

SIMUL8

Change the way you make
decisions

How to Support Healthcare Staff and Achieve Operational Excellence

SIMULATION-POWERED
DIGITAL TWINS

SOLVING THE HEALTH CRISIS BEGINS BY LOOKING AFTER NHS STAFF

Are long hours and patient wait times overwhelming your team?

Research by [The King's Fund](#) found that NHS workers are 50% more likely to experience high levels of work-related stress compared to the rest of the working population, while as many as one in two in the NHS are experiencing symptoms of burnout, according to [research from University of Bath](#).

The impact on NHS staff of an increasing backlog of appointments while resources are being depleted should not be underestimated. While looking after the health and wellbeing of people is the business of the NHS, any plans to improve the UK's healthcare system must begin with looking after and retaining the valuable NHS workforce.

The ability to alleviate pressures felt by healthcare workers and release time to care offers a useful litmus test for the introduction of any new solution to tackle the challenges faced across healthcare. It's a time when pragmatic and simple changes will make the biggest, immediate impact on the day-to-day experiences of staff.

How can we ensure that resources have been distributed appropriately so that staff are not left trying to stop a flood with a paper cup when demand levels fluctuate? How can we better prepare for winter pressures? How do we ensure better allocation of patients in the right beds for improved outcomes? How can we identify cases of hospital-acquired sepsis earlier so that patient care plans are not made more complicated than they need to be? How can we find ways to optimize scheduling and rotas so that staff aren't required to work such long hours or miss their lunch breaks?

For nurses and clinicians to be able to deliver the best quality of care possible, and to save them from being stretched to their limits, they need to be able to rely on a system that cuts wastage and inefficiencies wherever possible.

Solving the health crisis begins by looking after NHS staff

This paper will demonstrate how simulation-powered digital twins can deliver on optimizing the available capacity and fine-tuning processes, even before any further funding is required. It will share examples where forward-thinking Trusts and hospital departments are already reaping the benefits of this technology.

We will see how simulation-powered digital twins are being applied to everything from appointment scheduling to bed management, patient flow and more. We will look at how they are being used to test and optimize real world healthcare processes to improve decision-making, increase efficiency, reduce costs, and, importantly, support healthcare staff.

“I’ve managed to have my lunch at a reasonable hour, left on time and haven’t felt overwhelmed every day”

Haematology and Oncology Day Unit (HODU)
nurse, Airedale General Hospital

WHAT ARE SIMULATION-POWERED DIGITAL TWINS?

Simulation-powered digital twins combine the real-time data of digital twins with the experimentation of simulation.

Digital Twins

Digital twins are fast becoming the planning method of choice for organizations across industrial sectors. Increasingly, they are also being developed to map healthcare pathways and optimize in-hospital processes. It's a method of digitally recreating a system to provide a static representation of its current state. In recent years, digital twins have become far more sophisticated thanks to the greater sources of real-time data now available via things such as Electronic Health Records, interconnected medical devices and process mining tools.

Simulation

Process simulation is a method of experimentation in which you take the current state of a process and then run various scenarios to discover possible future states. By asking 'what if?' questions you can understand how the process will be impacted by changes or reconfigurations. It provides a safe, digital testing ground designed to explore exactly what the optimal process looks like and how to achieve it.

Users can run simulations forward over hours, weeks, or even years to understand the impact of each scenario and provide evidence on which course of action is the best to take. In this way, simulation provides foresight in planning ahead with highly accurate forecasts.

Simulation-Powered Digital Twins

Combining the real time data capabilities of digital twins with the experimentation and forward running of simulation creates a simulation-powered digital twin that lives alongside the real world system for the most optimum forecasting and planning available.

When you add simulation to a digital twin, it will quickly understand the dynamic behavior of the system, the process rules, and how each element interacts with others. This means that it is able to conduct continuous 'what-if' scenarios and facilitate advanced optimization by running thousands of permutations to evaluate and then optimize the different strategies available.

When you add simulation to a digital twin, it will quickly understand the dynamic behavior of the system, the process rules, and how each element interacts with others. This means that it is able to conduct continuous 'what-if' scenarios and facilitate advanced optimization by running thousands of permutations to evaluate and then optimize the different strategies available.

The simulation-powered digital twin can inform process owners on the best corrective action to take, whether responding to different inputs, potential challenges, or changes to the operating environment. Furthermore, the robust simulation engine enables the digital twin to adapt in real-time, meaning quick adjustments can be made based on the emerging data to forecast future process performance.

Think of simulation-powered digital twins as being able to capture all of the thinking of the most experienced hospital planner. The recommendations are then accessible to anyone that needs to make a quick decision on where to allocate resources based on up-to-the-minute data.

For example, a simulation-powered digital twin can quickly identify the impact of a surge in emergency department inpatients on onward referrals so that appropriate plans can be implemented ahead of time. Eliminate the domino effect when things start to go wrong by identifying and pivoting away from issues before they have a chance to escalate.

Simulation-powered digital twins can remove the element of surprise for hospital planners by providing a way of taking up-to-the-minute corrective action ahead of problems materializing. This makes them extremely useful in healthcare settings, and over the following pages we are going to see how it is being done.

"We know that simulation-powered digital twins can help us plan more effectively, building in all the variations that are experienced in the real world. This way we can understand the impact of things such as the patients not attending, or the clinic being cancelled. It gives us a much better opportunity to plan forward, and that's something that we need to get better at."

Dr John Boulton, a national director for NHS Quality Improvement and Patient Safety

USE CASE: APPOINTMENT SCHEDULING

NHS Airedale General Hospital Haematology & Oncology Day Unit

Patients are now waiting longer for appointments than ever before. Research from [The Health Foundation](#) suggests a worst case scenario where the total UK backlog could peak at 8.4 million by the end of 2024.

Simulation-powered digital twins offer an unrivaled opportunity to match available resourcing against accurate demand forecasts. In this way, staff and equipment can be utilized to best effect where wards and clinics are appropriately resourced according to when patients' appointments need to be booked.

In doing so, staff are given more sense of control over managing busy periods without needing to compromise on how much time they can spend administering care to each individual patient.

Airedale General Hospital Haematology & Oncology Day Unit transformed its appointment scheduling using a simulation-powered digital twin. Their outcomes:

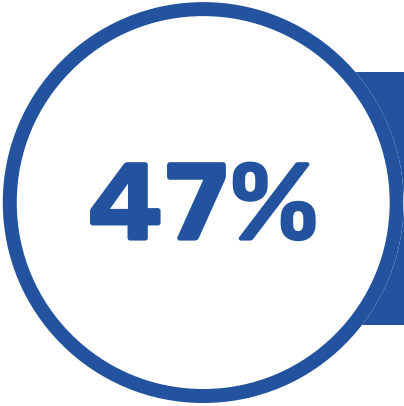
- Over 50% reduction in **patient wait times**
- 75% reduction in **staff overtime hours**
- £15,000 generated in **savings per month**
- 5% increase in **capacity to see more patients**

When the management of the Haematology and Oncology Day Unit (HODU) at Airedale General Hospital first started working with change management specialist [Changeology](#), they were struggling from the pressures of staff working long hours while patient wait times were regularly impacted by a challenging scheduling system.

Patients across West Yorkshire could book appointments without restriction. However, the unit didn't match appointments to the resources needed to deliver a complex matrix of treatments. The overall result was that its modern new treatment chairs were often underutilized, but staff still worked long hours to ensure all patients completed their treatments.

There was a significant wellbeing issue for patients when important appointments needed to be rescheduled or they were worried about their condition. At the same time, staff would be stretched in different directions and suffer long working days, often without time for lunch. A simulation-powered digital twin helped to redefine the management of patient scheduling so that resources could be optimized, staff wellbeing would improve, and patient flow managed in the most efficient way for better patient outcomes.

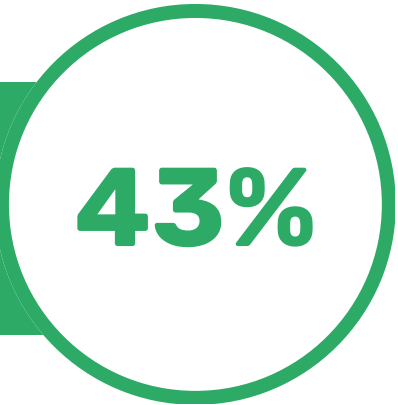
The simulation was developed for continuous use, to live alongside the real world system as a digital twin with several easy-to-use tools for the team to use daily without technical knowledge. It was built to be agile and adjust the appointment options depending on the changing dynamics experienced within the unit day-to-day.



47%

Nearly half of cancer centres face weekly delays in administering systemic anticancer therapy (SACT)

The Royal College of Radiologists



Delays for weekly treatment for radiotherapy rose from 22% of patients in 2022 to 43% in 2023

The Royal College of Radiologists

43%



crisis

Waiting times for cancer patients in Wales labelled as a crisis

Macmillan Cancer Support

USE CASE: BED MANAGEMENT

Isle of Wight NHS Trust

53%

The number of NHS hospital beds in England reduced by more than half between 1987 and 2020, while the number of patients increased.

The King's Fund

The number of hospital beds for general and acute care has fallen by 44% since 1987/88

The King's Fund

44%

fewer

The UK has fewer acute beds relative to its population than comparable health systems.

The King's Fund

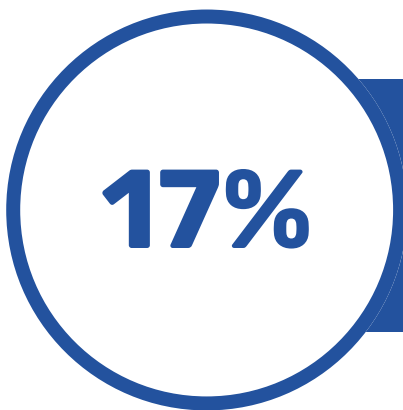
Bed management remains one the most complex challenges for hospital department managers. The twists and turns during an average day in a hospital department can go in any number of different directions depending on the flow of patients in and out of the system. Appointments can be missed, clinics can be cancelled, discharges delayed by a low availability of ambulances, staff levels can be impacted by sickness or strikes, or a surge in emergency admissions can mean that resourcing is suddenly required to pivot. There can be seasonal variations too, or sometimes unexpected correlations such as more elderly admissions for falls when we're hit by an overnight frost.

There are also challenges in managing patient pathways according to the profile of each individual as they come through the door. For example, cardiac patients have a higher survival rate when placed in a cardiac bed, so the best course of action is to accommodate them accordingly, but what happens when several cardiac patients arrive in one day? Or another example would be maintaining single sex wards. If a male patient occupies one bed in a ward, it then restricts female patients from using the other available beds.

“I think there’s a huge opportunity to use simulation-powered digital twins to understand how healthcare systems actually behave, and the dynamics that cause that behavior. But we are still planning to averages.”

Dr John Boulton, a national director for NHS Quality Improvement and Patient Safety

The most common approach across many NHS departments remains a reliance on deterministic spreadsheets. This manual process for capacity planning is time-consuming and means planning by averages. The problem here is that there are always going to be upstream and downstream challenges and these will not be accounted for if you are working according to what’s happening in the middle.



17%

Isle of Wight NHS Trust gained 17% bed capacity for inpatients from their simulation-powered digital twin.

As the sole provider of integrated acute, community, mental health and ambulance healthcare to an isolated offshore population of 14,000, Isle of Wight NHS Trust is continuously in search of creative and unique ways of improving and developing this challenging and often complex healthcare system.

The Trust used a simulation-powered digital twin to rapidly test a wide range of bed management scenarios at the start of every shift to maximize efficiency and drive success. Using simulation has allowed the Trust to involve and engage its Clinical Commissioning Groups, consultants and clinicians throughout the process to develop a comprehensive bed management solution that everyone trusted.

“Consultants have been particularly impressed by our ability to recognize the maximum bed requirements and how often a certain number of beds will be utilized rather than referring to average bed requirements.”

Iain Hendey, deputy director – information finance & performance information services, Isle of Wight NHS Trust

The NHS Isle of Wight team wanted to move beyond using simple deterministic spreadsheet calculations and planning on averages, to incorporate real world variables into bed management and planning analysis to provide more accurate and reliable results.

Isle of Wight has been able to use simulation to reconfigure beds within the hospital, allowing for increasing bed capacity for medical patients by approximately 17%. It was also identified using the simulation-powered digital twin that these beds did not necessarily have to be within the hospital but instead could be placed in the community or even in the homes of patients with additional support.

USE CASE: PATIENT FLOW

Guy's and St Thomas' NHS Trust

Productive patient flows are those which support a patient's journey through the department so that they receive appropriate care in a timely manner and are kept well informed during this process. This enables the department to maximize the number of patients that can be treated.

[NHS Institute for Innovation and Improvement](#)

Managing patient flow is one of the most important and challenging aspects of operational management within healthcare that touches on every stage of the patient journey. Key considerations include:

- Avoiding overcrowding in wards
- Ensuring the safety and dignity of patients
- Managing infection control
- Avoiding patients being left in corridors or in ambulances
- Moving patients between beds, wards, units or hospitals
- Providing timely treatments
- Pre- and post-surgery accommodation
- Inpatient management
- Safe discharge

As pressure on services across health and social care increases and hospitals become more overcrowded, so does the burden on staff to speed up patient flow.

This pressure to move patients on within hospitals, or discharge them out, is passed from department to department which can result in healthcare staff being so focused on patient flow that they lose focus on the patient.

All this may, of course, negatively impact the already threatened physical and mental health and wellbeing of staff, including moral injury from not being able to provide high levels of patient care.

[Royal College of Nursing Congress](#)

Guy's and St Thomas' NHS Trust has proven to be a trailblazer in employing simulation-powered digital twins to improve patient flow. In particular, the London hospital handles a large volume of complex cardio-vascular surgical cases where patient pathways are long and made up of lots of interlinked steps. They may be elective surgeries, or they may be in the form of unplanned emergency admissions.

The Trust wanted to analyze how changing capacity at various points in the patient pathway would impact activity volumes and wait times for patients. It called on the data involved in more than 1,000 major cardiac operations to create a blueprint for its digital twin.

Using simulation to bring experimental powers to the twin, the hospital was able to join data for different parts of the system to build a full story of the patient flow. This enabled them to understand how things play out in changing conditions such as when elective procedures are at risk of cancellation. What happens if operating rooms are free but recovery beds are too congested? What happens when these recovery beds may be shared with other specialties?

"We don't just have to add capacity (increasing theater lists and beds), we were also able to consider rule sets such as ring-fencing specific amounts of recovery beds or combining wards. Using simulation really helped to surface these complex issues of a joined system."

James Roxburgh, Consultant Cardiac Surgeon, Guy's and St Thomas' NHS Trust

ARE YOU READY FOR SIMULATION-POWERED DIGITAL TWINS?

The technology discussed in these pages might almost sound like it is too good to be true. But, as we have seen, it is very accessible and is already being used with great success in forward-thinking hospital departments up and down the country.

Simulation-powered digital twins enable healthcare planners to see the full picture ahead of time and take corrective action. Meanwhile, department staff are given an easy-to-use tool that they can rely on on a daily and ongoing basis, putting them back in control when managing the busiest times of a shift.

“It’s been so refreshing to walk into the unit throughout the day and see how much calmer it feels.”

Clinical nurse specialist (CNS), Airedale General Hospital

While combating the broader challenge of patient waiting lists will take time and more funding, adopting simple, ready-to-rollout solutions like simulation in the immediate future can give healthcare departments the very best chance of success.

This technology offers an unrivalled way to leverage already-available data and unlock process improvements that would otherwise be hidden. It has the ability to deliver the marginal gains in day-to-day operations that can make a huge difference in removing unnecessary burdens for staff and release more time to care.

So where can your department benefit most?

The SIMUL8 logo is displayed in a bold, white, sans-serif font. The background of the entire page is a dark blue overlay featuring a collage of various simulation software interfaces. These interfaces include flowcharts, bar charts, and text labels such as 'Assembly line throughput', 'Raw materials', 'Throughput', 'Warehouse forecast', and 'Patient flow'.

SIMUL8

Do you have questions about using Simulation-powered digital twins?

If you would like to complete a free readiness assessment to find out where simulation-powered digital twins can make the most impact in your department, please contact our team.

Our specialist healthcare simulation consultants will help you to assess the opportunities for resource and process optimization and equip you with the skills you need to start taking advantage of our world-leading simulation technology.

[Get in touch with our team](#)