



Cost-Management & Green Sustainability

ANALYSIS - EVALUATION - OPPORTUNITIES - KEY DEVELOPMENTS

Lisa Ward

Making Hospitals More Hospitable

Héctor González Jiménez, Ali Haidar

The Transformative Role of AI in Healthcare: From Clinical Breakthroughs to Sustainability Goals

José A. Cano

Reimagining Tomorrow's Hospitals: How to Reduce the Carbon Fingerprint to Achieve Harmony Between Health and Sustainability

Cristina Galindo

Recruiting for Sustainability: Building a Resilient Healthcare Workforce

Maria Beatriz Piñeiro-Lago

Leading the Global Climate Challenge: Galician Health Service as a Climate Champion





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countries in
Europe

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equipment

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million
scans / year

13
million
patients / year



Editorial



**PROF. LLUIS
DONOSO BACH**

Consultant at the Department of Research and Innovation. Hospital Clínic de Barcelona. University of Barcelona | President of the EspañaSalud Foundation | HealthManagement.org Editor-in-Chief Imaging

Cost Management and Green Sustainability

Healthcare systems around the world are increasingly pressured to reduce costs while maintaining high-quality patient care. Rising operational expenses, changing regulations and workforce challenges require a more strategic approach to financial management. Cost efficiency now extends beyond simply cutting expenses; it involves optimising processes, improving resource allocation and leveraging innovative frameworks to ensure long-term financial sustainability. Achieving this balance is crucial for strengthening healthcare resilience and delivering value-based care.

At the same time, sustainability has become a vital priority. Healthcare institutions must reduce waste and energy consumption while adopting circular economy principles to align environmental responsibility with operational efficiency. Implementing sustainable practices not only lowers costs in the long run but also enhances the wellbeing of patients and staff. As climate-related health risks continue to rise, integrating green initiatives into healthcare strategies becomes essential for creating systems that are both economically and environmentally sustainable.

This issue explores strategies for cost optimisation and sustainable practices, covering topics such as AI-driven efficiency, lean management, circular economy initiatives, innovative workforce planning and value-based cost allocation.

Lisa Ward talks about making hospitals more hospitable because the shift in modern healthcare settings and strategic choices in elements of the built environment can contribute to patient wellbeing and recovery.

Héctor González Jiménez and Ali Haidar explore how AI is transforming healthcare by enhancing diagnostics, optimising operations, improving accessibility and advancing sustainability, while emphasising the need for integrated frameworks and multidimensional metrics to maximise its impact.

José A. Cano advocates for hospitals to adopt sustainable measures like renewable energy and waste reduction to balance health with environmental responsibility.

Cristina Galindo underscores the importance of sustainable recruitment in healthcare, emphasising the need for ethical hiring, green skills and long-term workforce strategies to ensure resilience, cost-efficiency and high-quality patient care.

Maria Beatriz Piñeiro-Lago showcases how the Galician Health Service leads sustainable healthcare with a Circular Economy strategy to achieve net-zero emissions by 2040.

Dr. Andrew Whiteley argues that embracing technology is essential for sustainable healthcare, as digital tools enhance efficiency, reduce workloads, and improve patient care.

Dr. Thorsten Junkermann and Prof. Dr. Pierre-Michael Meier detail how Andernach State Hospital and Hosp.Do.IT developed a digital agenda to align IT strategies with corporate objectives, enhance processes and meet regulatory requirements.

Bilal Aslam Qureshi examines how Time-Driven Activity-Based Costing (TDABC) is transforming healthcare cost allocation, driving efficiency and supporting value-based care.

J. Antônio Cirino explores how gamification transforms healthcare training by fostering engagement, skill development and organisational excellence.

Christoph Kamp and Gerold Unterhumer describe how virtual reality enhances radiography training, improving accuracy, engagement and efficiency while complementing hands-on practice.

Susana Álvarez Gómez discusses how collaboration and centralisation in EU public procurement can foster innovation, sustainability and efficiency through strategic leadership and reforms like the 2014 directives.

Johan Claire and Alan Zettelman explain how ISO 56001 strengthens innovation management, fostering adaptability and value in healthcare.

Hans Crampe, Senne Terryn and Prof. Dr. Dominique Vandijck outline how Lean management enhances healthcare efficiency by reducing waste, optimising workflows and increasing direct patient care time.

I hope you will enjoy this issue. As always, your thoughts and experiences are welcome—your perspectives drive meaningful progress.

Happy reading!

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Reimagining Tomorrow's Hospitals: How to Reduce the Carbon Fingerprint to Achieve Harmony Between Health and Sustainability

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Gamification: Revolutionising Healthcare Training for Leaders and Professionals

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Lean Management in Healthcare: Enhancing Patient Care, Reducing Workload and Overcoming Barriers to Implementation

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Digital Transformation of Andernach State Hospital Using Hosp. Do.IT's Generic Strategy Template

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Enabling Radiographers for Better Imaging through VR training in Plain Radiography

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Lean Management in Healthcare: Enhancing Patient Care, Reducing Workload and Overcoming Barriers to Implementation

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Lean Management in Healthcare: Enhancing Patient Care, Reducing Workload and Overcoming Barriers to Implementation

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Making Hospitals More Hospitable

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Why Clinicians Should Embrace Technology

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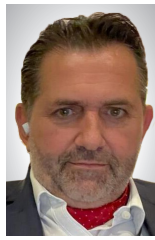
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Spotlight



Advancing Diagnostic Imaging with United Imaging's Global Expansion

United Imaging is expanding globally, installing cutting-edge diagnostic imaging systems in Italy, France and Lithuania. Innovations like the uCT 960+ and uMR 680 enhance diagnostic precision, patient accessibility and workflow efficiency. The company's AI-powered technologies and commitment to healthcare accessibility are advancing both human and veterinary medicine. Through research, collaboration and craftsmanship, United Imaging is shaping the future of medical imaging worldwide.

CHRISTIAN
MAROLT



Executive & Editorial Director I
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key points

- United Imaging expands globally with new diagnostic imaging systems in Italy, France and Lithuania.
- The uCT 960+ and uMR 680 improve diagnostic accuracy, patient access and workflow efficiency.
- AI-powered tools enhance imaging, reducing scan times and improving precision in key medical fields.
- United Imaging drives innovation through research, collaboration and user-focused technology.
- The company advances global healthcare with high-quality, accessible imaging solutions.

United Imaging is advancing diagnostic imaging with major installations in Italy, France and Lithuania. These innovations reflect the company's dedication to technological excellence and its mission to enhance access to advanced medical imaging solutions globally.

Strengthening Medical Imaging in Italy

Diagnostica e Terapia Centro Aktis in Marano di Napoli has expanded its diagnostic capabilities with three state-of-the-art imaging systems from United Imaging. Through a partnership with Fora, a leader in outsourced diagnostic and therapy services, this installation strengthens the Aktis Centre's position as a premier healthcare provider in Naples and the Campania region.

uCT 960+: High-Performance Computed Tomography

The uCT 960+ is a 640-slice CT scanner setting new standards in diagnostic imaging. Its ultra-wide 82 cm bore and 318 kg table weight capacity ensure

accessibility for all patients. Featuring a 16 cm-wide Z-detector and 0.5 mm detector acquisition, it delivers high-resolution imaging with enhanced diagnostic precision. A 0.25s rotation speed optimises temporal resolution, while advanced reconstruction technology minimises imaging artefacts, making it particularly effective in cardiology, oncology and emergency medicine.

uCT 820: Optimised Imaging for High-Volume Centres

Designed for efficiency, the uCT 820 features an 82 cm bore, a 0.25s rotation speed and liquid-metal bearing technology equivalent to a 30 MHU heat capacity. Its 0.5 mm Detector Pixel Size and 1024x1024 Reconstruction Matrix optimise image clarity, ensuring accurate diagnostics. AI-powered tools, such as uAI Vision for automated isocentric positioning, improve workflow efficiency, making the uCT 820 a vital asset for stroke, cardiology and oncology imaging.



uMR 680: Innovations in MRI Technology

The uMR 680 MRI system features a spacious 70 cm bore, offering exceptional gradient performance of 45 mT/m and 200 T/m/s. Powered by the uCS 2.0 Platform, it enables faster and more precise 2D, 3D and 4D MR examinations. With features like EasySense, a dual-source phased array millimetre-wave technology for contactless respiratory motion sensing and DeepRecon, an AI-powered image reconstruction tool, the system enhances diagnostic precision while ensuring patient comfort with QScan noise reduction technology.

Advancing Healthcare in France and Lithuania

uMI 550 at Eure TEP Scan, France

United Imaging, in collaboration with Qualimedis, has installed the uMI 550 at Eure TEP Scan in Évreux, France. This advanced PET/CT system enhances oncology and molecular imaging diagnostics while minimising radiation exposure. The uMI 550 features an Integrated-Light-Guide Digital PET detector, AI-powered image reconstruction and motion correction algorithms that improve workflow efficiency and reduce the need for repeat scans. This installation reinforces United

Imaging's dedication to advancing nuclear medicine and expanding access to high-quality imaging technology in France.

uCT 520 at Kauno Gyvūnų Ligoninė, Lithuania

Expanding its impact on veterinary medicine, United Imaging has deployed the uCT 520 at Kauno Gyvūnų Ligoninė, a premier veterinary hospital in Kaunas, Lithuania. Developed in collaboration with MedUS Medical, this 40-slice CT system improves imaging accuracy while reducing radiation exposure. Key features such as Real 3D Cone Beam Reconstruction, KARL 3D Iterative Denoising and AI-powered workflow tools enhance diagnostic capabilities, setting a new standard in veterinary imaging.

Innovation at the Core of United Imaging

United Imaging's relentless pursuit of innovation is at the heart of its mission. The company continuously adapts to evolving healthcare needs, pioneering advancements that ensure equal access to high-quality diagnostics.

Pioneering Future Technologies. The company's research and development efforts focus on brain science, artificial intelligence and critical illness treatment. By integrating advanced diagnostics with digital intelligence technologies, United Imaging is





shaping the future of healthcare. This commitment to innovation drives medical technology evolution and healthcare system transformation in partnership with industry leaders worldwide.

Craftsmanship and Excellence. United Imaging seamlessly integrates technology and craftsmanship, refining every product to meet the highest standards. From core component development to ergonomic product design, precision and quality remain central. The synergy between cutting-edge technology and human-centric design ensures superior imaging solutions that prioritise both accuracy and patient wellbeing.

About United Imaging Healthcare

Shanghai United Imaging Healthcare Co., Ltd. is a global leader in medical imaging systems, radiotherapy equipment and life science instruments. The company provides intelligent digital solutions to healthcare institutions worldwide, partnering with hospitals, universities and research organisations to expand access to cutting-edge medical technologies.

United Imaging's mission is to lead healthcare innovation by integrating advanced imaging solutions with user-centred design. Through continuous technological advancements and strategic

“United Imaging’s relentless pursuit of innovation is at the heart of its mission.”

Collaborative Growth. United Imaging fosters collaboration across enterprises, universities, research institutions and hospitals. Open communication between disciplines and industries fuels technological breakthroughs, driving advancements that benefit future generations. From large-scale product innovation to refining intricate design details, United Imaging remains at the forefront of healthcare technology.

A Commitment to Healthcare Accessibility. United Imaging's installations in Italy, France and Lithuania reflect its commitment to transforming healthcare through state-of-the-art imaging technology. By delivering groundbreaking solutions tailored to both human and veterinary medicine, the company is addressing global healthcare challenges while improving diagnostic accuracy and treatment outcomes. Through continued research and development, United Imaging is setting new benchmarks in medical imaging, making high-quality healthcare more accessible worldwide.

collaborations, the company is driving new standards in medical imaging, ensuring that healthcare providers worldwide have access to reliable, high-performance diagnostic solutions.

A Global Presence

With a presence across Asia, Europe, North America and Africa, United Imaging is continuously expanding its global footprint. The company's network of expertise and partnerships enables it to develop pioneering solutions that empower healthcare providers with the latest advancements in diagnostic imaging, shaping the future of medical technology worldwide.



Cover Story

Making Hospitals More Hospitable

The shift in modern healthcare settings and how strategic choices in elements of the built environment can contribute to patient well-being and recovery.

LISA WARD



Product Line Manager, UK & France |
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key points

- Research suggests a strong correlation between the quality of design in healthcare facilities and patient outcomes, linked to reduced anxiety, lower blood pressure, decreased painkiller usage and improved recovery.
- Patients with views of nature experienced shorter hospital stays, reduced pain medication use, and fewer negative evaluations than those facing brick walls.
- Aesthetic appeal in healthcare facilities also impacts employee productivity and well-being, making the work environment more comfortable, calming and welcoming.
- Colour has also been found to influence mood, reduce anxiety and instil a more comfortable atmosphere.

Recent research has indicated a strong correlation between the quality of design in healthcare facilities and resulting patient outcomes, with links to reduced anxiety, lower blood pressure, decreased painkiller usage and improved overall recovery. As healthcare executives grapple with the dual challenges of elevating care standards whilst managing costs, the strategic implementation of warm, welcoming, patient-centred spaces over predominantly clinical functionality offers a promising solution.

This article explores this paradigm shift in modern healthcare settings and discusses how strategic choices in elements of the built environment can significantly contribute to patient well-being and recovery.

The Impact of Design on Clinical Outcomes

A growing body of research points to the impact of thoughtful interior design on clinical outcomes. Professor Roger Ulrich, a pioneer in healthcare design, laid the groundwork for this movement in 1984, with his seminal paper, “View Through A Window May Influence Recovery From Surgery”(Ulrich 1984). Published in *Science*, this study demonstrated that patients with views of nature experienced shorter hospital stays, reduced pain medication use, and fewer negative evaluations, compared to those facing brick walls.

More recent studies have shown how natural light regulated hormone secretion, improves circadian rhythms and reduces perceived stress, pain, and – in turn – the use of pain medication (UCL 2021). And evidence suggests that exposure to real or artificial depictions of nature can reduce levels of stress (Beukeboom et al. 2012) in healthcare settings.

These benefits don’t relate solely to patients; aesthetic appeal has also been found to impact employee productivity and well-being (Jin et al. 2022). For staff working in any hospital environment, they are often subject to demanding and stressful schedules, working long, irregular hours while coping with the emotional toll of patient suffering and loss.

If more comfortable, calming and welcoming environments can help to reduce stress and irritability, the consequence is that workers will be more productive and attentive to patients, thus providing a better standard of care. In the UK, as the NHS experiences substantial staffing challenges, it is essential that every effort is made to promote employee well-being.

Colour Theory in Practice

It’s clear from this research why managers are reassessing the role that good, well-considered interior design can play in improving patient outcomes and staff



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“Buildings, spaces and architecture can impact emotions, physiological responses and in the case of healthcare environments, recovery outcomes.”

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Colour Theory in Practice

It's clear from this research why managers are reassessing the role that good, well-considered interior design can play in improving patient outcomes and staff productivity. While this may include everything from acoustics to ergonomics, the use of colour has been found to have an influence on mood (Ghamari and Amor 2016).

Though white was once the go-to colour for hospitals, soft blues and pastel greens are increasingly employed in therapy and operating rooms to reduce anxiety, while warmer tones of orange, yellow and beige may be used in common areas like hallways and waiting rooms, to instil a welcoming and more comfortable atmosphere.

An example of this can be found in the recent work at the Kolding super-hospital in Denmark. With an overall design ethos based on the principle of ‘Healing

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The Transformative Role of AI in Healthcare: From Clinical Breakthroughs to Sustainability Goals

Artificial Intelligence is reshaping healthcare by enhancing diagnostics, improving clinical outcomes and optimising operational efficiency. It enables remote patient care, streamlines workflows and reduces healthcare costs. AI also contributes to sustainability by minimising waste and energy consumption. However, realising its full potential requires integrated frameworks and multidimensional metrics to measure impact across clinical, operational and environmental dimensions.

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key points

- AI improves accuracy, speeds up disease detection and enables personalised treatment.
- It reduces inefficiencies, lowers costs and streamlines workflows, optimising operations.
- AI bridges healthcare gaps through telemedicine and remote patient monitoring.
- It supports sustainability by minimising waste, reducing energy consumption and lowering carbon footprints.
- AI's impact must be measured using integrated frameworks and metrics to align with healthcare goals

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Artificial Intelligence (AI) is transforming healthcare, but what the healthcare sector has seen so far is just the tip of the iceberg. AI's ability to improve clinical outcomes, reduce inefficiencies and connect isolated communities is remarkable—but it merely scratches the surface of what is possible. Beneath this visible success lies a vast, uncharted potential waiting to be realised. While AI systems can be energy-intensive and contribute to sustainability challenges due to their high computational demands (Bratan et al. 2024), AI also holds significant potential to advance sustainable development as a result of optimising resource use, enhancing operational efficiency, reducing waste and expanding equitable access to essential services like healthcare (Ueda et al. 2024). To unlock this potential, the healthcare



sector must move beyond fragmented innovations. What is needed is a clear path encompassing cohesive frameworks with proactive, multidimensional metrics that allow measuring the outcomes of AI in healthcare (Chustecki 2024).

The Intriguing Promise of AI in Healthcare

AI has already proven its worth, reshaping how diseases are diagnosed, managed and prevented. Hospitals across the globe are leveraging its computational might to streamline workflows, accelerate life-saving decisions and alleviate resource constraints. By collaborating with AI, radiologists are not just faster but more precise—able to identify subtle abnormalities with machine-learning tools while dedicating time to solving complex cases. AI also entails the potential to enable remote clinics to no longer be disconnected from specialists, with AI-powered telehealth tools bridging that gap in a matter of seconds. Indeed, there are numerous real-world examples of AI transforming healthcare, including enhancing diagnostic precision in imaging, optimising workflows and enabling remote patient monitoring and proactive care, all of which contribute to improved clinical outcomes and patient experiences (Philips Editorial Team 2022). Hence, AI's ability to revolutionise direct clinical outcomes is vast, offering unparalleled opportunities to enhance diagnostic accuracy, personalise treatments and improve patient care at an unprecedented scale.

lead to savings of 5 to 10 per cent in U. S. healthcare spending, totalling approximately €192 billion to €345 billion (\$200 billion to \$360 billion) each year. The global savings may thus be immense. These savings flow throughout the value chain by enhancing resource utilisation, minimising waste and promoting innovation, which ultimately leads to better environmental, social and economic outcomes. Hence, AI contributes to operational efficiency by optimising resource use, reducing waste and streamlining energy-intensive processes, creating more sustainable and cost-effective healthcare systems.

Building on the foundation of operational efficiency, AI's potential extends further to address one of healthcare's most pressing challenges: breaking down geographic and economic barriers to ensure equitable access to quality care for all, *accessibility*. AI is helping healthcare leap geographic and economic barriers. From telemedicine platforms that connect rural populations with world-class care to predictive algorithms that ensure supplies reach the areas that need them most, technology is rewriting the rules of equity in care. Consider, for example, the case of an AI-powered remote monitoring system for diabetes management (Tenovi 2024), which tracks blood glucose levels, physical activity and diet to provide personalised meal and exercise plans. This system helps individuals manage their condition effectively, regardless of location

“AI's ability to improve clinical outcomes, reduce inefficiencies and connect isolated communities is remarkable—but it merely scratches the surface of what is possible.”

Beyond clinical outcomes, AI can also be considered a facilitator of significant clinical improvements—quick, accurate diagnostics and timely treatments. However, looking deeper, one will discover operational efficiencies that extend well beyond clinical care. Healthcare facilities operate as energy-intensive ecosystems, often burdened by inefficient practices. When applied thoughtfully, AI can transform how hospitals utilise resources. From optimising energy consumption to accurately predicting supply chain demands, it can reduce carbon footprints and lower costs. For instance, a working paper from the Economics of Artificial Intelligence Conference (Sahni et al. 2023) estimates that broader AI adoption could

or proximity to specialised healthcare facilities. Similarly, AI-driven heart failure monitoring devices analyse real-time data like heart rate and blood pressure, enabling early detection of exacerbations and preventing costly hospitalisations. These examples showcase AI's potential to transform remote healthcare, making advanced care accessible to patients worldwide.

These outcomes are undoubtedly crucial, delivering significant improvements in clinical care, operational efficiency and accessibility. Yet, as incredible as these strides are, they are only part of a much larger story. These currently visible advancements—the intriguing

clinical promises, optimised workflows and enhanced patient access—form the innermost layers of a convoluted structure. Beyond this, AI holds the power to fundamentally change the way healthcare interacts with society and the planet.

Unveiling the Hidden Layers

What is often missing in these discussions on these layers is their direct and indirect contribution to social and ecological sustainability. On the one hand, in terms of direct contributions, the previous layers generally underscore tangible outcomes—such as improved patient care and cost savings—yet often overlook their broader environmental implications. First, AI's ability to enhance diagnostic accuracy and streamline care pathways indirectly reduces resource waste, such as unnecessary tests, hospital readmissions and excessive medication use. For example, predictive models can minimise overstocking in supply chains while optimised treatment plans reduce the environmental impact of prolonged hospital stays. Second, operational efficiencies brought about by AI—such as energy optimisation in hospitals and predictive maintenance of equipment—significantly lower the carbon footprint of healthcare facilities. For instance, AI-driven energy management systems ensure minimal resource wastage by adjusting lighting, heating and cooling based on real-time demand. Third, accessibility advancements like telemedicine and remote monitoring contribute further to sustainability by reducing travel-related emissions. For example, fewer patient journeys not only decrease

greenhouse gas emissions but also alleviate the strain on infrastructure in underserved regions. Taken together, these indirect contributions across clinical care, operational efficiency and accessibility advancements highlight the deeper, systemic role AI can play in aligning healthcare systems with broader sustainability goals, even beyond its immediate and visible impacts.

This broader perspective is depicted in the following diagram (Figure 1), illustrating how AI's influence spans from immediate clinical outcomes to system-wide social and ecological sustainability. As one moves from the inner to the outer layers of the diagram, the focus on AI's applications in healthcare may seem to diminish. Yet the outcomes of the first three layers—direct clinical improvements, operational efficiencies and enhanced accessibility—are not merely compartmentalised gains; in reality, each contributes directly to social and ecological sustainability. By reducing hospital waste, facilitating remote care and streamlining resource usage, AI's more immediate benefits cascade into broader, system-wide transformations that lower carbon footprints and bridge healthcare gaps across diverse communities. Although social and ecological sustainability is often the hardest layer to quantify, it is precisely this realm that elevates AI from a narrow clinical tool to a catalyst for long-term societal and environmental wellbeing. Embracing the fluid interconnections among these layers is crucial, ensuring that AI's impact extends beyond quick wins and accelerates healthcare's transformation into a truly sustainable and equitable ecosystem.

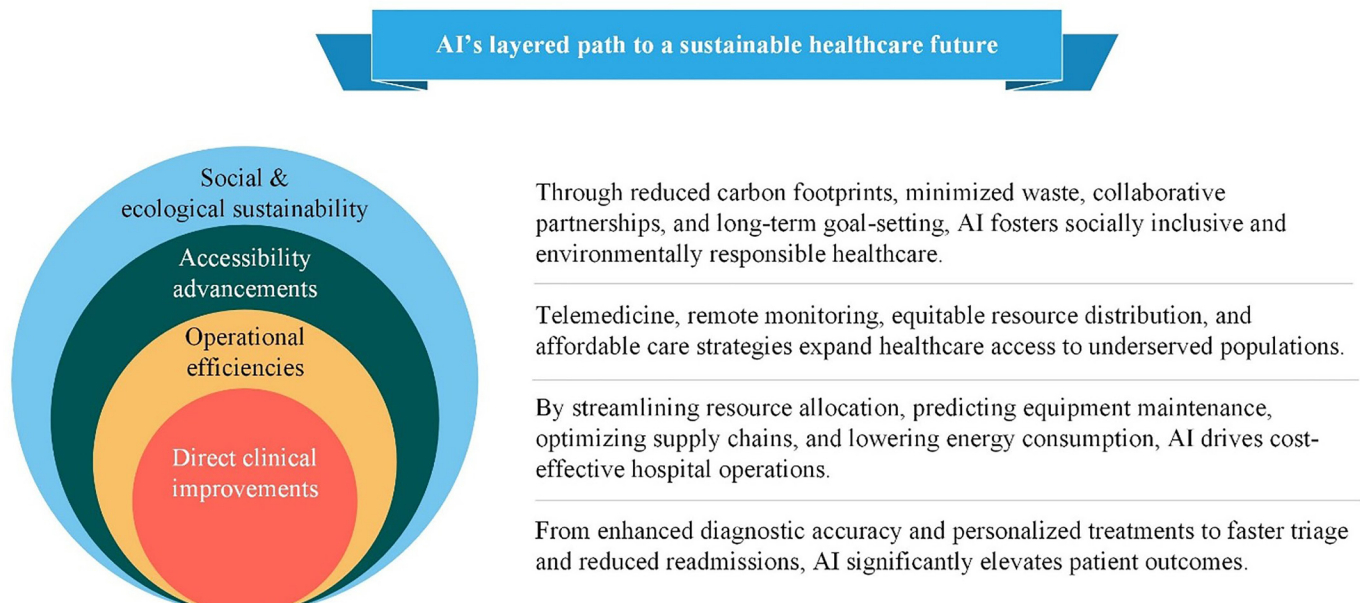


Figure 1. Diagram depicting the extent of AI's impact in healthcare. Source: Authors' own elaboration



Though overshadowed by the breakthroughs at the centre, the outer layers of the diagram hold equally pivotal roles in shaping the broader trajectory of AI in healthcare. This is primarily due to two reasons: first, the immense attention commanded by clinical breakthroughs—such as improved diagnostic precision, personalised treatments and life-saving interventions—tends to overshadow the broader systemic and societal impacts represented by the outer layers. Second, the contributions of the outer layers, such as operational efficiency, accessibility and particularly social and ecological sustainability, are inherently more challenging to measure and quantify. These impacts often span long-term outcomes and involve complex interdependencies that do not lend themselves to straightforward metrics. Despite being less talked about, these outer layers are

objectives like cost-cutting or technical precision. While these are important, they alone are insufficient. What about the carbon footprint of AI systems themselves? What about their long-term role in reducing global health disparities? These concerns are reinforced by insights from the *Journal of Big Data*, where Raman et al. (2024) assert the critical need for a unified approach to AI innovation—one that seamlessly integrates sustainability goals to shape a more responsible and transformative trajectory for AI in healthcare. Along the same line, another study by Ueda et al. (2024) suggests that “*The integration of AI sustainability within broader institutional and societal sustainability efforts will be crucial for achieving a future where healthcare not only improves patient outcomes but also promotes environmental stewardship.*”

“AI contributes to operational efficiency by optimising resource use, reducing waste and streamlining energy-intensive processes.”

equally critical, as they represent the broader potential of AI to transform healthcare into a system that is efficient, inclusive and deeply aligned with sustainability goals. Ignoring these layers risks undervaluing AI’s capacity to address some of the healthcare system’s most pressing challenges while shaping its future in meaningful and transformative ways.

However, there is a crucial point to consider: without reliable benchmarks and holistic evaluation tools, many of these more profound potential risks remain hidden, undervalued or unachieved. This is where multidimensional metrics become indispensable. Tools that combine measurements of energy savings, carbon reductions, patient outcomes and social equity—could provide a roadmap to align AI innovations with broader sustainability goals. Furthermore, such frameworks and metrics also provide a way to communicate the bright side of AI’s adoption in healthcare.

The Metrics Needed to Measure Progress Across the Layers

For AI to ascend beyond these visible achievements and redefine healthcare on a systemic level, various frameworks that assess its impact holistically are needed. Current implementations often focus on narrow

To unlock AI’s full potential in healthcare and ensure it aligns with sustainability goals, robust frameworks are needed to measure its impact across various layers. Each layer—whether direct clinical improvements, operational efficiencies, accessibility advancements or social and ecological sustainability—requires tailored, multidimensional metrics that reflect its unique contributions.

For the innermost layer, metrics should focus on clinical outcomes such as diagnostic accuracy, treatment personalisation and patient recovery rates. These measures can highlight how AI is revolutionising healthcare at its core by improving care quality and saving lives.

In the operational efficiency layer, metrics must evaluate resource optimisation, such as reductions in energy consumption, hospital waste and operational costs. For example, tracking energy savings from AI-automated hospital management systems or quantifying cost reductions from supply chain predictions can make the case for AI’s economic and environmental value.

Moving outward, the accessibility advancements layer demands metrics that assess AI’s ability to bridge gaps in care delivery. These might include the number of rural or underserved communities gaining access to telemedicine services, the reduction in patient wait times

or the distribution of medical supplies to areas in need—clear indicators of AI's role in making healthcare more aligned with social and ecological sustainability.

Finally, in the outermost layer of social and ecological sustainability, the metrics must focus on long-term impacts, such as carbon footprint reductions in healthcare systems, progress toward carbon-neutral facilities and partnerships driving broader sustainability initiatives. These measures ensure AI is not just solving immediate problems but is also contributing to a healthier planet and society.

When these metrics are linked to each layer of the diagram, they can provide a cohesive roadmap for assessing AI's transformative potential in healthcare. Transparent, real-time dashboards are critical for assessing AI's impact across all layers of the diagram, particularly in the healthcare sector, where timely and actionable insights can directly influence patient outcomes and system-wide efficiency. For example, in hospitals utilising AI-powered energy management systems, dashboards can track energy consumption patterns in real time, enabling administrators to optimise lighting, heating and cooling systems based on patient

By embedding transparent, real-time dashboards into healthcare workflows, healthcare organisations gain a powerful tool to measure the direct and systemic contributions of AI. These dashboards ensure that advancements in clinical outcomes, operational efficiency, accessibility and sustainability are not only visible but also actionable, driving a future where healthcare systems are more efficient, equitable and environmentally responsible.

Looking to the Horizon: Aligning AI's Promise with Sustainable Healthcare Goals

As AI's transformative role is examined across the layers of the diagram, from direct clinical improvements to social and ecological sustainability, it becomes clear that the journey is only beginning. The road ahead requires intentionality and collaboration to ensure that AI not only reaches its potential in enhancing healthcare outcomes but also aligns with broader sustainability goals. Governments, healthcare organisations and tech innovators must work together to embed sustainability across all layers of the healthcare system.

“AI's more immediate benefits cascade into broader, system-wide transformations that lower carbon footprints and bridge healthcare gaps across diverse communities.”

flow and occupancy levels. Such tools not only reduce operational costs but also lower carbon emissions, aligning healthcare facilities with sustainability goals.

In clinical settings, AI-integrated dashboards can provide physicians with up-to-the-minute data on patient health metrics, such as vital signs from remote monitoring devices. For instance, a patient with chronic heart failure using an AI-enabled monitoring device can have their data—heart rate, blood pressure and respiratory rate—visualised on a real-time dashboard.

At a systemic level, healthcare organisations can use AI-driven dashboards to monitor supply chain efficiency. By tracking inventory levels, predicting demand and flagging potential shortages, these tools ensure that resources like essential medications and medical equipment are allocated where they are needed most, minimising waste and avoiding supply disruptions.

This begins with actionable steps, starting with the implementation of transparent, real-time dashboards to track progress across the various layers of healthcare operations. These dashboards can monitor everything from patient flow and staff allocation to energy consumption and waste production, providing immediate insights that help administrators make data-driven decisions. Developing tailored metrics for each layer—clinical, operational, accessibility and sustainability—is equally critical, ensuring that every domain's unique impact is accurately measured and improved upon. For instance, while clinical metrics might focus on diagnostic accuracy or patient recovery times, sustainability metrics could capture greenhouse gas reductions from AI-enabled energy management systems. Such systems, when integrated with remote monitoring technologies, can not only optimise hospital lighting, heating and cooling but also predict maintenance needs,



ultimately extending the lifespan of critical equipment. Finally, fostering partnerships among governments, healthcare providers, technology firms and community organisations can pave the way for ambitious initiatives, such as building carbon-neutral healthcare facilities and distributing resources equitably to underserved areas. By uniting diverse stakeholders, these collaborations accelerate the pace of innovation, broaden access to life-saving care and ensure that AI's benefits reach every corner of the health ecosystem—leading to a greener, more inclusive future.

The potential is enormous: healthcare systems that reduce emissions, enhance access to care for underserved populations and build resilience against future crises. However, realising this vision requires sustained investment in workforce training, ethical AI development and robust frameworks to measure and adapt progress across all dimensions of healthcare.

Conclusion

To fully realise the transformative potential of AI in healthcare, its impact must be measured across all layers of the system—enhancing clinical outcomes, streamlining operations, breaking down barriers to accessibility and advancing sustainability. AI-enabled dashboards, tailored metrics and partnerships can help bridge the gap between innovation and tangible, system-wide benefits. Achieving this vision demands novel forms of collaboration among healthcare providers and various other stakeholders to align their strategies and scale sustainable solutions. By doing so, AI will not only redefine patient care but also catalyse a greener, more equitable future for healthcare systems worldwide.

Conflict of Interest

None

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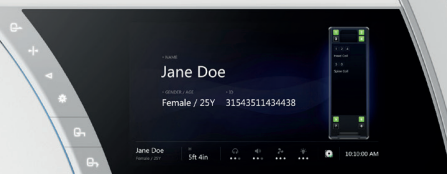
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MORE INFO:



Reimagining Tomorrow's Hospitals: How to Reduce the Carbon Fingerprint to Achieve Harmony Between Health and Sustainability

Hospitals protect public health but are responsible for 4.4% of global greenhouse gas emissions. Sustainable practices, such as using ScopeCO2 to measure carbon footprints, allow hospitals to identify their impact sources, structure a strategy to reduce their carbon footprint and transition towards a more environmentally sustainable facility. Practical strategies adopted by La Paz Hospital in Madrid include renewable energy, sustainable mobility and waste management improvements, and aligning operations with climate goals.

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key points

- Hospitals account for 4.4% of global greenhouse gas emissions, requiring urgent action.
- Measuring carbon footprints is vital for identifying and reducing emissions in healthcare.
- Sustainable practices include renewable energy, waste management and mobility plans.
- Tools like ScopeCO2 help hospitals track and mitigate their environmental impact.
- Decarbonisation aligns healthcare with climate resilience and global sustainability goals.

Sustainability is a priority in the current context, where healthcare systems face significant challenges related to climate change, resource depletion and the increase in waste generation. In this scenario, hospitals play an essential role in society by taking care of people's health; however, they paradoxically contribute significantly to the global environmental footprint. The healthcare sector is estimated to generate approximately 4.4% of global greenhouse gas emissions.

Embracing sustainability in hospitals represents both an opportunity and a responsibility to mitigate their environmental impacts while ensuring the continued delivery of essential services. This article explores the importance of integrating sustainable practices into

healthcare institutions. By understanding a hospital's carbon footprint, we can adopt better practices aimed at reducing that footprint. This approach also improves care quality, lowers operational costs and strengthens the resilience of healthcare systems.

Introduction

Sustainability has become an increasingly relevant topic in today's world. As we face environmental and social challenges, it is essential to seek ways to transform our lifestyles and systems to ensure a sustainable future for generations to come. Drawing from the definition of sustainable development outlined in the "Our Common Future" report by the Brundtland Commission,

sustainable development is understood as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” (World Commission on Environment and Development 1987) This concept takes on different nuances depending on the focus, scope and political context in which it is addressed.

From a business perspective, the emphasis is on efficient resource management. The environmental

In 2025, with the entry into force of the Kyoto Protocol, net Greenhouse Gas (GHG) emission reduction targets were established for the first time for major developed and transitioning countries. The primary GHG is carbon dioxide (CO₂), whose emissions have increased globally by an average of 1.9% annually over the past 30 years, mainly due to the use of fossil fuels such as coal, oil or natural gas, as well as other industrial processes. In addition to CO₂, other notable GHGs identified in the Kyoto Protocol include methane (CH₄), nitrous oxide

“The healthcare sector is estimated to generate approximately 4.4% of global greenhouse gas emissions.”

approach prioritises the conservation of ecosystems, the responsible use of natural resources and the minimisation of pollution. Meanwhile, the social dimension focuses on improving quality of life, ensuring access to education and healthcare and promoting equitable development. Therefore, a comprehensive approach to sustainable development requires it to be economically viable, environmentally responsible and socially just.

Thus, a sustainable hospital, within the framework of sustainable development, should conduct its operations in an economically viable, socially responsible and environmentally respectful manner (minimising its environmental impact through the efficient use of natural, energy and material resources). To achieve this, it must adopt measures to reduce its carbon footprint, promoting sustainable practices that ensure its contribution to the wellbeing of the community and the planet.

Towards Sustainable Healthcare Centres: The Importance of Understanding the Carbon Footprint

Hospital infrastructure and its daily operations require significant energy consumption to ensure the continuous functioning of their systems. Medical activities involve the use of specific inputs such as medications, medical equipment, medical gases, chemicals, textiles, office supplies and furniture, among others. This generates a variety of waste, including pathogenic, hazardous or chemical materials, as well as common urban-like waste from administrative activities, kitchens and green area maintenance.

(N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF₆) (Gusi Gil et al. 2024).

For this reason, governments and international institutions are reaching global agreements to guide progress in this area, such as the 2030 Agenda and the Sustainable Development Goals (SDGs), the United Nations Framework Convention on Climate Change (United Nations 1994) (Ministry for Ecological Transition and the Demographic Challenge n. d.) and the Paris Agreement.

The carbon footprint is a parameter that represents the total emissions of CO₂ and other greenhouse gases (GHGs) released into the atmosphere, expressed in mass of CO₂ equivalent, caused directly or indirectly by a product, organisation service or event throughout its lifecycle. It is important to measure it in order to quantify the main sources of emissions, gain a comprehensive understanding of the organisation's impact on climate change and serve as the first step in implementing an emissions reduction plan.

Therefore, one of the initiatives of the Strategic Plan for Health and the Environment 2022–2026 Spain (Ministry of Health of Spain 2021) focuses on reducing the health impact of major environmental factors and their determinants. This initiative aims to decrease the burden of diseases caused by them, identify new related threats and facilitate the development of policies on environmental health. A key aspect of this effort is the study of the carbon footprint in the healthcare sector. The goal of the initiative is to reduce morbidity and mortality associated with climate change-related events.



To this end, a tool has been developed to allow stakeholders in the healthcare sector to identify their carbon footprint and devise strategies to reduce GHG emissions and improve their environmental performance as organisations.

The tool, *ScopeCO2*, is based on Scopes 1, 2 and 3 of the Greenhouse Gas (GHG) Protocol and complies

used standard for calculating and preparing greenhouse gas (GHG) emission inventories. Emissions are calculated based on activity data for the calculation year, applying validated emission factors (e.g., kg of CO₂ per kWh of electricity consumed). In this way, the carbon footprint is determined by multiplying the activity data by the corresponding emission factor.

“A sustainable hospital (...) should conduct its operations in an economically viable, socially responsible and environmentally respectful manner.”

with all methodological criteria necessary to register calculations in the Carbon Footprint Registry of the Spanish Office for Climate Change (MITERD) (Ministry of Health of Spain n. d.). These scopes are listed here:

Scope 1: Direct emissions from sources owned or controlled by the hospital, such as:

1. Consumption of fossil fuels for heating, domestic hot water (DHW), backup generators, kitchens, steam generators etc.
2. Consumption of fossil fuels in vehicles owned by the entity for the transportation of materials, products, waste, employees etc.
3. Consumption of anesthetic gases.
4. Consumption of fire extinguishing gases.
5. Consumption of refrigerant gases (PFCs, HFCs, SF₆) due to leaks. Regulation (EU) 2024/573 establishes the periodic inspection of leaks (European Parliament 2024).

Scope 2: Indirect emissions from the consumption of purchased electricity, steam, heating or cooling.

Scope 3: Broader indirect emissions, such as those associated with the supply chain (water, paper, other supplied goods and services), purchases of IT equipment and real estate, waste disposal, transportation-related activities and subcontracted means (e.g., ambulances): staff travel, employee commuting, transportation of purchased materials and sold products, etc.

The calculation is carried out using the framework of the standard “*The Greenhouse Gas Protocol, a Corporate Accounting and Reporting Standard*” (World Resources Institute 2004), which is the most widely

The primary sources for the emission factors used are updated with those applied by the Spanish Office for Climate Change and the National Commission on Markets and Competition (CNMC) for electricity. These factors are updated annually by the CeroCO₂ initiative.

The ScopeCO₂ methodology enables the identification, quantification and prioritisation of environmental impact areas, assisting hospitals in designing effective strategies to reduce their emissions. This not only contributes to sustainability but also supports resource optimisation and regulatory compliance in the fight against climate change.

Case Study: Carbon Footprint Measurement at La Paz Hospital (Madrid)

La Paz University Hospital is one of Spain’s leading healthcare centres, renowned for its excellence in medical care, teaching and research. Located in Madrid, it is part of the Madrid Health Service (SERMAS). Since its inauguration in 1964, the hospital has been a cornerstone of healthcare in the region and the country.

With an approximate area of 170,000 square meters, the hospital features 1,052 beds, 49 operating rooms and specialised units such as ICUs, neonatology, oncology, transplant services and other specialities. It is a leader in several fields, including cardiology, oncology, neurology, neurosurgery, solid organ and tissue transplants, and paediatrics.

In teaching and research, the hospital is affiliated with the Autonomous University of Madrid, facilitating medical training and research projects. It is also a pioneer in healthcare technologies and advancements in medical treatments.

Scope 1: Direct GHG emissions	7.971,28 t CO₂
Emissions associated with the consumption of fossil fuels in fixed installations	5.511,48 t CO ₂
Emissions associated with the consumption of medicinal anaesthetic gases	2.427,89 t CO ₂
Emissions associated with the consumption of refrigerant gases for air conditioning and refrigeration	0,00 t CO ₂
Emissions associated with the consumption of fire-extinguishing gases	0,12 t CO ₂
Emissions associated with the consumption of fuel in vehicles	31,79 t CO ₂
Scope 2: Indirect GHG emissions	0,00 t CO₂
Associated with the consumption of electric energy	0,00 t CO ₂
Scope 3: Other indirect GHG emissions	11.493,47 t CO₂
Emissions associated with the consumption of water	98,42 t CO ₂
Emissions associated with the consumption of paper (sheets)	179,52 t CO ₂
Emissions associated with the generation of waste (paper and cardboard, plastic containers, similar to urban waste, organic matter, toner, glass, laboratory water, non-halogenated solvents, expired medicines, cytostatic, electronic waste, special bio sanitary products, remains in formaldehyde, special industrial waste, contaminated containers, batteries.	803,61 t CO ₂
Emissions associated with travel by external means (taxi, plane, car)	2044,64 t CO ₂
Emissions associated with transport by third parties (patients transported by ambulance and helicopter)	350,97 t CO ₂
Emissions associated with travel on employee routes	8016,31 t CO ₂
Total emissions	19.464,75 t CO₂

Table 1. Analysis results of the carbon footprint of Hospital de La Paz in Madrid, Spain. Source: Hospitecnia (Gusi Gil et al. 2024)



The hospital is undergoing comprehensive renovation under the “Health City” project, which will expand its facilities to over 300,000 square meters. The project includes new infrastructure with private rooms, state-of-the-art operating rooms and enhanced emergency department capacity.

La Paz University Hospital is recognised nationally and internationally for the quality of its care, innovative approach and contributions to medical advancement. This hospital carried out the work of measuring its carbon footprint during 2024, with the results presented in the Table 1.

Carrying out this exercise has allowed the hospital to establish a strategy for emission reduction, contribute to the SDGs and climate change mitigation as well as optimise its strategy by prioritising actions in specific areas, such as:

- incorporating renewable energy to self-supply the hospital and minimise the carbon footprint;
- establishing a sustainable mobility plan for employees and hospital-associated staff,
- creating a protocol for the disposal of certain anaesthetic gases,
- reducing some in-person consultations, awareness and sensitisation campaigns, etc.

System. This system focuses on material savings, improving environmental practices in the supply chain and reducing waste. Additionally, the incorporation of renewable energy is a key initiative being adopted by hospitals today.

Similarly, there are initiatives like “*Sanidad #PorElClima*” (Health for the Climate) in Spain, which currently includes nearly 90 hospitals, health centres and health services from various autonomous communities. Another programme is the ATACH (Alliance for Transformative Action in Climate and Health), which seeks to realise the ambition set at COP26 to build climate-resilient and sustainable health systems. It aims to leverage the collective power of WHO Member States (“Member States”) and other stakeholders to drive this agenda forward at pace and scale, as well as to promote the integration of climate change and health nexus into respective national, regional and global plans. Additionally, the MAPIC+s (Environment and Clinical Processes + Sustainable) project focuses on reducing the carbon footprint generated by the National Health System (SNS) and achieving a more sustainable healthcare system (Diariofarma 2024) (World Health Organisation 2022).

Currently, the Ministry of Health is developing an information system for the healthcare carbon footprint.

“The ScopeCO2 methodology enables the identification, quantification and prioritisation of environmental impact area.”

As a result of this emission reduction plan, the hospital aims to reduce its emissions by 2% over the next four years.

Initiatives for the Decarbonisation of Hospitals

Healthcare companies and the pharmaceutical industry are working on decarbonisation and energy efficiency processes at a rapid pace: by 2030, Europe is committed to reducing emissions by 60%. To support this initiative, actions are being taken to train and raise awareness among professionals about the importance of participating in environmental efforts. Hospitals are implementing various strategies, including obtaining quality certifications like ISO 14001, which require the establishment of an Environmental Management

This tool will allow the registration and consultation of results from calculations made by various healthcare centres. The goal is to evaluate the temporal consistency of the data, interpret the results and develop specific strategies and actions for mitigating and preventing greenhouse gas (GHG) emissions (Ministry of Health of Spain n.d.).

Conclusions

Initiatives aimed at the sustainable transformation of hospitals must stem from the need to reduce the use of fossil fuels and improve energy efficiency in hospitals and Primary Care centres. Medical products must be as sustainable as possible, as well as mobility, with the need for staff, patients and visitors to travel in the

most sustainable way possible, attending centres as close to their homes as possible to minimise the carbon footprint impact without compromising care. Hospitals must establish Sustainability and Climate Change Units, structures that become references, catalysts and coordinators of the various measures, plans and actions implemented in these areas. Healthcare centres must also be prepared and capable of addressing the health conditions that will arise as a response to climate change.

This change should lead to an organisational shift and greater efforts toward innovation to adapt to new situations. In this process, healthcare professionals must have the knowledge and capacity to participate and serve as models for these changes and measures.

Conflict of Interest

None

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Recruiting for Sustainability: Building a Resilient Healthcare Workforce

Sustainable recruitment in healthcare is vital for workforce stability, cost-efficiency and environmental responsibility. As the sector faces shortages, burnout and high turnover, hiring for sustainability integrates green healthcare, ethical employment and future-proof skills. New roles, career pathways and training programmes support this shift, ensuring resilience. Healthcare leaders must adopt sustainable workforce strategies to balance financial, social and environmental priorities.

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Director | Sustainability Talent | London, UK

key points

- Sustainable hiring ensures workforce stability, cost-efficiency and environmental responsibility.
- New roles in healthcare integrate green skills, ethical hiring and digital innovation.
- Career pathways and training are crucial for sustainability professionals' development.
- AI and technology improve recruitment but require ethical oversight to prevent bias.
- Workforce strategies must address ageing staff, burnout and global healthcare shortages.

As healthcare systems worldwide face increasing financial pressures, environmental challenges and workforce shortages, the need for sustainable people strategies and the incorporation of sustainability into business strategy and operations has never been more urgent.

Recruiting for sustainability requires a strategic approach to hiring and retaining healthcare professionals in a way that keeps up with the competitive landscape, ensuring long-term workforce stability, cost-efficiency, environmental responsibility and high-quality patient care. It goes beyond traditional recruitment by integrating new sustainability skills, green healthcare initiatives and ethical employment practices.

This concept is particularly relevant to a sector where workforce shortages, burnout and high turnover rates are especially high, thus potentially compromising patient outcomes and long-term financial sustainability. It's not only about building future-proof organisations with highly demanded sustainability skills but also about implementing sustainable recruitment strategies that ensure healthcare organisations attract, train and retain talent while promoting environmental, social and economic responsibility.

This article explores the new types of sustainability roles in the industry, the skills and training required, the opportunities and challenges facing healthcare leaders to remain competitive in a fast-moving environment and the sustainability of the workforce itself.

Aligning Profit with Planet and Long-Term Value

According to the World Economic Forum (2024), the global healthcare market is worth €8.67 trillion (\$9 trillion) and, as of 2024, makes up 11% of the world's GDP. It has, therefore, a significant impact on people and the planet worldwide. The sector isn't immune to global challenges affecting other industries, including increasing disruptions in supply chains, workforce shortages, financial constraints and, of course, climate change. The rate at which we are collectively using natural resources is depleting the Earth and putting pressure on planetary boundaries, six out of nine of which we have already surpassed. Irresponsibly continuing at this pace can have unintended but irreversible consequences.

Sustainability is here to stay. Against a backdrop of political pressures in many countries and the ongoing duel between profit and the planet, there is no turning back. Not just because it is the right thing to do and because we simply cannot keep consuming at this rate, but because it makes business sense. Yes, sometimes sustainable decisions can be more expensive in the short term, but they always pay off in the long term. More often, though, these decisions can lead to significant cost savings from day one, for example, through energy-efficient technologies, waste reduction programmes, sustainable supply chains and effective people policies. Profit and the planet don't have to be enemies.

Sustainability Careers

The companies in life sciences, pharma and healthcare that are making progress in their sustainability commitments and engaging in sustainability strategies are not merely box-ticking. They are making sustainability a core part of their purpose, strategy and business operations. But how is sustainability shaping the need for new roles in the industry?

It might sound very niche; however, there is a wide range of roles requiring a diverse set of skills across functions and at different levels of seniority. Some are of a more generalist nature and are likely to have counterparts in other industries, such as chief sustainability officers, environmental, social and governance (ESG) directors, social impact leaders, sustainability reporting analysts, diversity & inclusion leads, regulatory compliance managers, circular economy heads or human rights experts.

There is also a wave of green jobs, more technical in nature and revolving around main environmental pillars: energy, waste, air quality and water. These roles are key in the design and management of hospitals, clinics and medical centres, as well as in the handling of industry-specific products, including highly hazardous materials. Many of these roles allow transferable skills to be acquired from other industries, especially those dealing with the management of any type of building, factory or even agricultural installation. Roles in these areas include recycling & waste manager, energy efficiency and renewable energy expert, environmental

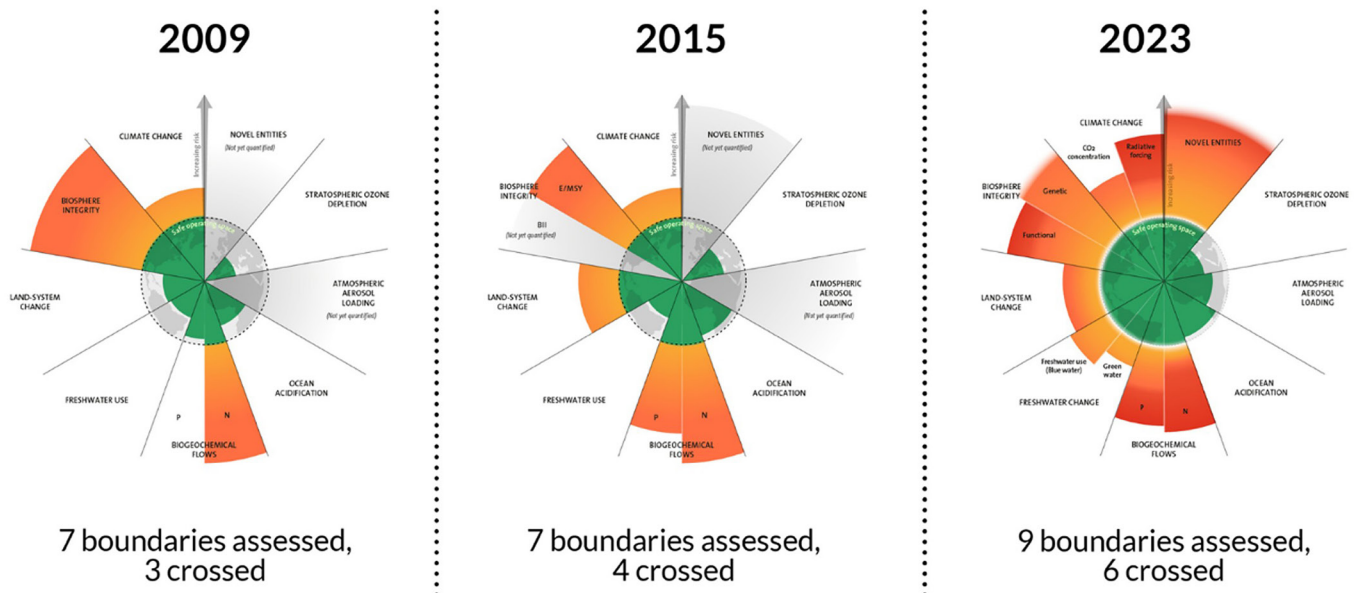


Figure 1. The evolution of the planetary boundaries framework. Source: Azote for Stockholm Resilience Centre, Stockholm University (Stockholm Resilience Centre n. d.)



public health practitioner, estates manager, indoor environmental quality specialist or water conservation expert.

Other jobs have made their way into the healthcare sector by combining innovation, artificial intelligence

very technical needs or temporary support during peak periods. The assignments they work on might range from a few days, providing expert advice as part of a larger project, to a couple of weeks or months designing a sustainability strategy or covering temporary staff absences.

“Recruiting for sustainability requires a strategic approach to hiring and retaining healthcare professionals.”

and digital skills leading to disruptive solutions in areas such as telemedicine, digital health or robotics. Some of these roles are completely new and are continuously evolving with technological advances accelerating the creation and delivery of more innovative and sustainable solutions.

Case Study: Sarah de Lagarde, The Bionic Woman

Sarah de Lagarde's life turned upside down following a London tube accident costing her part of her leg and an arm. After nine frustrating months with a basic prosthetic, her life changed again when she received an advanced AI-powered bionic arm able to learn her movements and anticipate her intent by detecting muscle signals. She is now able to perform delicate tasks again, allowing us to envision a future where robotic dexterity can significantly enhance the lives of people with disabilities, the elderly and others in need.

Case Study: Eniax

Eniax is a Chilean start-up providing healthcare services to patients in over 350 medical centres across seven countries in Europe and Latin America. A combination of challenges, including a shortage of physicians and specialists, a high patient no-show rate and deficiencies in customer support channels resulting in a dehumanised service experience for patients, led to the creation of a cloud-based solution. Their virtual assistant, named “Patricia”, has helped reduce no-show rates by 50% and achieved 98% satisfaction with outpatient care experiences whilst providing centralised management of infrastructure, guaranteeing optimal time management.

The rapid growth of the demand for sustainability experts, driven in great part by regulatory requirements, has also created opportunities for consultants and freelancers. Driven by purpose and more flexibility in their work, seasoned professionals with a combination of healthcare and sustainability expertise are setting up their own businesses and helping organisations with

What all these jobs have in common is that they attract people who want to have a positive impact and who care about the planet and about other people. A passion that can't be trained and often money can't buy.

Career Development

For those interested in pursuing careers in sustainability, it can be difficult to know where to start or what to expect in terms of career development in comparison to traditional functions.

Forward-thinking larger organisations are now able to offer “career pathways” in sustainability and provide a comprehensive curriculum from early careers to senior management, just as in any other industry.

Case Study: UK's National Health Service

The National Health Service (NHS) in the UK has developed the NHS Estates Sustainability Career Pathways, providing a framework to support staff development and help achieve ambitious net zero targets for core emission by 2040. This goal positions the NHS to become the world's first national health service to reach such a milestone. These career pathways include information on the skills, experience and qualifications needed to work in the department, along with examples of current employees and their journeys into these roles (NHS England 2023).

At the same time, sustainability allows for unique careers: many people currently working in this area have previously worked in other industries and were able to transition into sustainability roles by leveraging their transferable skills and prior experience.

Case Study: Sam's Journey

Sam studied law and started their career as a junior lawyer at a large professional services firm. Passionate about social justice, they volunteered for many years at an international NGO supporting vulnerable women.

Following a career break, they returned to the corporate world and now work as Corporate Social Responsibility Manager for a large healthcare manufacturer.

Sustainability Skills

Sustainability professionals face great challenges because they are caught up between the science warning about climate change, the public demands for businesses and governments to tackle these challenges, and those parts of society calling for a dial-back on ESG considerations. It is no surprise that resilience, perseverance, influence (often without authority), creative problem-solving, change management and collaboration rank high amongst the skills required for roles in sustainability. This is an area where so-called power skills (otherwise known as soft skills) are almost as important as technical skills and easily transferable from other sectors.

Technical skills remain inevitably central in a constantly developing profession. As organisations further develop or enter the world of sustainability, setting their net-zero targets and strategies, demand for professionals with solid experience increases. This has been particularly acute in the areas of decarbonisation, carbon accounting and carbon offsets. As new regulations come into place, professionals are increasingly expected to be well-versed in implementing the Corporate Sustainability Reporting Directive (CSRD), Corporate Sustainability Due Diligence Directive (CSD) and other sector-specific regulatory

requirements. Whilst organisations would welcome candidates with decades of experience, the reality is that some of these areas have only emerged recently.

The amount of competencies relevant to sustainability can be overwhelming. To equip professionals with a framework to further develop their skills, the Institute of Sustainability and Environmental Professionals has designed to help professionals assess their sustainability skills at all stages in their careers (IEMA n. d.).

Executives interested in transitioning into sustainability roles are turning to highly regarded organisations such as the Cambridge Institute of Sustainability Leadership (CISL, cisl.cam.ac.uk) and its Business Sustainability Programme to acquire a solid foundation that can be further cemented with more in-depth courses on a particular sector or area of sustainability such as circular economy, supply chain, human rights or sustainable finance. Organisations serious about investing in sustainability literacy for their sustainability professionals are increasingly partnering with world-class education institutions to develop in-house or cobranded solutions.

As sustainability professionals become more educated in environmental, social and economic considerations, they become better equipped to craft effective strategies. Both the challenges and opportunities related to sustainability are continuously evolving with technological advancements, regulatory changes and shifting societal expectations. Staying abreast of these through continuous professional development and accreditation will allow professionals to remain effective, relevant and compliant.

Executive boards also need to keep up with developments in the sustainability space and equip themselves to lead confidently on climate action to support their businesses through the net-zero transition. Whether it's due diligence, green procurement, sustainable finance or people-related issues, ESG-related topics are now an integral part of boardroom discussions.

Training the Wider Workforce

Whilst the emphasis on increasing sustainability literacy among those professionals responsible for designing and executing strategies has become an essential pillar of progress, the complexity of the current sustainability challenges requires an understanding that goes beyond traditional disciplinary boundaries.

However, the need for sustainability literacy extends past specialised roles within the sustainability department. To truly advance against sustainability goals, it is crucial to extend this knowledge to a much



Figure 2. IEMA's Sustainability Skills Map. Source: © The Institute of Sustainability and Environmental Professionals, 2025



broader audience: achieving company sustainability goals requires involvement from everyone at all levels in the organisation.

Ultimately, sustainability involves business transformation and will infiltrate practically every position. Professionals will be expected to make sustainable choices and operate in the most sustainable

out of the box. This is what led Victoria Tomlison, who had herself already stepped down from a long corporate career, to set up Next-Up (next-up.com). This organisation is committed to 'retiring the word retirement' by challenging how individuals and businesses think about careers for those over 50 through their Rethink Retirement platform.

"Profit and the planet don't have to be enemies."

way available. This might not automatically mean it will be a viable option in the short term but a goal to work towards. For example, replacing medical equipment with cutting-edge technology can lead to reduced emissions and shorter treatment times while also being accessible to everyone. This could be an ideal solution to many sustainability challenges, but it may be something an organisation might be unable to implement in the short term.

Upskilling & Retraining

We are all living longer and will have to extend our working lives. Careers used to be linear, but now they are 'squiggly', and career breaks are increasingly becoming normal. However, organisations are not adapting to these changes. A key aspect most are ignoring is the upskilling of their own staff, in particular older staff. These are generations who have reinvented themselves through multiple transformations and learned to operate in the digital age with tools no one could have even imagined at the time they joined the workforce. Employees who have been out of the corporate world for a longer period of time on a career break have often acquired new skills and are highly motivated to rejoin the workforce. Granted, they might need some support to get back up to speed, so a number of companies have developed Career Returner programmes.

Case Study: Nurses' Return to Practice

Nurses play a key role in the healthcare sector. However, the shortage of these very much needed professionals is a well-documented problem. Through the Return to Practice (RTP) programme, the UK's National Health Service (NHS) have pledged to boost the NHS's workforce with 50,000 more nurses and 25 universities across England now offer RTP nursing and midwifery courses.

Resolving the challenges of an ageing population and how they can contribute to society requires thinking

These strategies can, of course, help retain experienced senior professionals you have invested in over the years. Additionally, they can open new career paths for new talent interested in retraining for sustainability roles bringing a wealth of transferable skills from their previous roles and industries.

Sustainability Talent

In a fast-evolving and competitive market, where can healthcare organisations find the best talent to identify those sweet spots marrying purpose and profitability? What is the profile of those who are able to design strategies that give the company a competitive advantage, comply with all regulations and do the right thing for people and the planet?

The demand for sustainability talent is high and is expected to grow as the function develops. The regulatory framework keeps becoming more complex every year, technology evolves fast, and companies that truly position sustainability as a competitive advantage are reaping the benefits. Professionals who started early in the industry, obtained sustainability qualifications and have accumulated years of experience are well-placed to choose where to work. In fact, in some cases, candidates are approached to join a competitor not even having completed 18 months in a new role. These candidates have an advantage and can make choices about their careers. While many are eager to accept the challenge of guiding a company in the sustainability journey, they will be as quick to leave an employer who lacks genuine commitment to sustainability.

One of the organisations pioneering these developments in the sustainability space is Birdeo (birdeo.com), a boutique executive search firm based in Paris that has operated exclusively in the sustainability space since 2010. A B Corp company since 2015, it has evolved in parallel with its clients and candidates and understands the market's needs well.

Over the past few years, many other mainstream search firms have launched ESG or sustainability departments in an effort to meet the evolving recruitment needs of their clients. Understandably, many organisations don't exactly know what they are looking for. Given that they are investing in the search process, they might as well ask for as much as possible.

a focus on data protection, has also reduced email traffic, as candidates' data is now hosted on recruitment platforms that are regularly updated. A substantial number of interviews, at least at the early stages of the recruitment process, are held virtually—a practice that would have seemed unthinkable just a few years ago.

“Recruiting for sustainability is no longer an option – it is a necessity.”

However, these candidate profiles are ‘unicorns’: they are expected to have decades of experience in sustainability as well as industry expertise. They should be senior enough to deal with the boardroom but able to roll up their sleeves and manage a variety of tasks. This is especially important as they may have little or no dedicated resources and hence depend on their influencing and negotiation skills to secure support from other departments.

Consultants and freelancers are another growing segment of professionals to support the sustainability transformation. Some organisations, especially those smaller in size, simply can't afford a full-time resource. Sometimes, the need is very specific for a particular challenge in the supply chain, choice of material or building design. These professionals have the additional advantage of seeing similar projects from different industries or even across companies within the same sector, so they can bring best practices to design solutions to these challenges. This expertise would be more difficult to source from within the company itself.

The new sustainability roles also open new avenues for executives in transition—mid-career professionals who, after years in operations, marketing, communications or human resources, want to dedicate the next phase of their careers to a purpose-driven role. These positions align more closely with their values, allowing them to contribute to a larger cause. Sustainability roles and healthcare can certainly provide this path.

Considerations for a Sustainable Recruitment Process

Whilst piles of printed CVs might be a thing of the past, companies have numerous opportunities to make their recruitment process more sustainable, both environmentally and socially. Technology, along with

The use of Artificial Intelligence (AI) is helping reduce costs and speed up the hiring process. However, progress has still to be made regarding carbon footprint reduction in recruitment. The rapid growth of AI technologies is fuelling the demand for data centres, which in turn require more energy to operate and water for cooling. For example, in Uruguay, Google admitted that its proposed data centre would require 7.6 million litres of water per day, which is equivalent to the daily water consumption of 55,000 people.

While AI-driven recruitment platforms aim to streamline the hiring process by analysing candidate applications and using predictive analytics to identify the best candidates, there is a concerning side effect: potential unconscious bias. Several minority groups have reported being automatically and systematically rejected by Application Tracking Systems (ATS).

Given the high recruiting and training costs, sustainable hiring models must prioritise cost-effective and long-term workforce investments. Addressing these challenges requires innovative workforce planning and retention strategies.

Global migration of healthcare workers raises important ethical and human rights issues, especially when professionals are recruited from countries that experience workforce shortages and where healthcare workers may be in vulnerable situations.

The Sustainability of the Workforce

The healthcare industry is also impacted by global workforce trends, including an ageing population, five generations coexisting in the workplace, an increase in burnout and mental health challenges, and newer generations pushing for better work-life balance and jobs with purpose.



The World Health Organisation (WHO) estimates a projected shortfall of 11 million healthcare workers globally by 2030, with low-and middle-income countries facing the most severe shortages (WHO, 2024). At the same time, healthcare workforce turnover rates are rising, with studies indicating that replacing a nurse can cost hospitals between €42,991 (\$45,100) and €64,343 (\$67,500), factoring in recruitment, training and lost productivity. Alarming less than half (41.7%) of hospitals track this cost (NSI Nursing Solutions 2024).

What can healthcare organisations do to raise to these challenges?

In addition to some of the strategies mentioned in this article to attract and retain talent, some thinking outside the box will be required.

Hiring for Skills, not CVs

Pioneering companies are also exploring new ways to identify talent without using traditional CVs. Arctic Shores's (arcticshores.com) skills-based hiring uses tasks instead of questions, a method that can be particularly helpful when hiring for early careers, volume hiring and hard-to-fill roles.

Age Inclusion Strategy

A key factor that many organisations are currently overlooking is the development of a strategy to accommodate an ageing workforce. Employees who wish to remain in the workforce longer may not be able (and don't want to) work in the same way they did in their 30s. "If you don't have an age strategy, you don't have a growth strategy", says Lyndsey Simpson from 55 Redefined (55redefined.co), an organisation dedicated to helping employers engage, retain and attract older workers in a way that benefits everyone.

Human Resources Policies

Another important focus area is the modernisation of human resources policies and processes to become an employer of choice. Social enterprise "From Babies With Love" published an annual Cutting Edge Parental and Family Leave Guide. This guide includes best practice case studies from a variety of industries that demonstrate how to support employees during different key phases of their lives.

Diversity and inclusion policies and practices help in addressing systemic biases by ensuring equitable opportunities for all staff members. For healthcare professionals, an inclusive workplace fosters a sense of belonging and respect, which is crucial for job satisfaction and employee retention.

Wellbeing

Healthcare employees often face high levels of stress, burnout and other mental health challenges due to the demanding nature of their work. Addressing these issues in order to "take care of those who take care of us" is a priority that can't be reinforced enough. Key strategies for supporting employee mental health include:

- building a culture of psychological safety,
- enabling access to mental health services,
- reducing stigma associated with mental health,
- mental health awareness training,
- education on coping mechanisms and workplace adjustments.

Healthcare organisations that prioritise sustainability and incorporate it in recruitment and human resources management will be better positioned to address future workforce challenges, reduce costs and enhance patient outcomes. By embracing AI, digital transformation, green hospital initiatives and ethical workforce planning, healthcare leaders can build a system that is not only financially and operationally stable but also environmentally and socially responsible.

Recruiting for sustainability is no longer an option – it is a necessity for ensuring that healthcare institutions remain resilient, adaptable and capable of meeting the demands of a rapidly evolving industry.

Conflict of Interest

The author works for Birdeo as a freelancer and has a small crowdfunded investment in 55 Redefined.

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Leading the Global Climate Challenge: Galician Health Service as a Climate Champion

The Galician Health Service (SERGAS) is a global leader in sustainable healthcare, pioneering a Circular Economy strategy to achieve net-zero emissions by 2040. Recognised as a European Climate Champion, it focuses on reducing environmental impact, fostering innovation and training healthcare professionals. Through collaborations and pilot projects, SERGAS integrates sustainability into its operations, aligning with global climate goals and promoting resilient, eco-friendly healthcare systems.

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key points

- SERGAS leads sustainable healthcare with a Circular Economy strategy for net-zero by 2040.
- It is recognised as a European and global Climate Champion for eco-focused healthcare reforms.
- The strategy includes resource efficiency, eco-design and reducing environmental impact.
- SERGAS partners with global organisations for innovative, eco-friendly healthcare solutions.
- Healthcare training ensures sustainability becomes central to medical practices in Galicia.

What Are Our Reasons to Embrace the Circular Economy?

For over twenty years, the Galician Health Service (SERGAS) has been on a trajectory to transform into a sustainable and resilient health system that meets the future needs of the Galician population. This effort includes a strong commitment to rethinking health through the lens of circularity by developing its own circular economy strategy and achieving net-zero emissions by 2040.

The Galician Health Service is the public health system for the Autonomous Community of Galicia in Spain. It serves a population of approximately 2.7 million residents, along with a transient population of people who visit Galicia throughout the year. These visitors come for various reasons, such as the Camino de Santiago, tourism and seeking refuge from the climate due to the area's favourable weather conditions.

This influx of visitors makes the population multiply exponentially, a factor that must be considered in planning to meet the healthcare needs of both the Galician community and beyond.

The climate crisis is the biggest health challenge that humanity faces today. We are experiencing an unprecedented global situation where air pollution, heatwaves and food security risks are putting our lives at risk. Record temperatures over the past ten years have led to devastating extreme weather events, rising sea levels and melting ice, all driven by unprecedented levels of greenhouse gases. It is worth noting that 2024 was the warmest year on record, with temperatures exceeding pre-industrial levels by 1.5°C.

Climate change is clearly a global public health issue. The wellbeing of people is the primary goal of the health sector. Therefore, we must also focus on the health of the planet. Urgent action is required across all sectors, including healthcare.

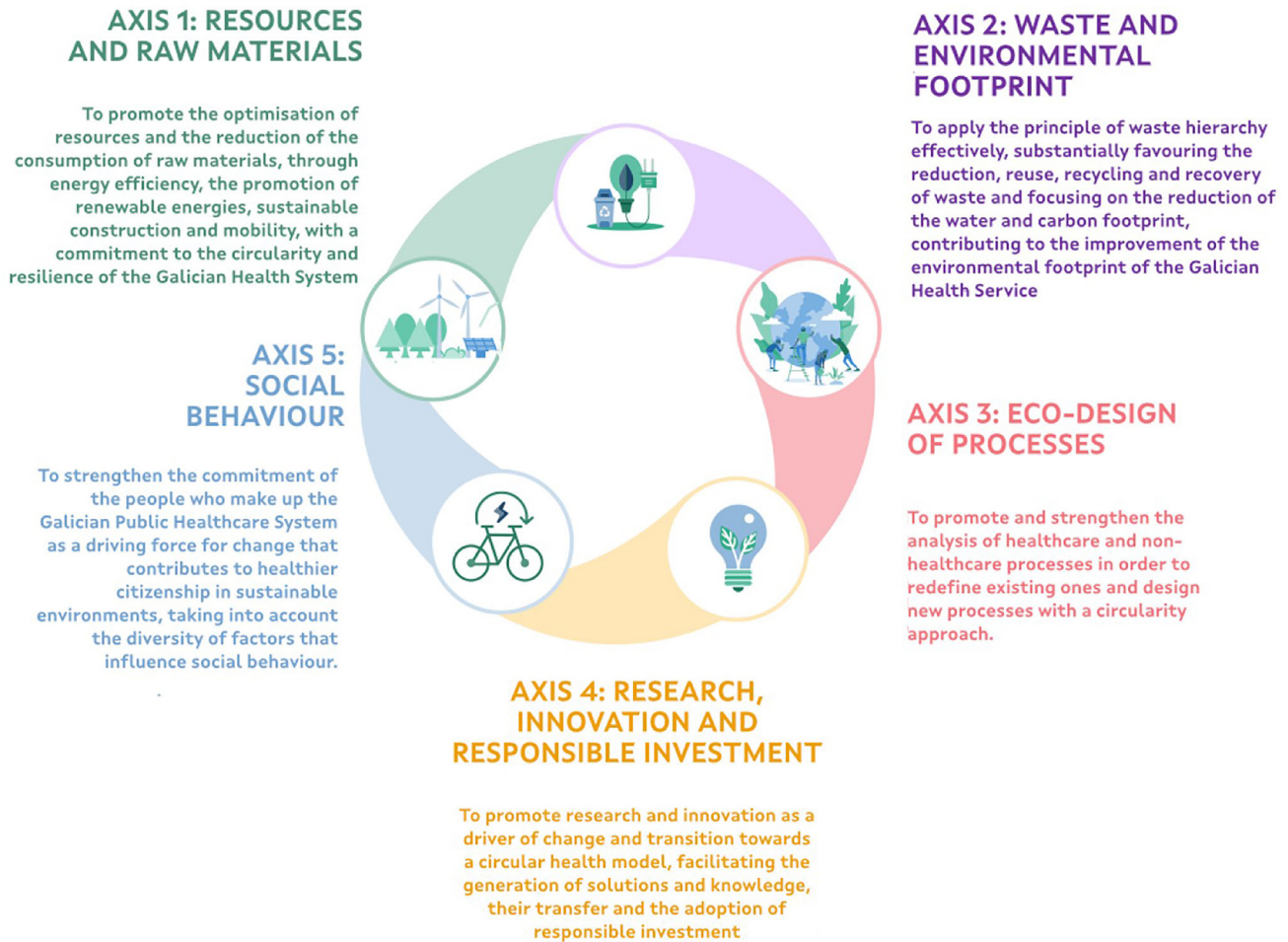


Figure 1. Model of the Circular Economy Strategy of the Galician Health Service. Source: SERGAS.

The healthcare sector significantly impacts the environment. At the Galician Health Service, we recognise this issue, which is why we have opted for the Circular Economy as a management model. This approach aims to reduce environmental impact, increase efficiency and reduce greenhouse gas (GHG) emissions, among other initiatives. Our goal is to ensure sustainability in both the healthcare system and our planet.

How Did We Get Here?

The journey of Galician healthcare towards a sustainable and resilient health system began in 2004 with the introduction of the computerised medical record system (IANUS). It continued with the SERGAS strategy for 2010–2014, which marked a paradigm shift by placing the patient at the centre of the healthcare system. Two key projects emerged during this period: Hospital

“Our goal is to ensure sustainability in both the healthcare system and our planet.”

SERGAS is the largest company in Galicia, operating 365 days a year, 24 hours a day. Taking responsibility for its significant environmental impact, it actively pursues innovative initiatives that promote sustainability.

2050 and InnovaSaúde, the first national initiative for Innovative Public Procurement, with a budget of €90 million.

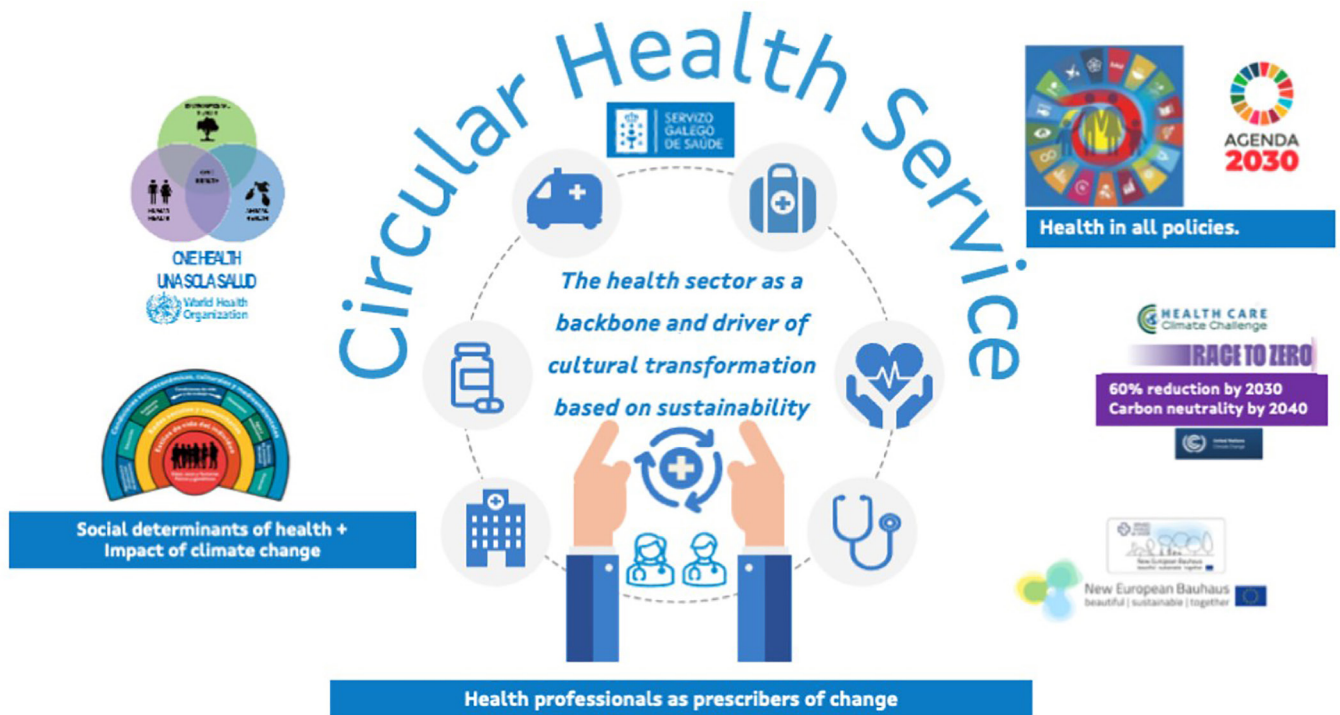


Figure 2. Health Sector as a Backbone. Source: SERGAS.

Starting with the development of eco-hospitals, these efforts continued with the SERGAS strategy for 2015–

the circular economy, improving people’s lives without harming the planet.

“We aim to lead the way towards a low-carbon, resilient and healthy future.”

2020, which focused on improving citizens’ health. In 2018, another step forward was taken with the strategy of humanising healthcare, followed in 2019 by adopting the Circular Economy as a management model. This model aimed to develop the framework for combating climate change and to ensure the sustainability of the Galician healthcare system, highlighting the importance of circularity initiatives that began more than 20 years ago. In June 2023, the Government of the Xunta de Galicia officially approved this strategy.

The SERGAS Circular Economy Strategy serves as a roadmap that highlights the sustainability and resilience of the Galician public health system. It is an open and participatory initiative aimed at people living in Galicia and beyond. The main lines of action outlined in the strategy will position the Galician Health Service at the forefront of policies to be developed by 2030. These policies will promote a new health model based on

The legislative framework for this strategy is informed by the European Union’s Circular Economy measures and the Circular Economy Strategies of the Governments of Spain and Galicia. This initiative is linked to the global action plan that began in 2015, coordinated by the United Nations under the 2030 Agenda.

As a methodology, we have opted for an open and participatory strategy, forming two working groups: one internal, consisting of representatives of the seven Health Areas and Central Services, and an external group that includes representatives of the three Galician universities (University of Santiago de Compostela-USC, University of A Coruña-UDC and the University of Vigo-UVigo) together with the Clúster Saúde de Galicia (CSG), the Dirección Xeral de Calidade ambiental, sostenibilidade e cambio climático, the Axencia Galega

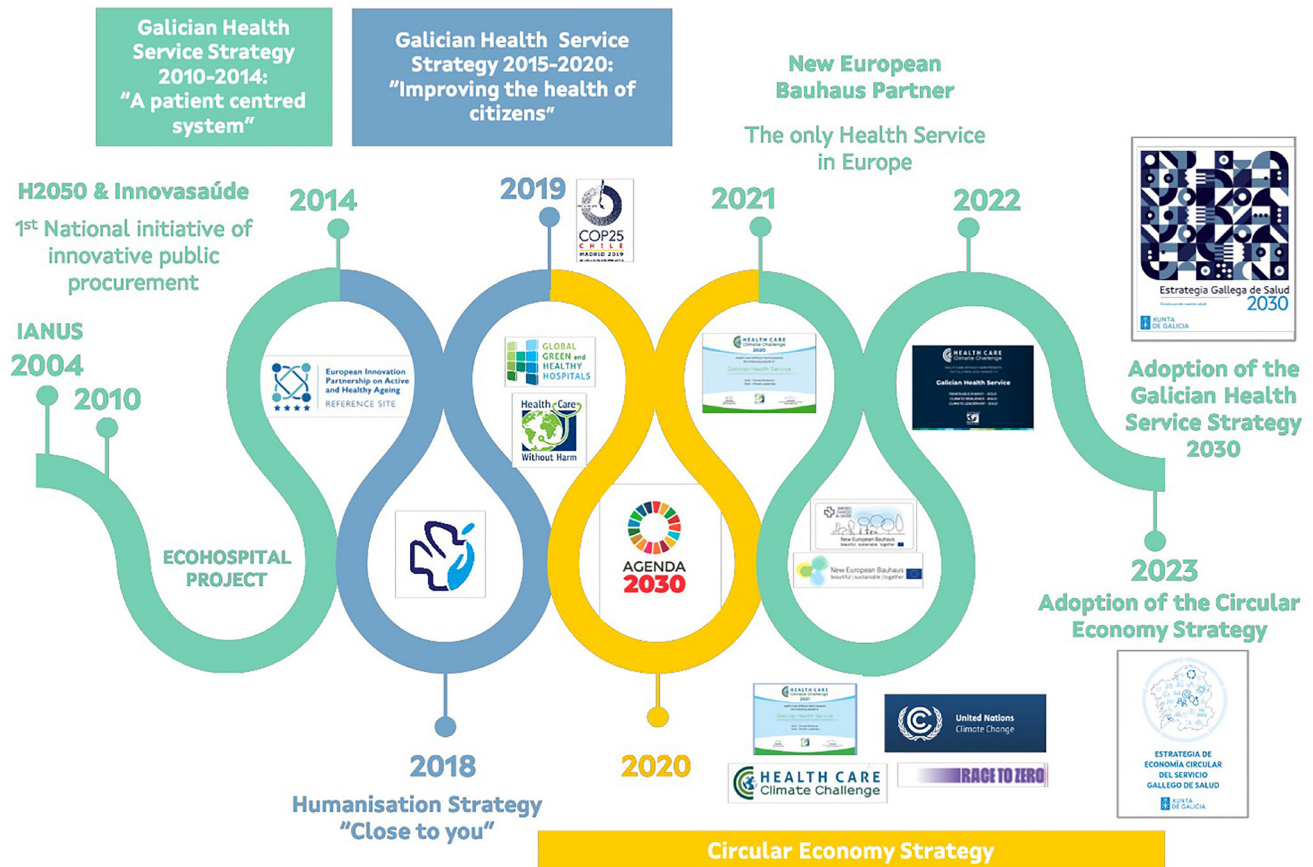


Figure 3. Roadmap of the Galician Health Service towards the Circular Economy. Source: SERGAS.

da Industria Forestal (XERA) and the Clúster de la Madera y Diseño de Galicia (CMD).

The start of the strategy was conditioned by the impact of the COVID-19 pandemic, which transformed the working practices into a telematic format. Health professionals had to prioritise patient care while addressing at the same time the pandemic's impact on healthcare itself. This involved participation in different projects and collaboration with international working groups, including the World Health Organisation (WHO), the Green Hospitals Network (GGHH), Health Care Without Harm (HCWH), the European Commission, the British Embassy and the Spanish Government.

In order to design the strategy, we first conducted a diagnosis of the existing sustainable projects and initiatives in the different health areas. This assessment aimed to highlight these efforts and help promote a culture of sustainability and circularity among health professionals, patients, their families, companions and suppliers—all focused on achieving circularity.

The essence and justification for the Circular Economy Strategy of the Galician Health Service are based on an open strategy that suggests a network of actions and interconnections among pilot projects. These projects

have already begun implementation tailored to the specific idiosyncrasies of each health area, hospital or health centre to achieve a homogeneous implementation throughout the Galician health system. As part of the strategy's design, various pilot projects have been proposed across different health areas, both in hospitals and health centres. These projects aim to facilitate replication and consolidate the defined lines of action.

The actions to be followed within the various strategic axes have been clearly defined, adopting a circular approach rather than a compartmentalised one. This facilitates feedback that can drive progress and help create new paradigms in healthcare. Implementing circularity in the healthcare sector is a priori complex. Still, the diverse projects developed alongside relevant legislation will pave the way for an efficient, sustainable, forward-looking health circularity without waiting too long.

Given the complexity of the healthcare system, a multidisciplinary and holistic strategy has been established to facilitate the transition to circular healthcare. This is an unavoidable challenge that the Galician Health Service has undertaken to ensure the sustainability of the health system as a path towards a



healthy and balanced environment for both the planet and its inhabitants.

The strategy is based on five strategic pillars: resources and raw materials, waste and environmental impact, eco-design of processes, research and innovation, and responsible social behaviour.

What Is the Vision of Galician Healthcare?

Our vision is to create a comprehensive healthcare system for Galicia that improves the health of individuals at home, in the workplace and within the community while fostering a healthier planet. The Galician Health Service is leading a project grounded in the WHO's ONE Health concept, aligned with the 2030 agenda to integrate healthcare into all policies. We emphasise the importance of social determinants of health and the impact of climate change, viewing health professionals as agents of change.

We see the health system as the backbone and driver of cultural and social transformation based on sustainability, inclusion and beauty. We rely on initiatives like the United Nations Race to Zero and the New European Bauhaus, which are developments that can be replicated in other regions to achieve social cohesion. Our leadership unites different actors with the same objective: to establish a new way of living, bringing the Green Pact closer to citizens through a holistic vision of health. Notably, the Galician Health Service is the only health service in Europe participating in this initiative of the European Commission.

We are therefore committed to establishing a Circular Health Service that adopts a holistic, resilient



Figures 5, 6. Award certificates. Source: SERGAS.

crisis. We continue to advocate for the elimination of fossil fuels due to their detrimental impact on health, with SERGAS being the only institution in Spain to sign this charter.

“This strategy serves as a roadmap to achieve net-zero emissions by 2040.”

and restorative approach. This approach involves implementing the circular economy as a path towards a balanced and healthy environment. It also ensures resilience against extreme climate events to protect people's health and demonstrate leadership in sustainability practices.

In 2019, SERGAS participated in COP25 in Madrid, where it presented its trajectory during the event titled “Resilient Galicia, Community and Climate”. During COP26, SERGAS was involved in a working group within the WHO, contributing to the development of recommendations to address climate crisis as a health

Since 2020, SERGAS has participated in the United Nations “Race to Zero” campaign, aiming for a 60% reduction in emissions by 2030 and achieving net-zero emissions by 2040. It is the only health system in Spain participating in this initiative.

Additionally, since 2019, we have been members of Health Care Without Harm and the global network of green and healthy hospitals. We actively collaborate on projects such as Low Carbon in the Mediterranean region, Plastic-free Healthcare in Europe 2.0, Life Resystal, Cool Food Pledge, Procure4health and the



Climate Challenge, earning various recognitions over the years. We are proud to have been recognised as a European Climate Champion and one of the seven Climate Champions of the world, as well as having received gold awards for resilience and climate leadership.

What Does It Mean to Be a Climate Champion?

Being Climate Champions in Healthcare in 2024 celebrates our commitment to the Health Climate Challenge. It also gives us an impetus to continue promoting climate-focused policies that protect people's health amid the evolving challenges of a warming world.

This recognition is a testament to the dedication of our entire team, whose passion and hard work continue to drive us towards a more sustainable healthcare future. We aim to lead the way towards a low-carbon, resilient and healthy future, fostering communities that care for people without harming the planet.

The Health Climate Challenge empowers healthcare facilities to commit to climate action and implement tangible strategies that reduce their carbon footprint. We look forward to building on this momentum in 2025 and beyond, joining the global health community to lead the way towards a low-carbon, more resilient and healthier future for all. Our commitment is to create communities that care for people without harming the planet.

We reinforce SERGAS' firm dedication to sustainable development across all areas: social, economic and environmental. This holistic approach is the only way towards a healthy and balanced environment for our planet and its inhabitants.

As the Climate Champion of Europe and one of the seven climate champions globally, we take pride in our efforts, which drive us to continue promoting our work. This complex task requires transversality, which is why we are developing collaborations with other health systems, such as the NHS, and working alongside various agencies, including the Department of Environment and Climate Change. Our goal is to achieve a Climate Neutral Galicia in 2040 in partnership with such organisations as Health without Harm, Green Hospitals, Health for the Climate or the Medical Alliance against Climate Change, among others.

This recognition rewards the dedication of the entire Galician health department in striving for a more sustainable future.

What Are the Next Steps?

We are currently working on certifying SERGAS' carbon footprint using the GHG protocol. Our goal is to actively reduce the carbon footprint of healthcare while preparing for the increasing impacts of extreme weather conditions and changes in the disease burden.

In 2025, we will initiate two new projects. The first of them focuses on the optimisation of the care process for Chronic Obstructive Pulmonary Disease (COPD) from an eco-design perspective. This involves field research on the COPD patient journey, considering clinical, technological, organisational and environmental impacts, while leveraging quantum-inspired technologies and advanced artificial intelligence to enhance the COPD clinical process. The second project is an Interreg initiative aimed at closing the loop on circular medical textiles, facilitating the transition to a circular economy under the name CEMTex.

One of the key pillars to introduce circularity in the DNA of the organisation is the training of healthcare professionals, patients, relatives, suppliers and users in general. We have already initiated training for health professionals on the vital intersection between health and climate change, adopting a tiered approach to sustainability in healthcare. This year, we will expand the programme to include more sector-specific training.

Our goal is to implement train-the-trainer courses so that this knowledge reaches all actors involved. We have started with specific training for anaesthesiologists, pulmonologists and primary care physicians, focusing on inhalers and anaesthetic gases due to the role they play in greenhouse gases emissions and global warming.

Conflict of Interest

None

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Digital Transformation

Why Clinicians Should Embrace Technology

Advances in technology are reshaping the delivery of healthcare. Digital transformation is not only vital for the long-term sustainability of the health service but failing to embrace technology risks undermining the quality of care.

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WHITELEY



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key points

- There are concerns that technology might erode the doctor-patient relationship; however, digital tools can strengthen it by freeing up time for meaningful interactions and improving job satisfaction and patient outcomes.
- Artificial Intelligence has the potential to renew doctor-patient relationships, reducing screen time and allowing more face-to-face care.
- AI-powered tools, such as wearables and predictive algorithms, also enable GPs to adopt a preventative approach.
- AI tools can support diagnosis by analysing vast datasets to identify patterns, acting as an invaluable assistant to clinicians.

Advances in technology are reshaping the delivery of healthcare, meaning that integrating digital tools into general practice is no longer optional but essential. This is highlighted in the Health and Social Care Committee's report on [Digital Transformation in the NHS](#), which emphasises that digital transformation is not only vital for the long-term sustainability of the health service but that failing to embrace technology risks undermining the quality of care.

It is important for clinicians to integrate technology into their clinical practice. Here are some important reasons why:

Combatting Workforce Challenges

The pressures on primary care are immense. With an estimated [42% of GPs projected to leave the profession](#) by 2030 due to long hours, administrative burdens, and patient safety concerns, technology offers a lifeline.

While there are concerns that technology might erode the doctor-patient relationship, digital tools can actually strengthen it by freeing up time for meaningful interactions, thus improving both job satisfaction and

patient outcomes. Tools such as digital dictation and speech recognition software have also been shown to reduce workloads, not only freeing up doctors to provide better patient care but also restoring their work-life balance.

In fact, the advent of Artificial Intelligence (AI) has the potential to renew doctor-patient relationships, reduce screen time, and allow for more face-to-face care. By reframing technology as a tool for empowerment rather than replacement, clinicians can focus on their primary mission: delivering quality care.

Streamlining Administrative Processes

Administrative tasks are a major contributor to clinician fatigue and burnout, but digital solutions can transform the way practices operate.

Tools that automate referrals, patient letters, and even the management of routine conditions can save valuable time, streamline workflows and reduce bottlenecks. Technology also allows for instant sharing of patient records across teams, enabling real-time updates that enhance coordination and reduce the risk of errors.



Moreover, a shift toward automation can improve the overall patient journey as referrals or test results can be rapidly processed and actioned, leading to quicker diagnoses and treatments.

As more practices adopt these types of streamlining technologies, the implications for individual users as well as the NHS at scale are immense.

results, offer the greatest potential. Surprisingly, only 39% of respondents have used clinical documentation technologies despite the availability of tried-and-tested tools that have already shown significant success.

The key to ensuring your practice is not left behind is to approach technology as an evolution rather than a revolution. Start small, but don't delay your digital

“The key to ensuring your practice is not left behind is to approach technology as an evolution rather than a revolution.”

Improving Patient Outcomes

One of the most exciting aspects of healthcare technology is its ability to enhance patient monitoring and care. AI-powered tools, such as wearables and predictive algorithms, enable GPs to adopt a preventative approach.

Devices like smart scales, fitness trackers, and AI-enabled apps can monitor patient data continuously, alerting clinicians to potential health issues before they escalate. One example is a John Radcliffe Hospital initiative in heart failure, which demonstrated that leveraging patient data can dramatically reduce hospital admissions. By alerting clinicians to early warning signs, technology can ensure timely interventions, reducing complications and improving patient outcomes.

Furthermore, AI tools can support diagnosis by analysing vast datasets to identify patterns, acting as an invaluable assistant to clinicians. Certain AI tools can also be used to improve the quality and completeness of clinical data at the point it is captured.

Futureproofing Your Practice

A report by the Health Foundation on [which technologies will bring significant benefits in the next five years](#) found that clinical documentation tools, including voice recognition and AI analysis of images and test

transformation, as it could create inequalities or disadvantages for patients.

Driving Change

Greater uptake of technology is not just about improving systems; it is about people. While GPs and practice managers may face various barriers – from resistance to change, to a lack of awareness or resources – those who embrace digital tools will ultimately be able to transform their practices, reduce clinician burnout, improve patient outcomes, and ensure sustainable healthcare delivery.

Of course, adequate training and support tailored to the specific needs of the practice are crucial for ensuring a smooth transition, but as adoption grows, and as the benefits of technology are demonstrated, it will create momentum for broader implementation.

Ultimately, technology should be seen as an ally in GP practices, designed to support, not replace, quality healthcare. With the right tools, GPs and practice managers can help reshape healthcare delivery, making it more efficient, effective, and empathetic.

Conflict of Interest

None.

Digital Transformation of Andernach State Hospital Using Hosp.Do.IT's Generic Strategy Template

Andernach State Hospital, in collaboration with Hosp.Do.IT, developed a comprehensive digital agenda aligned with the Hospital Future Act. This initiative focused on integrating digital strategy into corporate goals, fostering user-oriented IT processes and implementing structured project management. Key outcomes include enhanced digital platform structures, streamlined processes and improved compliance monitoring through KPIs, addressing the challenges of healthcare digitalisation.

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key points

- Andernach State Hospital partnered with Hosp.Do.IT for digital transformation.
- The Digital Agenda aligned IT strategies with corporate goals and HFA requirements.
- The initiative prioritised user-oriented IT processes and structured project management.
- Key performance indicators monitored progress and ensured regulatory compliance.
- The approach emphasised innovation despite challenges in the healthcare system.

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Problem & Challenges

Andernach State Hospital had a technically oriented IT strategy, primarily geared towards the necessary systems and the requirements for operation and security. User requirements were identified through working groups and process teams and then implemented by the IT department. The aforementioned process teams, primarily medicine and nursing, were the only ones that aligned with the corporate objectives and the strategic thrusts of the individual facilities. From the users' perspective, many work tasks were seen as "the responsibility of IT", leading to a lack of joint prioritisation and task definition, which was often fragmentary at best.

In 2019, management recognised the need to more closely align the digital strategy with the corporate strategy. Requirements were formulated in management committees that already made it clear that a deeper penetration of digitalised processes was imminent. Collaborative efforts within the hospital community,

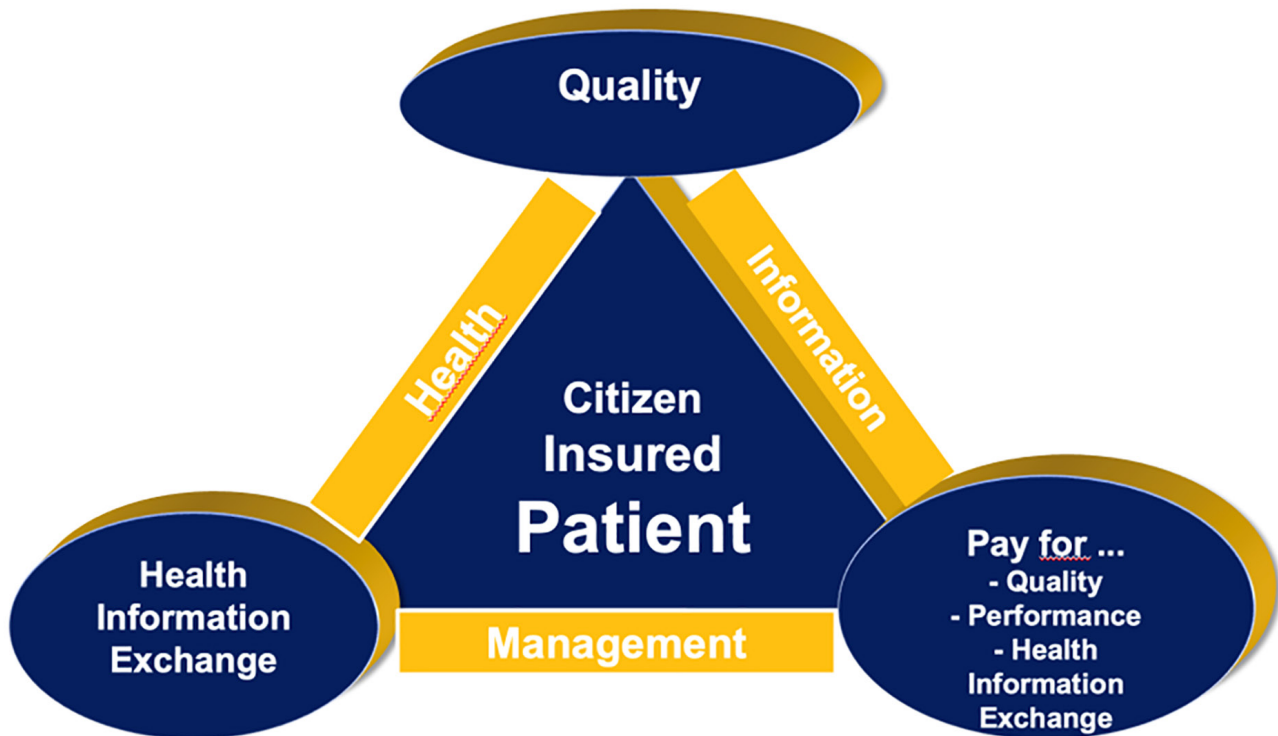


Figure 1. There Is No Success Without a Digital Strategy: What Should Our Management Focus Be?

along with the availability of a “toolbox” for establishing and implementing a digital agenda, appeared to be a logical step towards professionalisation.

Figure 1 illustrates the digital landscape of health information management that all players need to navigate. In order to survive in the market in the long

“The core of digitalisation consists of understanding the value of existing data and information for one’s business model.”

As is well known, the central challenge of digitalisation is not simply the existence of such tools as a well-formulated IT operating strategy for the secure operation of hardware and software (Meier 2023). Rather, it lies in the recognition that established and functional business processes, whether analogue or digital, must be deconstructed during the digital transformation to establish new business models. In this context, the term “disruption” is used to describe business models that swiftly wipe out the established competition. In cases where the success of the business model is less fundamental, it is referred to as transformation or even evolution. The core of digitalisation consists of understanding the value of existing data and information for one’s business model, which involves effective data or information management. In the healthcare industry, this specifically pertains to strategic health data or information management (HDM or HIM).

term, these players must successfully manage the “HIM triangle” (Meier 2019). New competitors are emerging in the field of psychological treatment, which traditionally seems rather insensitive to digitalisation, especially in the core aspects of providing therapeutic services. Numerous digital health applications (DIGA), which can be prescribed by general practitioners and are covered by statutory health insurance, could challenge the previous necessity of physical consultations between doctors and patients for certain episodes of illness. The Federal Institute for Drugs and Medical Devices (BfArM) provides a list of currently approved digital applications, categorised by disease type, on its website diga.bfarm.de. For a specialist hospital focused on psychiatry and neurology, the strategic question will be whether and how the state hospital will participate in this development.

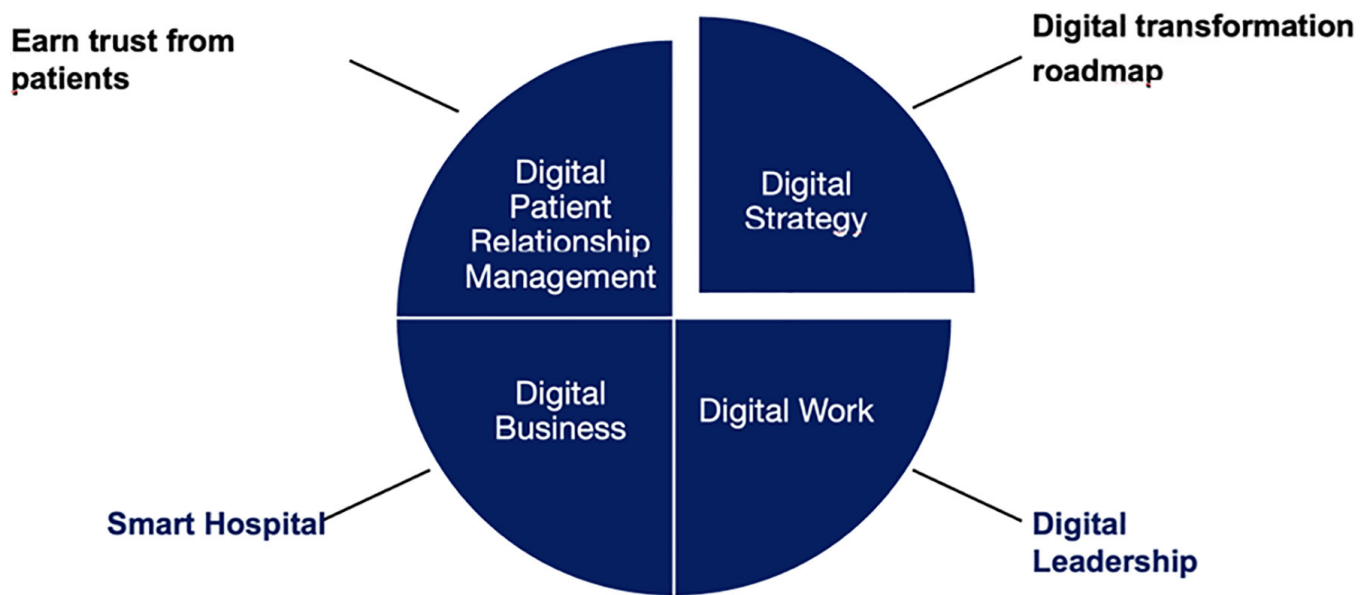


Figure 2. There Is No Success Without a Digital Agenda.

Objectives

In 2019, the hospital decided to join the hospital community, leading to the development of key elements for a future digital agenda. This was accomplished during a joint workshop that took place prior to the implementation of the Hospital Future Act (HFA or Krankenhausukunftsgesetz, KHZG). The workshop included the directorate of the Rhein-Mosel-Fachklinik and Corporate Development team, with moderation provided by the hospital community (Meier 2019). The management then deemed the resulting aspects relevant for the entire state hospital.

A comparison with the topics of the HFA (BAS 2021) showed that most of the issues were also addressed there, which led the Supervisory Board to approve the hospital's digital agenda. The integrated approach, which emphasised digital strategy, digital business, digital patient relationship management and a focus on employees in digital work (Meier 2022), received strong support.

Initially, all focus areas were developed with equal importance and urgency, followed by a structured internal prioritisation. The HFA then prioritised mapping the digital strategy to align it with the HFA funding

Guarantee future security with a scalable software and hardware landscape under the following conditions:

- Interoperability and
 - Revision security
- for the
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**Successful management of the digital/KHZG strategy with competence centers
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Figure 3. Pathway to the IT Strategy. Source: Hosp.Do.IT.



Figure 4. The Eight Pillars of the IT Strategy. Source: Hosp.Do.IT.

elements. However, the fundamental classification of the Digital Agenda as an essential component of the overall orientation of the state hospital company remained unaffected by this shift in priorities. Only the timeline (“when”) was adjusted, but not the essential decision (“if”).

The Digital Agenda (Fig. 2) resulted in a much stronger focus on the benefits of digitalisation in achieving strategic goals in terms of business alignment. As a result, it is not surprising that the management conference adopted user-oriented IT processes as an independent strategic goal for the five-year period from 2023 to 2028.

Description of Concept and Solution

The digital strategy has been developed based on the management focus shown in Fig. 1, the digital agenda presented in Fig. 2 and the associated mission statement that encompasses the vision, mission and code of values formulated for this purpose. This strategy includes the associated overall objectives according to standard strategy principles as shown in Fig. 3.

In the usual way, the rather general goals were translated into objectives and sub-objectives for the digital strategy of the Hosp.Do.IT hospital community. These objectives can be categorised into eight main pillars represented as a thematic grouping in Figure 4.

Based on the digital agenda that complements its corporate strategy and digital strategy, the state

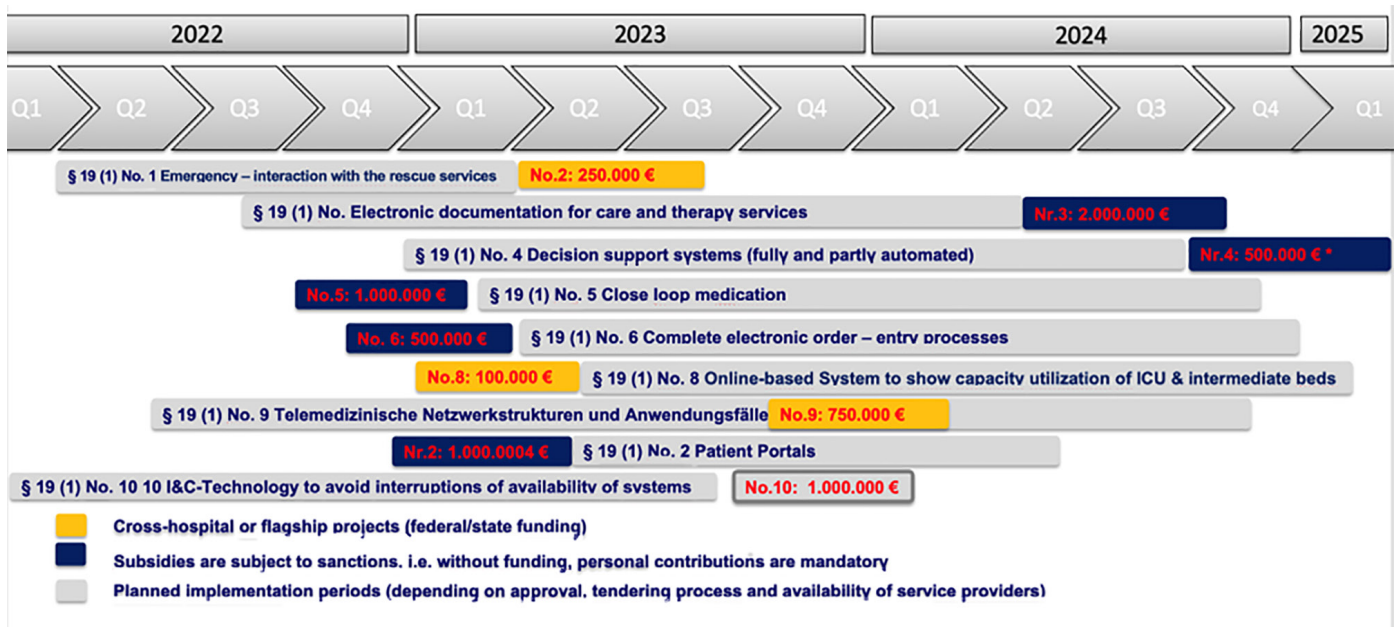


Figure 5. IT-Strategy Reporting within the German Hospital Future Act. Source: Hosp.Do.IT.



hospital in Andernach has undertaken an organisational realignment. This realignment included the establishment of a Chief Digital Officer (CDO) position and a stringent project management framework to implement the HFA projects. Ultimately, the goals of all pillars are reflected in this initiative, which spans digital platform structures, optimised processes for closed-loop medication and the necessary security architecture to maintain operational safety.

strategy evaluations and a straightforward alignment with the HFA funding criteria (BAS 2021).

Figure 5 illustrates the layout of the uniformly structured digital agenda.

At the state hospital in Andernach, this mapping was implemented accordingly, and the funding HFA Eligibility criteria outlined in §19 (1) nos. 2–6, 9 (hospital-wide), 9 (cross-hospital) and 10 were applied for and approved. The benefits of the jointly developed control documents

“IT serves as a business partner responsible for providing secure, stable and high-performance systems.”

Management committees of the hospital receive regular progress updates. The diverse, interprofessional and cross-hierarchical composition of project and sub-project groups ensures early and comprehensive engagement. The success of digitalisation efforts in the hospital depends on the participation of internal stakeholders. Due to the broad spectrum of services—ranging from outpatient to inpatient care, from acute care to rehabilitation, from residential and support services to outreach psychiatric care—having a tailored approach to tools and methods introduced is a success factor.

From the beginning, these projects have been regularly viewed as organisational projects rather than mere IT projects. In this context, IT serves as a business partner responsible for providing secure, stable and high-performance systems. However, it is not the systems themselves that generate added value, but the use cases created and implemented based on real-world requirements.

became particularly evident. The standardisation significantly simplified the overall project, and clear, transparent joint solutions were reached through discussions among the members regarding various open questions.

Conclusion and Outlook

The digital agenda system developed within the hospital community serves as a further dimension of the corporate strategy, closely linked with a digital strategy. This approach not only provides a sustainable method for institutionalising these topics within the hospital but has also proven well-suited to implementing the HFA and supporting its ongoing execution over the years. Almost en passant, the members benefit from an elaborated monitoring process that tracks compliance with mandatory criteria through jointly established key performance indicators (KPIs). This serves as a control mechanism to address impending revenue deductions.

“The success of digitalisation efforts in the hospital depends on the participation of internal stakeholders.”

Benefits/Added Value and Shortcomings of the Solution

The advantages of the current system were evident for the state hospital in Andernach, as well as for the other members of the hospital community. Each member has a detailed digitalisation and IT plan for 3–5 years which is reviewed quarterly. This includes ongoing quarterly

The KPIs are collaboratively developed and continuously refined in accordance with the agreements at both federal and state levels. The aim is to operationalise the legally mandated provision and ensure compliance with the mandatory criteria.

However, the intense pressure to innovate that has been placed on the market by the Hospital Future Act,



in conjunction with the current crises (eg coronavirus pandemic, war in Ukraine, inflation and shortage of skilled workers), shows that even industry partners often struggle to develop and implement solutions at the pace required by service providers. The complexity of the healthcare system, which can create non-standard case constellations due to the rights of representation of legal guardians and their influence on patient decision-making, necessitates standardised solutions.

Moreover, the limitations faced by vulnerable groups, particularly in psychiatric and geriatric care, require user interfaces to be designed to be barrier-free or at least low-barrier. Ensuring data protection and information security for highly sensitive health data, along with upholding the right to informational self-determination, are additional challenges that can hinder the digital implementation of even simple service processes.

Despite these challenges, the state hospital's digital agenda has a positive effect on the situation. It assists service providers in clearly articulating their requirements in alignment with their organisational goals. In cooperation with the control system being developed by the hospital community, the necessary conditions for achieving these targets have thus been established.

Conflict of Interest

Dr. Thorsten Junkermann: none

Prof. Dr. Pierre-Michael Meier is the CEO of the Hospital Community Hosp.Do.IT. He also developed the Digital-, Data- & IT-Strategy.

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Creatinine, eGFR, and Urea

Over 50% of patients admitted to the ICU develop some degree of acute kidney injury.¹ Creatinine, eGFR, and Urea monitoring provides indication of changes in kidney function and helps guide therapy to prevent AKI.

Estimated Plasma Volume (ePV)

The plasma volume status of a patient is one of the top priorities in evaluating and treating critical illness including CHF, ARDS, AKI, and Sepsis.²⁻⁴

Ionized Magnesium (iMg)

Hypomagnesemia is a frequent finding in critically ill patients.⁵ Magnesium therapy guided by real time ionized magnesium monitoring has been shown to improve outcome in these patients.⁶

Mean Corpuscular Hemoglobin Concentration (MCHC)

Helps differentiate types of anemia.



Test Menu:

pH PCO₂ PO₂ SO₂% Hct Hb MCHC Na K Cl TC0₂
iCa iMg Glu Lac Urea Creat CO-Ox tBil HbF

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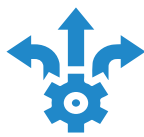
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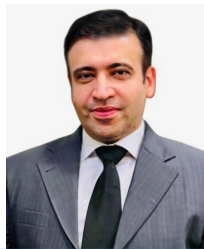


Finance

The Case for Time-Driven Activity-Based Costing in Healthcare's Shift to Value-Based Care

Time-Driven Activity-Based Costing (TDABC) offers a more efficient way to manage costs in healthcare, supporting the transition to value-based care (VBC). By simplifying cost allocation through time as the central driver, TDABC ensures accurate pricing for complex services and improves operational efficiency. The method helps identify inefficiencies, optimise resources and ensure financial sustainability, making it a valuable tool for healthcare providers aiming to deliver high-quality care while controlling costs.

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key points

- TDABC simplifies cost allocation by using time as the primary cost driver.
- It ensures accurate pricing in value-based care models through efficient cost management.
- TDABC helps identify inefficiencies, improving resource allocation and operational efficiency.
- The method supports financial sustainability in healthcare by ensuring correct cost allocation.
- TDABC provides transparency, fostering trust between healthcare providers and insurers.

Attending any healthcare summit, such as J.P. Morgan's annual conference (J.P. Morgan 2024) or the HIMSS Global Health Conference & Exhibition (HIMSS 2024), you will find Value-Based Care (VBC) at the forefront, alongside the rising provenance of artificial intelligence (AI). While the concept of VBC has been around for a while, its adoption has been slower than many advocates would have hoped. Yet the healthcare industry is nearing a tipping point, driven by rising costs, payer incentives and a broader push toward delivering measurable outcomes.

Redefining Healthcare Economics

Value-Based Care represents a significant departure from the traditional fee-for-service model. Instead of compensating providers based on the volume of services rendered, VBC shifts the focus to patient outcomes

and quality. Providers are rewarded for achieving specific health goals, improving patient satisfaction and delivering holistic, effective treatment.

This model encourages preventive care, evidence-based practices and better coordination among healthcare professionals. In essence, it transitions the emphasis from quantity to effectiveness, aiming to enhance patient wellbeing while controlling costs.

For instance, under the traditional fee-for-service model, a patient with diabetes might be billed separately for every visit, test and treatment. In contrast, a VBC approach would incentivise the provider to manage the patient's overall health, rewarding them for keeping blood sugar levels under control and reducing hospital admissions. This shift in focus encourages comprehensive, preventive care, leading to better long-term outcomes for the patient.



VBC Gains Momentum

The VBC market has experienced substantial growth—and for good reason. Amid rising healthcare costs and an inflationary environment, a system that charges for results delivered rather than services rendered holds significant merit.

place is an indirect cost. Other examples include facility maintenance, staffing expenses, equipment depreciation and technology overhead.

To ensure financial sustainability, hospitals must price their services in a way that not only covers direct costs like the syringe but also accounts for indirect expenses

“TDABC simplifies cost allocation by using time as the central cost driver.”

The global VBC market, valued at €11.8 billion (\$12.2 billion) in 2023, is projected to reach €41.9 billion (\$43.4 billion) by 2031, reflecting a compound annual growth rate (CAGR) of 14.6% (Dialog Health n. d.).

In the United States, the Centres for Medicare & Medicaid Services (CMS) projects that by 2030, the vast majority of Medicaid beneficiaries—recipients of state-backed health insurance for individuals with limited income and resources—will be in care arrangements accountable for both quality and total cost of care (HFMA 2024). This marks a significant shift toward VBC models.

Investment trends further underscore this momentum. Private capital inflows into value-based care companies increased more than fourfold between 2019 and 2021. These investments are driving a market expected to reach €966 billion (\$1 trillion) in enterprise value across payers, providers and investors (Abou-Atme et al. 2022).

such as electricity and operational costs, along with a profit margin. This task poses one of the more significant challenges in healthcare financial management: accurately allocating or apportioning indirect costs across various services.

VBC adds another layer to these costing complexities. In managing diabetes, for example, the provider is likely to be compensated based on the patient’s ability to achieve and maintain target blood glucose levels, reduce complications and enhance quality of life. Multiple services—consultations, diagnostic tests, medications—will contribute to delivering this outcome. These services and their respective costs, including the indirect portion, must be determined to ensure correct pricing. Failing to do so risks financial losses, misallocated resources and potentially suboptimal patient care.

“VBC is a transparent methodology that ensures indirect costs are allocated efficiently and equitably.”

For healthcare institutions and investors alike, VBC presents a compelling opportunity to achieve operational efficiencies while delivering measurable outcomes.

The Cost Conundrum in Healthcare

Providing healthcare services is a cost-intensive endeavour, with a significant portion of expenses classified as indirect costs—costs not directly attributable to a specific service or procedure. For instance, while the cost of a syringe would be considered a direct cost for administering an injection, the electricity required to power the hospital or clinic where the injection takes

Cost Allocation Techniques: From ABC to TDABC

How much of the indirect costs should be included in the total cost or, in other words, allocated to each product or service? This is the question that various cost allocation techniques aim to answer across industries. At their core, these techniques attempt to establish causality between consumption and allocation. Some methods are more refined and granular than others. Activity-Based Costing (ABC) is one such method on the granular end of the spectrum, designed to identify activities and their associated cost drivers.



To illustrate, consider a factory with a €10,000 electricity bill that produces two products. Together, these products require 2,000 labour hours—1,500 hours for Product A and 500 hours for Product B. In this case,

The indirect cost for producing one unit of Product A is $3.5 \times €5 = €17.5$. The same approach can be applied to determine costs for other products.

“For healthcare organisations, TDABC is more than a costing methodology—it is a strategic tool.”

labour hours (the cost driver) can be intuitively linked to electricity costs, assuming production as the sole activity for simplicity. Hence, under ABC, the electricity bill is allocated as follows: Product A, using 75% ($1,500 \div 2,000$) of the labour hours, is assigned €7,500, while Product B receives the remaining €2,500. This method works well for simple scenarios with limited products and activities. However, the situation becomes far more complex when thousands of product types and numerous activities are involved.

Imagine a factory producing a variety of products, each requiring multiple activities such as assembly, packaging and quality control, with numerous cost drivers interacting simultaneously. Identifying and allocating costs for every driver and activity would be prohibitively expensive and time-consuming. Enter **Time-Driven Activity-Based Costing (TDABC)**—a streamlined variation of ABC that uses time as the central cost driver, eliminating the need to track multiple variables for each activity.

TDABC: A Simplified and Scalable Solution

TDABC simplifies cost allocation by using time as the central cost driver. Indirect costs are pooled together, summed up and divided by the total available capacity (in hours) to determine a cost-per-hour rate. Costs are then allocated based on the time required to complete each service or activity.

Assume the aforementioned factory has a total available capacity of 20,000 operating hours and incurs €100,000 in total indirect costs. Using TDABC, the cost-per-hour rate is calculated as $100,000 \div 20,000 = €5$ per hour.

Now, suppose Product A requires:

- 2 hours for assembling,
- 1 hour for packaging and
- 0.5 hours for quality control, totalling 3.5 hours per unit.

TDABC in Healthcare

TDABC streamlines cost allocation, ensuring it is efficient, broadly accurate and scalable across a multitude of different product or service types. This makes it ideal for healthcare, where various services and cost drivers interact, requiring a cost-effective allocation solution. This is especially relevant for Value-Based Care (VBC), where multiple activities and procedures combine to achieve a particular health outcome.

To understand how TDABC works in healthcare, consider an oversimplified example of a hospital that performs only knee replacement surgeries. Each surgery involves several stages: pre-operative consultation, imaging, surgery and post-operative care. Below is a breakdown of time and costs for each stage, focusing on the activities involved, time spent and the resources used.

Assumptions

1. **Indirect Costs:** the hospital's total indirect costs (including staff salaries, equipment, electricity, facilities etc.) are €500,000 per month.
2. **Available Time:** the hospital has 10,000 hours of total available staff and facility capacity per month.
3. **Cost Rate per Hour:** $€500,000 \div 10,000 \text{ hours} = €50 \text{ per hour}$.

The knee replacement process involves the following stages and activities, with associated times:

Total Indirect Cost Per Patient

Adding the costs across all stages on a TDABC basis:

- **Pre-operative:** €50 (consultation) + €25 (imaging) + €25 (admin) = **€100**
- **Surgery:** €100 (surgeon) + €50 (anaesthesiologist) + €100 (nursing) + €100 (facility use) = **€350**
- **Post-operative:** €50 (physical therapy) + €100 (recovery monitoring) = **€150**

Grand Total Indirect Costs for Knee Replacement = $€100 + €350 + €150 = €600$ per patient.

Stage	Activity	Lead Provider	Time per Patient	Cost (Time × €50/hr)
Pre-operative	Consultation	Surgeon	1 hour	€50
	Imaging	Radiologist	0.5 hours	€25
	Admin & Scheduling	Administrative Staff	0.5 hours	€25
Surgery	Anaesthesia & Prep	Anaesthesiologist	1 hour	€50
	Surgery Procedure	Surgeon	2 hours	€100
	Post-Op	Nurses	2 hours	€100
Post-operative	Physical Therapy (Day 1)	Physical Therapist	1 hour	€50
	Recovery Room Monitoring	Nurses	2 hours	€100

Table 1. Cost and Time Analysis of Patient Care Stages

It is important to note that these are **indirect costs only**; direct costs will be added to determine the total package costs. Additional adjustments can be made for variations, such as more complex surgeries requiring extra time or resources.

In a VBC model, additional services needed to achieve the desired outcomes—such as follow-up consultations and physical therapy sessions—can also be priced on a per-patient basis or packaged together at an average cost. This can be done according to the specific VBC payment scheme being used, allowing costs to be allocated in a similar manner without the need for extensive data gathering and analysis.

Advantages of TDABC

VBC is a transparent methodology that ensures indirect costs are allocated efficiently and equitably, allowing providers to price packages accurately. It offers unique benefits for providers navigating the shift to VBC:

- 1. Improved Cost Accuracy:** ensures that all direct and indirect costs are reflected in pricing and aligned with outcomes.
- 2. Operational Efficiency:** identifies inefficiencies, such as administrative bottlenecks or resource underutilisation.

3. Simplified Bundled Payments: facilitates accurate cost calculation for entire episodes of care.

4. Financial Sustainability: supports pricing models that safeguard margins in outcome-based reimbursement systems.

5. Data-Driven Decisions: enables resource optimisation and process improvements.

6. Provider-Payer Trust: transparent cost structures strengthen relationships with insurers.

Real-World Applications

A systematic review by Etges et al. examined the application of Time-Driven Activity-Based Costing (TDABC) in real-world healthcare settings, evaluating its impact on value-based healthcare (da Silva Etges et al. 2020). The review analysed 26 studies, with 18 reporting that TDABC contributed to value-based initiatives, particularly in identifying cost-saving opportunities. The findings suggest that implementing TDABC leads to improved cost assessments, enabling healthcare providers to identify inefficiencies and optimise resource allocation. By providing precise cost information, TDABC supports the shift towards value-based healthcare, focusing on delivering high-quality care while controlling costs.



The study concludes that TDABC is a valuable tool for healthcare organisations aiming to implement value-based care models, as it facilitates a better understanding and management of costs associated with patient care (da Silva Etges et al. 2020).

In healthcare settings, TDABC serves as a powerful tool for optimising both costs and value. The University of Texas MD Anderson Cancer Centre used TDABC to analyse the costs of treating head and neck cancer patients. By mapping each step of care and allocating costs based on time and resource use, the centre identified inefficiencies, enabling more effective resource allocation without compromising quality (Kaplan et al. 2011).

At Brigham and Women's Hospital, TDABC was used to identify cost-saving opportunities in surgical procedures. By accurately measuring the costs of different activities, the hospital was able to redesign care processes, resulting in improved patient outcomes and reduced costs (Kaplan et al. 2011).

A Strategic Imperative

For healthcare organisations, TDABC is more than a costing methodology—it is a strategic tool. As providers embrace value-based models, the ability to understand, allocate and manage costs will be critical to sustaining financial health and delivering superior outcomes. TDABC offers a scalable, transparent and efficient framework to meet these demands, positioning healthcare providers for success in an increasingly value-driven landscape.

Conflict of Interest

None

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Talent Management

Gamification: Revolutionising Healthcare Training for Leaders and Professionals

Gamification in healthcare is an effective tool for developing skills, engaging professionals and promoting a culture of excellence. Combining storytelling, practical experiences and cooperative environments, it enhances learning and wellbeing. Careful planning, alignment with organisational goals and continuous evaluation ensure strategic results, transforming training into opportunities for growth and improved performance.

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key points

- Gamification enhances skill development and engagement in healthcare training.
- Interactive learning fosters a culture of excellence and well-being in organisations.
- Storytelling and practical experiences improve knowledge retention and teamwork.
- Effective planning ensures alignment with organisational goals and training success.
- Continuous evaluation enhances learning impact and strategic healthcare improvements.

Introduction

Developing individuals is a constant challenge in every area of society. In today's world, there is a growing demand for specific skills required for various positions and organisations. The complexity of the healthcare sector is amplified by the diversity of professions and the expected results in managing and delivering healthcare services. In the realm of healthcare leadership, there is a need for competencies and skills that transcend any technical training, demanding continuous updates and improvements to keep up with the rapid changes in the sector.

In 2023, the International Hospital Federation (IHF) developed a leadership model that presents the main competencies required for healthcare leaders. This model, which includes values, self-development, execution, relations and transformation, categorises more than 30 competencies into two main areas: action

domains and enabling domains (IHF 2023). In this context, healthcare organisations are increasingly facing challenges in effectively training their leaders and teams to remain current and capable in their roles.

In the meantime, it is important not only to develop skills in teams but also to provide an environment in which learning is free from the pressure of achieving results. This approach views training as a way to strengthen a culture focused on excellence while also ensuring that these practices align with ideals of wellbeing and quality of life. Gamification appears to meet this need for training that engages leaders and professionals; this method focuses on developing specific skills through play, enhancing the results by integrating practical experiences.

Historically, from childhood through adolescence, we learn new skills and abilities through games. Board or digital games are traditionally used at home or even in formal education to develop logical reasoning, strategic

thinking and other skills. Initially applied in education (Damaševičius et al. 2023), gamification arrives in healthcare area to bring new perspectives of training.

Playing has a powerful impact on the formation and development of human beings. It offers simulated, fictitious or real scenarios that allow individuals to experiment and obtain preliminary experience in a controlled, risk-free environment. This opportunity

- **Connection of Routine Issues with the Game.** By participating in meetings as well as in planning new projects and processes, the team will make conceptual connections and draw on experiences related to the gamification process. This facilitates a better understanding of various situations and even offers an alternative way of managing conflicts, referencing aspects perceived during the games.

“It is important not only to develop skills in teams but also to provide an environment in which learning is free from the pressure of achieving results.”

enables each professional and leader to maximise their potential. In fact, there are numerous publications on the application of gamification in healthcare, detailing the various methods employed (Al-Rayes et al. 2022; Muangsrinoon et al. 2018).

When a healthcare organisation fully aligns gamification with its purpose of developing the institution's leaders and professionals, significant results can be achieved:

- **Knowledge Fixation.** Using multiple human senses during the game enhances the retention of knowledge implicit in gamification. By incorporating elements that solidify concepts, theories and discussions, each professional can better grasp the material presented.
- **Cooperation Environment.** Even if some games involve competitions, they need to be designed to promote a healthy atmosphere with a specific focus on delivering value and results to the organisation. Therefore, it is essential to strengthen cooperative gamification within the same group, fostering better communication among participants.
- **Organisational Climate and Wellbeing.** Gamification practices also contribute to a better organisational climate. Unlike traditional training and meetings, gamification allows for a deeper connection between players and aligns it with the purposes of the healthcare organisation. Introducing play into the workspace also has the potential to increase the wellbeing of professionals and leaders, explicitly presenting innovative care and training approaches.

How to Plan Gamification in Healthcare

To effectively structure a gamification approach for training and developing healthcare leaders and professionals, we propose a series of steps that can help in this journey. There are different paths to take, all of which can lead the organisation to achieve its desired results.

The steps presented below reflect one approach to achieving effective gamification in healthcare. However, they can also be adapted for gamification aimed at patients and other stakeholders within the health service.

1. Planning

The first step is planning. During this phase, we will make decisions that will impact all the subsequent stages of building this gamification. It is recommended to dedicate the most time and effort to this stage, as it tends to make the entire process more effective by avoiding rework and communication issues between teams.

At this stage, we need to reflect on some essential questions and find answers that will guide us in the next steps:

- Is gamification the best strategy for sharing this knowledge? Do we have the time and resources to make it possible?
- What is the subject we want to work on and what results do we aim for with this gamification?
- Which professional category and hierarchical level will take part in this gamification? In other words: who is the public participating in gamification? What are their ways of learning, their professional desires and their main references?

- What resources will be needed and how can we make them effective?
- Which areas will need to contribute to and approve this gamification project?
- Can we conduct any benchmarking to evaluate the gamification we want to build?
- Is this an ongoing activity, a programme in the organisation or a specific project with a clear beginning, middle and end?
- What story would we like to tell with this game and what meanings do we want to convey to those who play? What are the sensations and learnings that should be the criterion of the game?
- Will this training be linked to people development, quality management or another area? What skills do we want to develop? How is this gamification strategy aligned with the organisation's training plan?
- Can we clearly define the rules of this game? What will be the rewards for those who achieve better results? How are we going to motivate professionals to take part?

These questions need to be carefully evaluated, as your answers will help define each of the following steps.

2. Purpose and Objective

After making all the necessary decisions and clarifications during the Planning stage, we can define the purpose and goal of our gamification. It is particularly important that the game is well-aligned with the organisational strategy, so it requires establishing the proper connection between the gamification initiative and the strategic planning of the healthcare service.

To do this, we can evaluate the strategic objectives outlined for each perspective of the organisation's balanced scorecard, as well as their relation to the result we aim to achieve through gamification. Moreover, since this initiative serves as a training strategy, it is important to ensure that the gamification aligns with the annual training and development plan for leaders and healthcare professionals.

In addition, this new game needs to be developed with a focus on communication and marketing within the healthcare service. It is crucial that the storytelling and the messages we want to convey have a direct and positive impact on the organisation's image. This analysis is necessary for the entire aesthetic of the game based on the story we aim to tell. The goal of this game is to reinforce the brand ideals, the institution's values and the meanings it wants to instil in the internal audience. We should also consider there whether

the healthcare service already has a mascot, as this could be relevant for including it in some way in the gamification process.

From the point of view of the gamification goals, it is essential to understand what results we are aiming to achieve with the game. Are we seeking changes in behaviour, improvements in care or the adoption of best practices in project and process management?

Regardless of the result expected, gamification needs to be well evaluated as an instrument of positive change in the healthcare organisation. To achieve this, we need to establish the starting point through a current diagnosis. For example, if we want to improve adherence to the effective communication protocol among healthcare professionals, we need to assess the current level of adherence is and set clear improvement targets for the short, medium and long term.

Example: Currently, our adherence to the effective communication protocol in the paediatric ICU stands at 65%. To address this, we plan to implement a gamification strategy aimed at increasing adherence to the protocol from 65% to 85% by October 2025.

By establishing clear indicators and a well-defined SMART goal—Specific, Measurable, Achievable, Realistic and Time-bound—we can focus our gamification efforts on achieving desired results. This approach enhances clarity for the project and for everyone involved in its development.

3. Storytelling

Now that we know what we want to achieve, we can consider what story would help us reach that outcome. Some healthcare organisations may opt for new themes or adapt stories that are already familiar to those involved. The most important thing here is to select a theme that motivates and engages participants to play.

It is also important to consider the feeling of belonging when telling stories. We should craft narratives that make sense for the profiles of the leaders and healthcare professionals participating in the gamification process. This consideration will also affect the next steps, as all symbolic elements will be anchored in this reality.

So, if we want to implement a sustainability programme through gamification, it makes sense to incorporate elements from nature and its developments. Conversely, if we are discussing healthcare processes, we could use a pizzeria theme to illustrate the clear steps of inputs and outputs of this processing. In other words, we need to make deliberate choices about the themes and stories we are going to tell, recognising that all the subsequent elements will be connected to it.

4. Format and Method

Now we have a clear understanding of the result we desire and the story we want to tell. The time has come to decide how are we going to tell this story and how we want people to interact and engage in this gamification.

One option is to develop digital strategies, which can take the form of software, application or live events

- treasure hunts and other possibilities aligned with the defined storytelling.

There is not a universally “good” or “bad” form of gamification; rather, its adequacy and effectiveness depend on how well it aligns with the objectives set for the healthcare organisation. So, allow yourself to learn and innovate with different formats.

“When a healthcare organisation fully aligns gamification with its purpose of developing the institution’s leaders and professionals, significant results can be achieved.”

held via videoconference. For in-person games, some aspects specific to healthcare need to be addressed.

If the activities are carried out in care environments, it is essential to consult with the infection control team to determine the appropriate areas for the experience. This includes evaluating the types of materials that can be used, sanitised or discarded, as well as assessing the team’s availability and the suitability of the environment for the game.

In both digital and face-to-face formats, the choice will be based on the profile of the audience we want to reach and how best to present the activity. If it is a one-time event, we need to consider the available resources for this investment. If it is an ongoing programme, we must think about how to maintain engagement among participants.

In the case of digital strategies, there are several effective examples, including:

- a scoring system and rewards for adherence to patient safety practices;
- monitoring panels for training in specific areas;
- badges of recognition of compliance with quality requirements;
- games featuring missions designed to improve communication between the participants etc.

For physical or face-to-face strategies, we can utilise:

- board games for learning certain topics;
- card games to promote cooperation in various activities;
- realistic simulations with rewards for correct answers;
- question-and-answer games;

Other essential points during this phase include the structuring of game levels, identifying challenges to overcome, providing practical solutions, defining missions to complete and mapping the player’s entire journey.

5. Structuring and Communication

After conducting all these steps of gamification planning, it is time to structure the game itself. To do this, you can hire suppliers or collaborate with your internal team to develop a digital strategy or physical materials.

At this stage, you will bring your ideas to life and identify elements that effectively tell all the stories of your gamification project in a suitable way and to the expected standard. Creating a good game does not necessarily require a large budget; instead, it is important to find the materials and equipment that align with your intended investment.

Therefore, this phase requires thorough research to identify quality suppliers and companies that can either provide, create or customise the items needed for your healthcare unit game. In addition to the elements of the game itself, it may be important to evaluate costumes that fit the theme and to create video and audio content that help participants visualise their experience. Practical role-playing contributions from those involved also enhance the experience.

As with the entire structuring of gamification, the communication of this strategy to the participants must align with the storytelling and the desired objectives. That is why it is important to develop a specific communication plan that should focus on engaging professionals, creating suspense and interest, and sharing the results achieved through gamification.

6. Implementation and Evaluation

After preparing everything with great enthusiasm and dedication, it is time to put the plan into action. Regardless of the format, digital or physical, this game and its gamification project for healthcare require mastery in the execution of each part of the story.

Since this is a playful endeavour, the professionals facilitating the gamification need to be fully immersed

in an innovative strategy to train leaders and professionals by allowing them to experience practical situations in a safe environment. This approach promotes learning, engagement and knowledge retention. When gamification is well-structured and aligned with organisational objectives, it transforms training into meaningful experiences, strengthening the culture of excellence and wellbeing in the workplace (Pereira et al. 2014).

“[Playing] offers simulated, fictitious or real scenarios that allow individuals to experiment and obtain preliminary experience in a controlled, risk-free environment.”

in the theme. They need to understand every part and stage of the process to guide the participants in a safe and effective way. Inadequate instruction can lead to significant frustration within a team, as they may feel harmed. Therefore, just as thorough planning was essential, effective execution is equally important.

To ensure a good result, we strongly recommend conducting preliminary tests and providing intense training for the gamification promoters. This ensures that everyone is aligned and fully aware of their roles.

After completing the gamification, it is crucial to conduct a reaction evaluation and satisfaction survey. The insights collected should inform revisions for future projects. In addition, a follow-up evaluation in the medium term is important: this allows you, for example, to check the effectiveness of the training and the retention of content.

Considerations

Developing healthcare skills is a growing challenge due to the complexity of the sector, which demands both technical and behavioural skills that must be constantly updated. Gamification has emerged as an

The effectiveness of gamification depends on careful planning that considers the target audience, establishes clear aims and evaluates available resources. Incorporating elements such as storytelling, game mechanics and alignment with organisational values enhance the impact of the method. In addition, the creation of a cooperative environment during the game favours communication, strengthens teams and helps internalise safe care and management practices, contributing to improvements in the organisational climate.

Finally, the success of gamification is linked to its continuous execution and evaluation. Training facilitators, conducting tests and monitoring results are essential to ensure the effectiveness of the training. Additionally, adapting strategies to meet the specific needs of the institution allows gamification to serve not only as a learning tool but also as a mechanism for transformation and strategic alignment within healthcare organisations.

Conflict of Interest

None

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CONTINUOUS BLOOD PRESSURE & ADVANCED HEMODYNAMICS

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Enabling Radiographers for Better Imaging through VR Training in Plain Radiography

Virtual reality (VR) training enhances radiography education by improving positioning accuracy, adaptability and cost-effectiveness. By combining traditional methods with VR, students gain better engagement, independence and skill retention. A pilot programme at UAS Campus Vienna demonstrated high usability and learning benefits. While VR is a valuable tool, it should complement rather than replace hands-on and clinical practice.

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key points

- Virtual reality improves radiography training by enhancing accuracy and adaptability.
- Combining VR with traditional methods boosts student engagement and skill retention.
- VR training offers cost-effective, flexible learning without requiring constant supervision.
- Students found VR simulations intuitive, realistic and beneficial for understanding radiography.
- While effective, VR should supplement hands-on training rather than replace clinical practice.

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Introduction

Accurate patient positioning is an essential skill in plain radiography. Even minor deviations, such as slight over-rotations or misalignments, can significantly compromise image quality and hinder diagnostic accuracy. Furthermore, minimising patient radiation exposure is a critical ethical and professional responsibility (Sapkaroski et al. 2019).

Contemporary practical radiographic positioning education primarily relies on two modalities: simulation-based training through laboratory exercises and clinical internships. These approaches, supported by academic coursework, constitute essential components of a comprehensive plain radiography education (Holmström 2019). Practical application of theoretical knowledge can enhance student comprehension and foster increased motivation for learning (Katajavuori et al. 2006).

Simulation-based training is widely utilised across various healthcare disciplines, including surgery, emergency medicine and radiology (Niell et al. 2015).

Virtual simulation technologies, particularly Virtual Reality (VR) platforms, are increasingly employed in healthcare education. These platforms offer simulations of diverse medical procedures, providing valuable supplementary learning experiences alongside traditional learning methods like lectures, textbooks and e-learning resources.

clinical placements is limited. Furthermore, students often encounter difficulties transitioning from theoretical knowledge to practical application in clinical settings, hindering the seamless integration of theory and practice (Shiner 2018) (Shiner et al. 2019) (Kengyelics et al. 2018). Therefore, integrating simulated learning environments, which are able to deliver a safe and

“Virtual training should never be seen as a do-it-all solution but rather as a supplement to traditional practical training methods.”

Three-dimensional (3D) virtual environments can enhance learning by improving contextual understanding and increasing student engagement (McCarthy et al. 2019). Furthermore, virtual training platforms offer the flexibility of independent learning, eliminating the reliance on the constant presence of instructors or supervisors as well as the availability of laboratory/clinical settings. This autonomy empowers students to tailor their learning schedules to their academic needs (Chang et al. 2016).

Despite the emergence of advanced imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI), which offer high-resolution three-dimensional imaging and facilitate precise diagnosis of pathologies, plain radiography continues to serve as a crucial diagnostic tool. This enduring significance stems from its inherent simplicity, affordability and accessibility, coupled with relatively low radiation exposure to patients. Moreover, plain radiography continues to provide valuable clinical information (Alzyoud et al. 2018).

State-of-the-Art in Simulation-Based Radiography Education

Effective radiographer training necessitates hands-on experience with patient positioning. While real-life patient interaction offers a great setting for skill development, clinical environments may not always provide a completely safe learning environment for students. Moreover, patients have the right to receive the highest quality and safest care possible (Lateef 2010).

Clinical education, involving supervised patient examinations within a clinical setting, is widely recognised as a cornerstone of radiography student training (Holmström 2019) (Shanahan 2016) (Kong et al. 2015). However, the universal accessibility of

stress-free learning environment, can benefit student radiographer education (Sapkaroski et al. 2019).

A study conducted by Acosta and López in 2024 explored the impact of a hybrid training approach, utilising both traditional radiographic equipment and VR simulation. This study involved 165 first-year radiography students divided into two cohorts. The control group received training using traditional radiographic simulation equipment. In contrast, the experimental group participated in a hybrid training programme that integrated VR simulation with traditional physical simulation. The hybrid group demonstrated significantly better performance in room setup, achieving more accurate configurations faster. Regarding radiographic positioning, the hybrid group showed greater precision and adaptability across various anatomical regions. Furthermore, students in the hybrid group exhibited quicker learning and improved retention of practical skills. While both groups demonstrated comparable performance in ensuring patient comfort, the hybrid approach proved to be more cost-effective. By reducing the reliance on physical resources and shortening training hours, the hybrid approach significantly decreased overall training costs.

The integration of VR technologies within radiography training programmes has demonstrated a significant enhancement of educational outcomes, student engagement and clinical skill acquisition. The hybrid model, which effectively combines the utilisation of VR tools with traditional radiographic equipment, emerges as a highly effective, scalable and engaging pedagogical approach (Acosta et al. 2024).

Choosing a hybrid approach is further supported by a study conducted by Kato et al. who tested for differences in student proficiency after either conventional practical training or VR training (Kato et al. 2022). The students' proficiency in radiographic patient positioning was then

evaluated by lecturers utilising a rubric method. This study revealed a mixed performance for the VR group. While proficiency in certain skills was comparable to the role-play group, significant deficits were observed in skills requiring palpation and patient interaction. This suggests that current VR training modalities may exhibit limitations compared to real-world training in radiographic techniques that necessitate physical examination and patient interaction. To ensure effective training outcomes, rigorous, objective evaluation of real-world proficiency remains crucial, even with the incorporation of advanced technologies such as haptic feedback and VR-simulated patient interaction (Kato et al. 2022).

O'Connor and Rainford studied the impact of 3D VR radiography practice on student performance in clinical practice (O'Connor et al. 2023) by conducting a retrospective analysis of first-year radiography clinical assessments of radiography students before and after the introduction of VR training. Students who trained with VR demonstrated superior performance across a majority of the 22 assessment criteria. Notably, VR-trained students exhibited significantly higher proficiency in critical areas such as patient positioning and image appraisal of both position and image quality. Furthermore, VR-trained students demonstrated significantly improved comprehension of clinical indications, equipment setup and procedural explanations. The findings of this study suggest that

Introduction of VR Training at UAS Campus Vienna

The undergraduate radiographer education at the University of Applied Sciences (UAS) Campus Vienna follows a structure similar to other undergraduate degree programmes in Austria and Europe. A combination of lectures, hands-on training and clinical internships is used. First-year cohorts of around 85 students each semester, resulting in around 170 students each year, ensue in a huge workload for instructors delivering role-play hands-on training sessions for students in groups of around ten people. Early training sessions especially need a lot of input from the instructors, resulting in slow progress.

Due to evidence for the positive impact of VR training on radiographer student education, virtual practical training for radiographic patient positioning was introduced at the UAS Campus Vienna in the winter semester of 2024/25. Similar to the approach described by Acosta and López (Acosta et al. 2024), first-year radiography students at the UAS Campus Vienna received both hands-on role-play training on real radiographic equipment and VR simulation training as their practical plain radiography exercises. To deliver VR training, the UAS Campus Vienna partnered with and purchased the VR radiography simulation software by VitaSim (vitasim.dk/x-ray-simulator), who are providing ready-to-use virtual simulation solutions for medical education and academic research.

“The integration of VR technologies within radiography training programmes has demonstrated a significant enhancement of educational outcomes, student engagement and clinical skill acquisition.”

VR-based training significantly enhances the clinical performance of first-year radiography students. In addition, VR training demonstrates potential as a valuable educational tool in preparing novice radiography students for clinical practice. This technology effectively enhances student proficiency in several key areas, including patient positioning, selection of appropriate exposure factors and the critical assessment of radiographic image quality (O'Connor et al. 2023).

As a pilot, 76 first-year students of the radiography undergraduate bachelor's degree programme at the UAS Campus Vienna received three hours of hands-on VR training in the university's newly equipped 3D laboratory. Student groups of nine to ten students were able to use four VR training workstations simultaneously, resulting in groups of two to three students per workstation. Each workstation is equipped with a Meta Quest 3 (meta.com/quest/quest-3) mixed reality headset and a monitor to allow for feedback given by spectators, such as peers and instructors.

Question No.	Question
1	I quickly found my way around the VR environment.
2	The depiction of the patient and the anatomical structures in the simulation was realistic.
3	The movements of the patient were realistic.
4	The responses of the virtual environment to my input were consistent with my expectations.
5	The operation of the virtual X-ray equipment was intuitive.
6	The functions and features of the virtual devices corresponded to those of real devices.
7	Technical difficulties were encountered during the operation of the simulation.
8	The image quality of the X-ray images in the simulation was sufficient.
9	I was able to clearly identify and differentiate anatomical structures.
10	The simulation deepened my understanding of X-ray examinations.
11	The simulation allowed me to acquire new skills or enhance existing ones.
12	The simulation allowed me to identify typical sources of error and how to avoid them.
13	The simulation increased my interest in radiology.
14	I had a positive experience using VR as part of my learning.
15	I would like to see more simulations for other radiological procedures.

Table 1. Evaluation Questions of the Likert-scale VR-training simulation

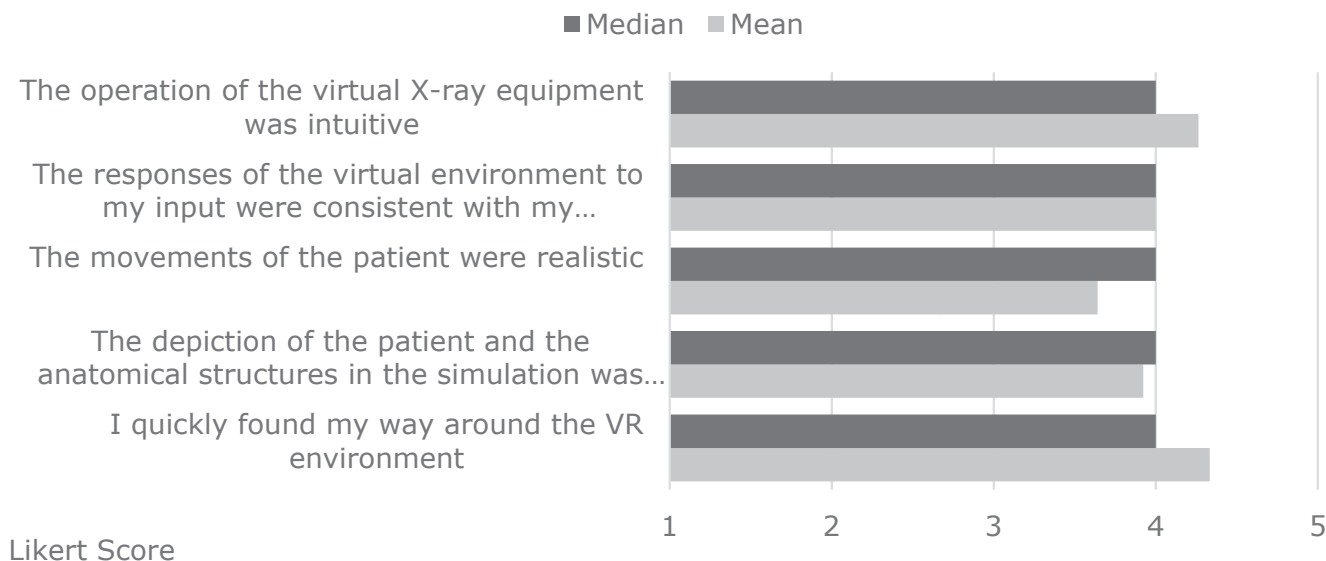


Figure 1. Mean and Median for Evaluation Questions 1 to 5

Before the hands-on training, each student group received a live demonstration by an instructor. Furthermore, manuals on how to operate the simulation were provided. All students then acquired both an anterior-posterior and a lateral projection of a knee joint in VR. In addition, each student acquired two further projections of anatomical regions of their own choice. Students had a choice of the following anatomical regions: shoulder, elbow, wrist, pelvis, knee, ankle and feet. During the simulation, the present lecturer provided feedback on patient and equipment positioning, exposition parameters and image quality. Students could then correct and reevaluate the parameters and outcome of their respective examinations. To enable self

programme, a voluntary and anonymous questionnaire was presented to first-year radiography students who completed the virtual training sessions. Out of 76 first-year students, 39 completed the survey, resulting in a 51,32 % response rate.

The questionnaire consisted of 15 questions regarding the usability and the student's perspective of VR training. Questions could be answered on a five-step Likert scale, ranging from one to five. (1 – strongly disagree, 2 – disagree, 3 – neither agree nor disagree, 4 – agree, 5 – strongly agree). The questions were in part derived from the system usability scale (SUS) and adapted to assess topics specific to radiography education; all 15 questions are listed in the Table 1.

“Students who trained with VR demonstrated superior performance across a majority of the 22 assessment criteria.”

and peer evaluation, each projection is provided with an example image of how the resulting x-ray should look in regard to projection and image quality.

Evaluation of VR Training at UAS Campus Vienna

To evaluate the introduction of VR training at the UAS Campus Vienna's radiography undergraduate degree

To give an overview of the feedback provided by the participants, the mean and median for each question were calculated. Questions regarding usability, realism and potential barriers for entry were universally answered with a mean and median of around 4 (agree). Detailed results for the mean and median of the first five questions are presented in Figure 1.

Questions six to ten focussed on the students' perceived knowledge gain regarding the execution of the X-ray examination, as well as the occurrence of

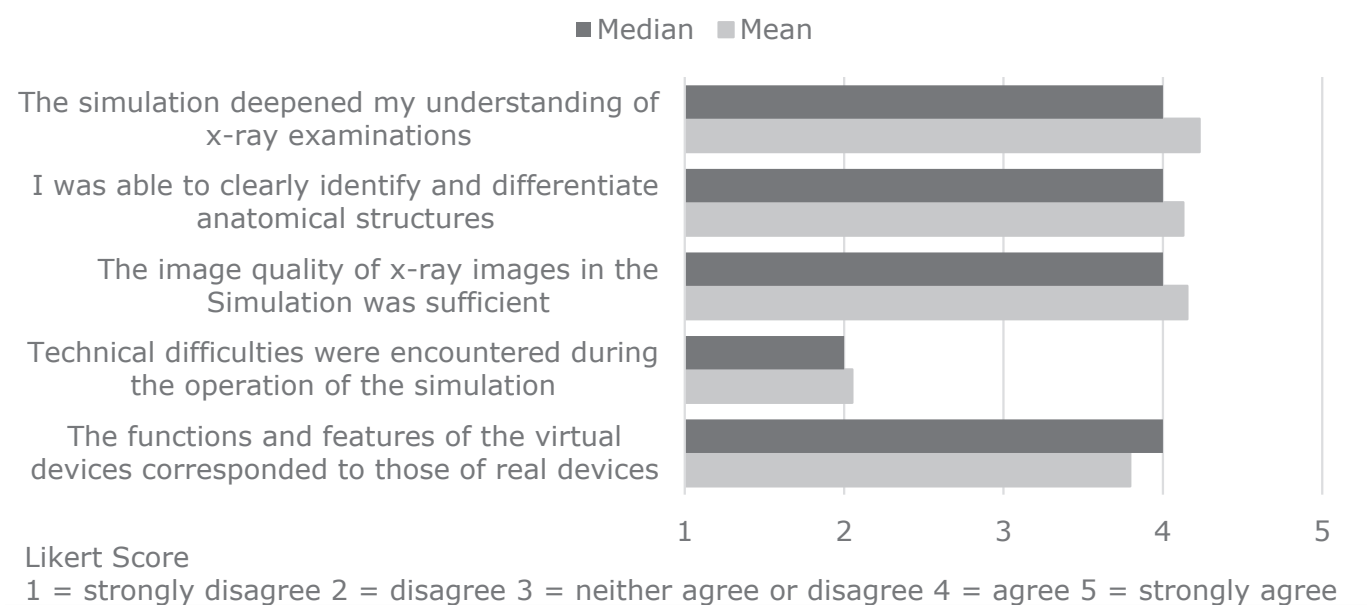


Figure 2. The Mean and Median for Evaluation Questions 6 to 10

technical issues during the simulation. The mean and median for the second set of questions are outlined in Figure 2. Again, students evaluated the questions with a mean and median of around four, meaning high approval of potential knowledge gain and application in real-life scenarios. Question nine, “Technical difficulties were encountered during the operation of the simulation”, was an exception: with a mean and median of around two (disagree), students report few technical issues.

The third set of questions, shown in Figure 3, aimed to classify the students’ acceptance of virtual training in

their education. Questions 11 to 15 received high scores, with a mean and median between four (agree) and five (strongly agree). The emphasis was on the positive experience and the wish for more virtual simulation in the radiographer’s education.

Discussion

Due to its sample size and the early stage of the VR training implementation, this evaluation can only be seen as a pilot to assess the virtual training project prospects in the undergraduate radiography curriculum at the UAS

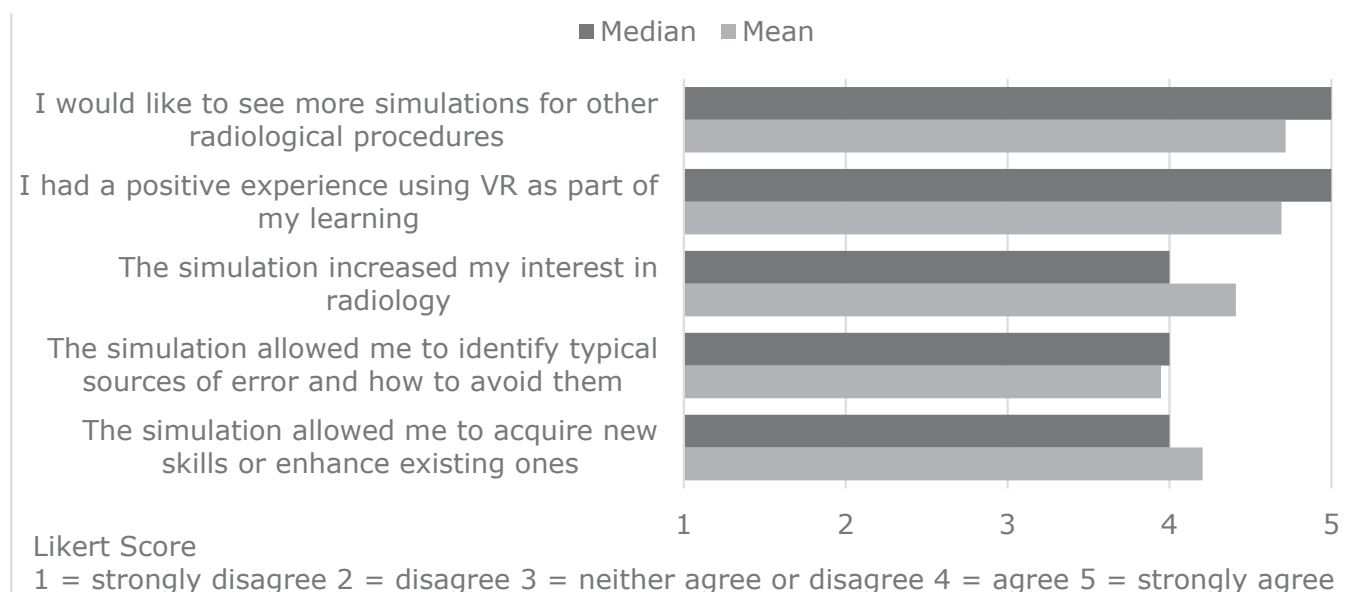


Figure 3: The Mean and Median for Evaluation Questions 11 to 15

Campus Vienna. Further studies regarding the learning outcome, usability and the impact of virtual training on clinical practice should be conducted.

The relatively high score on questions regarding the simulations' ease of use indicates a low barrier of entry for virtual training. With students being able to navigate the simulation independently after a single, short introduction by a trainer, virtual training can provide resource-efficient hands-on training for large student cohorts. The low score on the question regarding technical issues also indicates that time and space-independent, self-driven training without the presence of a trainer could be achieved by VR simulation. Enabling a higher learning time per person without the need for additional training staff.

In accordance with current research, students showed high interest and motivation in using virtual training as part of their practical training. The results also suggest that students are open to virtual learning in other parts of their curriculum. This could be enabled by the simple, stress-free and independent learning experience provided by a virtual simulation.

With high scores regarding the realism of the simulation, virtual simulation could be a great method to complement traditional practical training like hands-on role-play training and clinical practice, minimising the theory-practice dichotomy in radiography education.

Overall, the results suggest a positive student experience with virtual simulation. This indicates a cost- and time-effective method to encourage student

engagement in practical training. While this coincides with current research, it is important to note that virtual training should only be used as a supplement to traditional training methods and not as a standalone substitute for hands-on laboratory training and clinical practice. This is also emphasised by the results achieved by Kato et al., where the VR group displayed significant deficits in physical interaction and patient communication (Kato et al. 2022).

Conclusion

Virtual simulation, including VR training, shows high potential in supplementing the practical and clinical education of radiography students. While being relatively easy to use, cost-effective and time-efficient, virtual simulation can aid student engagement and heighten students' interest in a particular subject area.

With its limitations, virtual training should never be seen as a do-it-all solution but rather as a supplement to traditional practical training methods.

Nonetheless, the evaluation results indicate a successful launch of virtual training at the UAS Campus Vienna and a promising outlook for improving undergraduate radiographers' education.

Conflict of Interest

None

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Purchase Optimisation



Collaboration or Centralisation in Public Procurement: Antagonistic or Complementary?

Collaboration and centralisation in public procurement within the EU play a critical role in promoting sustainable growth, innovation and efficiency. Key reforms, including the 2014 directives and Spain's implementation, highlight progress and ongoing challenges such as transparency, competition and innovation. Achieving value-driven procurement outcomes depends on aligning leadership, strategic planning and professionalisation to meet societal needs effectively and sustainably.

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key points

- Public procurement plays a key role in driving growth, sustainability and innovation in the EU.
- The 2014 directives reformed procurement to enhance efficiency and achieve strategic objectives.
- Spain's implementation reveals challenges in balancing centralisation and collaboration.
- Key hurdles include improving transparency, fostering competition and encouraging innovation.
- Strong leadership, effective planning and professionalisation are vital for successful procurement.

Introduction

Public procurement is a strategic instrument in each European Union Member State's economic policy mix. The 2015 Single Market Strategy (European Commission 2015a) proposed more transparent, efficient and accountable public procurement systems. This calls for a shift from a purely administrative approach to a more strategic and needs-based approach while respecting existing rules. We cannot ignore the fact that with an annual expenditure of approximately 14% of the European Union's (EU) GDP, public procurement can help contribute to the achievement of sustainable growth and job creation (European Commission 2020).

It is through public procurement that we can facilitate investments in the real economy and stimulate demand to increase competitiveness based on innovation and digitisation, as well as promote the transition to a circular, resource- and energy-efficient economy and foster sustainable economic development and more equitable and inclusive societies (European Commission 2017a).

The new generation of public procurement directives, adopted in 2014 as part of the 2014 reform, were Directives 2014/23/EU (concessions), 2014/24/EU (general) and 2014/25/EU (utilities), which provide a more flexible framework for procurement by simplifying public procurement procedures and improving access to



procurement for SMEs. The overall objective is to obtain better value for public funds and deliver better outcomes for social and other public policy objectives while increasing the efficiency of public spending.

Areas for Improvement in Public Procurement

The Communication from the Commission to the European Parliament, the European Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank (European Commission 2017a) identified many specific areas where improved national public procurement could make a decisive contribution to greater competitiveness and efficiency.

The text also highlighted that Member States were not making full use of the potential of public procurement as a strategic tool to promote sustainable social policy objectives and foster innovation. A significant percentage, according to some sources, possibly as high as 55%, still rely on the lowest price as the sole

Area 4: Increasing transparency, integrity and better data.

Area 5: Boosting the digital transformation of public procurement.

Area 6: Cooperation for joint procurement.

The sixth area, “Cooperation for joint procurement”, was indicated as a priority (European Commission 2017b). Thus, the aggregation of public procurement has started to take hold across the EU.

The recent Special Report from the European Court of Auditors, entitled “Public procurement in the EU. Competition in the award of works, goods or services contracts has declined in the ten years to 2021” (ECA 2023), points at several issues. In particular, Recommendation 4 calls for a deeper analysis of the reasons behind the lack of a significant overall improvement in the achievement of the main objectives outlined in the 2014 Directives. It also emphasises the need to propose measures to overcome the main obstacles to competition and to encourage the exchange of best practices.

“It is through public procurement that we can facilitate investments in the real economy and stimulate demand to increase competitiveness based on innovation and digitisation”.

award criterion. This is despite the fact that public procurement directives allow for procurement based on qualitative cost-effectiveness criteria. However, the majority of economically advantageous tenders based on a cost-effectiveness approach, which may include social, environmental, innovative, accessibility and other qualitative criteria, remain under-utilised (European Commission 2015b).

In this scenario, the European Commission (European Commission 2017b) has identified six priority areas where clear and concrete action can transform public procurement into a powerful instrument of each Member State’s economic policy portfolio, leading to substantial benefits in contract outcomes.

Area 1: Ensuring greater uptake of strategic public procurement and a specific focus on selected priority sectors.

Area 2: Professionalise public sector purchasers.

Area 3: Promoting access to procurement markets.

The Council of the European Union welcomed the publication of this Special Report and has taken into consideration its conclusions and recommendations. Furthermore, the Council appreciates the initiatives undertaken by the Commission from 2021 onwards, including the Big Buyers initiative (Big Buyers for Climate and Environment n. d.), which aims to encourage greater uptake of strategic public procurement, as well as the establishment of the European Data Space on Public Procurement (EDCP) (European Commission 2023) to enable more targeted and transparent public spending. Additionally, it encourages the Commission and the Member States to collaborate more efficiently and support the sharing and dissemination of best practices, as well as to build the necessary competencies and capacities through dialogue with all stakeholders, such as buyers and sellers.

In Spain, Law 9/2017, dated November 8, 2017, regulates public sector contracts under the title “Ley



de Contratos del Sector Público” (LCSP). This law transposes into Spanish law the European Parliament and Council Directives 2014/23/EU and 2014/24/EU, both dated February 26, 2014. Specifically, it addresses “Procurement Centres” in Section 4a of Chapter II, “Technical Rationalisation of Procurement”, found in Book Two of the LCSP (articles 227–230) (Jefatura del Estado 2017). However, not all European provisions on electronic and aggregated procurement techniques and tools have been transposed. Thus, although Article 31.3 LCSP transposes Art. 38, relating to “Sporadic

the improvement and further integration of Member States’ procurement markets. This also has contributed to the creation of a Single EU Market in the field of public procurement. This is a major achievement compared to other regions in the world. According to various publications of the European Commission, total cross-border public procurement (direct and indirect) accounts for up to approximately 23% of the total value of procurement within the EU (European Commission 2017b).

“The aggregation of public procurement has started to take hold across the EU.”

joint procurement”, Article 39, “relating to procurement involving contracting authorities from different Member States”, has not been transposed.

In any case, the regulation of the centralisation of purchases in Law 9/2017 is fragmented. In addition to the previously mentioned articles, the second additional provision addressing “Specific rules for public procurement in Local Entities” outlines how local entities can join the central procurement centres created by the General State Administration, Autonomous Communities and associations of local entities. Furthermore, the twenty-seventh additional provision regulates the centralised procurement of medicines, health products and services for the National Health System.

The concept of “centralisation” of procurement, as understood in Spain, does not quite correspond to the European perspective. In Europe, centralisation refers more to the specialisation of certain contracting authorities that provide services to other authorities instead of focusing on internal organisational techniques within a single authority. In other words, the emphasis in Spain has been on designing a system for rationalising contract management within each organisation rather than on creating a robust system of collaborative purchasing.

Moreover, the National Public Procurement Strategy 2023-2026 refers to the need to enhance centralised procurement instruments and streamline procurement, especially as an alternative to, among other things, small-scale procurement (ENCP 2023).

In the EU, various initiatives have been implemented, particularly in the legal framework, which have led to

All this explains why Europe seems to be committed to collaborative partnerships leading to an effective, transparent, digital and smart public procurement system that fully responds to the challenges of today’s changing environment. To name but a few of these partnerships:

Public Buyers Community (public-buyers-community.ec.europa.eu) is a community platform for public purchasers that complements the European Commission’s strategy to improve public procurement in the EU. Public purchasers can find and join the community of practice that best suits their procurement interests and work closely with their peers to pool their resources, tools and knowledge and maximise their purchasing power and impact. “Communities of practice” have been created, each dedicated to the procurement of a specific product, work or service requiring European cooperation. One such community is “Efficiency in Health” (European Commission n. d.).

Health Proc Europe (healthproceurope.org) is an interest group representing European hospitals and healthcare procurement managers. Representing more than 15,000 hospitals across Europe, they provide essential support to improve procurement processes, ensuring efficiency and effectiveness in healthcare delivery. The group is characterised by:

- facilitating knowledge exchange and transfer within the European community;
- ensuring greater transparency in all procurement (medical and non-medical products and equipment);
- supporting the shift towards value-based decision-making;



- increasing the efficiency of EU-compliant public tenders;
- support access to and adoption of innovative medical technologies;
- increase procurement competencies;
- best practice.

European Health Public Procurement Alliance (EHPPA, ehppa.com) is an alliance of public and not-for-profit procurement organisations specialised in the health and care sector. Its purpose is to facilitate cooperation and information exchange between its members to improve their procurement performance and gain a competitive advantage in the European market. Countries that are part of this alliance are Portugal, England, Switzerland, Italy, France, the Netherlands, Belgium, Denmark, Norway and Spain.

Procure 4Health (procure4health.eu) is a community of 15 EU countries that is involved in public procurement of innovation in health. Its 33 founding partners are actively promoting innovation procurement through

doubts remain as to whether this will increase the degree of collaboration between the different contracting authorities in their purchasing decisions. No additional measures have been implemented to strengthen the role of central purchasing bodies as a means to facilitate collaboration between these authorities.

Secondly, Article 228.2 of the LCSP regulates cooperative relations outside the central contracting body of the state. It provides that, by means of the corresponding agreements, the Autonomous Regions, the Autonomous Cities of Ceuta and Melilla and the Local Entities, as well as the bodies and entities dependent on the above, may join centralised procurement systems of other Autonomous Regions or Local Entities of other public sector entities covered by the Law. It is important to note that adherence does not equate to collaboration: while membership in regional centres is governed by their own regulations, there is no provision for collaboration among different autonomous regions within centralised procurement systems.

“The current challenge of public procurement (...) is to manage the process in a more effective, efficient and transparent manner.”

knowledge sharing and capacity building, networking and matchmaking. They identify common needs, launch joint initiatives to address them and influence policy regarding the procurement of innovation. In Spain, the Andalusian Health Service (SAS), the Galician Health Service (SERGAS), the Aragonese Health Service, the Galician Health Knowledge Agency and the Aragonese Institute of Health Sciences form part of this community.

Centralisation and Collaboration in Spain

In Spain, on the other hand, centralisation and aggregate purchases are justified in the search for economic efficiency. However, in Vaquero García's terms, the savings generated in aggregate purchases have been lower than expected (García Vaquero 2016).

Thus, Article 227.2 of the LCSP notes that “*central purchasing bodies shall act by purchasing supplies and services for other public sector entities, or by awarding contracts or concluding framework agreements and dynamic purchasing systems for the performance of works, supplies or services intended for them*”. However,

Against this background, central purchasing bodies must be able to demonstrate that they are the best means of achieving the objectives of the LCSP (Jefatura del Estado 2017), especially in acquiring goods and services that offer the best value for money. Additionally, it is essential to recognise that the current challenge of public procurement, regardless of whether it is centralised or decentralised, is to manage the process in a more effective, efficient and transparent manner. To achieve this, it is necessary to:

- improve the quality-price ratio by applying economies of scale;
- reduce processing times and administrative burdens (reduction of deadlines, facilitating compliance with the requirements of the LCSP);
- include environmental or social objectives, strategic criteria (through solvency conditions and special performance conditions) and award criteria;
- implement electronic tools;
- enable more effective monitoring and control of the procurement cycle;



- professionalise public purchasers, ie to achieve the maturity of a collective culture of public procurement from the point of view of all the actors involved (public managers, the private sector and even the public as a beneficiary);
- facilitate the prevention of corruption in public procurement;
- consolidate the planning of public procurement;
- improve publicity and transparency.

Implementation Challenges

Difficulties of Centralisation

Despite the significant advantages associated with centralisation, it should also be noted that it can pose a number of problems, the most important of which are as follows:

- The mere aggregation of purchasing volumes is not a sufficient guarantee for permanent price reductions, let alone purchasing efficiency. To achieve the goal of efficiency, purchasing centres should be run by professionals with expertise in health procurement management.
- Centralisation may reduce competition with the risk of non-participation of small and medium-sized enterprises (SMEs), not able to compete on price with larger suppliers who can offer better prices and other purchasing conditions.
- Centralisation can negatively affect innovation by discouraging manufacturing companies from innovating their products.
- Centralised purchasing can lead to a decline in the quality of the products purchased, as the centralised purchasing policy is price-oriented rather than quality-oriented. Value-based purchasing minimises the risk of not introducing the best price/quality ratio.

In short, concentration in the aggregation of demand can lead to greater immediate savings of public resources, ie in the short term of the budget year, but it runs the risk of acquiring low value-added products, limiting competition, facilitating delocalisation and lack of investment.

Difficulties of Collaboration

Collaboration in healthcare procurement across EU member states faces several challenges due to regulatory differences, structural diversity and the complexity of joint purchasing initiatives:

- The 2014 European directives were transposed into the legal system of each member state of the

European Union. This results in variations in national regulations, which can complicate collaborative efforts.

- There is diversity among the members of the association; sometimes national services overlap with regional services, groups of hospitals etc. This diversity can make it challenging to pursue joint purchasing initiatives.

The most successful collaborative purchasing experiences tend to be those that seek a common nexus. An example of this is the case of the Healthy Ageing Public Procurement of Innovations (HAPPI) collaborative partnership. The HAPPI project aims to establish long-term collaboration among healthcare purchasing organisations across Europe. Its goal is to identify innovative health products, services and solutions that promote healthy ageing and to put in place procurement contracts for the benefit of healthcare organisations (AAL Programme 2013).

Difficulties of Public Procurement

For leading-edge public procurement, whether collaborative or centralised, several factors are essential:

- **Participatory Leadership.** It is essential to engage the knowledge, interest and dedication of the professionals in the purchasing departments. In addition, it is necessary to include the clinicians, who are the end users of the goods being purchased. The creation of committees and technical commissions adapted to the needs of procurement should be standard practice.
- **Establishment of Work Circuits.** To avoid redundancies and inefficiencies, work circuits should be created. This will also facilitate the onboarding of new staff and support a training plan that facilitates the recruitment of qualified and accredited staff, as promoted by the EU (OECD 2023).
- **Communication and Participation Plan.** A well-structured communication and participation plan is vital for effectively managing change in an open organisation. This plan should establish channels of communication and collaboration with other regional, national or international public organisations, as well as with economic operators and especially their representatives. Additionally, collaboration with professional and academic institutions, including professional associations and universities, is important.



Conclusion

In conclusion, the main question is not whether collaboration and centralisation in public procurement are antagonistic or complementary but rather how strategic public procurement should be carried out to provide value. This approach should focus on achieving the best quality-price ratio, meeting the needs of citizens and adhering to the essential elements that ensure success in public procurement. In my opinion, these elements include:

- leadership based on knowledge and participation;
- planning that aligns the purchasing plan with the needs of the centres;
- a unified catalogue allowing a common language;
- organisation that clearly defines competencies and responsibilities;

- circuits that streamline procedures and eliminate unnecessary steps;
- budget, adequate and efficiently managed;
- communication and participation plan that involves all stakeholders: administration, economic operators, professionals and patients;
- professional recognition and a clear career system;
- professional code of ethics.

In summary, the success of public procurement lies in strategically aligning leadership, planning, organisation and communication to deliver value and meet citizens' needs.

Conflict of Interest

None

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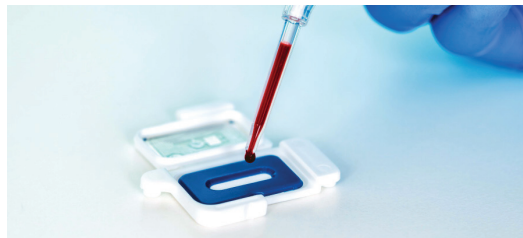
ACCELERATE TIME-TO-RECOGNITION REVEAL SEPSIS BEFORE IT STRIKES

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50 μ L of blood



TRANSFER

Sample on the capsule



MEASURE

Results within minutes

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Future Hospital



Driving Innovation: Understanding ISO 56001 and Its Impact on Healthcare

ISO 56001 is a new standard for innovation management systems, enabling organisations to enhance innovation performance, manage uncertainty and create value. It integrates seamlessly with existing standards and is suitable for all sectors, including healthcare. By fostering a culture of innovation, it supports the adoption of new technologies like AI and telemedicine. Effective implementation requires leadership, resources and adherence to principles outlined in ISO 56000.

JOHAN
CLAIRE



Founder and CEO | Innovation Way |
Nancy, France

key points

- ISO 56001 sets global standards for innovation management systems in organisations.
- It enhances innovation, resilience and value creation across diverse sectors, including healthcare.
- The standard supports managing uncertainty and integrating technologies like AI and telemedicine.
- Effective implementation requires leadership, resources and adherence to ISO 56000 principles.
- ISO 56001 promotes a structured framework for collaboration within healthcare ecosystems.

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Alan Zetzelmann is an innovation expert with 17+ years in technology and entrepreneurship. A partner at Innovation 360 Group AB, he holds a Master's in Business Innovation from Deusto and won Austria's 2017 Innovation Award. Founder of INNOCONSULT, he focuses on space travel, immortality and ESG projects. He is also a passionate educator, teaching at CEU, Deusto Business School and EOI, and is recognised for measuring organisations' 'Innovation IQ.'

Johan Claire is the chairperson of ISO TC 279—Innovation Management, overseeing standards development in the ISO 56000 series since 2015. Founder and CEO of Innovation Way, Johan graduated as an innovation engineer and established a Business Innovation Centre at the French Chamber of Commerce. He focused on innovation management at the ERPI research laboratory (University of Lorraine) before spinning off Innovation Way to implement research-based innovation management systems in companies.

ISO 56001 Standard and Its General Purpose

A.: What is the ISO 56001 standard, and what is its main objective?

J.: ISO 56001 is the new international requirement standard for innovation management systems. This document specifies the requirements for an innovation



management system that an organisation can use to develop and demonstrate its innovation capability, enhance its innovation performance and create value for users, customers and other interested parties.

from new products, services, processes, models and methods for the organisation and its stakeholders. It enhances innovation performance by enabling systematic management of activities in uncertain

“A culture of innovation can only take root if human resources processes acknowledge the importance of innovation.”

A.: How does ISO 56001 differ from other standards related to quality or innovation management?

J.: It is part of the ISO 56000 series of standards that are all related to innovation management. However, ISO 56001 is the only standard within this series that specifies requirements. This means that it is the only standard that could be used for certification purposes. The other documents in the series are guidance documents and cannot be used for formal external audits and organisation certification.

As a requirements document, ISO 56001 allows organisations to voluntarily engage certification bodies for audits. If the audit is successful, the organisation can be officially certified as compliant with ISO 56001.

ISO 9001 is another requirement standard that is probably the most well-known to date. Like ISO 9001, ISO 56001 is a management system standard, meaning it is designed to help organisations manage the interrelated parts of their business to achieve their objectives. While ISO 9001 focuses primarily on quality management, ISO 56001 emphasises innovation. Although both standards share a common framework, the content is quite distinct since quality management and innovation management are fundamentally different disciplines.

A.: What types of organisations can benefit from implementing ISO 56001?

J.: This document is applicable to any organisation, regardless of its type or size, the products and services it provides or the types of innovations and approaches it employs.

General Benefits for Organisations

A.: What are the main benefits that ISO 56001 brings to organisations, regardless of their sector?

J.: The main benefits of implementing an innovation management system include increased value realisation

conditions while fostering a sustained build-up of innovation capabilities. Organisations experience an improved reputation, making them more attractive to users, customers, employees and partners. Additionally, ISO 56001 enhances collaboration within value chains or innovation ecosystems, boosts the ability to attract funding and strengthens resilience and adaptability in dynamic and uncertain environments.

A.: How does this standard help foster a culture of innovation within organisations?

J.: I think that culture largely depends on the processes put in place and their consistency. ISO 56001 provides a framework for defining processes and activities that encourage innovation development. Simply promoting creativity is insufficient for innovation to become embedded in corporate culture; concrete solutions must be implemented to support innovation's emergence, development and deployment. A culture of innovation can only take root if human resources processes acknowledge the importance of innovation and ensure that the company possesses the necessary knowledge and skills to flourish. It is also essential for top management to demonstrate commitment to innovation management. ISO 56001 serves as a tool for setting up a consistent system while ensuring no key components are overlooked.

A.: How does the standard assist in managing the risks associated with innovation projects?

J.: When it comes to innovation, it is important to consider managing risk and uncertainty. This fundamental aspect highlights the difference between risk management and quality management. An approach based solely on risk analysis may kill off any innovation project during its early stages, as anything new always seems riskier than maintaining the status quo.

In innovation, our primary focus should be on the opportunities and value (social, environmental, strategic, financial and more) that can be achieved through



new ideas. Nevertheless, the greater the degree of innovation, the higher the level of unknown factors and uncertainty at the project's outset. Therefore, innovative project management revolves around uncertainty reduction. By conducting research and experiments, we can gather data and acquire knowledge that will enable us to reduce these uncertainties. ISO 56001 can thus help manage risks associated with innovation projects, providing new approaches based on uncertainty management while allowing them to coexist with traditional risk management within the organisation.

Application in the Healthcare Sector

A.: What role can ISO 56001 play in accelerating innovation in the healthcare sector?

healthcare sector likely requires collaboration among various actors. This collaboration necessitates the establishment of a common language and framework to guide innovation activities. ISO 56001 can serve as a neutral foundation for building and sharing innovation capabilities.

A.: How can the standard facilitate the integration of new technologies, such as artificial intelligence or telemedicine, in the healthcare sector?

J.: ISO 56001 is a management system standard that aims to improve an organisation's innovation performance and ability to adapt to changes. It does not focus on any specific types of innovations or technologies. However, projects involving radical or breakthrough innovations, such as most of those related

“ISO 56001 can thus help manage risks associated with innovation projects, providing new approaches based on uncertainty management.”

J.: The healthcare sector is very structured and accustomed to applying standards. As a management system standard, ISO 56001 integrates seamlessly with standards such as those for quality, environmental management, security and others.

ISO 56001 resulted from four years of drafting by hundreds of innovation management experts worldwide who shared their best practices. It is not just a fashionable method for innovation; instead, it combines the best elements of various tools, methods and approaches developed over the last decades into an unbiased reference system.

ISO 56001 can help organisations in the healthcare sector by providing a structured approach to innovation, allowing them to build lasting innovation capabilities. Additionally, it helps all healthcare organisations establish a common language and reference framework that will facilitate collaborative innovation.

A.: What specific benefits can healthcare organisations, both public and private, gain from adopting this standard?

J.: I believe part of the answer lies within the question itself. The healthcare ecosystem brings together a diverse range of organisations, including both public and private entities, which vary in size from small startups to large, well-established firms. It is a very dense and complex ecosystem. Therefore, innovating in the

to AI or new technologies, require a high level of maturity in innovation management. ISO 56001 is a tool to develop these capabilities.

Challenges and Requirements for Implementation

A.: What are the main challenges healthcare organisations face in their innovation efforts, and how does ISO 56001 address them?

J.: Healthcare organisations are obsessed with safety and effectiveness. No one could blame them because everybody wants to rely on their services with confidence. As a result, most organisations in the sector are built on highly secure processes that leave no room for novelty and uncertainty. However, we can now see that innovation can generate much value for organisations and end-users, including patients. ISO 56001 can help overcome this paradox by proposing a structured framework compatible with other management systems.

A.: What basic requirements must healthcare organisations meet to successfully implement this standard?

J.: Despite the existence of ISO 56001, ISO TC 279 has also developed a set of innovation management



principles outlined in ISO 56000 – Fundamentals and Vocabulary. These eight principles serve as a basis for the effective management of innovation activities and a foundation of the innovation management system. These principles are the realisation of value, future-

Organisations can implement ISO 56001 with the goal of fostering innovation to enhance productivity, which may ultimately result in organisational or process innovation.

A.: What impact does implementing this standard have on patient experience and operational efficiency?

“Top management must demonstrate leadership and commitment toward the innovation management system.”

focused leadership, strategic direction, organisational culture, the exploitation of insights, the management of uncertainty, adaptability and the use of systems approaches.

Healthcare organisations should consider these principles to successfully implement the standard. They should also be aware that implementing a management system takes time and requires adequate resources.

A.: What role does leadership play in adopting and maintaining ISO 56001 within a healthcare organisation?

J.: Top management must demonstrate leadership and commitment toward the innovation management system. They play a key role in implementing this system, as it involves transforming the existing organisation rather than simply creating a separate division. Strong support from top management is essential to inspire teams and ensure they receive the required support and resources over time.

Innovation activities and capabilities can and should be effectively managed. This requires not only awareness but also real knowledge and skills. Top management should recognise this need, be open to learning about innovation management and be prepared to rely on experts in the field.

Impact on Productivity and Organisational Outcomes

A.: How can ISO 56001 help improve the productivity of healthcare organisations?

J.: Innovation is defined in ISO 56000 as a “new or changed entity, realising or redistributing value”. This means that innovation is not limited to technology or products; it can also be related to a new service, value realisation model, process and more. Additionally, the concept of value should be understood broadly, encompassing both financial and non-financial aspects.

J.: Defining the innovation intent is one of the core elements of implementing an innovation management system. This allows the organisation to determine whether it expects to use innovation to improve productivity, enhance patient experience or increase operational efficiency. Once the intent is established, the other elements of the innovation management system can be designed to support this goal.

A.: Are there any practical examples or case studies of healthcare organisations that have successfully implemented ISO 56001?

J.: ISO 56001 was published in September 2024, so its deployment is just beginning. Implementing an innovation management system takes time, and it will probably take a few more months before we see the first certifications in the health sector. Even when the system is set up, some time is still required to develop innovations. Unfortunately, I cannot share the names of certified organisations at this time. However, some organisations have demonstrated their commitment to the innovation management system well before the publication of the standard requirements.

ISO 56002, another document from the ISO 56000 family, is also dedicated to the innovation management system, but it serves as a guidance standard and was published in 2019. I know that Karolinska University Hospital in Sweden implemented an innovation management system using ISO 56002 a couple of years ago, as they have produced some scientific publications related to this innovation.

Conflict of Interest

None



Lean Management in Healthcare: Enhancing Patient Care, Reducing Workload and Overcoming Barriers to Implementation

Lean management in healthcare enhances efficiency by eliminating waste, optimising workflows and increasing direct patient care time. It addresses challenges like high workloads and resource constraints while improving care quality. Implementation barriers include resistance to change and inadequate training, but strong leadership and proper tool selection facilitate success. Lean can transform healthcare by improving patient outcomes, reducing stress for professionals and ensuring sustainable operations.

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key points

- Lean management reduces inefficiencies and enhances healthcare workflow.
- It increases direct patient care time, improving outcomes and satisfaction.
- Strong leadership and staff training are key to successful Lean implementation.
- Resistance to change and organisational complexity hinder Lean adoption.
- Selecting the right Lean tools ensures efficiency and sustainable improvements.

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In Belgium, healthcare expenditures represent a significant portion of the gross national product (GNP), reaching 10.5% in 2019—well above the OECD (Organisation for Economic Co-operation and Development) average of 8.8%. This high investment in healthcare is driven by several factors, most notably an ageing population, increasing healthcare demands, new medical innovations and mounting pressure on the healthcare system to deliver high-quality care with limited resources. However, despite this significant investment, healthcare organisations continue to face numerous challenges, including reduced government funding, rising patient expectations and growing demands for transparent, efficient and high-quality care. Besides these challenges, healthcare professionals, especially nurses, face the ongoing issue of high work pressure and the complexity of nursing care. A nurse's responsibilities often extend to many patients, creating a



heavy burden and contributing to the perception of high stress and job dissatisfaction. The quest for solutions that can help reduce workload while improving care quality has led to the adoption of various management strategies, with Lean management being one of the most notable.

The Role of Lean Management in Healthcare

Lean management, which originated in the manufacturing sector, is both a philosophy and methodology that focuses on eliminating waste and improving efficiency by streamlining processes. In healthcare, Lean management has the potential to significantly improve the quality of patient care by reducing inefficiencies, optimising workflows and clinical outcomes, as well as enabling healthcare professionals to spend more time with their patients. At its core, Lean aims to maximise value by minimising activities that do not directly contribute to the desired outcomes. By focusing on value-added activities and eliminating waste, Lean can help healthcare organisations reduce costs, enhance patient experience and satisfaction and improve the overall quality of care.

Currently, nurses spend approximately 30% of their time on direct patient care. While this percentage is significant, it also indicates that a large portion of nurses' time is dedicated to non-patient care activities, such as administrative tasks, documentation and coordination. Lean management can help increase this percentage by streamlining workflows, reducing redundancies and eliminating unnecessary tasks, allowing nurses and other healthcare professionals to focus more on delivering care to their patients. A significant increase in the amount of time spent on direct patient

provided to patients. Moreover, Lean practices not only focus on increasing time for care but also help reduce interruptions, streamline communication and ensure that staff members can work more effectively. This reduction in interruptions can be particularly valuable in high-pressure environments such as hospitals, where frequent disruptions can contribute to burnout and fatigue.

The Challenges in Implementing Lean in Healthcare

While Lean management has the potential to significantly improve healthcare delivery, its implementation in healthcare settings has not been without challenges. Despite its proven effectiveness in manufacturing, Lean is still a relatively new concept in healthcare, with limited research on its integration into complex medical environments. Much of the existing literature focuses on how Lean can be applied to improve operational efficiency but offers little guidance on successfully embedding Lean within complex healthcare environments.

Healthcare organisations, particularly hospitals, are inherently more complex than manufacturing environments. The multidisciplinary nature of healthcare, the biovariability of patients and the involvement of diverse stakeholders make Lean implementation more difficult. Furthermore, healthcare organisations are often large, bureaucratic and resistant to change. As a result, Lean is frequently viewed as a set of tools aimed at improving specific processes rather than a holistic approach applicable across all aspects of healthcare operations.

“Lean management has the potential to significantly improve the quality of patient care by reducing inefficiencies, optimising workflows and clinical outcomes.”

care could potentially improve outcomes, enhance patient satisfaction and reduce work-related stress for healthcare professionals.

For example, if Lean management were to increase the percentage of time spent on direct patient care from 30% to 50%, this could translate into an additional 45 minutes of care per patient per day. This extra time could be crucial for enhancing the quality of care

Another challenge is the perception of Lean within the healthcare sector. In many cases, Lean is seen more as a process improvement strategy rather than a comprehensive management philosophy that can guide the entire organisation. This narrow view of Lean has led to inconsistent results in its implementation. While some healthcare institutions have seen improvements in efficiency and patient care, others have struggled to realise the full benefits of Lean management.



The key to successful Lean implementation lies in understanding the foundational mechanisms required to launch and structurally implement a Lean initiative in healthcare daily practice. This includes identifying the

is essential for ensuring that staff members have the necessary knowledge and skills to implement Lean practices effectively.

“Currently, nurses spend approximately 30% of their time on direct patient care.”

factors that facilitate or impede Lean adoption, selecting the right tools and ensuring that staff members are adequately trained to apply Lean principles effectively in practice.

Identifying Facilitators and Barriers to Lean Implementation

A systematic review of the literature on Lean implementation in healthcare was conducted to identify the factors that facilitate or hinder its adoption. The review focused on articles published between 2016 and 2020, with a total of 135 articles initially identified. After a critical review, 22 articles were selected for full analysis, which revealed 15 key factors that influence Lean implementation in healthcare.

These factors were categorised into two main groups: facilitators and barriers. Facilitators are practices, characteristics or conditions that help healthcare organisations successfully implement Lean by addressing potential inhibitors and providing the necessary knowledge and resources. Barriers, on the other hand, are factors that hinder the successful adoption of Lean and can impede the progress of Lean initiatives.

Facilitators for Lean Implementation

- 1. Leadership Support.** One of the most important facilitators for Lean implementation is strong support from leadership. When organisational leaders actively support Lean initiatives and create a culture of continuous improvement, it becomes easier to gain buy-in from staff and encourage the adoption of Lean principles across all levels of the organisation.
- 2. Clear Communication.** Effective communication is crucial for ensuring that everyone within the organisation understands the goals of the Lean initiative and is aligned with its objectives. Clear communication helps prevent misunderstandings and resistance to change.
- 3. Training and Education.** Providing adequate training and education on Lean principles and tools

- 4. Staff Engagement.** Involving staff in the Lean process, from planning to execution, increases the likelihood of success. When staff members feel engaged and empowered, they are more likely to contribute to the success of Lean initiatives.
- 5. Resource Allocation.** Ensuring that sufficient resources, such as time, personnel and financial support, are allocated to Lean initiatives is essential for their success. Without adequate resources, Lean projects may struggle to gain traction.

Barriers to Lean Implementation

- 1. Resistance to Change.** Healthcare organisations are often resistant to change, particularly when it comes to adopting new management practices like Lean. Resistance can come from both leadership and staff, and it is critical to overcome it for successful Lean implementation.
- 2. Insufficient Training.** A lack of training or inadequate education on Lean principles can hinder the effective implementation of Lean. Without proper training, staff members may not fully understand Lean concepts, making it difficult to apply them in practice.
- 3. Lack of Skilled Leadership.** Lean initiatives require strong leadership to guide the process, make decisions and ensure that the organisation is on track. A lack of experienced leaders who are knowledgeable about Lean can prevent its successful implementation.
- 4. Complex Organisational Structure.** Healthcare organisations are often large and complex, with numerous departments and stakeholders. This complexity can make it difficult to implement Lean effectively, as changes in one area of the organisation can have far-reaching effects on other parts of the system.
- 5. Limited Experience with Lean.** Many healthcare organisations have limited experience with Lean management, which can make it challenging to apply Lean principles effectively. Without a deep



understanding of Lean tools and techniques, organisations may struggle to see the full benefits of Lean initiatives.

The Importance of Choosing the Right Lean Tools

Once the facilitators and barriers are identified, the next step is to select the right Lean tools to achieve the desired outcomes. A systematic review of the literature identified 20 Lean tools that have been shown

questionnaire before and after undergoing Lean training. The results showed that certain factors, such as self-assessed knowledge of Lean, the number of hours spent on Lean training and the ability to draw and implement processes, were strongly correlated with higher scores on the Lean knowledge test.

While the training programmes in the study helped participants gain knowledge, the majority of participants did not reach the higher levels of Bloom's taxonomy, such as the ability to apply Lean concepts in practice. This highlights the importance of designing training

“One of the most important facilitators for Lean implementation is strong support from leadership.”

to be effective in healthcare settings. These tools include techniques such as value stream mapping, process standardisation, 5S (Sort, Set in Order, Shine, Standardise, Sustain), root cause analysis, heijunka, reducing variation and implementing TAKT analysis. After consulting a team of Lean experts, 13 tools were identified as having the most significant impact on improving efficiency and increasing direct patient care.

One of the most important aspects of Lean implementation is selecting the right tools for the specific context of the healthcare organisation. Not all Lean tools are suitable for every situation, and choosing the wrong tools can result in suboptimal outcomes. By selecting tools that are well-suited to the organisation's needs, healthcare managers can maximise the effectiveness of their Lean initiatives.

Training and Measuring Lean Knowledge

To ensure the success of Lean initiatives, it is essential to provide adequate training to healthcare professionals. However, the effectiveness of training programmes depends on the depth of learning and the ability of staff to apply Lean principles in practice. Bloom's taxonomy categorises learning into six levels ranging from basic knowledge acquisition to the ability to apply concepts in practice. The model can serve as a structured approach to evaluate Lean training effectiveness.

A study by Hans Crampe developed a measurement tool based on Bloom's taxonomy to assess the level of Lean knowledge among healthcare professionals. The study involved 86 participants who completed a

programmes that go beyond theoretical knowledge and ensure that staff members can effectively implement Lean principles in their daily work.

Conclusion

Lean management offers significant potential to improve both the efficiency and quality of healthcare delivery. By focusing on eliminating waste, streamlining processes and increasing direct patient care time, Lean can help healthcare organisations achieve better outcomes while reducing workload. However, the successful implementation of Lean in healthcare settings requires overcoming several challenges, including resistance to change, lack of training and organisational complexity.

By understanding the key facilitators and barriers to Lean implementation, selecting the appropriate Lean tools and providing effective training, healthcare organisations can maximise the benefits of Lean management. The ongoing research into Lean in healthcare will continue to refine our understanding of how to best apply Lean principles in this complex sector. Ultimately, this will enable healthcare institutions to enhance the quality of care while optimising resource utilisation.

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Conflict of Interest

None

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