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Value stream mapping

NHS England and NHS Improvement

Value stream mapping

What is it?

The purpose of value stream mapping is very similar to **conventional process mapping**, but it usually goes into more detail and also has a specific emphasis on which steps within the process add value for the patient.

The concept of the 'value stream' comes from the **LEAN** management approach. Value stream mapping analyses what is currently happening (the current state) and goes on to design a future state for the process focusing on how value is created and delivered to the patient.

Value stream mapping can be a particularly effective approach when investigating the high volume pathways that flow through a healthcare system. Improving the flow of these value streams first can have a big positive impact on service efficiency and patient experience.

When to use it

Like conventional process mapping, value stream mapping should be used to understand the steps in the patient journey and the patient experience of the journey. It is important to map the current state first before making any changes to the process or service.

Value stream mapping is often undertaken during 'rapid improvement events' – where those involved in delivering the process use a dedicated block of time to make improvements.

How to use it

Start by mapping what happens at the moment, the current state. This shows the reality of how the process is working. It is essential to involve people working in the value stream in creating the current and future states. It is also important to involve patients, service users and carers in the process. As the main drive of value stream mapping is to understand how value is delivered for the patient, it is impossible to do this effectively without understanding what value means for different patient groups.

Once the current state has been mapped, move to focus on designing the future state, which may represent a significant change in the way the system operates. Once the future state map has been drawn up, develop an implementation plan to make the future state a reality. As you develop your plan, identify what you will stop/start/continue doing as well as areas that need further improvement work.

Value stream mapping is supported by other process mapping approaches, such as **spaghetti diagrams**.

Current state map

1. Involving patients, define what value the patient gets from each part of the process, eg provision of information, pain relief, etc. Write this at the top of the value stream map so it is in the foreground at all times.

2. Consider not only the flow of the patient but also the flow of information needed to enable the patient to flow through the process.

3. Walk through the patient's journey in reverse for an overview of what happens. Having identified the main steps, map the process in more detail and add timings for each step.

4. Draw the journey with the starting point (referral, outpatient appointment, etc.) on the left and the end point on the right hand side of the paper.

5. Write each procedure down as a process box, which indicates the process that the patient flows through. Each process box stops when the patient is awaiting the next stage.

6. The individual steps in the patient's journey join together from left to right. If several paths converge at various points, show this as follows:

Figure 1
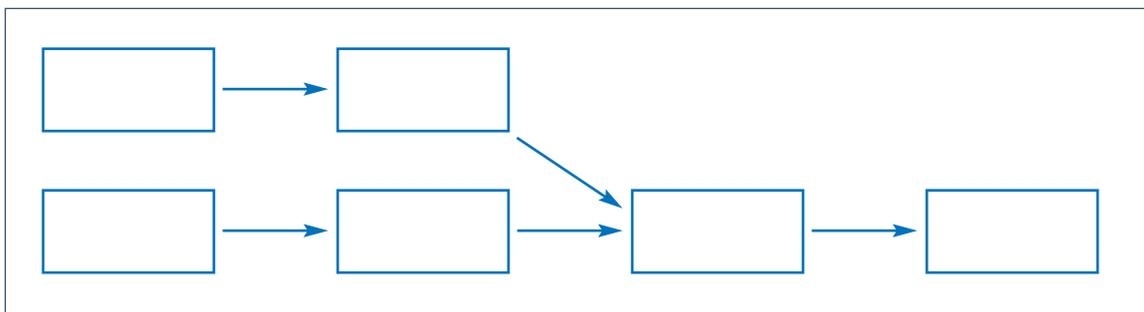
7. As you walk through the journey, collect data that will help you determine what the future journey will look like. Include a data box below each process with the relevant measured data for each step. Making the time unit measurements consistent (eg minutes or seconds) makes it easier to interpret the map and to calculate the overall journey time.
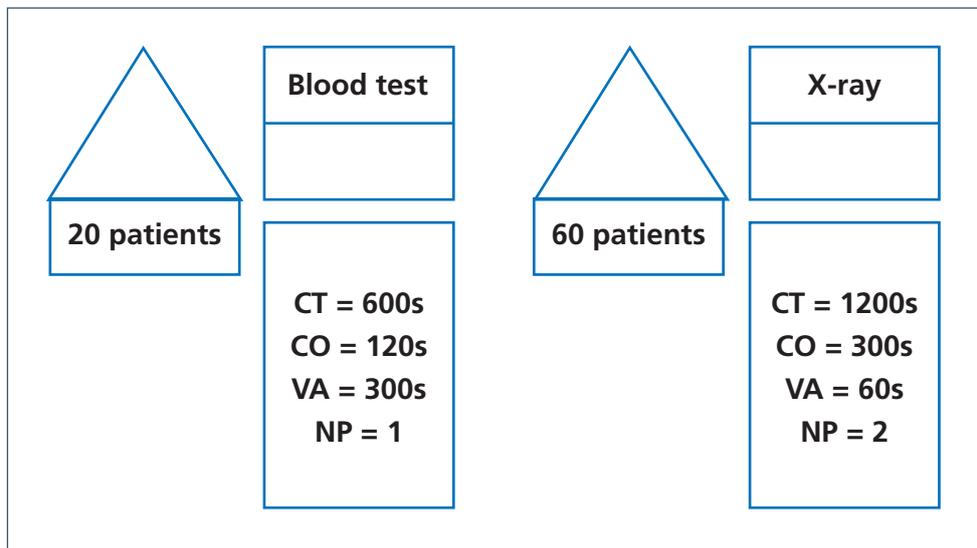
The following examples are useful common system measurements that can easily be applied to healthcare:

- Cycle time (CT) – the time that elapses between one patient finishing part of a process (eg a consultation) and the next patient finishing the same part of the process

- Value added time (VA) – the time that actually adds value to the patient journey

- Changeover time (CO) – the time taken to switch from one type of process to another – often referred to as handoffs in healthcare

- Number of people (NP) – that are required to undertake a particular process

- Available working time (AT) – of staff involved in part of the process. This represents the time staff are actually available (as opposed to what may be shown on a rota), eg the available time of staff on a shift (minus the breaks), which makes up the regular hourly, daily weekly or monthly work

- Lead time (LT) – the time it takes for a patient to move all the way through a process or value stream.

8. On the left of each process step, insert a triangle showing the number of patients waiting for the next process and in the data box below each process record the time it takes to process each patient (cycle time). Thus the journey starts to look like this:

Figure 2

20 patients	Blood test	60 patients	X-ray
	CT = 600s		CT = 1200s
	CO = 120s		CO = 300s
	VA = 300s		VA = 60s
	NP = 1		NP = 2

9. Next, add in the flow of information. This is shown above the pathway with arrows drawn from right to left – straight arrows for paper based information and lightning arrows for electronic information.

Figure 3

Weekly schedule

Outpatient clerk

Consultant
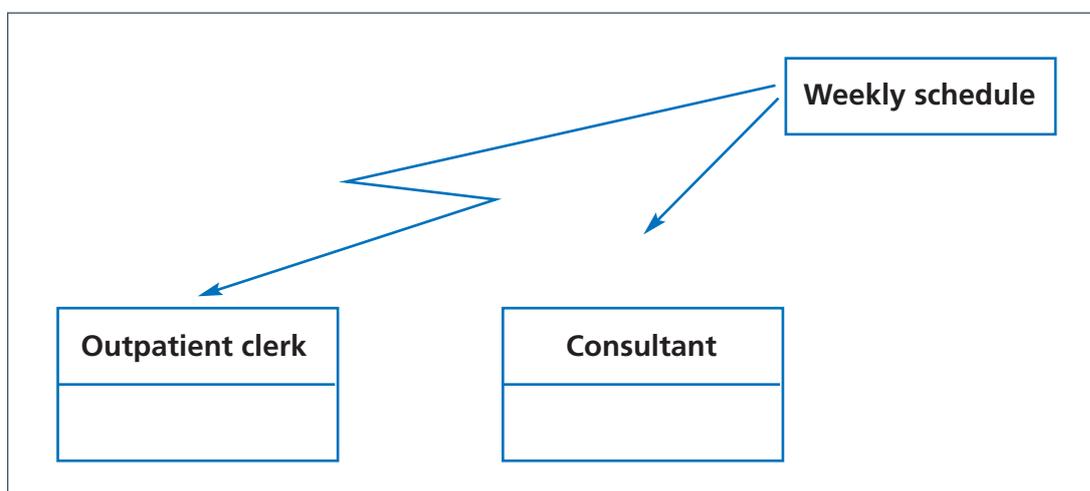
At each step of the journey, identify what information is provided to that step, where it comes from and in what form and then record it as above on the journey diagram.

10. Now enter whether the patient is 'pushed' through their journey or 'pulled' along the pathway. In most cases, this will be a push step. For example, patients are pushed from the medical assessment unit (MAU) to x-ray and then pushed from the MAU to the wards.
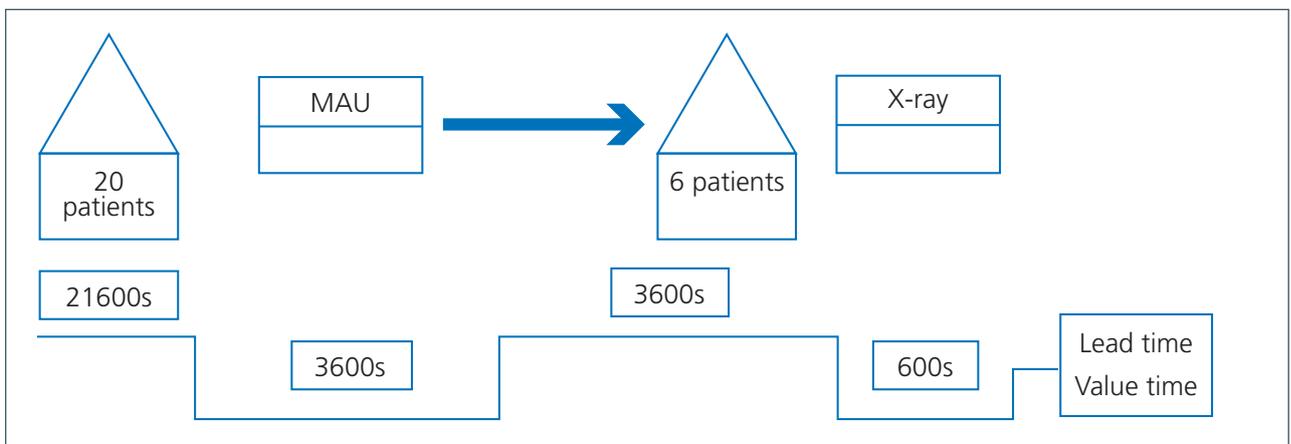
   The ideal end point is the conversion of many of these push steps to the more efficient pull form.

Figure 4
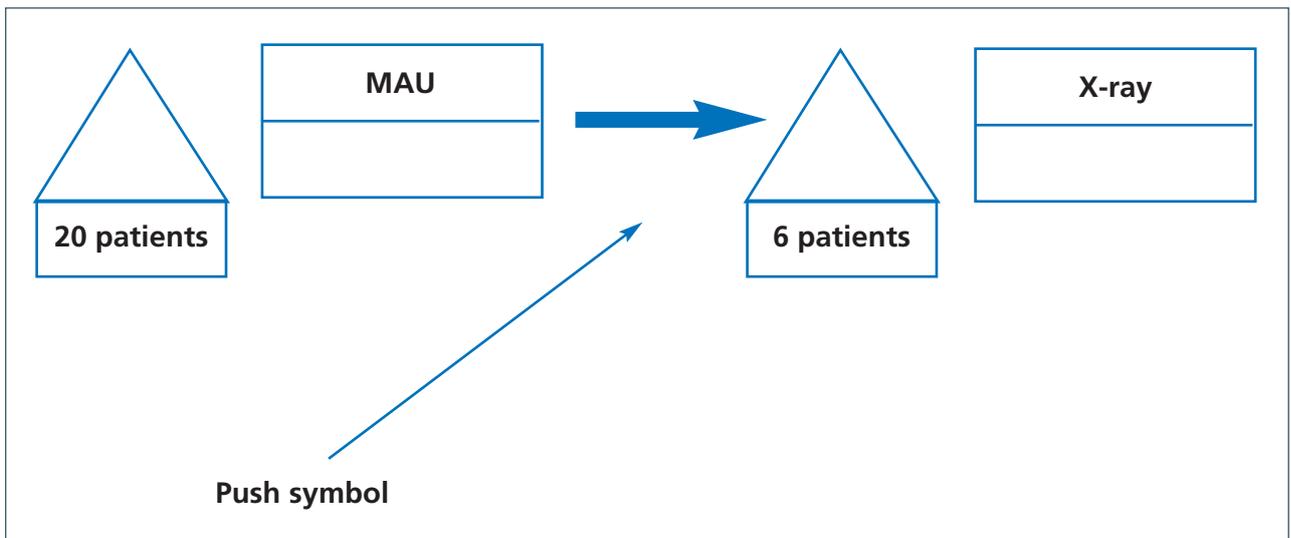
NB: In this example, the MAU would normally be broken down into smaller processes. It is shown as a single process to illustrate the example.

Figure 5

11. The final part of the journey is the addition of a timeline at the bottom of the page. Under each process and associated waiting box, insert the lead time for that process (time taken to complete it) over the value adding time in that process. You can then calculate the complete lead time for the journey and the complete value adding time.

Value adding, non-value adding and necessary but non value adding steps

Once the current state map is complete, you should be able to determine what adds value to patient care and what does not. Some steps add no value but are still necessary, such as transport. You should note these and aim to reduce or eliminate them in the long term.

You can use symbols to denote the value of a step, such as sticky dots (green for value adding, red for non-value adding and half green dot for a non-value adding but essential step). Alternatively, you could use happy and sad face symbols.

Future state map

To draw this and create the conditions for a Lean transformation, you need to ask specific questions. Consider the current state map and ask yourself where it is possible to:

- eliminate steps to reduce delay between them
- combine steps to prevent wasteful delay
- simplify the system/process where possible
- review the sequence of events to support greater efficiency.

Overall the aim is to have the least amount of waste with the highest quality and safety. Standardised procedures create stability and consistency but do not mean that the process remains static. The Lean approach is also concerned with building capability to make subsequent improvements. There are some tools to help improve standardisation and some key questions to address – as outlined below.

For demand:

- What is the Takt time? (See definition below.)
- What is the material flow?
- Where can we use continuous flow?
- Where can we use first in, first out (FIFO)?
- If we can't use flow, where should we use 'supermarket pull?'

For the flow of information:

- What are the information flows that support the value stream (letters to the GP, patients, other)?

Characteristics of a lean process

Takt time

This is defined as:

$$\frac{\text{The available work per shift}}{\text{Patient demand per shift}}$$

This is a manufacturing concept that can easily be translated to healthcare. It allows you to determine how many patients can be treated per unit of time. The amount of shift time available per member of staff or machine is measurable and therefore it should be possible to determine how many patients you need to see per shift to meet patient demand. This sounds simple, yet the ability to achieve takt is the fundamental question as to whether the system is set up to deliver what is required. It is particularly important to calculate this for the part of the journey that is the rate-limiting step as it will ensure that demand is met and waits do not accumulate. This involves a clear knowledge of both current and future capacity and demand.

The cycle time is the time it actually takes to 'do' the task and the aim is to match (where possible) takt time. If the cycle time is going to be the same as or less than takt, all the non-value adding activities need to be removed from each step. Only when all non-value adding activities have been removed should additional resources be considered.

Continuous flow

The notion of continuous flow is central to Lean thinking. This is where the patient moves from one step in their journey to the next without delay. It is the most efficient way to manage any process as it reduces waste to a minimum.

If you are able to introduce continuous flow, the future map should show the previous process boxes being joined together as one single process box. You only require separate boxes if each process has its own separate flow that stops before another commences.

While ideal, continuous flow isn't achievable in all situations. This may be because geography separates steps in the patient journey, or that some parts of the pathway have a very long lead time and are difficult to couple directly to the next stage.

Continuous flow is difficult to achieve, especially, as is often the case in health and care processes, when the people involved in the process or pathway have multiple tasks they need to perform. When continuous flow is not possible, the next most efficient type of flow is pull or 'the supermarket pull system'.

Pull

It is often called the supermarket pull system because the most common everyday example of this type of pull system that we are all familiar with is the supermarket. Shelves are stocked with goods for sale. When you remove an item, a vacant spot remains on the shelf. The inventory management system records how many of these items are purchased and signals to shelf-stackers how much of each item is to be brought out of storage onto the shelves.

In healthcare systems, pull is therefore where the next part of the process pulls patients from the one before.

The following is a simplified example showing a pull system for investigating patients with recurrent blackouts.

Figure 6: Pull system
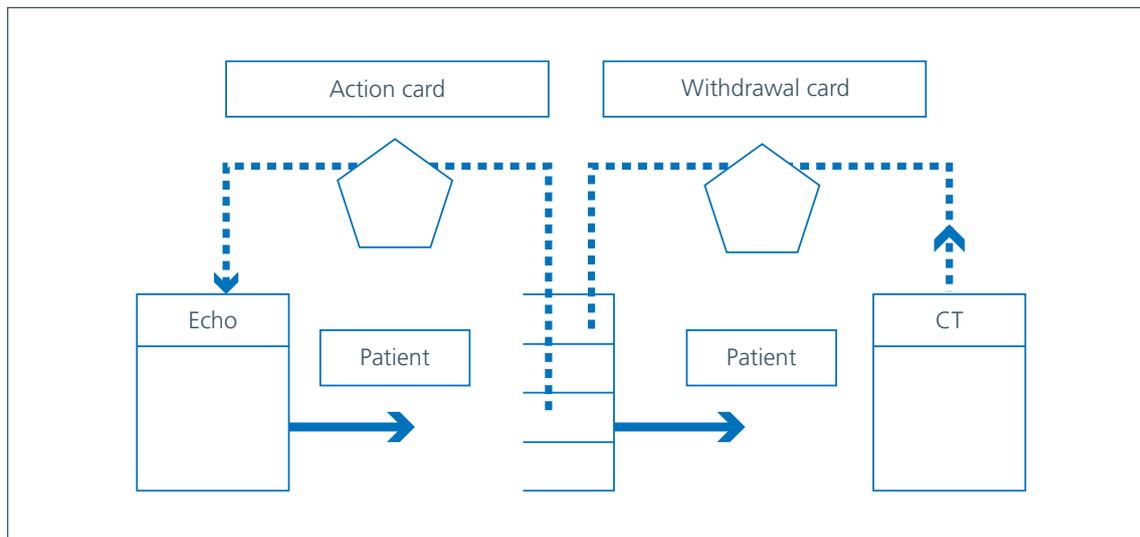
In a traditional 'push' based system, patients have an echo and then have a CT as independent processes. As ECGs are easier to carry out, a large queue of patients usually occurs between the echo and the CT, ie patients waiting for the CT to take place. However, wherever there is a queue, there are associated costs and issues with managing that queue.

In the 'pull' system that is shown, the CT scanner pulls patients through the echo process. Each time a CT is undertaken, a patient is removed from the small pool of patients between echo and CT. A card is sent to the control position, which in turn sends a card to the echo to see another patient. This way, a constant pool of patients is maintained between the two processes. The size of this pool should be large enough to ensure the CT is continuously fed, even if there are disruptions in the echo process, but not so large that patients are kept waiting for a long time. This is a fine balance, but over time, the aim should be to make the pool as small as possible and eventually replace it with a continuous pull system.

This simple system may seem familiar, but all too often there is no relationship between the different processes. This method enables the earlier process to control and regulate the flow. In industry, the cards used to communicate between processes are known as Kanban cards.

First in, first out (FIFO)

Another type of flow management system is first in, first out – or FIFO. (In **theory of constraints** it is known as CONWIP – constant work in process.) You can use this system to couple activities where continuous flow or pull is impossible. It is often used if the process is rare, or if there is a great deal of variation in the cycle time.

While most of healthcare is predictable and can be managed through dedicated flows identified through protocols and care pathways, there are times when this predictability can break down owing to small numbers. When this happens, it is best to organise the

flow according to FIFO. This allows a certain number of patients to pass through a process but when the number is exceeded the process stops. This maximises the downstream flow, particularly through bottleneck areas. You will need to implement some form of queuing to provide a buffer just prior to the FIFO process, but this system should help to ensure efficiency along the whole patient pathway.

Flow rate is determined by the pacemaker. Using pull systems, you will only need to schedule one point in the patient pathway, known as the pacemaker process. If combined with pull techniques, controlling this point will dictate the flow of the whole patient journey.

Figure 7: FIFO flow model
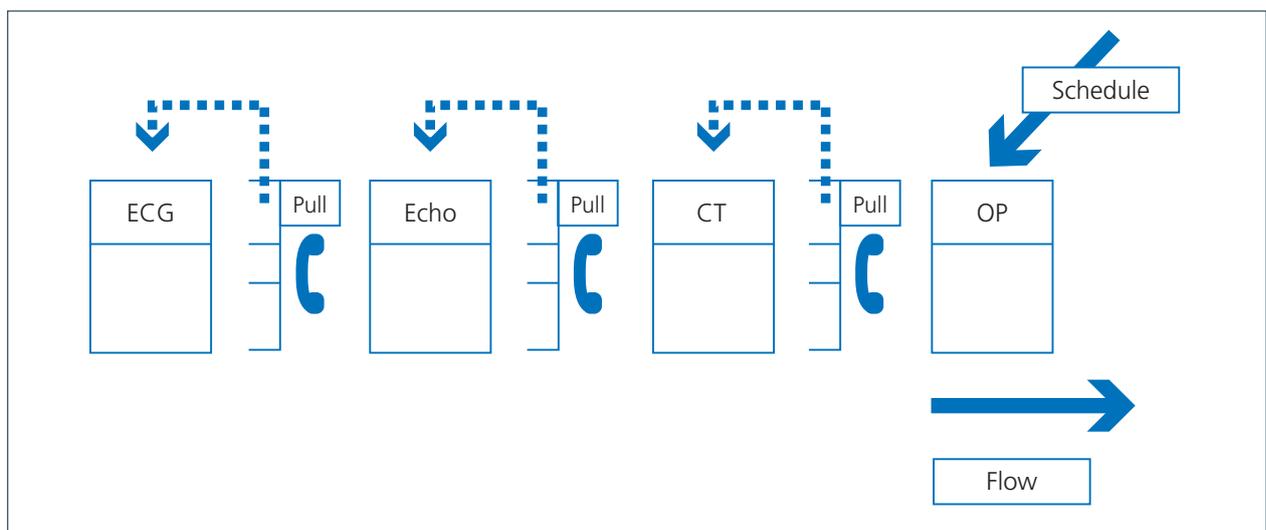
In many appointment systems (eg GP surgeries), patients/service users make appointments and are allocated to a particular GP so when they arrive at the surgery, they check in and wait until that GP calls them. One GP might see two patients in the same time as another GP sees only one. This means that some patients may wait longer than others, even if they arrive at the same time. In a GP surgery, there may be a need for some patients to see a particular GP but for others, FIFO systems can help avoid the delays caused by waiting if patients are not allocated to specific GPs and instead, GPs see patients in the order in which they arrive.

The process needs to occur as continuous flow – otherwise you will need multiple control sites, which you will have to co-ordinate. Using a pacemaker enables you to control the flow using one simple point. This makes scheduling much simpler than trying to co-ordinate many separate processes.

TIPS

- **The difference between value stream mapping and process mapping is that value stream mapping gathers and displays a broader range of information than conventional process mapping.**

- **You can use a high level value stream map to establish which strategic processes require reviewing and in what order. You can also use the map at a process level to identify areas for improvement.**

Additional resources

Bicheno, J (2014) *The New Lean Tool Box*, PICSIE Books: Buckingham

Martin, K and Osterling, M (2014) *Value Stream Mapping: How to Visualize Work and Align Leadership for Organizational Transformation*, McGraw Hill

Rich, N, Bateman, N, Esain, A, Massey, L and Samuel, D (2006) *Lean Evolutions*, Cambridge University Press: Cambridge

Womack, J and Jones, D (2007) *Lean Solutions*, Simon and Schuster: New York

Background

The techniques of value stream mapping have been around for a long time and are the cornerstones of the Lean thinking approach. This approach comes from the manufacturing sector and there are many examples of where Lean thinking has successfully led to improvements in healthcare services.