge units or other proactive approaches may also be used.

In England the Community Care ( Delayed Discharge ) Act (2003) and subsequent policy initiatives have aimed to address delayed discharges, such as through investment in intermediate care services to promote independence among older people after hospital admission and joint working between health and social services.

Studies have also explored the factors that may impede proactive discharge planning, such as insufficient staff capacity and communication as well as family/caregiver barriers and organisational-level issues such as not assigning an estimated discharge date from the outset or delayed diagnostic or allied health services.

For instance, researchers from England examined the determinants and outcomes of delayed transfer of older adults from hospital into the community. Over a month-long period, 37% of elderly patients on two wards had a delay in the transfer of their care. Most were awaiting social services physical therapist assessments or home care, rather than NHS care. Some patients developed additional medical issues during the delay which made them unfit for discharge and led to an average of five further days in hospital per person.

Impact on processes

A number of studies have examined tools to improve the quality of discharge and transition processes. For instance, a hospital in the US tested a computerised tool for providing patients with concise, easy-to-read discharge instructions and referral agencies with consistent information and directions for patient care. The information was automatically extracted from patient hospital records. The tool was found to strengthen the multidisciplinary discharge care planning process, speed transitions out of hospital by reducing the nursing time needed to prepare discharge plans and increase patient satisfaction.

However the findings about discharge planning and tools to support it are mixed. A systematic review of 11 trials exploring the effectiveness of planning hospital discharge found that the impact on readmission rates, hospital length of stay, health outcomes and cost is uncertain and potentially not significant. Another review of 48 studies reported similar findings, though noted improved patient satisfaction.

In England, one hospital undertook a patient pathway mapping audit of admissions for a specific surgery and implemented changes as a result. There were substantial reductions in the length of stay. Early discharge planning involving staff and patients as active participants had the greatest impact on reducing length of stay, however the researchers concluded that earlier discharges may also lead to increased readmissions if appropriate follow-on support is not available.

Elsewhere in England, a study to improve interprofessional collaboration in discharge planning explored the use of an integrated care pathway to help move people with a specific condition throughout one hospital. Interviews, notes audit and analysis of variances from the integrated care pathway found that although integrated care pathways led to improved process outcomes for the hospital, interprofessional relationships and communication did not appear to be enhanced. The key factors in discharge delays appeared to be organisational rather than professional.

Another study from England assessed the effectiveness of a discharge coordinator, whose sole responsibility was to plan and coordinate the discharge of patients from medical wards. There was an improved discharge planning process and a reduction in problems reportedly experienced by patients after discharge and in people’s perceived need for healthcare services. However, there was no evidence that the discharge coordinator resulted in a more timely or effective provision of community services or that the appropriateness or efficiency of bed use was improved. The study concluded that a discharge coordinator improved the quality of discharge planning, but at additional cost.
Impact on cost
A review found that few studies have explored health outcomes or cost savings from proactive discharge planning on a large scale or over the longer term.\(^{354}\)

Impact on safety
There is limited information about the impact of discharge planning or prompter discharge on safety, though some studies suggest more adverse events or readmissions if robust support mechanisms are not in place.\(^{355}\)

However there is research to suggest that interventions that proactively speed discharge do not need to be associated with negative clinical outcomes. A hospital in Scotland set up a fast track rehabilitation programme for people undergoing hip or knee replacement, with the aim of speeding discharge. Around eight out of ten patients were able to be discharged within three to five days of surgery using this approach, which also included discharge planning and linkages with social and community support. There were no adverse safety effects.\(^{356}\)

Impact on patient satisfaction
Although the impact of proactive discharge planning on flow outcomes, safety and cost is debated, more studies agree that improved individualised and early discharge planning can improve patient satisfaction.\(^{357,358}\)

Possible applicability for unscheduled care
Hospital discharges may occur late in the day, with some studies suggesting clusters after 4pm. A US study explored using a protocol to encourage discharge earlier in the day. This could potentially affect patient flow because when patients leave earlier in the day, new admissions awaiting beds may be able to leave A&E more quickly, thus reducing waiting room backlog.\(^{359}\)

Pulling through systems
A limited amount of research has examined approaches that aim to proactively move people through the system, whereby the next service in the chain is actively ‘pulling’ people towards them rather than waiting for them to be ‘pushed’ on from the previous department. This terminology is used by the US Institute for Healthcare Improvement.\(^{360,361}\)

The main focus in ‘pull’ initiatives spanning different departments within an organisation tends be improving co-ordination and communication between teams.\(^{362}\) This has sometimes been done by implementing clinical pathways that provide guidelines about components of care and encourage services to be more proactive about taking on specific roles.\(^{363}\)

A clinical pathway defines the optimal care process, sequencing and timing of interventions by healthcare professionals, departments or services for a particular diagnosis or procedure. This type of process improvement tool has been gaining popularity. The pathways tend to be developed via collaboration between doctors, case managers, nurses, and allied healthcare professionals with the aim of improving the quality of patient care, minimising cost, reducing unnecessary variation reducing delays in discharge and ensuring that all facets of the system know their role and when to proactively begin it.\(^{364}\)

Impact on processes
A number of studies about clinical pathways have suggested favourable impacts on throughput and length of stay,\(^{365,366}\) although findings are not always positive.\(^{367,368}\)

A systematic review of randomised trials about integrated care pathways found that, for relatively predictable trajectories of care, pathways can support proactive management, speed up access to care, improve guideline adherence and improve communication between teams and with patients. Pathways may be particularly effective for changing professional behaviours where there is much scope for improvement or where roles are new. However, pathways may be less effective at improving quality where patient trajectories are highly variable, where services are already based on best evidence or where multidisciplinary working is well established. There was insufficient evidence about the cost-benefits of integrated care pathways.\(^{369}\)

In the US, a large study explored whether using a clinical pathway that included ‘pull factors’ would reduce hospital costs and length of stay among children with asthma. The pathway provided guidelines for things such as: frequency of patient assessment; medication use; monitoring and measurement; social work interventions; discharge planning. The pathway resulted in a decreased length of stay and overall cost, without an increased rate of readmission.\(^{370}\)

Another US study explored whether using a clinical pathway focusing on pre-operative discharge planning and pre-emptive pain and nausea management lead to reduced length of stay, better pain management and more rapid functional gains without an increase in complications for people undergoing specific surgery. Physical therapy began the day of surgery. The pathway was associated with a reduced length of stay, which may in turn increase patient throughput and increase hospital capacity.\(^{371}\)
A more novel approach comes from a US hospital that used ‘parallel processing’ to increase efficiency in ambulatory surgery. Rather than patients moving through surgical care in a linear fashion, starting at registration and finishing in the recovery room, patients received their local anaesthesia in an induction room while the operating theatre was being cleaned and set up. Compared to the usual pathway, this parallel approach resulted in shorter turnover time and induction time which ultimately allowed more operations per day. The researchers concluded that it was possible to increase efficiency by changing patient flow rather than simply streamlining existing steps. Similar approaches have been found to be cost-effective.

In England, researchers explored whether GPs referring people with suspected cancer straight for a test reduced time to diagnosis and treatment compared with being referred first to an outpatient hospital appointment. The median time to first diagnostic test was half the time using the ‘straight to test’ pathway compared to those seen in the outpatient clinic. Median time to first treatment was also significantly less.

**Impact on safety**
In Malawi, a clinic for young children that provided outpatient services, immunisations and treatment for medical emergencies trained staff in emergency care and triage and sought to develop close cooperation between inpatient and outpatient services. There was also a restructuring of the physical layout of the department. These improvements streamlined the delivery of care and led to a reduction in inpatient mortality from 18% to 6%.

**Impact on cost**
Studies of clinical pathways have suggested that these can have knock-on effects on cost, by reducing overall length of stay. However these studies do not always make it explicit whether ‘pull’ was built in to the approach used.

In the US, a hospital developed a care pathway to support people undergoing an operation to prevent stroke. The pathway addressed different parts of the system and aimed to provide more proactive care and transitions between each link in the chain. Interventions included: a computerised order tool; standardised discharge instructions; a patient teaching brochure; a patient flow algorithm that helped to select patients to bypass some areas of care. This resulted in significant cost savings and increased the availability of beds for higher acuity patients without negatively affecting patient outcomes.

Another example of a potential ‘pull’ approach is offering hospital at home services, whereby patients are treated in their homes rather than in hospital beds. This can be as a form of supported early discharge or to avoid admission altogether. A US case study found that this approach can have significant cost savings.

**Possible applicability for unscheduled care**
Initiatives which seek to formalise care pathways and pull people through the wider system of care have also been found to be effective in unscheduled care.

The most effective redesign processes may involve wider organisational planning. For instance, structural and staff reorganisation of an A&E in Spain took an organisational-wide approach, acknowledging that the efficiency of A&E was closely linked to inpatient and discharge-related factors. After the reorganisation, the proportion of patients remaining in A&E due to hospital-related or non-A&E and non-hospital-related factors decreased. The reorganisation was associated with a reduction in the average number of patients waiting to be seen and a decrease in waiting time from 87 to 24 minutes. The researchers emphasised that A&E effectiveness and overcrowding are influenced by both internal and external pressures. Measuring patient flow across A&E and the wider organisation helped to detect these factors and plan change.

Another success factor may be wide staff engagement. A multidisciplinary team of nurses, doctors, clerical staff, a social worker and paramedic worked together to redesign trauma services at one Australian hospital. Staff collaboration, the involvement of wider stakeholders and buy-in and sponsorship from the hospital executive team were found to be crucial for improving patient flow.
4. Summary of key findings

This section outlines some of the implications for improving patient flow across organisations or pathways of care.

Approaches used
Many methods have been tested to analyse and improve patient flow across organisations or pathways of care. Some of the more well-known or most researched approaches include techniques for analysing flow, such as:

- analysing basic routinely collected data about service usage
- capacity and workflow planning
- simulation and other models
- queuing theory
- failure mode and effects analysis
- systematic feedback from staff
- observation and ethnography.

As well as analysing flow, a range of methods move on to make tangible changes to services via:

- reducing variation, including using structured approaches such as Lean thinking
- management based on real-time data
- matching demand and capacity, including workforce changes such including extra capacity and liaison roles
- proactively planning discharge
- ‘pulling’ people through the system rather than relying on previous departments or services to pass people onwards.

Impacts
Impact on processes and flow
There is evidence that methods to analyse or alter patient flow can improve throughput and continuity and reduce waiting time and length of stay. The size of the impact depends on the methodology used, but few studies have explicitly compared whether one method is more effective than others. The methods used to analyse or alter patient flow are heterogeneous so it is not possible to say that all flow-related methods result in similar outcomes. The outcomes will likely depend on the approach used.

Impact on other outcomes
The impact on patient satisfaction, safety and cost is less clear because few studies have investigated these outcomes at an organisation-wide or whole system level. Some studies suggest that methods to address patient flow reduce length of stay, which would in turn have cost implications, but there are few cost analyses which specifically look at the financial implications of using these methods. A key finding is that there is a paucity of evidence about the benefits of strategies to address patient flow on satisfaction, safety and cost.

Things to bear in mind
When interpreting the findings of this evidence scan it is important to bear in mind several caveats.

Firstly, the scan is not exhaustive. More than five thousand studies have been published about methods to analyse or alter patient flow across pathways, organisations or healthcare systems. The scan presents examples of readily available published empirical studies in order to give a flavour of available research, to signpost readers to interesting material and to highlight some of the key implications for practice and applicability to unscheduled care.

There are many descriptions of flow-related methodologies but such descriptions were not eligible for inclusion in the evidence scan unless they were based on published empirical research. This means that there may be many types of flow-related methods being used that are not included here because there is little research published about them.

Similarly the change techniques used were only included if they explicitly sought to analyse or alter patient flow across pathways or organisations (apart from the narrower unscheduled care examples).
Another important point is that there are relatively few studies providing detail about the exact approaches used or step-by-step guides to allow replication of patient flow approaches. There are even fewer studies detailing the impacts of methods to analyse or improve flow on outcomes such as patient satisfaction, cost or safety. This does not mean that these outcomes are not important or are not affected by flow-related methods, just that little has been published about these topics.

As well as issues with the quantity of evidence available, there are also some caveats about the quality of studies. Many of the studies included in the evidence scan were small and conducted in single hospitals, often outside the UK. They also tended to use simple before and after designs, without controlling for other potential influences on the outcomes. Furthermore, there were few studies comparing different methods for analysing or changing flow, so it is not possible to conclude that a specific approach is more or less effective than another.

**Learning points**

Bearing in mind the above, the published empirical research suggests five key learning points for healthcare teams wishing to implement methods to analyse or improve flow across organisations or pathways, or to apply these approaches at a broad level to unscheduled care.

1. **Focusing on patient flow has the potential to improve outcomes when a whole-systems approach or organisational-wide focus is taken**

   The evidence suggests that methods to analyse or improve flow have some merit and could be explored further in healthcare.

   In order to really address patient flow issues, it may be necessary to look at processes across an entire hospital or indeed a wider system of services comprising primary care, ambulance, hospital, social and community care. With regards to access, unscheduled care services may be highly fragmented. People may be confused about how and where to access care. New forms of urgent care such as walk-in and urgent care centres have not significantly reduced A&E attendances in the UK.  
   Many patients may attend hospital towards the end of the day after they have had an opportunity to visit a GP or receive a GP home visit, so the process for GP visits to urgent cases may need rethinking.  
   Handover time from ambulances has also been found to be a key factor.  
   In terms of discharge or follow-on care, there may be a lack of swift access to inpatient beds due to problems in outflow from the admissions units to longer-stay wards and from longer-stay wards to community discharge. Poor sharing of information as patients move between different providers can lead to significant failures of care. Thus, in order to really address patient flow in unscheduled care (and in other services), it may be essential to address bottlenecks across the whole continuum of care. Strategies may include: signposting to help patients choose the right service; adjusting service levels in response to changes in demand; supporting hospitals, primary care and local authority social service and housing departments to work in partnership to reduce delayed discharges and shorten lengths of stay; redesigning structures and processes to support patient flow. Mapping and analysing patient flow around the system to identify bottlenecks and the potential for change is thus just one of a number of initiatives that could be implemented simultaneously.

2. **It is essential to undertake detailed diagnostic work when considering patient flow. Real-time demand and capacity management may be key.**

   Detailed ‘diagnostic’ work will help teams to understand patient flow before moving straight into redesigning services. Research has found that it is useful for services to have data to compare to and benchmark against and that analysing patient flow at both a service level and on an organisation-wide basis can provide useful insights. Using resources that display data visually, such as statistical process control charts, fishbone cause and effect diagrams or pathway diagrams may help to get wider groups of staff engaged.
Some of the issues that diagnostic work may seek to explore include: the measures that may best be used to understand and improve the efficiency and quality of interventions; how workforce factors may affect efficiency; how service design, patient flow structures and technology interact and impact on efficiency; which factors outside the organisation or service’s control affect flow.\textsuperscript{411,412}

Undertaking an appropriate needs assessment and analysis of potential bottlenecks then trying short tests of new approaches has been found to work well,\textsuperscript{413} but there is no evidence to suggest that one method of analysing flow is any more effective than another. Instead, it appears useful for organisations to select easy to use approaches that fit with data availability and involve multiple stakeholders in exploring the findings and planning next steps. In other words, it is not the exact method used that appears important, but rather the process of examining flow and bottlenecks and engaging the wider team in generating solutions.

3. A number of methodologies can be used to analyse and improve flow, but localised adaptation is key

The evidence illustrates that there is no ‘one size fits all’ approach for addressing patient flow. Various strategies may work best in different contexts and it is important for organisations to tailor evidence-based strategies to redesign flow to suit their individual services.\textsuperscript{414,415}

There is research to show that it is possible to transfer techniques used in other industries, such as Lean, queuing theory and capacity analysis, to a healthcare context, but it is essential to recognise contextual factors and adapt the methods appropriately\textsuperscript{416–421}.

Much work has been undertaken to apply flow-related methods successfully to individual departments, and it may now be time to explore how the wide range of methodologies available can be used more robustly across broader pathways or organisations.

Although for simplicity the evidence scan is divided into sections on ‘analysing flow’ and ‘changing flow’, each describing a range of discrete approaches, in practice many of these methods may be used together as part of a broad improvement programme.\textsuperscript{422}

4. Time and resources are needed to address patient flow issues in a sustainable manner

It can take time for new processes and systems to embed.\textsuperscript{423} Whilst changes to patient flow can result in reasonably prompt impacts, adequate time should be allowed to facilitate change.\textsuperscript{424}

Research emphasises that organisational realignment and changes to flow require time and analysis of financial, clinical and demographic data. It can take time to build a collaborative model across multidisciplinary staff and between managers and clinicians.\textsuperscript{425–427}

Key practical elements for success may include strong leadership by senior executives, clinical leadership, team-based problem solving, a focus on the patient journey, access to data, ambitious targets, strong performance management and having a process for ongoing improvement.\textsuperscript{428–430} Having strategies for rollout and sustainability from the outset appears important.\textsuperscript{435}

Another practical issue is that it can be time-consuming and complicated to extract patient flow data from routine (hospital) databases and to apply modelling tools. Spreadsheets and other simple tools may provide a starting point for analysis. It may also be useful to ensure that dedicated time is secured from technical staff.

5. Healthcare teams are a crucial resource so ensuring appropriate engagement and training may be a key success factor

Extensive staff engagement and training is included in the most successful flow redesign initiatives.\textsuperscript{436–439} If people are being asked to change the way they work, it is important that they understand why and what the benefits will be for themselves and patients.\textsuperscript{440} This could take the form of engaging clinicians in planning redesign elements as well as training and follow-up refresher sessions about new approaches.\textsuperscript{441}

Numerous studies suggest that staff collaboration, the involvement of wider stakeholders and buy-in and sponsorship from the hospital executive team are crucial to improving patient flow strategies across pathways and organisations, specifically within unscheduled care services.\textsuperscript{442–447} Some studies suggest that gaining commitment from each member of the interdisciplinary team is essential for successful outcomes.\textsuperscript{448, 449}

Research also supports participating in cross-organisational learning networks and strategic selection of improvement team members.\textsuperscript{450} Common challenges to initiatives for improving patient flow include staff resistance and entrenched organisational culture.\textsuperscript{451} These can be mitigated to some extent by staff education and constant reinforcement by clinical and managerial leaders.\textsuperscript{452}
Conclusion

To conclude, the empirical evidence suggests that methods to analyse and change patient flow have potential in healthcare both on an organisational or pathway-wide basis and also with specific applicability to unscheduled care. These approaches are heterogeneous, but have been applied in a number of countries with positive outcomes, particularly regarding improving throughput and reducing waiting time or length of stay.

Improving patient flow may seem like a relatively straightforward thing to do, but often services or departments work in isolation. Few organisations and health systems have funding that truly follows the patient through whatever journey is safest and most efficient for them, though this may be what is needed to really impact upon flow. More radical reorganisation of services and funding may be needed so that the patient pathway is the key focus, rather than specific services or departments. However evidence to date has focused on relatively small scale or narrow interventions that tend not to cut across services or sectors.

Research suggests that the five key principles of

1. whole-systems development
2. diagnostic needs assessment and real-time data
3. adapting the range of methods to local contexts
4. accounting for practicalities
5. staff engagement may be central to the success of implementing any patient flow methodology.

These factors are perhaps no different to the critical success strategies needed to support other types of quality improvement. Thus lessons about implementing and sustaining change more broadly may be equally applicable to organisations considering implementing methods to analyse or improve patient flow. Focusing on these core principles is likely to support improvement better than emulating specific process changes made at other institutions, but there is great potential in exploring ways to analyse and improve patient flow further.
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