NHS
Institute for Innovation and Improvement

Improvement Leaders' Guide

# Improving flow

## Process and systems thinking

# Improvement Leaders' Guides

**The ideas and advice in these Improvement Leaders' Guides will provide a foundation for all your improvement work:**

- Improvement knowledge and skills
- Managing the human dimensions of change
- Building and nurturing an improvement culture
- Working with groups
- Evaluating improvement
- Leading improvement

**These Improvement Leaders' Guides will give you the basic tools and techniques:**

- Involving patients and carers
- Process mapping, analysis and redesign
- Measurement for improvement
- Matching capacity and demand

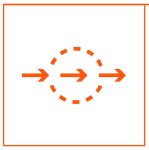
**These Improvement Leaders' Guides build on the basic tools and techniques:**

- Working in systems
- Redesigning roles
- **Improving flow**

You will find all these Improvement Leaders' Guides at www.institute.nhs.uk/improvementguides

Every single person is enabled, encouraged and capable to work with others to improve their part of the service

Discipline of Improvement in Health and Social Care

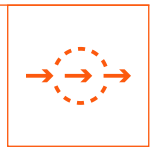


# Contents



This Improvement Leaders' Guide will help you to understand the theory associated with 'improving flow' and offer practical tips on its application. It will introduce the concepts using case studies from across health and social care. This Improvement Leaders' Guide builds on the work of other guides: Process mapping, analysis and redesign, Matching capacity and demand and Measurement for improvement. We strongly recommend you read these before starting to work on improving flow.

Reading this Improvement Leaders' Guide will not make you an expert. It simply offers you an insight into the various approaches to improving flow across health, social care and other systems.



# 1. Introduction

''All improvement takes place project by project …..and in no other way"

Dr. Joseph M. Juran

## 1.1 Introduction

Have you ever wondered why supermarkets seem to have an endless supply of goods that flow effortlessly from the supplier via the storeroom to the shelves? They are open all hours and yet still manage to offer good value for money with few queues at the checkouts. This is achieved through excellent market research, responding to their customer needs and thinking about flow.

Imagine a situation in your service where satisfied users flow with ease from one department to the next with no waits or delays. A number of organisations have managed to achieve this by using many of the approaches described in this Improvement Leaders' Guide.

Staff have been involved in analysing the flow of patients through whole healthcare systems: from the GP, via the ambulance services, through secondary care, tertiary care and out again to primary care and social services. This work has shown that improving patient flow across health and social care systems is beneficial to patients and staff in many ways, such as:

- improving the clinical outcome and experience of patients
- eliminating waits and delays
- saving time and effort by avoiding duplication of work
- saving money from the cost of overtime, waiting list initiatives, locum and agency fees
- improving the reputation of the NHS

Just as the flow of traffic is improved on a motorway by controlling the variation in the speed of individual cars and the stop-starting or batching caused by traffic lights, the flow of patients can also be improved by understanding the causes of variation in the healthcare system. Variation will be explained in more detail later in this guide and you can learn more about Statistical Process Control (SPC) in the Improvement Leaders' Guide: Measurement for improvement www.institute.nhs.uk/improvementguides

## 1.2 How has our thinking developed?

We started by involving patients and their carers and mapping the process as they experienced it. We recognised that one step in the process tends to be slower than the other steps: this is the 'rate limiting step' or 'bottleneck'. We have seen that queues of patients may build up before this step in the process if the demand and needs of the patient are not matched to the capacity.

The original focus of early improvement work to match capacity and demand concentrated on single bottlenecks with little understanding of the impact on other services. For example, resolving a specific bottleneck in a GP surgery without considering the effect on other services such as pharmacy or physiotherapy may just shift the bottleneck on to somewhere else.

We now know that the emphasis should be on improving the flow of patients across departments, organisations and the whole system.

For more information on process mapping see the Improvement Leaders' Guides: Process mapping, analysis and redesign and Matching capacity and demand www.institute.nhs.uk/improvementguides. If you find the e-learning approach helpful work through the module 'Planning for change' at www.wise.nhs.uk click on cross-cutting themes and Clinical Systems Improvement.

For a quick reminder of process and systems terms, see the glossary at the end of this Improvement Leaders' Guide (section 9).

# 2. Flow

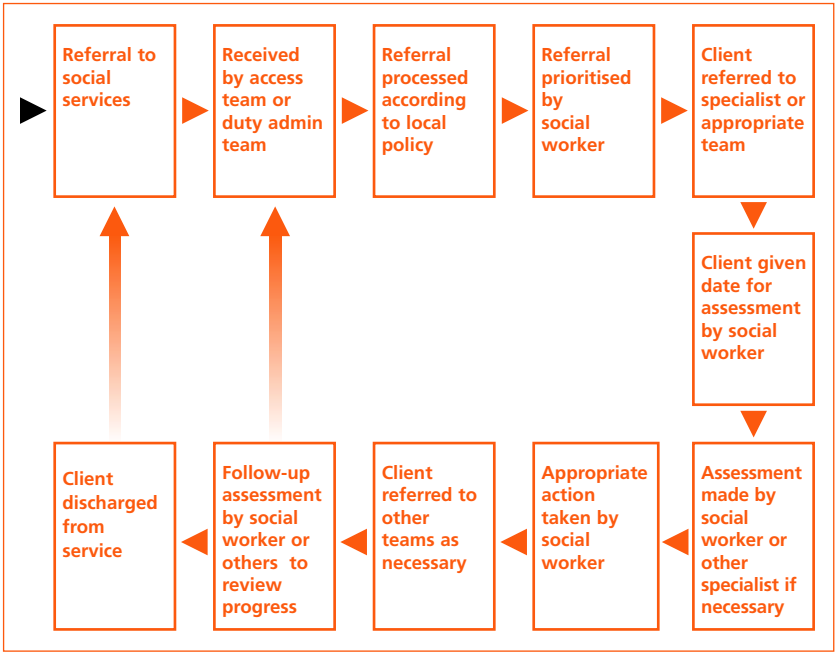
## 2.1 What is flow

The term flow describes the progressive movement of products, information and people through a sequence of processes. In simple terms, flow is about uninterrupted movement, like driving steadily along the motorway without interruptions, or being stuck in a traffic jam.

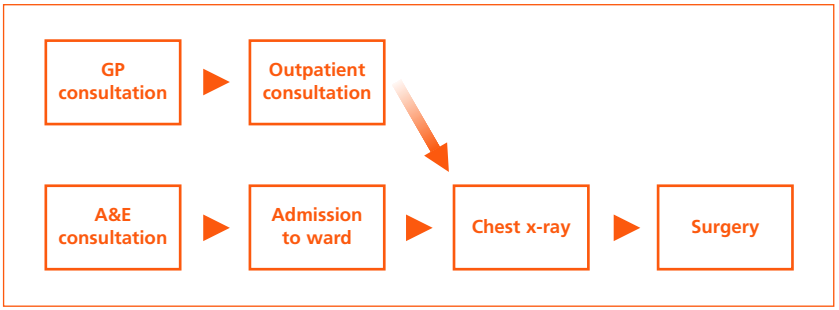
In healthcare flow is the movement of patients, information or equipment between departments, staff groups or organisations as part of their care pathway. Ideally they should move from one step in their care to the next without delay. This is known as continuous flow.

To understand flow, you first need to map and understand your process. This is a series of steps or actions required to achieve an outcome.

Example: A high-level process map showing the referral process in social services.



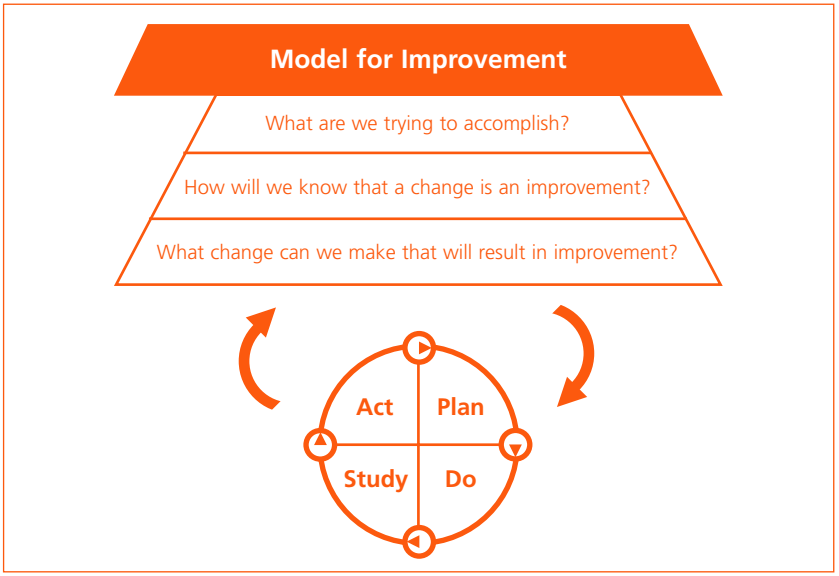
Each smaller process usually feeds into another process and often is part of one or more larger processes. The patient flows through a series of processes in the patient pathway. This can be represented as a series of process boxes with each box indicating the different processes through which a patient has to travel. As shown in the diagram below, a flow diagram shows where several pathways converge at various points and where one pathway can interrupt another.



## 2.2 Getting ready to improve flow

In order to achieve constant flow, you need to have an accurate understanding of the process, identify any bottlenecks, their causes, and balance demand with capacity at each stage of the process. This requires a multidisciplinary team approach. You will need to involve all staff working in the process, patients and key stakeholders. Ask what they value, what they need, their frustrations and their suggestions for improvement.

Think very carefully when establishing aims and measures of improvement. Use the Model for Improvement and Plan Do Study Act (PDSA) cycles in which small scale changes are tested and built on gradually to change the larger system. Process mapping and the Model for Improvement are described in the Improvement Leaders' Guide: Process mapping, analysis and redesign. Use Statistical Process Control (SPC), as described in the Improvement Leaders' Guide: Measurement for improvement, as a means of demonstrating the impact of any changes tested. Find all the Improvement Leaders' Guides on www.institute.nhs.uk/improvementguides.

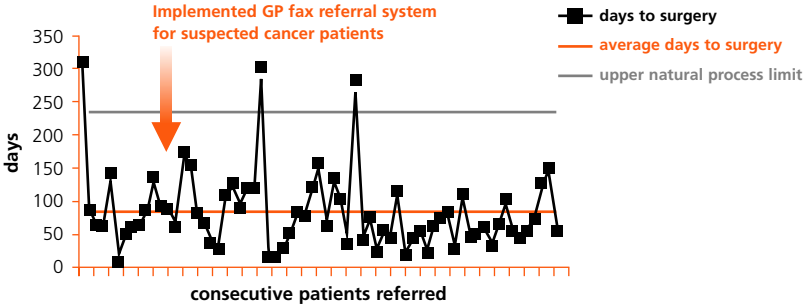



Reference: Langley G, Nolan K, Nolan T, Norman C, Provost L, (1996), The improvement guide: a practical approach to enhancing organisational performance, Jossey Bass Publishers, San Francisco

## Case study

**A hospital in the West Midlands which used Statistical Process Control to show if the ideas being tested were effective**

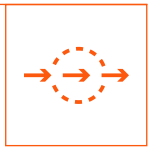
**Control chart:** days to surgery for all patients referred by GP's to one surgeon and diagnosed and treated for colorectal cancer (no radiotherapy)




The aim was to reduce the waiting time from date of GP referral to surgery for all patients. The first change tested was the introduction of a GP fax referral system. However the control chart shows that it made no difference because the main delay was in diagnostic tests. It was only after the 73 carved out queues for endoscopy were addressed that there was a noticeable reduction in the time from referral to treatments for patients.

We advise you to:

- speak with someone who has actually improved flow in their service and ask what they have learnt and what they would do differently
- read the many improvement stories by visiting the website at www.wise.nhs.uk
- study the 10 High-Impact Changes for Service Improvement and Delivery www.institute.nhs.uk/highimpactchanges
- look at the other Improvement Leaders' Guides www.institute.nhs.uk/improvementguides
- use the flow analysis tool developed by the Emergency Services Collaborative and used in the 'Making best use of beds' e learning programme at www.wise.nhs.uk



# 3. Queues

## 3.1 Why do we get queues?

Work on single bottlenecks in the service such as GP surgeries, accident and emergency departments, x-ray departments, endoscopy units, outpatient clinics and physiotherapy, etc has shown that there are three main reasons why we get queues, waiting lists and cancellations:

- demand exceeds capacity. If the average demand (requests and referrals) is greater than the average capacity (staff and equipment) by just one patient each week, you will get a continuously growing queue as one patient will be added to the waiting list each week. Very few queues grow like this in the health service, most queues go up and down. They vary, but tend to be surprisingly constant. This suggests that it is unusual for the average patient demand to exceed the average capacity for a service
- mismatch between the variations in weekly demand and weekly capacity. Even if the average demand equals average capacity, a mismatch in variations will cause queues. This mismatch in skills, expertise and resources may be due to shift patterns, or clinic and theatre sessions not being scheduled at the right time to meet the predictable peaks and troughs in demand
- perverse incentives for having a queue. Queues keep us busy so we appear to be highly utilised and important. In return we are often rewarded with extra resources for initiatives to reduce queues

To discover the reason for a queue, we need to measure the demand, the capacity, and the queue or backlog over time. See Improvement Leaders' Guide: Matching demand and capacity www.institute.nhs.uk/improvementguides

The demand for the service, shown in the case study on the following page, varies each week and so does the clinic capacity as staffing levels vary. Unmet demand is passed forward and accumulates as a backlog (queues or waiting lists) which begins to fill clinic slots in the future. However, unused clinic slots (capacity) cannot be passed forward to the following week. So empty slots are lost unless they are filled from the backlog (queues and waiting lists). Notice how the average weekly demand equals average weekly capacity, but the average weekly activity is slightly less. So a queue will build up over time.

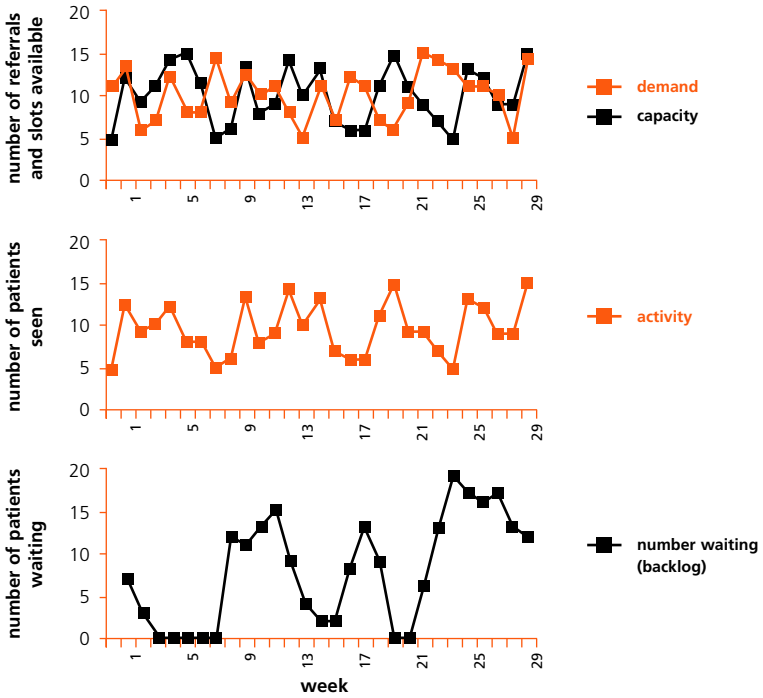
**Note:** Don't confuse the activity (the number of patients that were seen) with demand, the actual number of referrals and requests

## Case study

**Table of weekly demand (referrals and requests for a service), weekly capacity (total number of slots available in the clinics), activity, and backlog.**

| Week | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | weekly average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| demand | 11 | 13 | 06 | 07 | 12 | 08 | 08 | 14 | 09 | 12 | 10 | 11 | 08 | 05 | 11 | 07 | 12 | 11 | 07 | 06 | 09 | 15 | 14 | 13 | 11 | 11 | 10 | 05 | 14 | 10 |
| capacity | 05 | 12 | 09 | 11 | 14 | 15 | 11 | 05 | 06 | 13 | 08 | 09 | 14 | 10 | 13 | 07 | 06 | 06 | 11 | 15 | 11 | 09 | 07 | 05 | 13 | 12 | 09 | 09 | 15 | 10 |
| activity | 05 | 12 | 09 | 10 | 12 | 08 | 08 | 05 | 06 | 13 | 08 | 09 | 14 | 10 | 13 | 07 | 06 | 06 | 11 | 15 | 09 | 09 | 07 | 05 | 13 | 12 | 09 | 09 | 15 | 9.48 |
| unmet demand | 06 | 01 | 0 | 0 | 0 | 0 | 0 | 09 | 03 | 0 | 02 | 02 | 0 | 0 | 0 | 0 | 06 | 05 | 0 | 0 | 0 | 06 | 07 | 08 | 0 | 0 | 01 | 0 | 0 | |
| number waiting (backlog) | 0 | 07 | 03 | 0 | 0 | 0 | 0 | 0 | 12 | 11 | 13 | 15 | 09 | 04 | 02 | 02 | 08 | 13 | 09 | 0 | 0 | 06 | 13 | 19 | 17 | 16 | 17 | 13 | 12 | |

Below are run charts of the same data showing the mismatch in the variations between the demand and capacity each week. The run charts also show the pattern of activity and resulting backlog (waiting list) for the clinic. Putting the data into charts has an immediate visual impact.



## 3.2 Current strategies for managing queues

Faced with a backlog, or waiting list, and delays for patients, staff have no option but to start prioritising the queue. This means that the patients who are urgent will be seen more quickly than patients who are routine. This has other adverse effects such as:

- resources and time are used to draw up and implement complicated referral criteria
- slots are reserved or carved out (see section 5) for urgent or specific groups, e.g. cancer patients or children, but the overall capacity remains unchanged
- demand for urgent patients varies each week but the number of reserved urgent slots in the clinic does not. Any unused urgent slots are wasted unless someone can find a patient to fill it at short notice
- patients are seen out of turn. This creates variation in the amount of time that each routine patient waits and leads to unethical management of waiting lists
- routine waiting times start to grow because capacity is being wasted
- a greater proportion of patients are referred as 'urgent' because of the lengthening routine waiting times
- staff are constantly trying to alter the ratio of urgent to routine slots

We use several short-term tactics to manage the queue rather than solving the underlying problem in the system. Some of these tactics may be familiar to you:

- triaging and prioritising the queue
- delaying patients
- overbooking appointments or forcing patients into existing slots at short notice that may not be suitable for them. Consequently, there is a high DNA (Did Not Attend) rate, in which more valuable capacity is wasted
- performing expensive and exhausting waiting list initiatives

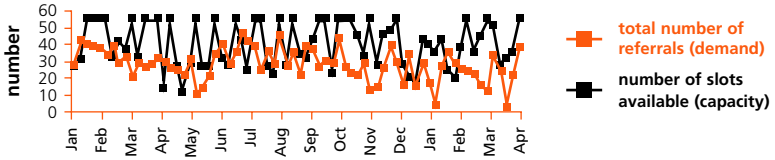
## 3.3 How to avoid queues

You will need to measure the demand and capacity in your system and think about the following points to gain some insight into avoiding queues:

- plan for predictable events such as bank holidays and staff leave
- commission an appropriate capacity. The extra capacity required should be dependant on the amount of variation in the system and acceptability of the waiting time
  - if there is no variation in either the demand or the capacity, then it is easy to match demand and capacity and have no queue
  - however, if there is variation in both and you have emergency patients who cannot wait, then you need an average capacity that meets the normal peaks of demand, but be aware this could result in wasted capacity
  - in general, if patients are not emergencies and can wait a short time to be seen, try to set the average capacity at 80% of the normal peaks in demand
  - if extra capacity is not affordable, then the only option is to reduce the variation in the demand and capacity

### Case study
### Breast Clinic at a hospital in the West Midlands

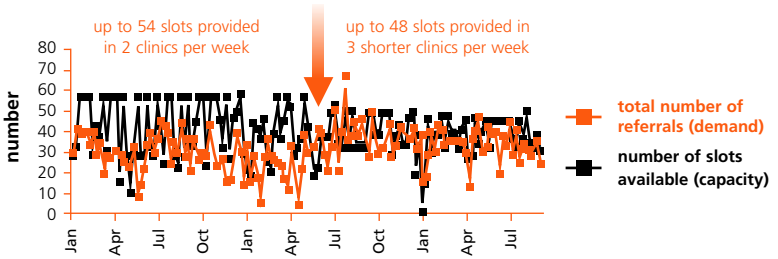
**Demand (referrals) and capacity (clinic slots) for a breast clinic**




This clinic, held each Monday, maintained a constant wait of one month for routine breast referrals. They had compensated for the variation in capacity caused by Bank Holiday Mondays by providing extra slots in the clinics. The maximum variation in the demand is 49 requests per week. 80% of this variation in demand is 40. Therefore, an average of 40 slots per week should keep the wait under control. They now had an average of 41 slots each week. This extra capacity compensated for the variation mismatch between demand and capacity in their system.

The team worked to understand and reduce the impact of variation in order to reduce the mismatch between demand and capacity. They eliminated the really busy clinics, in which up to 54 patients could be scheduled, by reducing the variation in the capacity.
Instead of two big clinics on Mondays and Wednesdays, they started to hold three shorter clinics each week on Mondays, Tuesdays and Wednesdays. This reduced the impact of bank holidays so that 1/3 rather than 1/2 of the weekly capacity was lost.
As a result, they eliminated their waiting list completely by providing a service in which 100% of patients were offered a booked appointment at a time convenient to them and all patients were seen within five days of referral. This eliminated any need for prioritisation by the GP, consultant or administration staff.
The average weekly capacity of the clinic was now 37 slots rather than 41 slots and staff were working less hard, in happier, less crowded clinics. Demand did increase from an average of 31 to 36 requests, but the clinic was still able to cope with no further increase in capacity.

**Demand (referrals) and capacity (clinic slots) for a breast clinic following change to the schedule**




Improvement teams up and down the country have consistently shown that the main cause of queuing in the NHS is variation and the mismatch between demand and available capacity. This is contrary to the previously held belief that it was demand alone creating unmanageable queues. We therefore need to develop our understanding of variation, particularly variation in capacity, in order to prevent putting additional capacity at parts of the process that are not bottlenecks, eg medical assessment units.

# 4. Variation

## 4.1 What is variation?

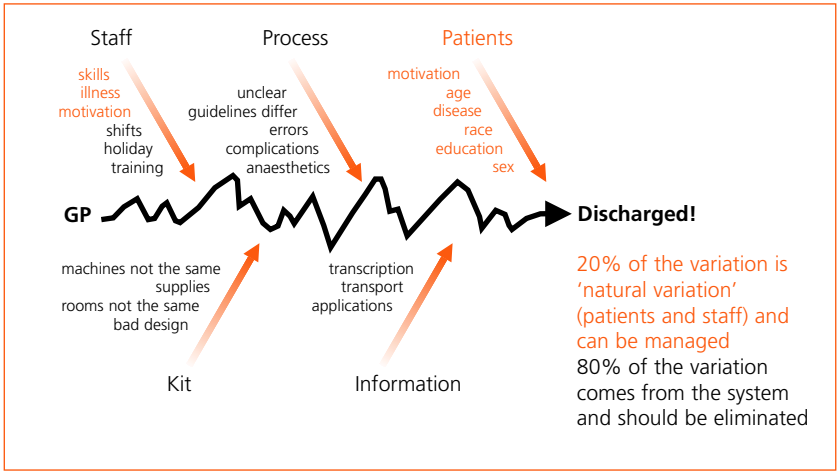
### "80% of the problem is the system not the people"

Deming

Variation is a part of everyday life. When you look around, you can see that there are differences in most things: cars, trees, people, etc. For example, in a class full of children, you would expect to find a range of weight and height. These differences may be large or small, but they are usually present. This natural variation would affect the way the children would be seen in a clinic and the rate at which they would flow through the nurse's or doctor's surgery. The very overweight children and those who are underweight would need dietary advice and take longer to flow through the clinic than those of average height and weight.

In health and social care, there are many sources of variation that impact on flow, apart from the natural variation of the patients. Improvement teams have found that most of the variation is artificial variation which is caused by the way we organise and deliver our services: people, processes, staff, resources, information. These all vary, as well as the types of treatment given and they will all have an impact on the flow, cost and outcomes of the process.

**Sources of variation within a clinical system that impact on patient flow**



## 4.2 Natural and artificial variation

Natural variation is an inevitable characteristic of any healthcare system and steps need to be taken to manage it. Sources of natural variation include:

- differences in symptoms and diseases that patients present with
- the times of day that emergency patients arrive
- the socio-economic or demographic differences between patients
- staff skills, motivation, etc.

Artificial variation is created by the way the system is set up and managed. Sources of artificial variation include:

- the way we schedule elective admissions
- working hours of staff
- how staff leave is planned
- availability of clinical equipment

Artificial variation has much more impact on patient flow than natural variation. It is usually driven by personal preferences and the priorities of staff rather than the demands of the patient. Steps could be taken to eliminate it.

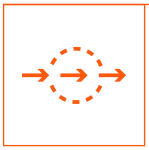
## 4.3 Common cause and special cause variation

Common cause variation is normal and expected. Special cause variation produces unusual or unexpected variations for the system. As special cause variations occur only occasionally, they need to be addressed differently from common cause variations. This is to prevent you making unnecessary changes or tampering with a system that usually works well.

Understanding the variation will help us not to react unnecessarily to causes of variation that are natural or common. The regular and routine measuring by Statistical Process Control (SPC) is a reliable way to make appropriate decisions.

For more information on variation and Statistical Process Control (SPC) visit:

- www.institute.nhs.uk/improvementguides for the Improvement Leaders' Guide: Measurement for improvement
- www.steyn.org.uk for a practical demonstration of variation
- www.wise.nhs.uk and click on crosscutting themes and Clinical Systems Improvement for e-learning modules 'Plotting the dots' and 'Managing variation'



# 5. Carve out

Carve out, also known as ring fencing, simply means to chopping up the available capacity into smaller fixed amounts of capacity. Examples of carve out are:

- dividing the week into five working days, and two out of hours days, called weekends, despite patients falling ill seven days a week
- dividing the day into nine to five, with the rest being out of hours, despite the fact that patients fall ill 24 hours a day
- dividing the day into shifts or sessions reserved for specific tasks or sub groups of patients, despite there being a continuous demand for these tasks and sub-groups

It appears that carving out capacity through specialisation, triage and prioritisation is a key cause of variation and, therefore, queues.

In general carve out:

- creates significant variation in the length of time that routine patients wait
- keeps patients waiting at all stages in the process by interrupting flow
- keeps non-urgent cases waiting much longer to be seen than urgent patients
- prioritises queues irrespective of individual needs

Experience has shown that one of the most powerful ways of reducing the queues and waiting lists for a service is to reduce variations in capacity by reducing or eliminating carve out.

Example 1: A GP practice divides the available capacity each working week into morning and afternoon sessions. They also run special clinics, eg clinics for asthma, pregnancy or immunisation, on specific days. Each morning is carved up into urgent, routine, follow-up appointments and yet all patients require the input of the GP or practice nurse. It is virtually impossible to balance all the different and varying demands for these sub-queues against the fixed chunks of capacity that have been carved out for them. There will be wasted slots and the wrong type of patients waiting.

Example 2: A radiologist may carve out two sessions each week in which to do their reporting. Everything waits for these two sessions causing a delay between the film being taken and the report being available. The radiologist's carved out reporting sessions are well utilised as they have a pile of films to keep them busy. However, there is a cost to the hospital for inpatients waiting for their reports, and the delay for patients waiting for the result is not what we would want for our families or friends.

Example 3**:** an ENT service had three consultants each running emergency, urgent, soon and routine queues making twelve queues for the same service. Some of the changes they made included:

- reducing the number of queues to emergency and routine appointments only by eliminating urgent and soon appointments
- pooling all the referrals to the three consultants into one queue. This is possible as 80% of patients have common conditions

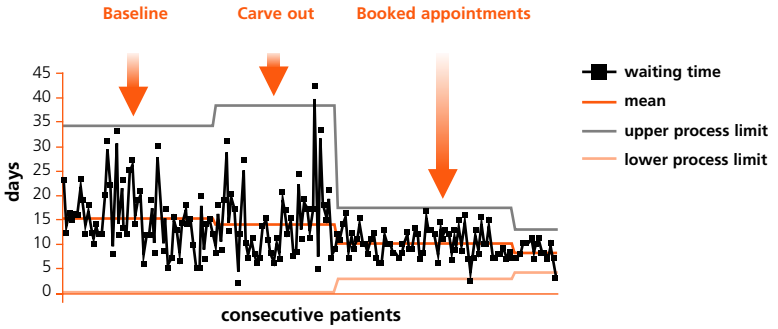
These changes eliminated the queues and enabled all patients to be seen in turn and more quickly as they were all seen within the response time for urgent cases. This in turn reduces clinical risks and avoids wasting resources due to the time and effort of prioritisation.

## Case study
## Chemotherapy service at a hospital in East Anglia

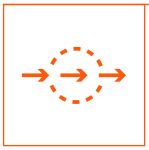
This organisation had a problem with variation in waiting times for chemotherapy patients, which inevitably resulted in a queue of patients waiting to start their treatment. As the situation got worse groups of chemotherapy patients requiring different treatments were prioritised over others (carve out).

After six months a booked appointment system was introduced. This eliminated carve out dramatically reducing waiting times, giving patients certainty and choice. As this system was more predictable, staff were better able to plan services around actual demand and available capacity.

**Booked appointments - Chemotherapy**




For more information on carve out look at the Improvement Leaders' Guide: Matching capacity and demand
www.institute.nhs.uk/improvementguides



# 6. Improving flow

## 6.1 What do we need to do?

### Understand the processes and the system

- map the patient's journey through the clinical, administration, social or relevant processes and identify the bottlenecks
- do a baseline assessment of patient flow by collecting data to understand the issues
- familiarise yourself with the main complaints, issues and rates of missed appointments within your department or organisation for useful clues about problem areas and key issues
- understand the demand and capacity of the system at a macro level and the impact that different flows have on each other, eg variation in emergency and elective admissions (see section 7.1)

### Identify measures of improvement

- the measures should focus on quality, time and cost. Improving the quality at each step will have the greatest impact on the flow, and costs will come down automatically by addressing the quality and reliability of the process

### Simplify the process

- reduce the number of steps in your process that do not add value for patients
- reduce or eliminate the number of bottlenecks

### Control the variation

- identify patients with similar flow characteristics and separate (segment) these flows where appropriate. These are groups of patients who need similar skills or equipment and who take a similar time to flow through the whole process

### Reduce the variation

- measure the demand and capacity continuously over time
- understand the causes of variation that affect the demand and capacity of your system

### Make the system safe

- set the capacity appropriately to minimise the delay for all patients
- monitor the variation using Statistical Process Control (SPC)

## 6.2 Improving flow at a functional bottleneck

We know that some departments have multiple patient flows depending on their services: these are functional bottlenecks. Radiology is a good example as it provides a function for several different types of patients by producing and interpreting images.

Plain film imaging covers many different disease groups and the process is fundamentally no different for a patient with a chest infection, a broken leg, rheumatoid arthritis, or a fractured skull. If we were to have equipment and radiographers carved out for each plain film process, it would be very inefficient. In this case, it is best to measure the total demand for plain films and ensure that the all the equipment and staff available for plain film work are pooled, and the radiology department can cope with the overall demand.

However, equipment used for mammography (breast imaging) is not used for any other patient group. Therefore the whole process can be segmented creating a specific breast unit in which the radiographers, nurses, doctors and other staff can work to improve the flow and quality of services for patients with breast disease.

**Note:** the differences

**Carve out and segmentation**
Carve out: the ringfencing of the time of an expert or keeping the recourses or facilities for one group of patients. This has the effect of prioritising the care of one group of patients over another group eg ring fenced beds for elective admissions

Segmentation: the separation of the whole process of care for one group of patients but not at the expense of other patients eg nurse led diabetic clinics in General Practice

**Process and functional bottlenecks**
Process bottleneck: the stage in a process that takes the longest time to complete eg seeing the consultant in the outpatient process

Functional bottleneck: Service or resources that have to cope with demand from several sources eg radiology, pathology and physiotherapy departments

## 6.3 Improving flow by reducing the variability

You need to measure capacity and demand continuously over time to spot any trends and begin to understand the root causes of variation. This will give you a better idea of any seasonal variation or special causes. For more information on measurement see Improvement Leaders' Guides: Measurement for improvement, and Managing capacity and demand www.institute.nhs.uk/improvementguides

### Ask the right questions

Start by asking questions about demand, capacity and variation such as the ones listed below in the following primary care example:

Demand: how many calls do GPs get for appointments?

- count urgent and routine phone calls and follow up requests at the desk
- plot this data over time on a run chart
- is there a predictable pattern?

Capacity: how many slots are available each day?

- make sure you include emergencies and patients seen out of hours in your calculations

Variation: does the variation in capacity match the demand?

- look to see if the right people are doing the correct job
- is there carve out of different types of GPs or nurses for appointments
- look for multiple appointment types and any special clinics, eg asthma, pregnancy clinics
- can the capacity be pooled more effectively?
- look at section 4 for other sources of artificial variation

It is possible to balance the demand and capacity in primary care so that all patients are seen on the day they request an appointment. Once the carve outs are removed and the daily demand and capacity are matched:

- patients then find that it is easier to get an appointment with the practitioner of their choice
- patients learn that they don't have to 'play the system', the demand goes down and the Did Not Attends (DNAs, ie patients who fail to turn up) is reduced
- this frees further capacity
- the appointment time can then be lengthened
- GPs can complete their examinations, tests, make notes and do any dictation after every patient rather than batching up the administration for a whole afternoon or until the end of the week, which leads to mistakes, rework and further delays for patients

**Useful tips for primary care**

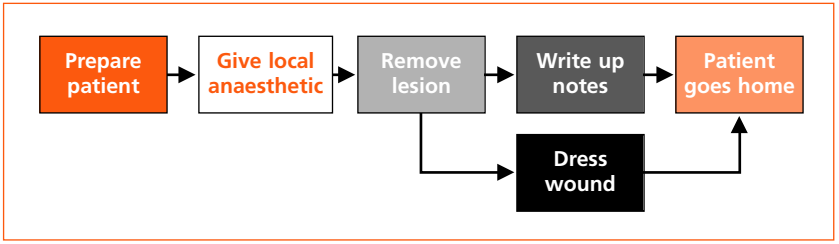
- involve your wider community care colleagues in thinking about innovative ways of working together to improve the service
- involve your users in any decision making (you are more likely to succeed if they are part of the process)
- take advantage of your unique position of having a systems view of the local health economy

## 6.4. Improving flow by scheduling using process templates

Process templates are used to build up a picture of the time and resources required by a patient during their process of care. A process template can be used to identify bottlenecks and reduce the effect of variation in demand and capacity at the bottlenecks to improve scheduling of patient care.

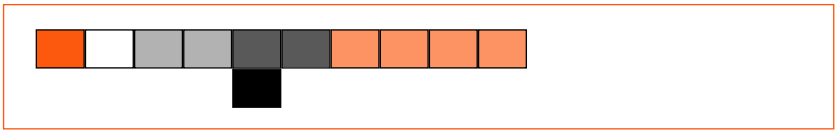
**Example: Day case unit**

Step 1: Map the process with each box representing a step. The surgeon performs the first four steps since 'preparing patient' includes making sure they consent to the procedure. The nurse or nursing aid can dress the wound and perform the last procedure of giving the patient a cup of tea and advice about wound management. In this unit there is one theatre, one surgeon, one nurse and one nursing-aid.

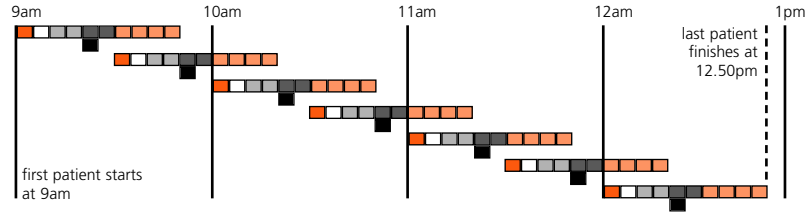



Step 2: Time how long each step takes for the majority (80%) of patients in the process

Step 3: Use squared paper, or an adapted Excel spread sheet, to create a process template to represent the time required at each step in the process. Each square represents five minutes.



Step 4: Line up the process templates to see how the flow through the unit will work and what appointment times patients will need



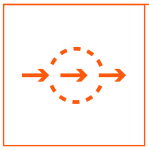

| Suggested appointment times for 7 patients | |
|---|---|
| | Appointment time |
| 1st patient | 09.00 |
| 2nd patient | 09.30 |
| 3rd patient | 10.00 |
| 4th patient | 10.30 |
| 5th patient | 11.00 |
| 6th patient | 11.30 |
| 7th patient | 12.00 |

Step 5: Discuss the implications with the team. Possible points raised by team members in relation to this initial template might be:

- nurse and nursing aid need to arrive before 9.00 to prepare the theatre and unit
- surgeon must be there and changed by 9.00
- surgeon doesn't get a break between one patient and the next
- nurse points out that that there is no time scheduled to clean the theatre between cases

Stage 6: Now consider what else should be scheduled in to address the points raised by the team and change the appointment times appropriately.

Look at the 10 High Impact Changes for Service Improvement and Delivery. Change 9 is 'Optimise patient flow through service bottlenecks using process templates' www.institute.nhs.uk/highimpactchanges



# 7. Improving flow across whole systems

So far, we have introduced the concept of flow as the patient experiences it. This means a focus on clinical pathways, such as the emergency pathway, mental health pathway, breast pathway, etc. The principles for improving the flow in a single clinical pathway introduced so far are (section 6.1):

- understanding the process and the system
- identify measures of improvement
- simplify the process
- control the variation
- reduce the variation
- make the system safe

These same principles can be used by Boards and directors to improve flow at a higher level. Whole systems of care involve several different pathways and patients crossing several organisational boundaries e.g. from their home, into primary care, via ambulance services into secondary care, back to their home, back to primary care and onto community care and possibly social services. See the Improvement Leaders' Guide: Working in systems www.institute.nhs.uk/improvementguides.

Many of the key problems have been perceived to be in secondary care:

- unacceptable waiting for patients on trolleys in A&E departments
- unacceptable cancellations for patients who have waited a very long time for elective procedures

Therefore, much of the current learning and examples are very secondary care focused. However, the principles and approach are generic. They are being used in mental health services, community services and social care. The principles are also being used with Boards of organisations, particularly in addressing the commissioning process in primary care, and with performance management teams and finance departments. The ability of these groups to understand their systems and interpret the data correctly are key to providing safe, timely and cost effective flows of patients across whole systems.

## 7.1 A worked example

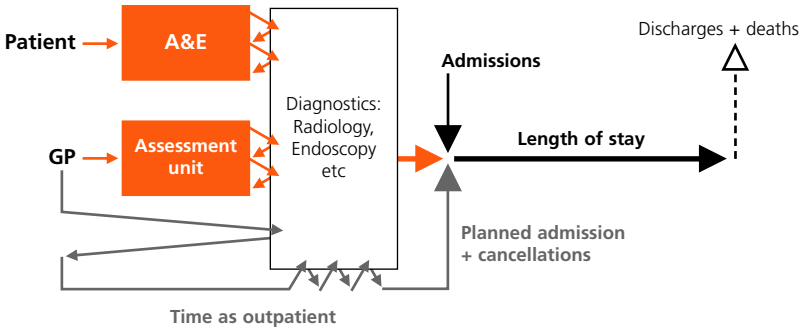
Imagine you are a director of a hospital: the chief executive, director of finance, operations, nursing or medicine. Your organisation has a regular problem relating to the availability of beds both for the emergency patients flowing from A&E and the assessment units, and the elective patients coming in for surgery. You are wondering if the principles of flow can be used to identify the underlying problems in your hospital. We would suggest the following steps:

Step 1: map the process at a 'high level'
Step 2: develop measures for improvement
Step 3: measure and demonstrate the variation in demand and capacity
Step 4: look for causes of variation

Step 1: Map the process at a high level

Map at a high level to show the flow of patients through your hospital.

Example: A typical schematic diagram for any hospital anywhere in the world.



## Step 2: Develop measures for improvement

Choose the measures that are right for you, that will show if the changes you make are actually improvements. Consider the measures used by the various organisations that audit your organisation, or the high level measures suggested below. Collect the data weekly (unless indicted otherwise) and display on run or control charts.

### Measures for secondary care or PCT commissioning:

- patients waiting for an inpatient procedure - total number of patients, or wait time from referral to procedure
- patient waiting for named diagnostic procedure - total number of patients, or wait time from request to results available
- patients waiting longer than the target of four hours in A&E - the time consecutive patients spend in A&E, or the % of patients seen in four hours or less
- elective procedures cancelled on the day of admission for non clinical reasons - total numbers of patients, or % of patients
- time for GP referral to first definitive treatment for elective patients - time for consecutive elective patients from GP referral to 1st treatment

### Measures for improvement concerning the cost of care:

- capital costs and running costs, e.g. overtime, agency, and locum costs

### Measures for improvement concerning quality:

- % patients discharged at weekends - number of patients discharged at weekends v total discharged over the week
- number of outliers
- hospital acquired infections - % of numbers of new infections identified
- patients dying in hospital - total deaths against total discharges
- readmissions - % or number of unplanned readmissions within 28 days of discharge

## Work with your Board

Introduce the Board to the Model for Improvement and PDSA cycles as a method of regular measurement, testing improvement ideas and learning. Plot your measures on run or control charts for the Board to study. For any analysis you ideally need at least 20 data points to make any sense of the data. The more the better especially when there may be a different system in operation at weekends. For more information see Improvement Leaders' Guide: Measurement for Improvement www.institute.nhs.uk/improvementguides

Step 3: Measure and demonstrate the variation in demand and capacity
Measure1 calculate and plot:

- daily demand for beds (total intended admissions) = daily emergency admissions + elective admissions + cancellations on the day (they should have come in but did not)
- daily capacity for beds = daily discharges + daily deaths

Measure 2 for a more accurate measure, calculate and plot:

- daily demand = emergency admissions + elective admissions + cancellations + transfers due in that day
- daily capacity = beds free at 00.00 + following day discharges + deaths + transfers out

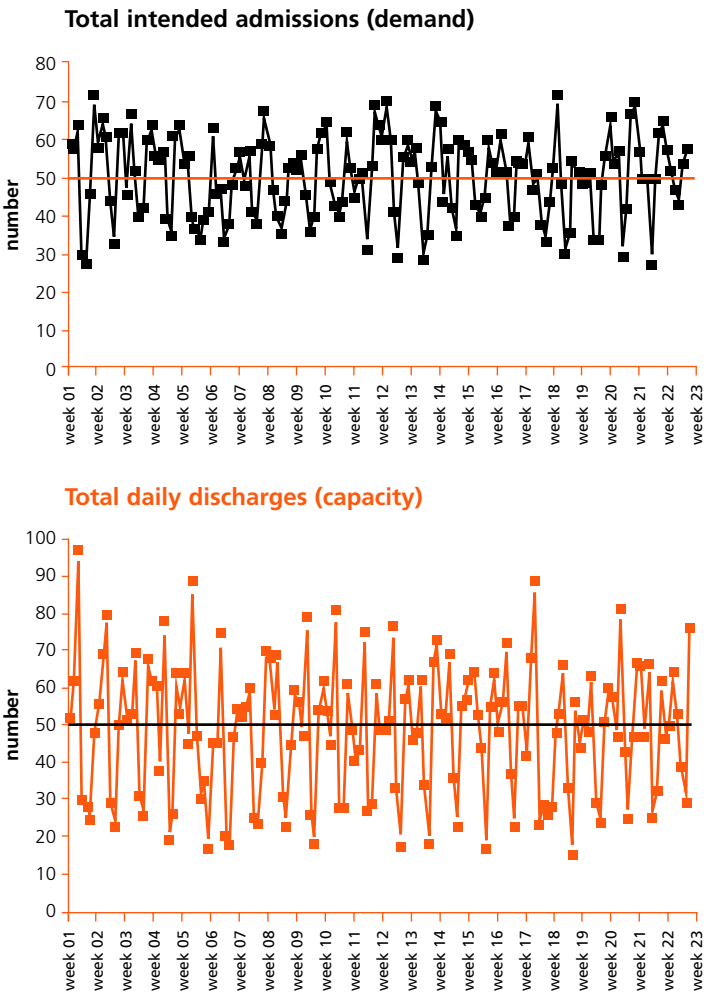
Ask yourself

- what is the demand for the beds and what is the capacity for the beds?
- is there a pattern to the data?
- is demand greater than capacity or is there a mismatch between the variations in demand and variations in capacity? Overlay the demand chart with the capacity chart

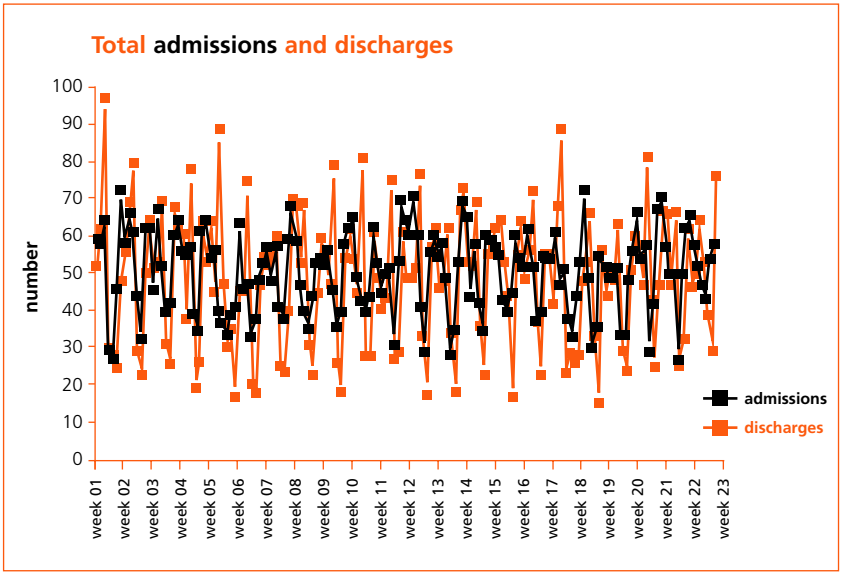
Example: The charts over the page show the daily variations in the demand and capacity (using the measure1 above) for beds for a small district general hospital. The charts show:

- the average demand is equal to the average capacity. So, in theory, we have not got a bed capacity problem. But why are elective patients being cancelled and why are patients waiting for admission in A&E and the assessment units?
- both the demand and the capacity are very variable
- discharges vary more than admissions

Ten to twelve measures of the whole system that relate to the improvement work you are doing, are better than hundreds of unhelpful measures



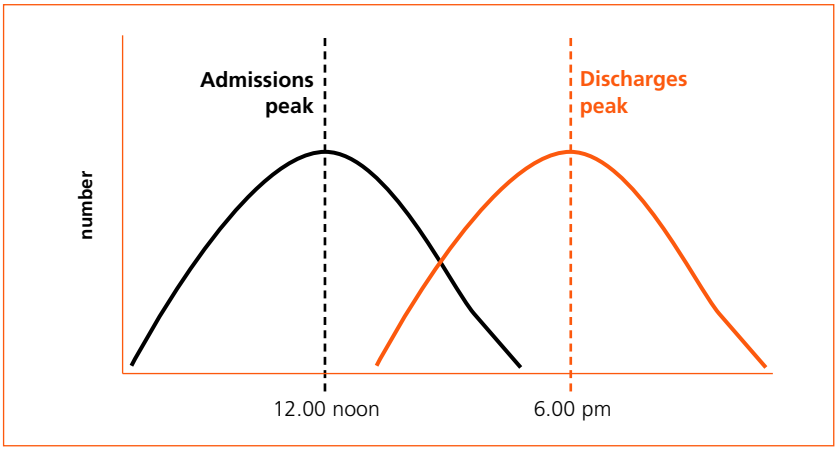

For all these charts, maternity, paediatric and day case unit beds have been excluded from the data. These are separate from the main system to serve very particular groups of patients. However there is nothing stopping you from using the same principles to examine the demand and capacity for each of these services.




If we overlay the daily demand and capacity for beds we can clearly see the mismatch.

### Step 4: Look for and reduce the causes of variation

This schematic graph below shows the typical hourly requests for beds and the hourly number of discharges on just one day.



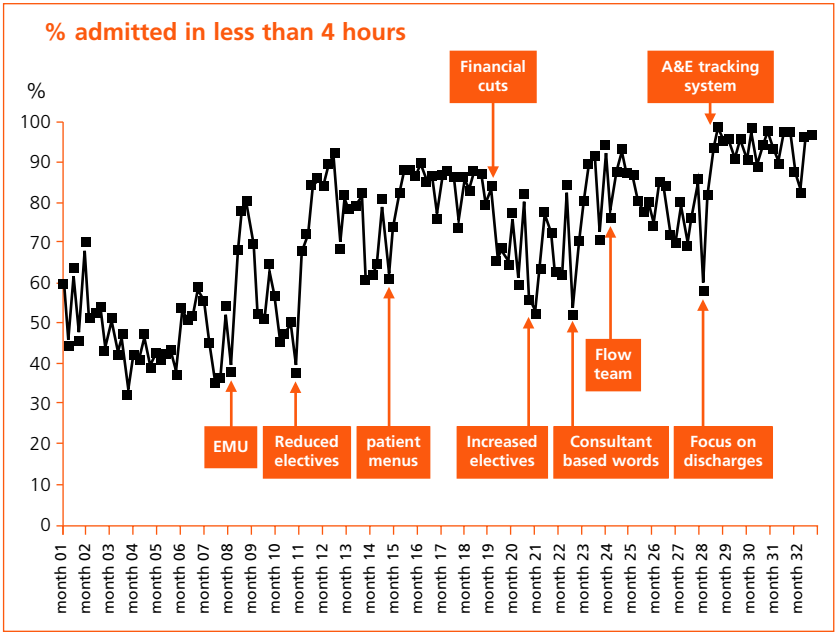
The appropriate action would be:
- discharge patients before 2 pm each day
- increase the % of patients discharged at weekends

For information:
- the Making Best Use of Beds on-line learning module discharge scenario will help you with improving discharges from hospital. You can find this at www.wise.nhs.uk

## 7.2 Case study: Applying the principles of flow and learning from the data

This case study shows the effectiveness of changes, 'warts and all'. There are few Trusts in England who monitor their weekly A&E data as effectively as this organisation and learn from their actions.

The following chart shows the time spent by patients in A&E requiring admission over 33 months and the change ideas that were tested to get this improvement.



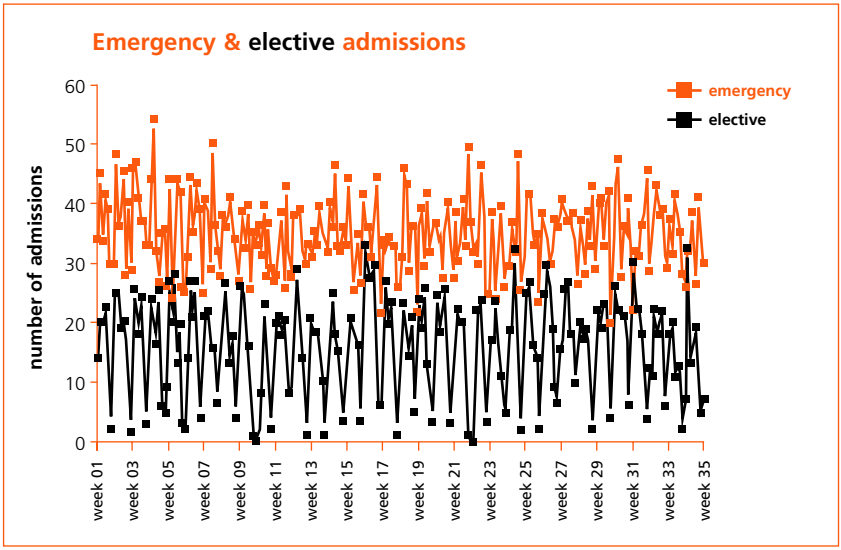

## Change ideas tested:

### Change 1: Emergency Medical Unit (EMU) in month 8

A discharge lounge was converted into a 16-bedded emergency medical unit for emergency GP admissions. This had a short-term impact on improving flow, but since nothing was done to address the main problem, which was later found to be the variation in daily discharges from hospital, the beds just filled up and the queues of patients reappeared in A&E. It was the equivalent of creating a large warehouse for patients waiting to get into beds.

### Change 2: Reduced electives in month 11

The commissioners reduced the elective admissions by 25 patients per week from an average of 110 to 85 admissions. This had the effect of improving the emergency flow that was entirely unplanned. Because the elective admissions to this hospital were more variable than the emergency admissions, reducing the volume of this very variable flow by 25% had a dramatic impact on improving the emergency flow. The chart on the next page shows that, for this hospital, the variation in daily emergency admissions is greater than that for the daily elective admission. This meant elective planned admissions are more unpredictable than the emergency admissions.




**Note**: Collecting the right data will allow you to produce similar charts for your organisation. The pattern is different for every hospital and, in your organisation,the emergency patients could be more variable than the electives. This is one reason why it is so important to measure demand and capacity and look at the variation before trying to change your system.

### Change 3: 'Patient menus' in month 15

It was realised that the Medical Assessment Unit had done nothing to improve the quality of the initial assessment, treatment and discharge plan. So a patient menu was introduced. This was a standardised form clipped to the front of every emergency admission's notes. It listed and tracked diagnostic tests, treatment, and discharge plan as the patient started their journey from the admissions unit to their discharge from the main wards.

### Change 4: Financial cuts in month 19

Due to the loss of predicted income from the reduced elective admissions and increased capital and staff expenditure, the Trust had to find extra savings in order to reach its end of year financial target. Cuts were made across the board but particularly on overtime, agency and locum costs including the funding for the patients menus (change 3).

### Change 5: Increased electives in month 21

Elective admissions were again increased by an average of 30 inpatient admissions per week. This increased the turbulence in the elective stream and impacted the smoother emergency flow.

### Change 6: Consultant based wards in month 22

Continual use of these charts raised the awareness of the discharge issue.

The medical staff changed their weekly ward rounds to daily rounds. This had the effect of reducing the batching of their decision-making and discharging. However the new ward rounds took up to four hours with less than 30 minutes of this time being spent at the patient's bedside. The rest of the time was spent finding their patients, the wards, the nurses in charge, the junior doctor, test results, case notes and the various forms required to process a patient.

The consultants agreed to move to a ward based system in which they paired up to look after two wards each. They agreed to take and look after any patient sent to those wards following assessment on the Emergency Medical Unit. When one consultant was away the other consultant would review all the patients. It was now possible for consultants to do daily ward rounds and the nurses and junior doctors reported improved communications and planning.

### Change 7: Flow team in month 24

It was recognised that the majority of patients required no, or very little, support to get them home. However a very small proportion of patients who had very long lengths of stay, of between 14 and 210 days, required extensive support to get them home or into residential care.

Three senior nurses with extensive knowledge of support services became the flow team. They were tasked with reducing the average length of stay for these few patients, which they did by 10 days. However, it had little impact on the overall flow, which according to the chart got worse, when the flow team was implemented. One possible reason was that discharging patients was now seen to be the responsibility of the flow team alone.

### Change 8: Chief Executive focuses on discharges in month 28

With over two years of good data, experience, learning and a new chief executive, senior attention was focused on discharge.

The changes included:

- ward staff are encouraged to discharge patients before 2pm. The chart for the % of discharges before 2pm is discussed daily
- medical staff are encouraged to plan the discharge of a greater proportion of patients at weekends
- a simple patient tracking system was implemented so that every patient could be tracked and any reason for delay acted upon i.e. radiology delay, delay in junior staff assessment, delay getting a bed
- air tubes, installed across the hospital to stop the three times a day batching caused by the portering rounds, have reduced the turnaround time by 4 hours for each sample

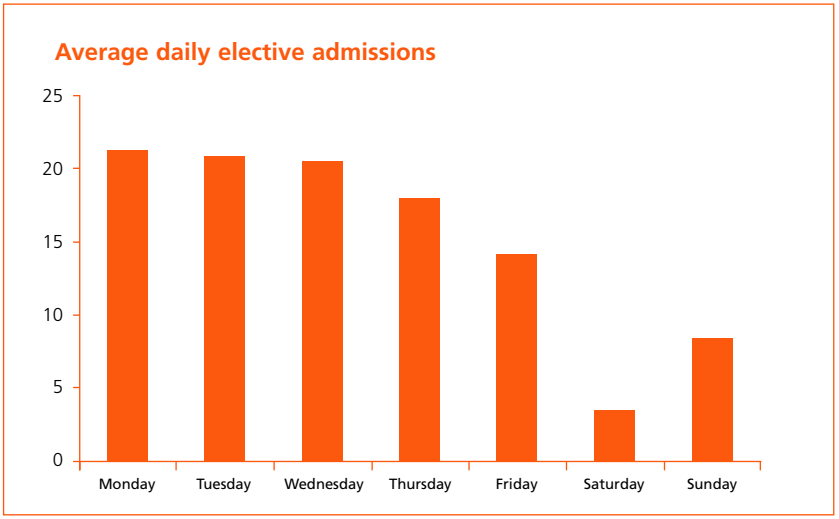
### Current plans

The team are rightly proud of the achievements they have made since they started applying the principles of flow across their whole hospital. Their focus has now moved to the following areas:

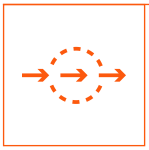
- asking the PCT to commission more responsive intermediate care services
- reducing the time GPs spend chasing appointments in elective care
- encouraging consultants to do a daily ward round with discharge letters typed up and sent to the GP, along with a copy for the patient on the day of discharge
- reducing the turnaround for radiology imaging and reporting
- reducing the variability of the elective length of stay
- reducing the variability in elective scheduling so the admissions are no longer 'front loaded' at the start of the week, with few procedures being planned at the end of the week (see chart opposite)

All these plans will involve addressing the underlying quality issues of:

- controlling and reducing hospital acquired infections
- understanding and reducing readmissions
- understanding and reducing deaths in hospital




Some hospitals have chosen to expand the capacity in their A&E department or with assessment units in response to a demand problem. Rather than relieving the situation, it can make matters worse. It is like widening the large end of a funnel without increasing the size or capacity of the neck.



# 8. Frequently asked questions

**Question**
What advice can you give me about positioning flow strategically?

**Answer**
When considering flow improvement across a whole organisation, or even across a whole health community, it is vital to secure executive leadership and commitment. Indeed, it would be extremely difficult to try to implement change on a large scale without it. You will probably be changing the fundamental components of these organisations: the way people work, the processes through which they deliver care, and the way that they interact with other service providers in their supply chain. For instance pharmaceutical firms, equipment suppliers and designers and builders of the physical environment. These all have the potential to be altered as flows are improved.

The strategic teams need to understand the current picture in order to:

- decide what the critical success factors will be
- translate the overall objectives into key deliverables for their organisation in terms that all employees can relate to and which connect all employees to the overall goals
- agree how improved performance against the critical success factors will be measured. This is not necessarily in traditional finance based measurements but may include quality related measures for patients and staff
- prioritise improvements on a timeline which may span several years
- decide upon the few key business processes that will be the initial focus of improvement work. Generally these are the high volume patient processes as the biggest gains will be seen here

The strategic team also need to look ahead and begin work to prepare for the time when flow is improved. This may be around workforce development or challenging the traditional design of new services.

For more information see the Improvement Leaders' Guide: Leading improvement and Working in systems www.institute.nhs.uk/improvementguides

**Question**
Does improving flow really benefit organisations?

**Answer**
Yes. Healthcare organisations that have been successful in improving flow have been able to make improvement in the following areas:

for patients and staff
- engaging users and key stakeholders at every stage in the process
- making the system safe for the patients and staff
- increasing customer and staff satisfaction

for the process
- simplifying the process
- identifying and reducing the non-value adding steps
- matching capacity and demand at bottlenecks and reducing variation
- improving access to diagnostics e.g. radiology, endoscopy, pathology

for the organisation
- eliminating wasted time and resources at multiple levels
- increasing throughput
- reducing and controlling the variation in length of hospital stay
- scheduling patient discharges
- changing the focus from more capacity to less variation

**Question**
What would be your advice for developing a system for continuous flow?

**Answer**
We would advise you to:
- design a system that continuously improves
- take a process view of patients across the boundaries of specialties, functions and departments
- work smarter by:
  - focusing on bottlenecks that prevent smooth patient flow
  - managing and reducing causes of variation in patient flow
  - segmenting patients and designing processes according to their specific needs
- implement measurement systems of improvement that reveal the true performance of the system and the impact of any changes

**Question**
What other learning resources can I access which are related to improving flow?

**Answer**
The Clinical Systems Improvement (CSI) e-learning modules, and associated off-line activities and tools are available at www.wise.nhs.uk
Click on Cross Cutting Themes and Clinical Systems Improvement.
There are five modules:

- Introducing Clinical Systems Improvement (CSI) demonstrates, through a case study, how effective CSI can be effectively aligned to Trust strategy and performance measurement systems
- Plotting the dots will help you to understand variation in processes. It shows how Statistical Process Control (SPC) is an appropriate tool to measure, understand and control process variation. There are step-by-step guides to generate control charts, and understand more about common and special causes of variation and the importance of treating these two types of variation appropriately
- Planning for change explores the principles and potential benefits of process redesign. It covers strategies to control capacity constraints, build capacity flexibility, and manage waiting lists effectively
- Managing variation explores the idea that variation is the root cause of delays, queues and unpredictable process times. This module deals with managing queues and bottlenecks properly, and understanding and reducing variation within healthcare processes
- Achieving improvement covers the critical success factors necessary to implement and sustain improvement, getting the most out of change ideas, developing staff, and the role of programme management in improvement initiatives

These e-learning resources are a range of tutorials, covering specific learning objectives. They contain case studies, suggestions for off-line activities, quick on-line exercises, and pointers to further resources. These are designed to be used by improvement leaders as they need them, and to support face-to-face workshops. It is important to remember that e-learning is not sufficient on its own. You will need to make sure you can make links with colleagues and experts in the subject matter for support and advice. You should find out what face to face support is available to help you apply what has been learnt in your own area.

**Question**
Where can I read more about improving flow?

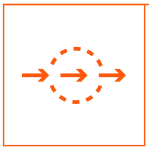
**Answer**
Look to the operations management and Statistical Process Control literature in books and papers such as:

- Carey RG, Lloyd RC (1995) Measuring quality improvement in healthcare: A guide to statistical process control applications, Quality Resources
- Dettmer HW (1998) Breaking the constraints to world class performance, American Society for Quality, McGraw-Hill Education
- Goldratt EM, Cox J (1999) The Goal 2nd ed, Aldershot, Gower Press
- Goldratt EM (1990 ) Theory of Constraints, USA, North River Press
- Haraden C, Resar R (2004) Patient flow in hospitals: understanding it and controlling it better, Frontiers of health Services Management 20:4 p3-15
- Hart MK, Hart RK (2002) Statistical process control for healthcare, Duxbury Thompson Learning
- NHS Confederation and NHS Institute (2004) Leading edge: breaking the rules: is capacity a problem? www.nhsconfed.org/publications
- Silvester K, Bevan H, Steyn R, Lendon R, Whalley P (2004) Reducing waiting times in the NHS: is lack of capacity a problem, Clinician in Management
- Wheeler DJ ( 2000 ) Understanding Variation: The Key to Managing Chaos (2nd Edition), SPC Press
- Wheeler DJ, Chambers DJ (1992) Understanding Statistical Process Control, SPC Press
- Womack J, Jones D (1998) Lean Thinking, Touchstone Books

Also go to:

- www.wise.nhs.uk
  This will take you to lots of different improvement initiatives
- www.steyn.org.uk
  Richard Steyn's website for demand and capacity models and presentations
- www.ihi.org
  The Institute of Healthcare Improvement is an organisation set up by Professor Don Berwick and based in Boston USA. They have a dynamic web site with information about improvement programmes and several case studies

Don't forget to look at all the other Improvement Leaders' Guides especially the guides to Process mapping, analysis and redesign and the other guides in the Process and systems thinking group www.institute.nhs.uk/improvementguides



# 9. Glossary

| | |
|---|---|
| Activity | All the work done. This does not necessarily reflect capacity or demand as the activity in June may well include demand carried over from May, April, or even March |
| Backlog | Previous demand that has not yet been dealt with, showing itself as a queue or a waiting list |
| Batching | Piling up a type of work as it comes in until a later time when it is all done together e.g. saving all the paperwork until the end of the day |
| Bottleneck | Part of the system where patient flow is obstructed, causing waits and delays e.g. waiting for a diagnostic test |
| Capacity | Resources available to do work e.g. the number of pieces of equipment available multiplied by the hours of staff time available to run it |
| Carve out | The ringfencing of the time of an expert or keeping the resources or facilities for one group of patients e.g. ring fenced beds for elective admissions |
| Constraint | The actual cause of the bottleneck. Usually a necessary skill or piece of equipment e.g. the bottleneck may be the imaging department but the constraint may be the skill of the radiologist |
| Demand | All the requests/referrals coming in from all sources |
| Flow | The progressive, uninterrupted movement of products, information and people through a sequence of processes. |
| Functional bottleneck | Service or resources that have to cope with demand from several sources e.g. radiology, pathology and physiotherapy departments |
| Lead time | The time it takes for a patient to move all the way through a process |
| Pareto principle | This is also known as the 80/20 principle. It says that 80% of outputs, consequences or results come from 20% of inputs, causes or efforts e.g. 80% of requests for diagnostics investigations are for approximately 20% of all the investigations available |
| Process bottleneck | That stage in a process that takes the longest time to complete e.g. seeing the consultant in the outpatient process |
| Queue | Work waiting to be done at a given point e.g. patients waiting to be seen in the clinic |
| Segmentation | The separation of the whole process of care for one group of patients but not at the expense of other patients e.g. nurse led diabetic clinics in General Practice |

The Improvement Leaders' Guides have been organised into three groups:
**General improvement skills**
**Process and systems thinking**
**Personal and organisational development**

Each group of guides will give you a range of ideas, tools and techniques for you to choose according to what is best for you, your patients and your organisation. However, they have been designed to be complementary and will be most effective if used collectively, giving you a set of principles for creating the best conditions for improvement in health and social care.

The development of this guide for Improvement Leaders has been a truly collaborative process. We would like to thank everyone who has contributed by sharing their experiences, knowledge and case studies.

Design Team
Helen Bevan, Elizabeth Bradbury, Clare Cape, Diana Cowles, Lisa Hollins, Richard Lendon, Mike McBride, Jean Penny, Caroline Sandford, Kate Silvester, Valerie Swaby.

To download the PDFs of the guides go to www.institute.nhs.uk/improvementguides

The mission of the NHS Institute for Innovation and Improvement is to support the NHS and its workforce in accelerating the delivery of world-class health and healthcare for patients and public by encouraging innovation and developing capability at the frontline.

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