

## Can Lean Save Lives

Healthcare is a risky business. Doctors, nurses and other healthcare professionals deal with a group of customers who are often frail, vulnerable and frightened. The degree of organizational complexity is high and many procedures have a significant level of risk. It is therefore perhaps not surprising that a recent report from the National Audit Office at the Department of Health (1) highlighted that one in ten patients passing through NHS hospitals suffer an adverse event of some kind. Drug errors, falls, infections, misdiagnoses can all lead to harm to patients within the healthcare system. At the same time both the popular press and medical journals run constant stories of low morale within healthcare “Doctors and Nurses are Sick of the NHS” was one typical headline from the Daily Express in October 2006.

The government response to this in the UK in recent years has been a huge investment of public funds in to healthcare. This has undoubtedly brought about improvements in access times for services and in the quality of the physical environment. However improvements in the quality of the patient experience are harder to substantiate with evidence. What’s more the money is due to run out. The projections of the Treasury in the UK are that public spending will be increasingly constrained in the years ahead and that the times of increases in allocations to the English National Health Service many points ahead of inflation are shortly to come to an end. The introduction of the Payment by Results system is utilizing a national tariff to drive productivity improvements, particularly

in the hospital sector. Healthcare managers, Boards and clinical leaders are therefore faced with a significant challenge. They desperately need something that can simultaneously improve quality, morale and productivity. Such a method would indeed be the holy grail of healthcare management. But can techniques developed in manufacturing really work in hospitals? Could it possibly be that “lean” can save lives?

Over the last eighteen months Bolton Hospitals NHS Trust have been exploring whether or not lean methodologies, often known as the Toyota Production System, can indeed be applied to healthcare. The early experience is that they can and the potential is enormous. However the practical difficulties of implementation can not be overstated and the gains to be had from applying lean in healthcare are only likely to be realized over years or indeed decades, not over weeks or months.

Bolton Hospitals NHS Trust is a large, busy District General Hospital on the north-west edge of Greater Manchester. With just under 800 beds and over 3,000 staff it is a complex organization delivering the general hospital needs of a population with high levels of sickness. In 2004 the hospital had a spiraling financial deficit, significant problems with long waits for diagnostics and many treatments. The future of the hospital as a viable entity was in question. By 2007 things are still far from perfect, however the first steps on the road to recovery have been taken. Financial balance has been restored, waiting times

greatly reduced and a clear vision for the future established. At the centre of this has been the application of lessons from Toyota and from others of the world's leading lean organizations.

### **What is “Lean”?**

So what is lean? Unfortunately the term is widely misunderstood. “Lean and Mean” is all too often what is assumed, particularly by frontline staff and staff representatives. Lean is taken to mean paring things back to the bone, asking staff to work harder and doing more with less. It is not this. In fact by removing many of the frustrations and timewasters that staff encounter lean can make work a more fulfilling experience. But undoubtedly, the first reaction of staff is often the natural one that a manufacturing approach simply can not work in a hospital setting. “We’re not Japanese and we don’t make cars” is the inevitable initial response of many.

In their books “Lean Thinking” and “Lean Solutions” James Womack and Daniel Jones describe how the underpinning principles of a Toyota like approach can be applied to any form of work (2) (3). In their studies of Toyota and other organizations subsequently they demonstrated that first we must see all work as it contributes to an overall end-to-end process. This is because only having seen the end-to-end process can we be in a position to know how to safely improve it. Further to this end-to-end view, being Toyota-like requires that we decide for each step in the process whether it is either ‘adding value’ or not. Such a black-

and-white distinction is difficult to learn but essential. Unlike 99% of traditional management approaches Toyota suggests that the most effective way of making improvement is to focus on eliminating the non-value added steps as opposed to seeking the more obvious but smaller improvements to be had by improving the value adding steps. We have learned that in any given process, non value added steps, or put more simply wasteful steps, typically out-number the value added steps 9:1. The big insight therefore is that going after waste is a much more effective way to improve.

Unfortunately most organizations simply do not have this process focus. In hospitals staff work in departmental silos such as the A&E department, Radiology, the wards and the theatres. Indeed often the only person who sees the whole of the patient journey is the patient themselves! This becomes even more complex when the administrative and information processes that surround the patient journey are taken in to account as these are often five or six times more complex than the journey itself. The result is a process that is riddled with errors, duplication and delay. It is this which is highly frustrating and dispiriting for frontline staff and leaves many feeling that they are working as hard as they can and yet still failing to deliver a good quality service. Much of the work that goes on within the healthcare setting does not directly add value from the patient's point of view. Our processes have rarely been consciously designed – they've evolved in a hotch potch way, often over many years. By learning to see our processes in all of their full horror with the problems clearly set out we can

then take the first step along the road towards improving them. This is the journey which Bolton Hospitals embarked upon late in 2005.

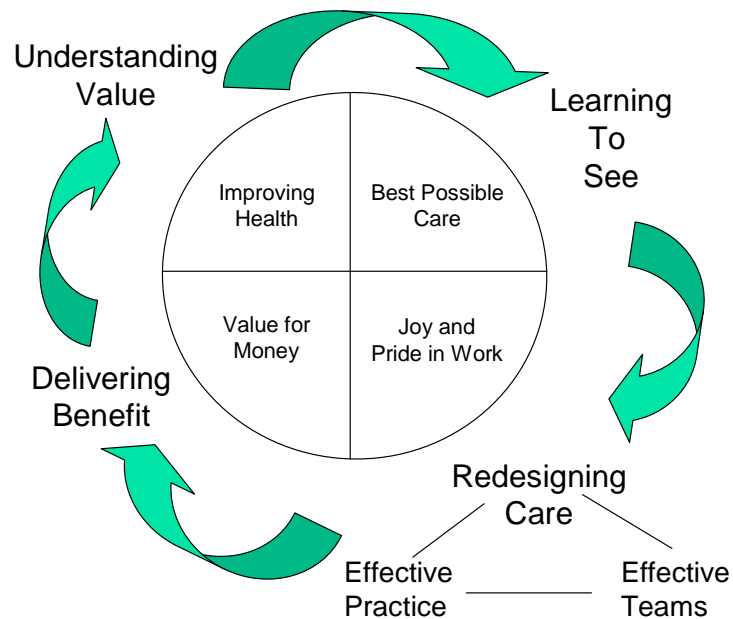
### **Applying Lean to Healthcare**

So how did our lean journey come about? Prior to taking up my post at Bolton Hospitals NHS Trust I was Director of the NHS Modernisation Agency. This was a national body with responsibility for spreading quality improvement methods throughout the NHS. We were fortunate to get Dan Jones' support to work with us on the emergency services collaborative which was established to improve the turnaround times of A&E departments. By applying lean principles of process management, flow and pull hospitals were able to bring about radical improvements. But the Modernisation Agency was successful only on a programme by programme basis. It didn't have the facility to bring about whole organization improvement. And it is undoubtedly true that it is much easier exhorting others to improve than it is doing it in practice! In reality it is all too easy for Trust chief Executives and Boards, even with those with the best of intentions, to become swamped by day to day firefighting and so struggle to create a systematic organization wide approach to improving quality.

Perhaps for this reason, no-one before 2005 in the NHS had tried to apply lean principles across a hospital as a whole. Indeed by 2005 there were only a few hospitals world-wide who were attempting this such as Virginia Mason in Seattle, Flinders in Adelaide and Thedacare in Wisconsin. Beginning in late 2005 Bolton

secured the support of an external consultancy, Simpler, who have a track record in helping organizations carry out lean transformations. With their help Bolton has taken its first tentative steps towards becoming a lean hospital. We are learning that this is likely to be a ten or even twenty year journey! Simpler have been keen to point out that the Toyota way must be interpreted into our own language and adapted to suit a healthcare culture. This has resulted in our approach becoming systematized as the Bolton Improving Care System. The main elements of that system are set out in the diagram below. The remainder of this article describes the steps of the BICS improvement cycle one by one and illuminates them by using a specific case study – that of trauma services.

## The Bolton Improved Care System (BICS)



The fundamental method for embedding culture change and achieving ever-improving transformation is the use of 'Rapid Improvement Events' (RIEs). These week long hands-on change activities sit within a rolling seven week cycle of planning, executing and following up change which piece-by-piece build better end-to-end processes for patient journeys. The RIE approach has a sixty year history of success and is indeed being re-discovered by many as the only sure fire way of mobilizing and sustaining the level of activity to fundamentally shift the culture to that of never-ending improvement.

Since late 2005 over 650 frontline hospital staff in Bolton have been involved in these week long events. These have tackled many different aspects of the patient journey in areas such as antenatal care, radiology, pathology, trauma services, cataracts, surgery, stroke care and even the laundry. All of these are linked to strategic Trust wide transformation plans to avoid isolated pockets of improvement that ultimately do not connect together for improved care. The best way to understand the Bolton Improving Care System (BICS) in action is to consider one of these case examples in more depth that of trauma care.

### **BICS in action: trauma as a case study**

Bolton is a busy emergency hospital. Indeed due to its location between major motorways and metropolitan centre's it is the main emergency receiving centre for Greater Manchester with over 30,000 emergency ambulances arrivals each year. Over 1500 of these are complex fractures. Many of these patients are

elderly and have other presenting problems such as a respiratory condition, heart disease, diabetes or other chronic illness. Historically there have been serious concerns in Bolton regarding mortality, productivity and morale within this service. The hospitals' length of stay for fractured hips was higher than the national average. The service was prone to cancellations of surgery and at times felt chaotic. Despite many attempts at improvement using clinical audit and other approaches the problems remained. Most worryingly of all mortality rates were high. The relative adjusted risk of mortality for a fractured hip in Bolton in 2004/5 was 173.9, in other words over a 70% higher than expected chance of a death from this condition. The problem was serious and urgent action was needed. As a consequence this was the first area chosen as a trial for lean methodologies.

### **Understanding Value**

The first step in the BICS cycle is to understand what is really valuable to the patient. Only by doing this can we identify what is value added as opposed to non-value added work and then seek to eliminate the non-value added steps. Often in healthcare, doctors, nurses and other care professionals will say "of course we know what patients want we are with them all day every day". But being in daily contact with patients isn't necessarily the same as really understanding what is valuable to them. The first step in the BICS cycle is to use rigorous techniques to truly understand value through the eyes of our customer. This includes a variety of approaches such as direct observation which is sometimes called the Ohno Circle. This was named after Tahichi Ohno one of

the founding fathers of Toyota (he was a particularly robust character and some people have said that 'Ohno' was also what people said when they saw him coming!). He used to ask newly appointed young engineers to stand in a chalk circle on the factory floor for up to eight hours at a time just watching what was going on. He would then quiz them ruthlessly about the problems that they saw and the need for improvement. We haven't been quite so draconian in Bolton but the first step of the process is indeed direct observation to watch what is going on in the clinical area, to see how patients flow through the system, what the obstacles and barriers are and to get an understanding of what it feels like to be a patient. Other techniques used include patient diaries, questionnaires, interviews and focus groups. As far as possible in our lean events we actually get patients on the team and this proves particularly valuable as they are constantly challenging the preconceived notions of staff.

When this was done for trauma services we had a much clearer understanding of what was truly valuable to patients. Not surprisingly pain relief came high up on the list followed closely by a wish for information given in a clear and coordinated way and high levels of anxiety about cleanliness, hygiene and infection.

### **Learning to See**

Once value is understood through the customers' eyes we need to establish whether or not what we are delivering is valuable. All too often we become so

used to problems that we “work around them” and accept them as part of the necessities of day to day hospital life. Learning to see is about asking staff to put on their “waste goggles” and to try to see the waste inherent in all of our processes. We have adapted Toyota’s seven wastes to be relevant to healthcare.



## Seven Wastes in Healthcare

- Transport – movement of patients and equipment
- Inventory – unneeded stocks and supplies
- Motion – movement of staff and information
- Waiting – delays in diagnosis and treatment
- Over production – unnecessary tests
- Over burden – stressed, overworked staff
- Defects – e.g. medication errors, infections

All too often hospitals are so cluttered and untidy it is hard to see where the waste is, and almost impossible to create a smooth workflow. A lean consultant who worked with us remembered that he used to tell clients their factories should be well organized and orderly as a hospital; after working in a hospital he no longer does so! A lean technique for creating order and cleanliness is ‘6s’

(sometimes called 5s). This translates imperfectly from the Japanese but in Bolton it means:-

•Sort	-	<b>Separate needed from not needed</b>
•Straighten	-	<b>A place for everything...</b>
•Shine	-	<b>Clean and wash</b>
•Standardise	-	<b>Build into accepted routines</b>
•Sustain	-	<b>Discipline to ensure maintained</b>
•Safety	-	<b>Checking for hazards and defects</b>

A 6S exercise is more than just a clean up of the workplace, it is a way of ensuring that calm and orderliness are built in to the day to day way of doing things. This has now been carried out on a range of clinical areas. As a spin off of our trauma work a 6S exercise was undertaken in the A&E resuscitation room. One might imagine that this would have already have been in good order, however staff found that there were a wide range of improvements that could be made. During a single week long 6S event 71 separate improvements were made in the A&E resuscitation room. This has led to fewer clinical incidents, fewer medication errors and higher staff morale.

There is always a danger that a 6S exercise will be seen as a one-off clean up. In reality it should only prepare the ground for what needs to be a daily discipline. With the help of Michael Balle, author of the lean novel The Goldmine (4), Bolton

has been working to instill this discipline at ward level. This has been termed the “Go and See Approach”. Nurse Managers at ward level are encouraged to regularly look at their wards with fresh eyes to spot the waste and potential for harm to patients. Each week they are asked to identify at least three problems. They then work with their staff to identify and implement solutions before tackling a further three problems the following week. Over a period of weeks and months the cumulative effect can be dramatic. Most importantly it creates a culture where looking for and solving problems is the norm rather than simply working around them as is all too often the case. Establishing such a discipline is far from easy! Whilst this has begun to take hold in some areas in Bolton there remains a long way to go and other ways are needed of enabling staff to see the defects that exist within the hospitals processes.

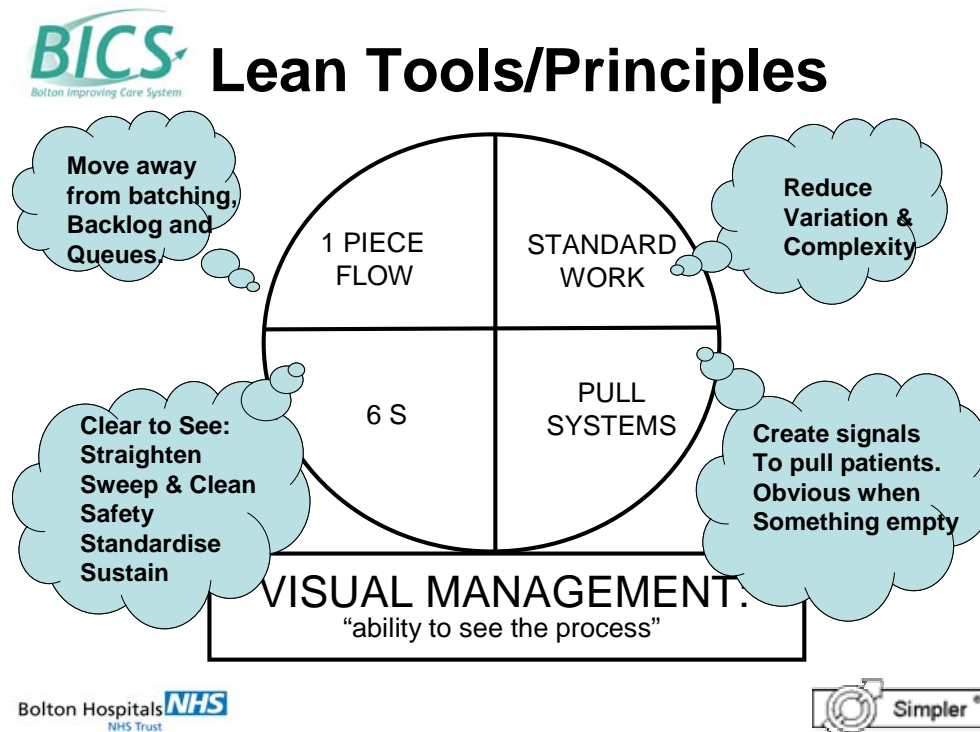
The most developed form of “learning to see” is a valuestream analysis event. This sounds like a fairly dry bit of jargon but in reality it is an extremely powerful way of engaging frontline staff to identify problems and come up with solutions. The valuestream analysis event for the trauma service took place late in 2005. A multidisciplinary team of doctors, nurses, therapists, managers and patients, spent a week removed from their other duties focusing just on this task. They were taught the method and then put it into practice by mapping in detail the progress of the patient’s journey from arrival at A&E through radiology, the wards, theatres, back to the wards and the discharge process. In doing this they identified enormous waste, error and duplication. In fact a number of staff were

visibly moved by what they found. One doctor said he didn't realize that the service we were delivering was so poor and reflected that he had never seen the whole journey end to end. On observing the complexity of our discharge processes one of the patients who had been invited to participate asked the question "how did I ever get out?" From a low point early in the week when they fully understood all of the problems the team moved to develop an exciting vision of how the service could be in the future. That future state was made challenging but achievable and pitched some 12-18 months into the future. Finally the team ended the week by developing an improvement plan to deliver their future state. This consisted of some major projects that would be needed; some "just do it's" simple things which staff could do quickly to put things right; and other areas where further week long rapid improvement events would be beneficial in helping to transform the service.

### **Redesigning Care**

Throughout the early part of 2006 the trauma team worked to implement their future state vision for the service. Six week long rapid improvement events were run looking at flow through A&E, the way the radiology service worked, the establishment of a trauma stabilization unit with significant input from the physicians, the processes within theatres, the discharge process, and multidisciplinary team working. It is at the redesigning care stage of the BICS cycle that we have really begun to creatively adapt lean methodology for a healthcare setting. Our consulting partners Simpler have shared with us a simple

model which they use to help get lean principles embedded in any organization they work with.



Arranged in a deliberate order of implementation the logic (starting in the 12 'o'clock position on the diagram) is as follows:- Get the process flowing one-by-one from one value adding step to the next without waste. For us this is the flow of patients and of information. Underpin this new and counterintuitive working into staff habits through simple visual standard work that not only captures the current best way of performing the flow but also calculates correct staffing for given demand scenarios. Make this flow and standard work easy to do through good 6S (correct arrangement, housekeeping and use of the workspace). Next never try to force things through the process by pushing patients through in a false hope that things will speed up. Instead smooth out the irregularities in flow

and ensure success by only having downstream steps pull patients from upstream steps when they are ready. Finally design visual management aids so that leaders can simply go-and-see what is happening and (because they have flow) exactly the next problem they should be solving without disturbing staff from their value added tasks.

The trauma team worked creatively to apply this in a healthcare setting. They quickly came to see that standard work should be what we have in the past termed effective clinical practice. The trick is not just to identify it but to embed it so it is carried out consistently on a daily basis. The team also concentrated on ensuring that patients flowed in a smooth manner through the unit. Previously very sick and more stable patients had been muddled together on the same ward. The team redesigned the area to create a trauma stabilization unit in which the sickest patients were received and stabilized medically prior to theatre. A good flow was then established to allow quicker access to theatre, proper rehabilitation and effective multidisciplinary team working after patients had had their operation. A single set of much reduced paperwork was created for use by medical staff, nurses and therapists alike eliminating much of the form filling that had grown in an ad hoc way over the years. This greatly reduced the number of non-value adding steps and alleviated a large source of staff dissatisfaction and frustration. 6S was introduced into the area, particularly into the trauma stabilization unit, so that all of the equipment and information that would be needed for the most poorly patients was always in the same place and always to

hand. Finally visual management systems were set up so that staff could see on a continuing basis whether or not the process was operating as it should and what quality problems and defects were occurring.

### **Delivering Benefit**

The final step in the BICS cycle is to close the loop and make sure that the changes that are implemented really are delivering benefit. This phase also builds in reflection on what has worked and what hasn't as a precursor to starting the cycle again. One of the surprising things about a lean approach, as well as one of the most encouraging, is that even though a single pass through produces a large percentage improvement repeated cycles can also produce a similar scale of gain. In a healthcare setting delivering benefit is one of the most difficult phases. We have found that the key is to be clear at the outset about aims whether these be for reductions in mortality, improvements in productivity or increases in patient satisfaction. Unless line managers fully own the programme of work and are committed to implementing the changes and sustaining them on a continuing basis then gains made during the heady days of a rapid improvement event are likely to be quickly lost. In the case of trauma the strong commitment of the orthogeriatrician, the lead orthopaedic surgeon, the matron, the nurse ward manager and the senior therapist were absolutely critical in sustaining the improvements which the teams identified during rapid improvement weeks.

We have learned that it is vital for senior leadership to show a genuine interest in this work and pay attention to the results that are being delivered. In Bolton the Executive Board (made up of directors and senior clinical leaders which meets once a month), now considers all of the previous months lean improvement activity, checking that the expected results have been delivered and asking questions as to why if they haven't. It is necessary to program manage lean benefits realization in as disciplined and systematic a way as any other aspect of the hospital's core business.

### **So what was Achieved?**

The outcomes delivered in the trauma pathway were surprising to us both in terms of their scale and their sustainability. Over a period of just nine months the team delivered:-

- a 42% reduction in paperwork
- better multidisciplinary team working
- a reduction in the time taken to get patients into theatre with a fractured hip from 2.3 days to 1.7 days (a 38% decrease)
- faster recovery and lower demand on the rehabilitation ward
- total length of stay reduced by 33%
- mortality reduced by 36%
- resulting in a relative risk adjusted mortality rate of 105.5

These improvements were spectacular. Clearly however they do not go far enough as mortality has only been reduced to the expected national average level. The team are therefore about to embark on a further cycle of improvement to find ways of taking the service forward and achieving still higher levels of performance.

In other parts of the hospital where BICS has been applied, similar successes have been achieved. In pathology there has been a reduction in floor space of almost 50% which has allowed the Trust to bring in new work at a fraction of the expected cost. The routine sample processing time in the blood sciences area has reduced from an average of five hours to less than 60 minutes. 6S has created a much better working environment in the laboratory which is now designed for flow whilst visual management means that staff know on a daily basis how well they are doing and are actively engaged in solving problems as they arise. The pathology department has increased its income by 10% in the last year with 2% fewer staff and the management team believe that BICs has been a highly important contributor to this. Similarly in the laundry the productivity improvements have been impressive. This was an area which the Trust was previously considering moving out to an external contractor. Pressure from laundry management and staff side representatives led to us using lean techniques to see whether or not the in-house service could be improved. It certainly could! To date the laundry has generated almost £300,000 worth of savings and additional commercial income using its lean approach. This in itself

has more than funded the total cash outlay on the first two years of our lean initiative.

The approach taken in trauma is now being replicated in other areas. Four end-to-end patient journeys are being tackled - cataract surgery, joint replacements, stroke care and patients with acute abdominal pain. All of this is intended to move us towards a desired future state for the hospital as a whole, our vision of what a truly “lean” hospital should be. Our vision is that we should move rapidly to assess patients upon admission and stream them as simple or complex whether or not they are elective or emergency patients. For simple patients we are concentrating on reducing batch sizes, putting patients in to flow, taking out unnecessary steps and non-value adding work and making sure that we give the right kind of customer care at key points in the process to achieve a good patient experience. Our aim for this group of simple patients is to improve throughput and improve patient and staff satisfaction. For complex patients we have quickly learned that the challenge is somewhat different and unlike any car factory! It is often in these areas that we have higher mortality rates and unsatisfactory outcomes. Our work here is not so much about putting the patients themselves into flow as achieving “one decision flow” i.e. getting the right information and clinical decision makers together in a timely manner to get a speedy diagnosis and the right treatment plan. This will lead to improved outcomes and also improve productivity through lower infection rates, quicker recovery and shorter lengths of stay.

## **Reflections and Lessons**

Bolton's early progress on its lean journey has been encouraging but it has not been without its dilemmas and challenges. The cash outlay on BICS has been relatively small but the input of staff time has been considerable. Inevitably there is a feeling from many that "we are too busy to do this". We have tackled this by recognizing that we already create dedicated time and resources for frontline staff for training and development, clinical audit, research and other activities. However these don't always produce the gains in terms of improved patient care or staff satisfaction that we are seeing from the BICS programme and so we have been trying to find ways to redirect those efforts to create the dedicated time and resource that staff need to be involved in BICS.

Secondly, much of this is counter-cultural for the NHS. It is certainly true that we are not Japanese and we don't make cars! However staff can quickly come to understand that all work is a process and all processes can be improved. The result is the revelation that good quality can cost less not more. This is something that staff will rarely accept when told it in theory but are beginning to see for themselves through their hands on involvement with the BICS work. General managers at times have perhaps felt that the effort going in to BICS is a distraction from the importance business of hitting targets and delivering financial balance. It is true that this has been a challenge as to some extent we are trying to build the aeroplane whilst flying it! In the long term however it is clear that the BICS approach is a sustainable way of achieving targets and financial balance

whilst at the same time improving staff morale and patient satisfaction. This is a prize worth fighting for.

Finally we are all too well aware that the NHS suffers from “initiativitis”. It feels as if every possible improvement methodology, programme or fad has been tried out in the NHS in recent years. As a result staff can become battle weary and cynical. There is the temptation for some to see lean as the latest new idea that will go away again in a year or two when the Chief Executive thinks of something new. The only way of rising to this particular challenge is to show resilience, consistency and perseverance. Implementing lean in a healthcare setting is far from easy but the potential gains are enormous. Our early experience is that lean really can save lives. The Toyota production system is an amazingly successful way of manufacturing cars. It can't be simply translated unthinkingly into a hospital but lessons can be learned from it and the method can be adapted and developed so that it becomes owned by healthcare staff and focused towards the goal of improved patient care. Perhaps most heart-warming of all has been the response of frontline staff themselves. Working in healthcare is a stressful and difficult thing to do. Everyone needs a touch of inspiration and encouragement. Applying lean to healthcare in Bolton seems to be achieving just that for those who work there.

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- 1) National Audit Office and Department of Health; A Safer Place for Patients: Learning to Improve Patient Safety, TSO, November 2005
- 2) Womack J and Jones D, Lean Thinking, Simon and Schuster, New York, 1996
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- 4) Ballé M, The Goldmine, Lean Enterprise Institute, Bookline M.A., 2005