



# UnBLOCK the Chain

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# Unblock the Chain

**B**lockchain. What diverse reactions the mention of this technology gets both within and without the healthcare setting.

There are those who are convinced that it's going to transform not only healthcare but society as well.

Others see it as a hyped-up technology beset with limitations which has nothing constructive to offer the healthcare sector – or, at least, for many years to come.

The truth probably lies somewhere in between.

The application of healthcare Blockchain is not a 'black and white' proposition. It depends on what we are trying to achieve and to whom that achievement is a priority. Who wants improved data security? What about healthcare transaction transparency? Let's not forget the power a patient could gain through having control of their health data. And what about the cost of implementing Blockchain in terms of energy and disruption?

It's controversial and it's not going to go away any time soon. This is why HealthManagement.org is passionate about examining the potential of Blockchain in healthcare head-on, with views from esteemed experts in the field.

In our first journal of 2019, we look at the myths and facts about Blockchain technology. We examine the potential of tokenomics for healthcare players, weigh in with CISOs and their front line perspectives on the tech, look at data privacy and compliance and, of course, cover the financial power Blockchain could give patients with their data.

It's all exciting food for thought and we hope, after reading Unblocking the Chain, you'll have gained new insights into what Blockchain could mean for healthcare.

As always, for a taste of innovation, turn to Winning Practices where we put hospital sustainability, the latest cardiology devices, mHealth for seniors and patient safety in Imaging processes in the spotlight.

We hope you're inspired and motivated by what you read in these pages. Happy 2019! May it be a successful year for healthcare. ■



**Christian Lovis**

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## What do you think?

Do you think Blockchain can fulfill its promise for more secure and transparent healthcare or do we need to be cautious about its implementation across the sector? Let us know your views. As a leading digital and print publication on healthcare management and leadership, there are many ways to share your expertise and join our faculty of highly-esteemed contributors. To contribute, contact us on [edito@healthmanagement.org](mailto:edito@healthmanagement.org).

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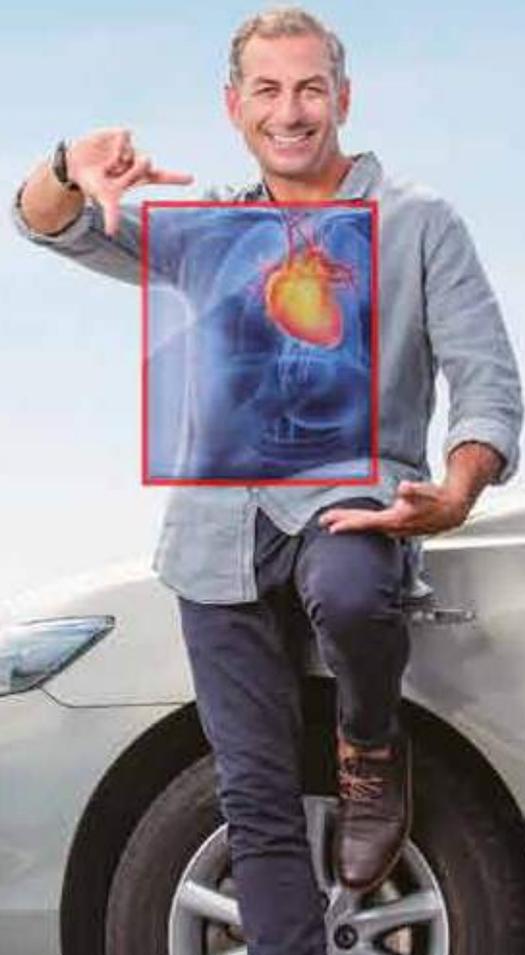


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# Integrating labs into clinical care pathways

Based on an Abbott-sponsored symposium “Diagnostics, Data and Integrated Clinical Care – From Insight to Action” presented at European Association of Hospital Managers (EAHM) congress, Cascais, Portugal, 27th September 2018.



**David C. Humphreys**

Practice Head, Health Policy & Clinical Evidence, Economist Intelligence Unit, Washington, USA

## Introduction

Pressure on healthcare systems continues to rise as the world’s population grows and lives longer; factors such as lifestyle and obesity also play a part, with the cost of diabetes, as an example, set to double by 2030 to \$2.5 trillion at current rates of increasing incidence. Providing value-based healthcare in this scenario can be challenging and unfortunately cost, not outcome, is often the overriding factor in the development of healthcare pathways. The obvious answer to reducing the economic burden of disease, while still increasing the standard of care, is to improve population health as a whole. Better diet, regular exercise and maintaining wellbeing all contribute to this, and predictive healthcare and screening programmes – rather than simply treating illness – are also key. Closer integration of laboratories into these kinds of initiatives, as well as care pathways in general, is essential in order to make significant improvements and ultimately achieve better healthcare.

## The role of the lab

The laboratory plays a vital function in today’s healthcare systems, with over 70% of medical decisions based on test results. However, the role of the lab is still undervalued, with many senior healthcare managers seeing it as just a service provider – reducing it to either a profit or cost centre – especially where there is more pressure on health budgets. In reality, labs offer so much more; 77% of healthcare professionals would welcome more support from the lab for results interpretation that has a direct bearing on clinical decision making. The laboratory is also one of the most important departments when it comes to hospital key performance indicators (KPIs), from A&E turnaround times and numbers of bed days to complication rates and patient satisfaction. Despite this, lab managers have relatively little involvement in hospital management

issues or in setting these performance targets, and there appears to be little connection between the labs themselves and patients. The good news is that healthcare is changing rapidly, creating an opportunity for labs to play a larger role in the care continuum by bridging the gap between various stakeholders.

## Managing appropriate testing

As the number of tests requested and performed each year continues to grow rapidly, it is vital that unnecessary testing is minimised to conserve resources. With over \$200 billion a year wasted in diagnosis and treatment monitoring in the US alone, reducing this excess would increase clinical efficiency and release valuable funds that could be redirected to other care areas. Increasing the daily interaction between lab and clinical staff all along the care pathway can help this by ensuring more timely and appropriate testing. On the other hand, under-testing is also an immense problem globally.

“HEALTHCARE IS CHANGING RAPIDLY, CREATING AN OPPORTUNITY FOR LABS TO PLAY A LARGER ROLE IN THE CARE CONTINUUM”

For example, over 50% of diabetes cases go undiagnosed in Sub-Saharan Africa, opening up the potential for complications and the development of advanced disease in untreated individuals, and ultimately leading to even higher treatment and management costs in the long run. Picking up these missed cases is vital to reduce the future economic burden of disease.

Lab data is critical for identifying current or emerging health issues and predicting future trends, especially for chronic conditions associated with multiple risk factors, such as diabetes or heart disease. Powerful bioinformatics tools

and advanced analytical systems, as well as much closer collaborations with other departments, will help labs to use this data to drive operational excellence and develop a more integrated approach to healthcare. As previously stated, healthcare professionals are keen for laboratories to provide more diagnostic guidance, and there is clearly a desire within the system to follow this approach. However, closer examination of the current recognition of the lab's role highlights distinct differences in perception between stakeholders. More than 75% of health executives believe the lab is already well integrated, and outwardly acknowledge the fact that it directly impacts on a number of critical KPIs. But, on the whole, lab directors do not agree, and lab staff themselves often fail to understand how their metrics influence outside outcomes. The misconception over perceived roles, values and expectations can also lead to missed opportunities. For instance, around 60% of healthcare professionals say they want to learn about the latest standards within the lab, but less than 30% of labs communicate this kind of information. Getting all stakeholders on the same page, involving labs in setting organisational goals, and investing in advanced data processing and analytics, are essential steps leading to a shared vision that will direct healthcare towards both operational excellence and integrated care.

### Conclusion

No other discipline within a healthcare organisation has a base of scientific knowledge similar to that of the lab. It is an integral part of value-based healthcare and, by investing in data processing and analytics, there is an immense opportunity to bring stakeholders together and ensure timely, evidence-based decisions.

While patients remain the focus for healthcare, organisational support is key to improving care. This begins with understanding an organisation's current status and, from there, you can identify what steps must be taken, and in what order, to make the most positive impact. All of these actions are underpinned by health value and the outcomes of healthcare, which not only affect individuals' wellbeing, but also have wider socio-economic implications. The ultimate aim must be to move towards a more integrated healthcare continuum, better diagnoses and predictive medicine, that together will lead to improvements in both outcomes and patient experience. ■

**60%**  
OF HEALTHCARE  
PROFESSIONALS SAY  
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**77%**  
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PROFESSIONALS  
WOULD WELCOME  
MORE SUPPORT FROM  
THE LAB FOR RESULTS  
INTERPRETATION THAT  
HAS A DIRECT BEARING  
ON CLINICAL DECISION  
MAKING

- Against the background of challenges facing healthcare today, labs offer so much more for both outcomes and patient experience.
- No other discipline has a base of knowledge to match it for better diagnoses and predictive medicine.



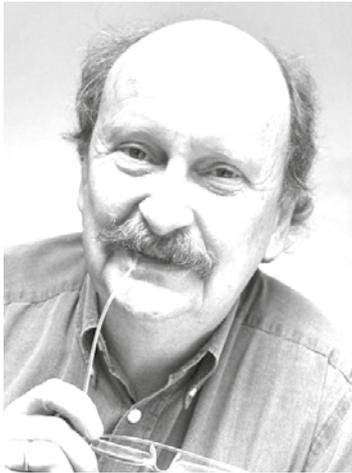
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# The essential truth

## Critical evaluation of complementary and alternative medicine

Due to a reverence for scientific truth in an area of healthcare that is hazardously left uncontrolled, Professor Edzard Ernst left his position as chair of physical and rehabilitation medicine at the Medical Faculty of Vienna to become the world's first chair in complementary and alternative medicine (CAM). That was in 1993; for 25 years he has been refuting pseudoscience and violation of medical ethics, raising awareness and encouraging action from the authorities, journalists, physicians and schools. He speaks to HealthManagement.org about his findings and the changes he believes are urgently needed.

### Moving over to CAM research

**You left your post as chair of physical and rehabilitation medicine at the Medical Faculty of the University of Vienna. Why were you convinced that there was enough medicinal value in complementary and alternative therapies to dedicate your working life to it?**

I wasn't convinced! This is why I insisted that my remit would be entirely research-based. There were and still are many open questions in CAM, and I thought it would be rewarding trying to answer some of them.

**You became the first and only professor of CAM in the UK. How did doctors and medical researchers respond to this? Are there many such professors of complementary medicine around the world?**

The reaction was mixed; some thought it was a waste of a promising career, and others felt it was worth doing. At the time, in 1993, there was no other such professorship anywhere; now there are several, but none has a particular focus on 'critical' evaluation of CAM.

**How did CAM practitioners take it?**

Once I started publishing, they were aghast. They had expected the first professor to be a promoter of CAM and did not understand why I insisted on critical assessments.

**Do CAM practitioners appreciate that by putting therapies and treatments under rigorous scrutiny, you will open the field to the discovery of evidence which could render their treatments (if effective) more respected by doctors and medical boards?**

No. Most of them do not see any point in research at all; those who do seem to view research more as a marketing tool than a means of finding the truth.

“ CAM PRACTITIONERS CONTINUE TO DO MORE OR LESS WHAT THEY WANT AND VIOLATE MEDICAL ETHICS ON A DAILY BASIS ”

### Performance of CAM therapies

**Your research spans acupuncture to herbs to reflexology. In which area are you finding most evidence of positive performance?**

Apart from some mind-body therapies such as relaxation techniques and some manual treatments such as massage, the best evidence by far comes from herbal medicine. This is hardly surprising because many herbs contain pharmacologically active ingredients.

**In your reports on the efficacy of CAM treatments and therapies, you express that most**

**of the findings are negative or inconclusive. What do you consider to be your most important findings since you moved your focus to CAM research?**

Firstly, that many CAMs are not nearly as safe as the public is led to believe. Secondly, that most of the therapeutic claims for efficacy made by CAM proponents are demonstrably false.

**Some herbal treatments are illegal in the UK, despite evidence of positive medicinal value. Kava kava proved effective in relieving anxiety, yet it was banned following some studies that linked it to liver damage (although mixed research data exists about its liver toxicity). Do you believe that authorities commonly address risks in isolation and neglect the efficacy side of some treatments?**

By and large, the authorities act responsibly. Sadly, they often are slow because they have little manpower and do rarely consider CAM a priority.

**Do you think that more research into CAM treatments could lead to healthcare system savings throughout the world?**

There have been several cost-effectiveness analyses of CAM. Their findings are sobering. As a rule of thumb, it is fair to say that where there is no effectiveness, there can also be no cost-effectiveness.

### Homeopathy

**You express that homeopathy as a treatment is scientifically implausible, yet in centres you've worked at, people have got better. What do you put this down to?**

Patients tend to get better because of the placebo effect and—more importantly—because of the natural history of the condition. Homeopaths are specialists in treating self-limiting conditions and subsequently taking the credit for any improvement that would also have occurred without any treatment at all.

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### **Do any randomised controlled trials (RCTs) for homeopathy treatment indicate its efficacy?**

There are hundreds of such RCTs. This means that pure chance, plus publication bias, plus flawed methodology, plus wishful thinking all add up to the fact that some studies come out positive. However, the relevant point is that the totality of the reliable data fails to show that highly diluted homeopathic remedies are more than placebos.

## **Chiropractic**

### **Do you think visiting a chiropractor is dangerous?**

Potentially yes; chiropractic spinal manipulations can lead to stroke and even death. About 500 such cases are on record, and that figure is probably just the tip of an iceberg because there is no reporting system that could monitor such events.

“CHIROPRACTIC  
SPINAL MANIPULATIONS CAN  
LEAD TO STROKE AND  
EVEN DEATH”

### **Chiropractic is a widely respected profession; they are regulated, and in the UK we have the Royal College and General Chiropractic Council. This suggests transparency. Is this not the case?**

I cannot find the lack of an adverse event reporting system very transparent.

### **Do you believe recent literature has raised awareness of the dangers of chiropractic and that it can contribute more problems?**

When the British Chiropractic Association (BCA) sued my friend and co-author Simon Singh for libel because he had stated that “they happily promote bogus treatments,” they shot a huge own goal. Their behaviour caused huge reputational damage, and people became aware that chiropractic is not what it’s often made out to be.

## **Research methods, analysis and clinical competence**

### **Do you believe that your rigorous scrutiny of the CAM field has reduced the amount of unethical research and unethical assertions taking**

### **place? Are CAM researchers conducting more RCTs and sticking to better protocol and ethical procedures?**

Sorry, but I do not believe that there is rigorous scrutiny of the CAM field. Practitioners continue to do more or less what they want and violate medical ethics on a daily basis. Their collective research output is close to zero, and the few studies that do emerge tend to be of deplorable quality.

### **Do you think your publications, articles and interviews will encourage people to be more sceptical, educate them on how to choose a therapy, and make the most dangerous therapies commonly known in the mainstream?**

On a good day, yes, I do hope my work has an effect. There is now a growing group of active sceptics in the UK. But when I see the amount of nonsense that is still out there, I sometimes despair.

### **Is there increasing literature on malpractice in alternative medicine?**

No, by and large CAM practitioners continue to have a free ride. The UK Government seems to not care very much, and it is up to a relatively small group of highly motivated sceptics to try and prevent the worst.

### **What more could be done to educate the public?**

About a million things! For starters, we urgently need better science education in schools. And then we require many more politicians to have a minimum understanding of science. Their ignorance is often frightening, in my view. The same sadly applies to many journalists.

### **What controls are in place to regulate clinical competence in conducting CAM therapies?**

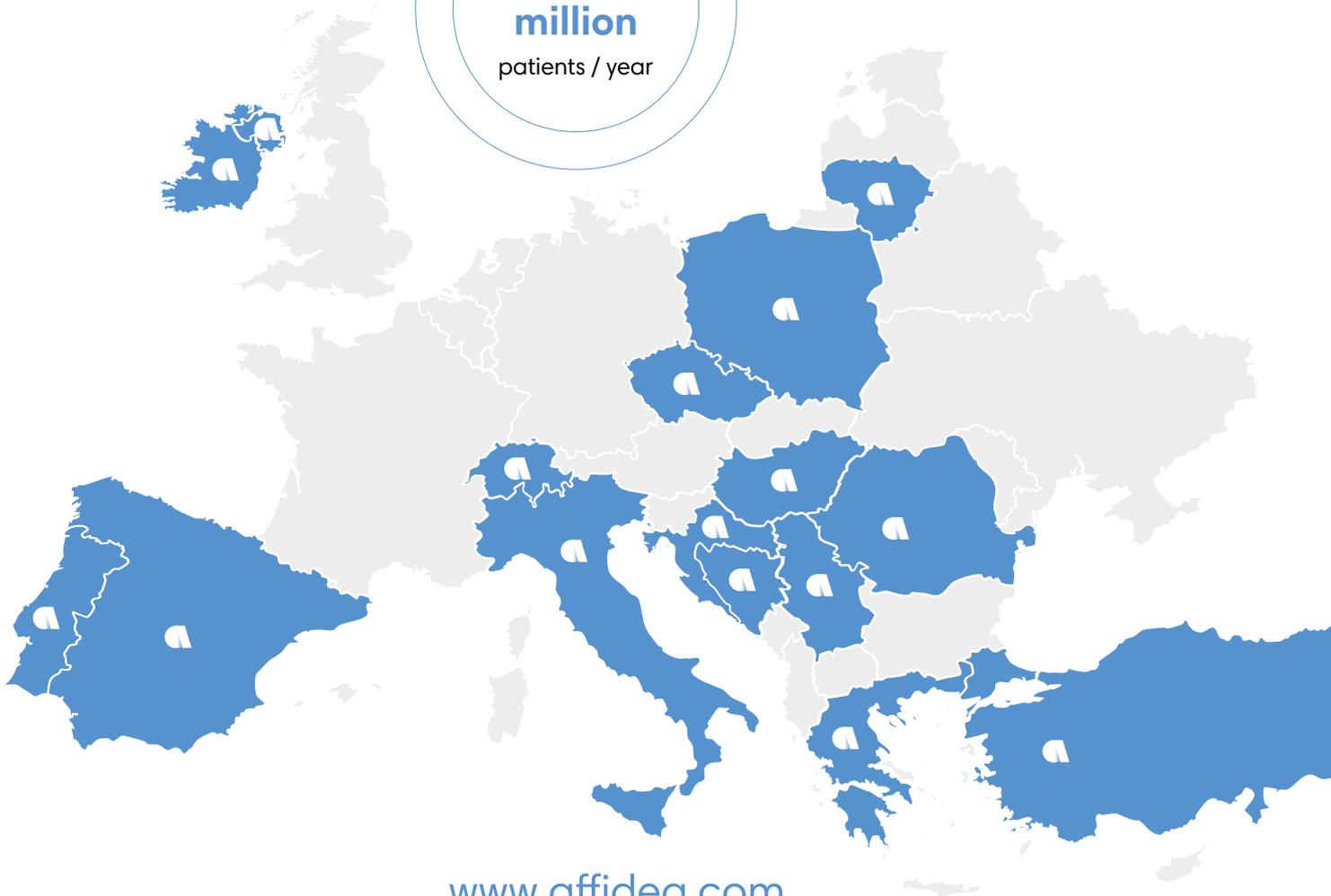
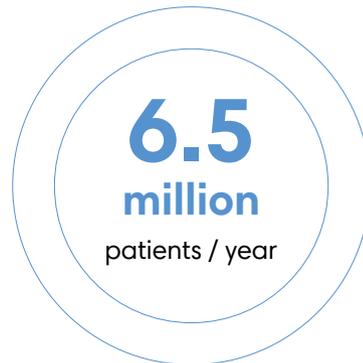
Regulation is still very lax. Regulation should foremost protect consumers. However, in CAM it is mostly seen as giving practitioners a veneer of credibility.

### **What do you believe to be the gravest area of malpractice in CAM?**

Where to start? Perhaps the lack of proper informed consent is one of the gravest problems. It is almost completely missing in CAM which basically means that the current practice of CAM is unethical. ■



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# Digitizing healthcare

## Affidea launches new digital tools in its network to improve patient experience and boost operations workflow

Affidea, the leading pan-European provider of advanced diagnostic imaging, outpatient and cancer care services, has announced the launch of two new applications to drive forward the digitisation of its operations and increase productivity and quality in imaging.



**Zisis Sotiriou**  
Senior Vice-President  
Chief Operational Excellence  
Affidea

Affidea will introduce for almost 70% of its centres a cloud-based KPI Dashboard and a Mobile App to support the company's drive for digital healthcare, in a bid to improve workflow management, utilize better the capacity of the installed equipment base and enhance patient experience across Affidea's expanding network.

The new digital tools use machine learning and complex algorithms to produce real-time and predictive insights, with the purpose to increase productivity while maintaining quality, preventing delays in appointments and reducing waiting times which results in improved patient experience.

On this announcement, Affidea's Chief Executive Officer, **Giuseppe Recchi**, stated:

*"The launch of our KPI Dashboard and KPI Mobile App rounds off a very successful year for Affidea, as we aim to become the premier digital healthcare provider with the most extensive network of medical centres powered by AI.*

*Value can be created by utilizing data extracted out of medical equipment in order to constantly improve our operations and deliver faster, better, more efficient care. We see healthcare transforming to a more data driven industry, where we need to continuously improve our daily operations and workflow management, enhancing patient safety and overall experience. We look forward to making a number of exciting announcements as we move into 2019, enhancing our offer to patients and doctors."*

Commenting on the launch of these two new digital tools, **Zisis Sotiriou**, Affidea's Senior Vice-President and Chief Operational Excellence, said:

*"This is the beginning of Affidea's journey developing KPIs dashboards across our network to address downtime, capacity, patient safety and*

*overall increase the quality of our medical services. Radiology is no longer an industry driven only by state of the art technology. These digital tools will help us be more proactive by using predictive data. For example, we are one of the first healthcare providers that can predict the replacement of a CT tube before it breaks and avoid unpleasant incidents and delays.*

*Our goal in operational excellence is to use state of the art technology, insight-rich data out of our machines and the best human expertise all together. The positive impact of our digital dashboard and KPI Mobile App will be felt immediately by our expert clinical teams and technicians across the business, and, most importantly, by our patients. These two digital tools are initially installed in 165 centres across our network, the rest being completed by the end of the year."*

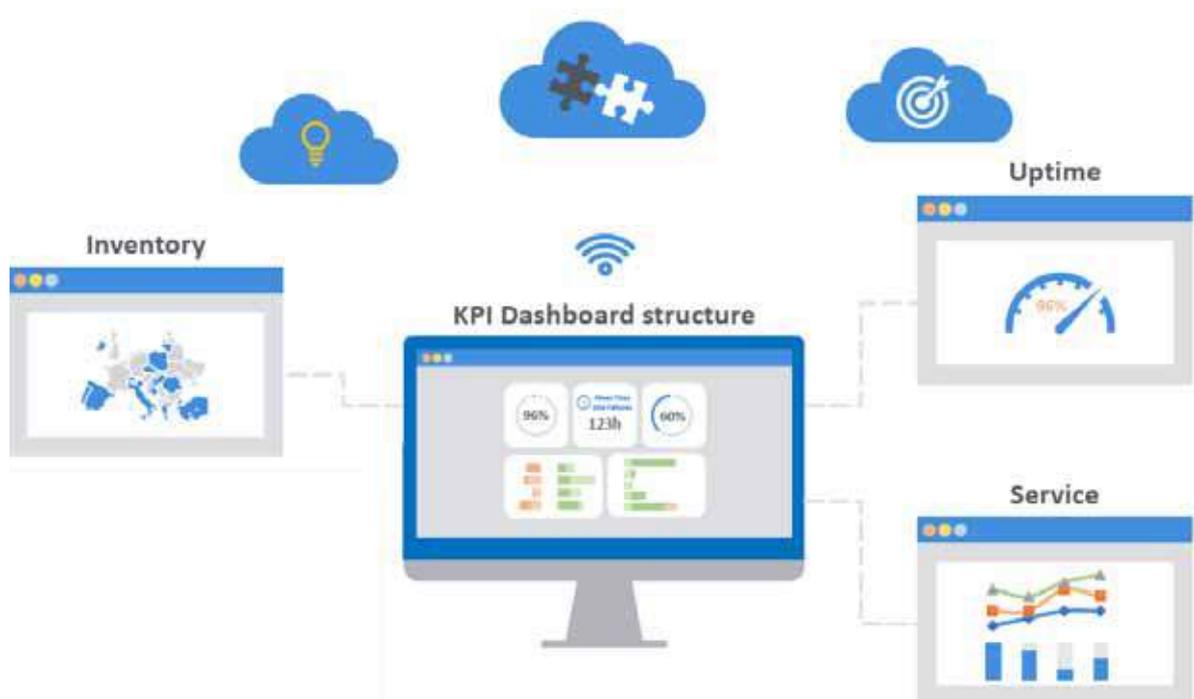
### About the KPI Dashboard and KPI Mobile App

#### KPI Dashboard

Affidea will work with different vendors for the KPI Dashboard which contains a set of key performance indicators to assess the quality and productivity of Affidea's service vendors across 16 countries in the continent.

These KPIs are displayed in a dashboard, where management can analyze workflows, machine utilization, uptime and time in between failures to draw conclusions about productivity and workflow and drive actions for improvements around efficiency, quality and overall patient experience.

The KPIs allow Affidea's teams to access data on performance across different centres with aggregated metrics. Affidea's team of over 7,000 healthcare professionals will benefit from a combination of state of the art technology and insight-rich data



#### KPI Dashboard

sets that will support them in:

- Continuing to improve upon Affidea's award winning patient safety record
- Maximizing the available capacity of Affidea's state of the art medical equipment
- Becoming more proactive by using predictive data, ensuring the maximum operational performance of medical equipment

#### KPI Mobile App

Affidea's new KPI Mobile App, developed by GE Healthcare, will feature the service KPI Dashboard, and will be installed directly on the mobiles of the centre managers and operations managers. The app's dashboard will display the health and status of Affidea's advanced medical equipment in real time, sending dynamic information updates from our equipment installed base across our 246 centres in 16 countries.

By installing the app across Affidea's network of medical centres, clinical teams can be assured of uninterrupted operations and equipment data sharing, with notifications on asset status and service operations delivered in real time. ■

#### Affidea at a glance:

- Multinational healthcare provider, with presence in 246 centres across 16 countries in Europe, providing high quality affordable care for millions of patients every year.
- Working with over 7,500 professionals, producing 13 million scans every year.
- Affidea is the only healthcare operator in Europe to sit on the Imaging Advisory Board of IBM Watson Health and also sits on Microsoft Cloud's board
- 50% of the European winning centres awarded by the European Society of Radiology belong to Affidea

# How to analyse past professional experience for future success

Reviewing performance for focused and effective learning

A New Year represents a time to focus, regroup and set new professional targets. Corporate trainer, Michael Virardi, provides tips on getting the most out of reflection time.



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**A**s we head into 2019, I'd like to share with you three of the most vital lessons I learnt last year.

## Don't be afraid to be vulnerable

I live on the small island of Cyprus where everyone knows almost everyone else and, because of this, I had come to believe that vulnerability was a sign of weakness and that what others might say about you was perhaps more important than the cry from within. Since reading *Rising Strong* by Professor Brené Brown, I have come to understand that concealing your feelings and presenting them as society dictates is certainly not a measure of courage but rather a yardstick of failure.

Being true to yourself and your inner feelings is not vulnerability but rather a philosophy for embracing situations, people and, above all, inner feelings.

Last year, I embraced vulnerability like never before. I stood in an auditorium, in front of 150 University College London business students and a dozen UK industry professionals and shared – for the first time ever since it happened – my decision to part ways with my wife-to-be just 23 hours before our wedding and with over 3,000 invitations sent out. I was emotionally exposed but it felt good to share a story that had been buried deep inside me for 12-years.

As Professor Brown says in her book, "Vulnerability is an act of courage because it helps us merge with

our authentic self instead of hiding behind a facade to appease others.”

My promise for 2019 is to be even more courageous as I have found vulnerability to be both liberating and the path to – and the birthplace of – connection.

### Preparation eats experience for breakfast

Legend has it that Abraham Lincoln once said, “Give me six hours to chop down a tree and I will spend the first four sharpening the axe.”

‘Sharpen the axe’ has been my mantra ever since I can remember. From the long and arduous hours spent every weekend, preparing our in-house seminars when I worked full time in the family business, to my recent 50 hours of preparation time to present to a demanding, capable and knowledgeable audience in New York City last September, preparation has always been key.

“ THE MINOR DETAILS ARE WHAT MAY MAKE A MAJOR DIFFERENCE IN YOUR PROFESSIONAL AND PERSONAL LIFE ”

The best preparation for tomorrow is doing your best today by crosschecking information, triangulating and making sure that you are fully prepared for each and every detail. The minor details are what may make a major difference in your professional and personal life.

### Do the one thing that matters most

I was browsing through the shelves of a bookstore at the airport when I came across a book entitled *The One Thing. The Surprisingly Simple Truth Behind Extraordinary Results*. After devouring it, I can vouch for the fact that it really delivers on its promise to help you cut through the clutter and achieve better results in less time.

Author Gary Keller and contributor Jay Papasan argue that achievers always work with a clear sense of priority. They also state their view that ‘To-Do lists’ are just survival lists which get you through your day and your life and that ‘Success lists’ are what we need: lists that are purposefully created around extraordinary results.

Below are some of the highlights that profoundly resonated with me. They are simple, direct, honest and, above all, immediately actionable.

- Focusing question: What’s the ‘One Thing’ I can do, so that by doing it everything else will be easier or unnecessary?
- Extraordinary results are directly determined by how narrow you can make your focus
- The majority of what you want will come from the minority of what you do
- Success is actually a short race – a sprint fuelled by discipline just long enough for habit to kick in and take over
- It takes an average of 66 days to acquire a new habit (University College London research)
- Our purpose sets our priority and our priority determines the productivity our actions produce
- Who we are and where we want to go determine what we do and what we accomplish

Based on the ‘One Thing’ philosophy, my top professional success priority going into 2019 is to complete an online programme (which will also be turned into a book) on the topic of public speaking.

### Live and learn

Every year I look back and see that, once again, I have lived and learned so many things. I have shared three with you that stand out for me as having been significant last year and, on the surface, they appear to be totally unconnected: discovering a positive side to vulnerability, recognising the incalculable value of preparation, and learning to prioritise. And yet, together, they have made me a better person and a better professional.

What did you learn in 2018? How do you intend to implement it in 2019? At the University of Life, in which we are all enrolled, learning never stops. ■

## KEY POINTS



- ✓ Vulnerability is strength and fosters authenticity
- ✓ Preparation is king; make adequate space for it
- ✓ Identifying and doing the one thing that matters most can save precious time and energy

# Is Blockchain the right technology for healthcare?

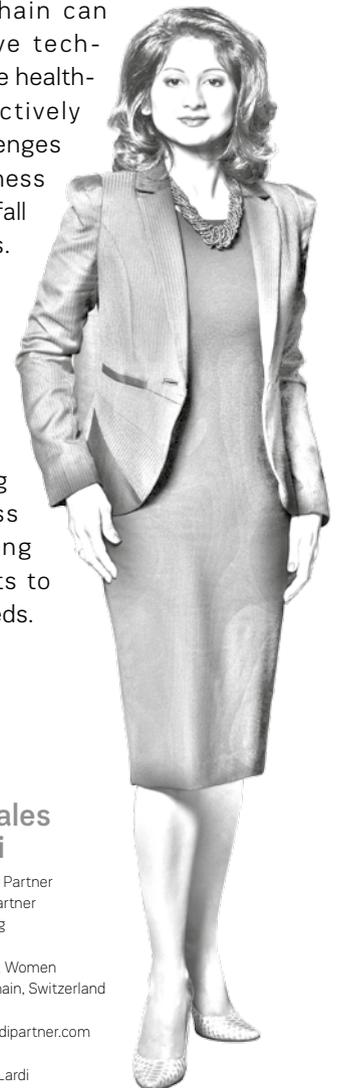
Blockchain technology is touted as being potentially revolutionary, but what's the view for the healthcare sector? Known for being an industry that's slow to adopt and adapt to new tech, could there be any value in Blockchain for healthcare? HealthManagement.org spoke to four Blockchain experts for their views.

**B**lockchain technology initially gained recognition in the framework of the cryptocurrency Bitcoin. However, the benefits of Blockchain go far beyond offering a simple payment method for medical bills and healthcare with cryptocurrencies. Blockchain is an immutable, digitally-distributed ledger system that provides the medical industry with real-time, universal records.

Application of Blockchain technology will allow all stakeholders in the healthcare industry to access a single source of records that are timestamped and tamper-proof, from anywhere in the world. In addition to patients being able to fully manage their data and control who gets access to it, they will be able to remain anonymous and, potentially even monetise their data. For example, there are new marketplace models that allow patients to receive tokens (cryptocurrency payments) in exchange for use of their data in pharmaceutical trials.

Blockchain creates new security and data privacy standards that never existed before. In order to tamper with records, all nodes in a Blockchain network need to be changed, making it extremely difficult to carry out. This prevents incidents that have plagued healthcare institutions where hackers accessed computer systems and held data ransom. The combination of Blockchain with other disruptive technologies such as artificial intelligence and internet of things enables real-time data collection, transparent supply chain management, increased integrity of clinical research results, optimised processes for payments, claims management, and regulatory compliance, to name a few.

I believe Blockchain can be a transformative technology solution for the healthcare industry, effectively addressing key challenges and disrupting business models that currently fall short of global needs. However, as with any technology solution, Blockchain is just an enabler. Successful transformation for the industry will depend on creating sustainable business models and changing traditional mind-sets to focus on people's needs.



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Firstly, there is no such thing as “the right technology for healthcare.” However, there are appropriate technologies to address specific challenges in healthcare, at least as long they are not replaced by the next technology. Blockchain is a distributed ledger. A distributed ledger is a database spread across several nodes where each node replicates and saves an identical copy of the ledger. Blockchain organises the database in blocks and validates addition to the database through a consensual method between nodes. Blockchain could address the problem of identities: a trusted source for the ID’s of citizen, care providers, and other stakeholders. This is a major problem in the healthcare sector which becomes even worse when it goes transborder. Blockchain cannot solve the problem of data interoperability, but it can address accessibility of data and trace exchanges. This would suppose however to have a trusted source for citizens and providers identities, which is not yet the case. Blockchain could help developing a global, shared and dynamic approach to consent management, crossing the boundaries of research and care. There are some other points, but the important message is that Blockchain is a great technology that will really help addressing specific important challenges of the healthcare system.

As a field that prides itself on data, technology, and being on the cutting edge, cardiology has the potential to benefit highly from a new infrastructure built to help implement evidence-based medicine. By decentralising information about patient care, research, cost effectiveness, and clinical outcomes, Blockchain technology truly has the power to recreate the foundation on which our system operates, providing a turbo boost in a field ripe for innovation. It could be the “X factor” that brings us to a next level we can’t even imagine. Overall, I see Blockchain playing an important role in cardiology in the years to come.”

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It is impossible for me to overstate the importance of Blockchain to the healthcare industry. Healthcare will increasingly move into the digital area, and that means sensitive healthcare data needs to be collected securely, shared, analysed and adequately controlled.

For all those steps, distributed ledgers are highly useful. For example, using immutable Blockchain technology, all stakeholders in the healthcare vertical can easily share data with anyone without the fear of data corruption or tampering. There will always be absolute proof and confidence that a medical

record, research data or anonymised genomic data, cannot be altered. Blockchain-based micropayments can help to incentivise people to participate in medical research by contributing their anonymised data to clinical trials. Using smart contracts and automated digital consents, patients can be empowered to manage their own health. Blockchain will also improve the pharma supply chain, enable trust-free collaboration, improve interoperability and help to fight counterfeit drugs and insurance fraud. Blockchain in healthcare will be particularly disruptive if it is combined with other technologies, ie artificial intelligence. Despite some resistance, there cannot be any doubt that Blockchain should and will disrupt and improve many parts of the healthcare ecosystem. ■

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# How Blockchain will transform healthcare

## Adoption of distributed ledger technology will benefit patients and providers

Blockchain is more than just a technology that allows us to do what we already do better, faster and cheaper. This peer-to-peer new technology has the potential to create a more inclusive economy, where patients can benefit from health data ownership.



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One reason people don't understand Blockchain is because we describe it rather than explain it. When we say Blockchain is a distributed ledger to someone who is not familiar with append-only databases, this is meaningless. It's like saying water is H<sub>2</sub>O without knowing the table of elements. In order to explain, not describe something, you must talk about the why or the intentionality behind it. If you say that water is the source of life, it sustains us, it makes more sense, it becomes meaningful.

So what is Blockchain? It is a distributed ledger, but the intention behind it is to obviate the need for a "trustful" intermediary. With Blockchain through encryption, transparency, immutability and verifiability of data you can directly rely on the truthfulness of information through a distributed trust network.

### The human-driven approach

The potential of Blockchain goes hand-in-hand with the human-driven approach or holacracy. Holacracy is a type of self-governance, which not only follows a mission but is also evidence-based, data-driven and situational-aware. You don't just see holacracy in start-up or entrepreneurial worlds; you see it in agile corporations and in the military. When battle ensues, military units take initiatives within their frameworks and start to self organise in order to complete the mission. This is very different from political representative democracy where we freely elect someone else to do our work. In fact, what we have seen is that the representatives we elect can collude, do things that are counter to 'the mission' they were elected for and can be self-serving. In comparison to other forms of

governance, holacracy is selfless and fearless in the way it achieves objectives.

The whole idea of Blockchain is based on not needing to rely on a privileged minority operating behind closed doors. This doesn't mean this is the age of distrust, but rather trust has shifted into a new form of distributed trust. Instead of trust flowing upwards to institutions, experts, authorities and regulators, it now flows horizontally to peers, friends, colleagues and fellow users. This distributed model creates a decentralised ecosystem that is attack-resistant, collusion-resistant and censorship-resistant, when compared to centralised organisations, institutions and governments.

### Empowering patients with Blockchain

If you take the attributes of censorship and collusion resistance and translate them into healthcare, you can understand it will bring a few important changes in how we practice healthcare. First, you can make sure that health data is not only secure but also private, and that the ownership of that data is controlled by the patient (aka self-sovereign).

Second, if you look at monetary transactions, it can disintermediate all kinds of third parties that lack value and create unnecessary friction that currently make the healthcare experience less pleasurable and increase costs. Third, and most importantly is that through behavioural economics using monetary (rewards) and non-monetary (reputation) incentives, Blockchain-based solutions can transform people from being passive health service consumers into health producers.

What makes Blockchain even more interesting is that what we can add to value-based or outcome-based care the opportunity to generate wealth through the use of tokens (utility tokens) or digitised assets (security tokens). What that means in practical terms is, today I wear a fitbit and it gives me information that stimulates me to be a health producer. But the data that this fitbit generates doesn't belong to me. It belongs to a company that can sell it without my consent and they will make money on it while I won't. That's not fair. Blockchain technology creates a more inclusive economy where if a company makes \$10,000, for example, on my information, I can get half of it and I can earn it through a utility token. In addition, through the use of security tokens, I can actually have fractional ownership of fitbit stock, which will incentivise me even more to use the platform. Blockchain really enables a human-driven approach in the sense that I can be the owner and earner of my information.

### Blockchain adoption is a question of time.

Blockchain will be more important for people who need it the most. In the western world, a lot of people sacrifice their privacy and their health and, to some extent, their wealth for the convenience and comfort of their lives. But the more you are existentially threatened and don't have the luxury to give up that health and wealth, the more you seek tools that empower you directly to be the master of your data. I can argue that I am too comfortable in my life to be bothered, but when will I be bothered? People will start to care when they understand the demands on their health, wealth and environment are unsustainable.

I also think it's a generational matter. Many people don't understand what self-sovereignty is in the sense they're so used to living in a centralised system that is opaque and full of friction, they sacrifice their sovereignty for convenience or because they don't believe a centralised world can be changed.

However, my 12-year-old daughter and her generation learn digital citizenry and what an interconnected interdependent world means. From their perspective, Generation Zers interact through non-monetary incentives leveraging their contributions to society through reputation (think YouTube or social media) as opposed to money. The younger generation doesn't expect parents or governments to help. They already practice holacracy by creating chat groups where they directly ask how to solve problems and

understand that bad actors who badly impact the community will be expunged because they make the whole system unviable.

### What's in it for healthcare?

What Blockchain does it is it changes the equation of value. Value today is usually thought of as quality divided by cost ( $V = Q/C$ ). So if something has high quality and low cost, it has high value. How does this equation work in healthcare? Mostly by lowering the denominator, in other words doing more for less. However excessive cost suppression (like not covering preventative care) has actually caused healthcare to be more expensive and people are dying younger and younger. So the current healthcare system offers a low quality proposition.

What Blockchain does is it transforms the value equation into what you are willing to give divided by what you want to get ( $V = \text{give/get}$ ). Using this equation, a patient who is not willing give up unhealthy behaviours (smoking, drinking, sedentary life), offers a zero-value proposition. A drug company that offers cost-prohibitive treatments and is not willing to give up profit has a zero-value proposition. A government that wants all of its citizens to be healthy but isn't willing to provide affordable care offers a zero-value value proposition. The Blockchain economy doesn't want everything cheap and easy, but is about creating a sustainable and resilient business-ecosystem, where all stakeholders share a common mission, taxonomy and sense of purpose. ■

## KEY POINTS

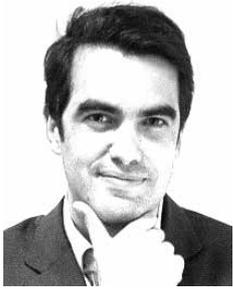


- ✓ Blockchain is a foundational technology that allows implementation of holacratic human-drive approach.
- ✓ Trust is embedded in the technology, through decentralisation
- ✓ Blockchain can make health records self-sovereign
- ✓ Patients will own their health data and its monetisation, incentivising long-term healthy behaviors
- ✓ The decentralised society Blockchain creates is already accepted by Generation Z

# Who stands to benefit from healthcare Blockchain?

Blockchain revolutionises data security, research and monetisation

Blockchain can provide the backbone for a health data infrastructure that enables patients to control and benefit financially from their health data.



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## The power of health data

The tsunami of personal data brought about by the digital revolution now extends far beyond consumer preferences, as monetised by Facebook, Google and the likes. As life sciences merges with information technology, our most precious health data is also being digitised. In the last 10 years, quantified health has gone from electronic medical records to massive DNA or microbiome sequencing. The Precision Medicine Initiative launched in 2015 prompted the National Institute of Health to create a research cohort gathering all available data for one million people, allowing scientists to explore why people get sick or stay healthy. With similar ambitions, Verily Life Sciences' (formerly Google Life Sciences), Project Baseline collects phenotypic health data from approximately 10,000 participants over four years to identify tipping points in the transition from health to disease. These initiatives are paving the way for better diagnosis, preventative alerts and more personalised treatments.

Beyond research, this new wealth of data is being used by the Food & Drug Administration (FDA) to modernise how it monitors the safety and efficacy of new products. The FDA's commissioner Scott Gottlieb laid out a clear policy for the agency in 2018: "we are expanding the opportunities for digital health tools to become a part of drug review, to couple these capabilities to drug delivery to form a drug delivery system."

But to fulfill the outstanding promise of digital health, we must still trust third parties with our most intimate data. Of course, regulations exist to protect our privacy. In the U.S., the Health Insurance Patient Portability and Accountability Act (HIPAA), was enacted

in 1996 to secure the confidentiality, integrity, and availability of electronic Patient Health Information (ePHI).

HIPAA imposes technical safeguards and processes to restrict access to data, avoid or report any disclosure. But HIPAA compliance is mostly self-declared, and providers share information freely with third parties, provided they sign a Business Associate Agreement. This transfers responsibility to third parties, but it does not extend controls. Most startups analysing ePHI on behalf of providers will say they comply with HIPAA. Few are ever audited.

## Blockchain's privacy promise

It should come as little comfort to patients that unauthorised access to ePHI is commonplace. The numbers are staggering. HIPAA breaches affected more than 5 million patient records in 2017, 27 million in 2016 and more than 100 million in 2015. More than a third of medical records have been compromised in the last five years, mostly because of insiders mishandling our data. With such figures, and lack of trust undermines the very willingness of patients to share sensitive information with care providers.

Because the laws that try to protect our privacy have essentially failed to achieve desired results, we urgently need to invent tools that let patients become the custodians of their own data. The good news is that this is exactly the value proposition of Blockchain for healthcare.

How does it work? Today, no patient knows where his health data goes for lack of access to transaction logs ie who shares what with whom. By distributing

ledgers of transactions across all participants (nodes) in a given network, Blockchain essentially creates trust by design. Indeed, no participant of the network can falsify the log, because a consensus algorithm reconciles the information across nodes, spotting any discrepancy. This means each participant, ie patient, knows at all time what happens to his data. It also offers a way to share the same information with all stakeholders in real time, fine-tuning who has access to de-encrypted data.

“ THE LAWS THAT TRY TO PROTECT OUR PRIVACY HAVE FAILED TO ACHIEVE THE DESIRED RESULTS; PATIENTS NEED TO BECOME CUSTODIANS OF THEIR OWN DATA ”

To avoid any misconception, only the information on the Blockchain is public, ie the index of what data is shared with whom. Sensitive patient data, however, can stay off-chain, secured in HIPAA compliant clouds, in accordance with legal requirements. Transparency with Blockchain technology is a first step to allowing patients own their data.

### Revolutionary elimination of the third party

Ownership goes beyond controlling how data is shared. It involves appropriation of data as an economic asset. But today, our records are being sold without patient buy-in. Typically, when life sciences companies investigate a particular disease, they are required by regulators to benchmark the efficacy of new treatments or monitor the safety of new. Studies are slow and expensive. Brokers will buy datasets from hospitals and pharmacy chains, and resell it to pharma, for what constitutes a \$15 billion business. The emergence of new digital platforms has created new ways to acquire medical records. For instance, when Roche bought Flatiron (a software vendor that tracks cancer data) for \$1.9 billion, it got hold of the complete medical history of 200 thousand patient records. This valued each record at nearly \$10,000. Even if pharmaceutical companies have good reasons to acquire these datasets, ie accelerate the discovery of new treatments, patients never get a single dime for their own data.

Here, Blockchain opens up a revolutionary possibility: for the first time, individuals will be able to own their digital assets. Quite simply, distributed ledgers eliminate the need for a third-party reseller. It makes it possible to automate payments in cryptocurrencies via smart contracts. A person can be paid for giving his consent to his data being aggregated within a cohort.

### Data as ‘Information Age’ oil

The technology is here. Now, the law must also evolve to treat personal data-like property, much in the same way that it evolved to create real estate laws when land was the prime asset, and to invent intellectual property and finance during the industrial revolution. This would secure equitable trade for the Information Age’s new "oil". Citizens should be able to grant licenses on their data for specific purposes and be compensated with royalties. This would also mean outlining the difference between data that cannot be sold, for instance one’s name or age, and that which represents an economic asset

In healthcare, the stakes far exceed the business of selling health data, even though the possibility of compensating patients does offer a promising new way to reduce their economic dependence. Pricing data provides unprecedented transparency, as opposed to current-day opacity. More importantly, giving patients access to a marketplace where their health data could be funneled into clinical research expands their medical options. This is especially true for rare diseases, where wider access to data is acutely needed, and holds the potential to radically accelerate the development of treatments, and monitor their effects in real time. ■

### KEY POINTS

- ✓ Health data is used for health and drug safety purposes, amongst other research
- ✓ Unauthorised access to health data is commonplace
- ✓ Patients rarely know how their health data is used and monetised
- ✓ Blockchain provides framework for patient control over data
- ✓ This increases monetisation opportunities for patients and greater access to medical options



# Blockchain solves healthcare data obstacles

## Incentivising patients with tokenomics of health data

A cryptocurrency that represents the value of health information can motivate individuals to make their health data shareable to those who are willing to pay for it.



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Tokens are well established in the context of Blockchain technology and cryptocurrencies. It's a digital asset that has a utility or a payment function. Very often, it's a hybrid token and possesses both properties. However, technically, it is just a piece of cryptographic code of no intrinsic value. Although Blockchain and its related cryptocurrencies are a recent development, tokens have been the subject of psychological research for a long time.

In psychology, tokens are used to shape a target behavior, and therefore tokens have to be backed by reinforcers. A relation between a token of no intrinsic value with an unconditioned reinforcer like food or a conditioned one like money has to be established by reinforcement. The law of effect (Thorndike 1898) describes that behaviour which is followed by pleasant consequences as having a higher likelihood of being repeated, whereas unpleasant consequences decrease the likelihood of repeat behaviour. The effectiveness of a token reward as a means of behaviour modification has not only been observed in humans but also in primates (Wolfe 1936) or pigeons and rats (Skinner 1948; Skinner 1953). In humans, it is often applied in cognitive behavioural therapy and childrearing.

But how does that apply to health data and how could the tokenisation of health data be the solution of some of the most pressing problems in modern healthcare?

### Health data as the currency of healthcare systems

Modern healthcare runs on data. Everybody is on the hunt for data in order to optimise processes or

develop better therapies. Tremendous amounts of data are being generated by medical documentation, regulatory requirements, and patient care (Raghupathi 2010). In addition, precision medicine and the general trend of digitisation in healthcare lead to a constant rise of data being gathered at the individual user or patient's level (Andreu-Perez et al 2015; HM Government UK 2014). Another driving force in this massive growth of data is the individual himself when using a fitness or wellness app.

“ TODAY, IT IS STILL DIFFICULT TO SAY WE LOOK AT THE WHOLE PATIENT FOR THE FOLLOW-UP OF CHRONIC AND COMPLEX ILLNESSES ”

There are only estimates what personal health data are worth, but it can be deducted from what companies are willing to invest in order to gather those data. IBM bought Truven Health Analytics for \$2.6 billion to train Watson on 200 million patient records, meaning that one record was worth 13 USD. It is a low price if you take into account what pharmaceutical companies invest in order to gather clinical trial data and real-world evidence. Prices that are being paid for so-called post-market surveillance might be a good indicator of the data value, with an average of €441 per patient paid to the physician providing the data (Spelsberg et al 2017).

It is needless to say, that in today's data economy,



in external repositories and share revenues with the information holders such as personal health records, claims processing companies, hospitals and pharmacies. The central asset to be exchanged in the HIT-ecosystem is information that has a token value attached to it. The token value depends on how much the network participant values the information in question.

“A BLOCKCHAIN-BASED TOKEN SYSTEM WOULD PUT PATIENTS IN CONTROL OF THE USE AND MONETISATION OF THEIR HEALTH DATA”

#### Use cases for tokenising health information

- **Research**  
Researchers have direct access to potential study participants
- **Population health data**  
Population survey and representative surveys can be conducted via contacting individuals directly
- **Compliance Support**  
Individuals receive tokens when predefined

health goals that are incorporated in a digital contract are achieved.

#### Solutions with Blockchain-enabled ecosystem

Such a distributed ecosystem can be implemented with Blockchain technology, making transaction processes transparent and more efficient at the same time. A Blockchain-based token system is predestined to align incentives among ecosystem participants, for example, providers of health information and those who want to analyse health data. It allows the latter to have direct access to providers of health information without the need for intermediaries. At the same time, it puts individuals in control of the use and monetisation of their health data. Tokenisation of health data motivates individuals to make their data shareable, thus solving the fundamental problem of modern healthcare. ■

#### KEY POINTS

- ✓ Healthcare runs on huge volumes of data
- ✓ Value of health data varies
- ✓ Patients can be financially-incentivised to control their health data
- ✓ Blockchain technology can facilitate establishment of decentralised data marketplace



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# Is Blockchain impacting the healthcare arena?

The Blockchain race in healthcare has yet to begin

Supporters say it has everything to offer healthcare security and transparency, but what do practical, on-the-ground C-levels really think about Blockchain's potential today?



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While the technology trend-o-metre and cryptocurrency world at large set off fireworks of exciting talk and disruptive use cases with Blockchain, the healthcare industry, by contrast, sits on the sidelines today as a mostly casual observer. Or maybe even as an opponent.

When you consider that Blockchain is said to make data more secure and more transparent, more available and more reliable, the truth is that the very minimal use of Blockchain in healthcare today just doesn't seem to make a lot of sense.

In fact, with effective data sharing and security representing two of the biggest health information technology (HIT) issues that we struggle with, you would naturally think that the built-up frustration around interoperability and the high-profile recent cybersecurity attacks would create the ideal environment in which Blockchain would take off. Not so fast.

## The healthcare C-suite views on Blockchain

Taking a step back to seek out the on-the-ground perspective and experience of healthcare CIOs and CISOs, the current hesitation on Blockchain becomes more clear, perhaps even pronounced.

Asked if they would use Blockchain in the future, three healthcare CISOs of influence and recognition each shared with KLAS that, without hesitation, today they do not plan to use Blockchain for future projects. Following are key reasons they shared that contribute to their current conclusion, along with context and insight from KLAS on each topic.

### Bleeding edge

To use Blockchain means you are not just leading out in terms of a new technology standard, but that you are operating on the bleeding edge.

### KLAS context and insight

Healthcare organisations historically tend to be risk averse, and understandably so. Changes in health information technology and new, unproven standards are often questioned—if not directly perceived — as placing potential or actual risks on direct patient care. To be on the bleeding edge in terms of technology use and adoption gives healthcare providers concern that clinical care could be impacted. For healthcare, the bleeding edge isn't just a matter of innovation where something could turn out to be a mistake and a widget is compromised—it could possibly lead to bleeding or other problems at the hospital bedside. In healthcare, the quest for safety almost always comes before starting a race on innovation, thus introducing a likely delay in the timing with which healthcare providers adopt Blockchain or other new technologies.

### Lacking vendor adoption

If vendors don't actively embrace and support Blockchain, the technology isn't feasible for the sector.

### KLAS context and insight.

The idea of a new technology standard in healthcare, particularly as it relates to interoperability, is anything but new. In recent years, standards such as Fast Healthcare Interoperability Resources (FIHR), Carequality, CommonWell, and others have come on the scene in hopes to help crack the thick interoperability nut. There is a great deal of industry talk about FIHR, and the recent connection of CommonWell to Carequality provides promising opportunity. However, we have not arrived at the destination of a healthcare industry-wide and deeply adopted standard for all, despite the best efforts of various healthcare leaders, influencers, and even the government.

Active support and ongoing investment from the HIT vendor community in Blockchain is only just starting—at best — thus leaving healthcare provider organisations with uncertainty about the future of Blockchain and with reservations about if and when to jump in.

It's not just a vendor thing, though. All stakeholders have a part to play. While not specific to Blockchain but still related to security, one interesting and important development KLAS has noticed is that some leading US healthcare organisations, including the Cleveland Clinic, Tufts Medical Centre, University of Pittsburgh Medical Centre, and others have joined together to mandate that, within the next 24 months, any third party vendors desiring to work with them must adopt “standard cybersecurity measures and achieve certification to demonstrate their products and services are safe and secure for use in a hospital or other patient care settings” (Tufts 2018). For Blockchain to be valid and valuable, support from the HIT community – vendors and healthcare organisations – will be necessary. That mature support is years away, if it ever fully comes.

“PROMINENT CISOS EACH SHARED WITH KLAS THAT TODAY THEY DO NOT PLAN TO USE BLOCKCHAIN FOR FUTURE PROJECTS”

### Shiny toys don't guarantee shiny results

Blockchain today is a shiny toy, but it's still far from practical.

#### KLAS context and insight.

Just a decade or so ago one could have argued that electronic health records (EHRs) might be shiny toys, far from reality or practicality. While the value and clinical effectiveness of EHRs are widely researched and disputed, it's common knowledge that nearly all hospitals use EHRs, with billions of dollars across the industry put into development, support, purchases, and enhancements of those systems today. With regard to Blockchain, the question stands, over the next decade, will Blockchain see such a rise?

The handful of respected healthcare professionals who have shared their views with KLAS thus far have

a difficult time seeing the landscape beyond the mountain of uncertainty and hesitation today. One CIO shared with KLAS that they are “watching Blockchain” but “don't think anything is happening. Some payers are using it. Some claims clearinghouses are using it. It is something that could be really cool, but it is still really in its infancy, and there are not a lot of use cases you can attach to it.”

The shine from what healthcare provider organisations today perceive as a “shiny toy” is far from shiny results. With the continued advance towards and pressure from value-based payment and models, the industry is turning its focus to practical results.

### The future of healthcare Blockchain So, what does all this mean for Blockchain in healthcare? Is it doomed?

No. Even among the respected healthcare CIO and CISO leaders who have been candid in sharing their views with KLAS about Blockchain thus far, Blockchain pilots have either already taken place or are actively underway. And while in healthcare the technology isn't seen as productive or practical as of yet, it's also not being written off. The potential and promise of Blockchain has certainly not taken hold, but its demise is not certain, either.

Simply said, the Blockchain race in healthcare just isn't a real race yet. ■

## KEY POINTS

- ✓ Healthcare is watching Blockchain closely but with reservations
- ✓ In healthcare, patient safety usually (and understandably) takes precedence over innovation
- ✓ Prominent CISOs say they don't see a use for Blockchain in the near to mid-term
- ✓ HIT community support for Blockchain is still in the distant future
- ✓ It's early days for HIT Blockchain viability, but the tech has not been written off



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- Harnessing Big Data to better plan and monitor the purchase and provision of care

IFC—a member of the World Bank Group—is the largest global development institution focused exclusively on the private sector in developing countries.



*Creating Markets, Creating Opportunities*

# Can Blockchain support advances in radiology?

In 2019 we will embrace Blockchain and innovation as necessary support for the healthcare of our time.

Blockchain can influence the design and implementation of new models by refining data security; provide more robust audit trail mechanisms required, eliminate medical imaging acquisitions repetition, reduce transaction costs, while allowing clinicians to access data easily, compare images, and provide patients with better and quicker treatment options.

The main technology trends of 2018 that have been identified in Healthcare such as AI, machine learning VR/AR, Internet of things (IoT's) and Blockchain, should not be seen as "trends" anymore.

In fact, in 2019 we will move from viewing these as over-hyped buzzwords to embracing them as necessary support for the healthcare of our time.

The acknowledgement of the potential of these technologies brings new opportunities for flourishing new economies, new business models and most importantly the leverage for enabling true citizen-centric care and efficiency in the care process.

Even though the healthcare landscape has seen benefits from these technologies, the industry is still on a learning process to better understand how to fully unleash these tools.

## Blockchain as enabling technology for teleradiology

It has been said that approximately 90% of the health data generated is medical imaging. A study indicated a growth of 35 ZB of imaging data by 2020 produced by the world's devices (Alexander et al. 2018). In such a scenario, it becomes critical to establish secure, reliable and efficient processes and tools for exchanging and leveraging this growing wealth of data toward improving clinical outcomes and overall efficiency along the care process.

At the same time, such great amount of data

is exposed– with the current technologies and approaches, to high risk of cyberattack. Fragmented PACS systems, siloed databases for different kind of data (notes in one system, medicine records in another system), has made it very difficult to properly use data while ensuring proper security.

“ APPROXIMATELY  
90% OF THE HEALTH DATA  
GENERATED IS MEDICAL  
IMAGING ”

As a consequence, it is not surprising that several cyberattacks have affected a fair number of organisations and institutions. One of the most notable ransom attacks called the WannaCry in 2017 was yet another reminder of the vulnerability of healthcare organisations and the need of continuously finding better ways to protect patient data but also obtain and maintain trust in the ecosystem and most importantly patient trust.

In such a scenario, Blockchain could likely influence the design and implementation of new storage models by not only refining the security of the data and providing more robust audit trails mechanisms required by regulatory bodies, but also eliminating the repetition of medical imaging acquisitions,



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reducing transaction costs, at the same time allowing clinicians to have access to data more easily, compare images, and provide patients with better and quicker treatment options.

Such innovations can be of benefit in enabling distributed teleradiology, allowing offsite and onsite diagnostics to read data while providing transparency to all parties in the care chain.

A real-world implementation of the above-described scenario was presented at the 2018 Radiological Society of North America (RSNA) annual meeting, where Medical Diagnostic Web (MDW) presented the first radiology Blockchain platform for connecting stakeholders of the imaging ecosystem.

### Blockchain and AI: teaming up for improved care

The usage of AI and machine learning for processing large data sets, imaging analysis and clinical decision support, is becoming more and more widespread worldwide, along with progressive demystification of such technologies. Indeed, the importance and efficiency that is gained from AI in the field of radiology is currently becoming more and more difficult to argue against.

In particular in image analytics, AI – thanks to its pattern recognition and data-crunching capabilities, can play a fundamental role to support radiology departments to deal with the ever-increasing amount of available imaging, making sense of such enormous quantity of data and extracting valuable insight for improving diagnosis and therapies. It doesn't therefore come as a surprise that the relevant AI in the medical imaging market is expected to grow to 2 billion USD by 2023, according to recent forecasts (Harris 2018).

Still, it is very important for the proper and successful implementation of these technologies in an operational environment, that a thorough learning phase is completed. In such a scenario, introducing a more open, distributed, and “democratised” way of accessing and sharing medical images, via Blockchain-based open and distributed database, could dramatically improve AI training process at the same time reducing the risk of biases of the resulting algorithms, by taking data from a variety of sparse and different sources, therefore improving clinical value.

Such a new open environment would greatly contribute in improving interoperability and

accessibility, as key drivers for delivering proper care at the right time.

Additionally, and coming to a conclusion, a further layer of security and trust in the data exchange process could be added, also outlining a greater role for patients, by using smart contracts. In such cases, in which data are openly available but still in control of the relevant providers and of the patients/data owners, personal smart-contract based tools could be entrusted by the patients for sharing the data on the basis of specific and pre-defined consent and permission options – seeking for second opinions and allowing for data access by third party (and data-driven services) in an automated fashion.

In conclusion, DLTs and their “cooperation” with AI hold great promises for the future of radiology and healthcare at large, but we must always remain mindful of the fact that an environment of trust remains a challenge, for all parties within institutions and between patients and healthcare providers. ■

## KEY POINTS



- ✓ 2018 main technology trends in healthcare such as AI, machine learning VR/AR, IoT and Blockchain, should not be seen as “trends” anymore.
- ✓ Approximately 90% of the health data generated is medical imaging.
- ✓ Fragmented PACS systems and siloed databases make it very difficult to properly use data while ensuring security.
- ✓ Blockchain can benefit imaging by enabling distributed teleradiology, allowing offsite and onsite diagnostics, providing transparency to all parties in the care chain.



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# Can Blockchain change the healthcare ecosystem?

Discovering the potential of Blockchain development; pursuing advantages of creating decentralised architectures.

This article presents an abstract concept and predictive benefit of applying Blockchain technology in the healthcare ecosystem. Some current working use cases show the potential short-term benefits of Blockchain database replacement.

**D**ata sensitiveness by nature and by law prevents it to be shared freely among institutions—a silent obstacle—building barriers we find surrounding each of the clinical operations. Interoperability is a necessary element to enable the seamless distribution of medical data in order to provide patients with efficient treatment and eliminate miscommunication. From a medical viewpoint, Blockchain technology originally embraces some deployment features, in addition to, propelling digital-driven healthcare counterparts.

## Who owns medical data?

Medical information is respectively administrated within the specific healthcare institutions, derived from a patient's data and diagnosis and is kept in its original format regardless of the standard within which similar categorised operations share it. It burdens the patients and healthcare providers, when they wish to visit other facilities, as data which can not be evaluated or analysed through consecutive formats is of no use or value. The Electric Data Interchange has revealed critical issues among different services that are harnessing information on a medical database with limited interoperation and a 'connected' environment. From a business point of view, this is a nasty arrangement that leads the customer/patient to reject their services and never come back again as a consequence.

Furthermore, what is worse, the data had been sold to third parties without the permission or agreement of patients and without ensuring any data safety provisions in some cases. Medical data is one of the most sensitive assets for an individual. From Pew Research analysis, "Americans Consider Certain Kinds of Data to be More Sensitive than Others" in 2014 (Madden 2014), over half of American respondents said they consider private health and medical information to have the highest sensitivity level among all their data.

Exponentially, with the enormous amount of data in healthcare, both the administration of this data and patient usability becomes significant. Blockchain technology is expected to disrupt the concept of privacy settlement from centralised ownership to empowering the individual management of personal data.

The asset in the case of Blockchain is that once you have received any medical information in the clinic and are diagnosed with a specific symptom, your medical record inherits a personal database and is encrypted in real time. As this output is not governed by any third party, it will be able to submit unbiased or altered information within the available environment.

The government has tried individual data authorities; My Health My Data ([www.myhealthmydata.eu/](http://www.myhealthmydata.eu/)) for example is a European project, aiming to create a transmittable medical information transaction by storing data on Blockchain.



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From the operational point, a Blockchain database is capable of retaining multiple adaptations in parallel among some medical institutions, by all means increasing effective access while releasing data management from centralised ownerships.

### Who covers security costs?

The onslaught of data theft further burdens health-care providers with issues of liability concerning information ownership, the constant need to strengthen security teams and the increasing cost of compensation. This will continue to put great pressure on institutions that have large centralised data pools. In 2015, the Japanese Pension Service was hacked and 1.25 million files of personal data were leaked instantly, including sensitive personal information like people's pension IDs, names, addresses and birth dates, according to a report published in the Japan Times.

“THE PROBLEM BECOMES WORSE SINCE THERE IS ALREADY A SHORTAGE OF RADIOLOGY SUBSPECIALISTS IN THE US TO MAINTAIN SUFFICIENT SERVICES”

This incident happened as a result of an agency officer opening a suspicious file which then instantly infected the PC. All emails sent from there contained the virus and helped it spread infecting the entire administration core storage files simultaneously. When it comes to preventing a data hacking invasion from outside threats, it is not easy to predict; education and anti-virus software alone are not enough, a comprehensive safety plan requires serious scrutiny inside the management process. In accordance with the set protocols in any operation structure and the relevant data sharing regulations put in place, the owner of the information is held accountable and forced to pay attention and do the utmost to predict and protect the network against potential unknown attacks. In particular, medical data is one of the most valuable and sensitive sets of information and contains varieties of tangled asset records. Patients and healthcare providers are becoming more anxious demanding that their security service is perfect, in an effort to prove the best safety capabilities against

a hacking incident and potential targeting, otherwise risking to lose customer trust and ultimately any profits to their bottom line. Evaluating the security costs of implementing adequate measures strong enough to avoid critical assaults requires expertise and additional cost.

Recently, Korea's Myongji Hospital announced they signed an agreement with BICube, to collaborate on the development of a Blockchain-based medical information exchange system. In the recent announcement by the hospital, the main purpose of the agreement is to “Build a hybrid cloud that combines public and private clouds, and to secure the safety of online medical information exchange system by combining blockchain technology in the process of exchanging medical data through the cloud”, essentially to combine Blockchain technology and a cloud database (Myongji Hospital News 2014).

Managing medical information will require a great deal of expenses on behalf of the data holder, it is therefore preferable to adopt a decentralised operation system cutting cost in the long-run of all future endeavours.

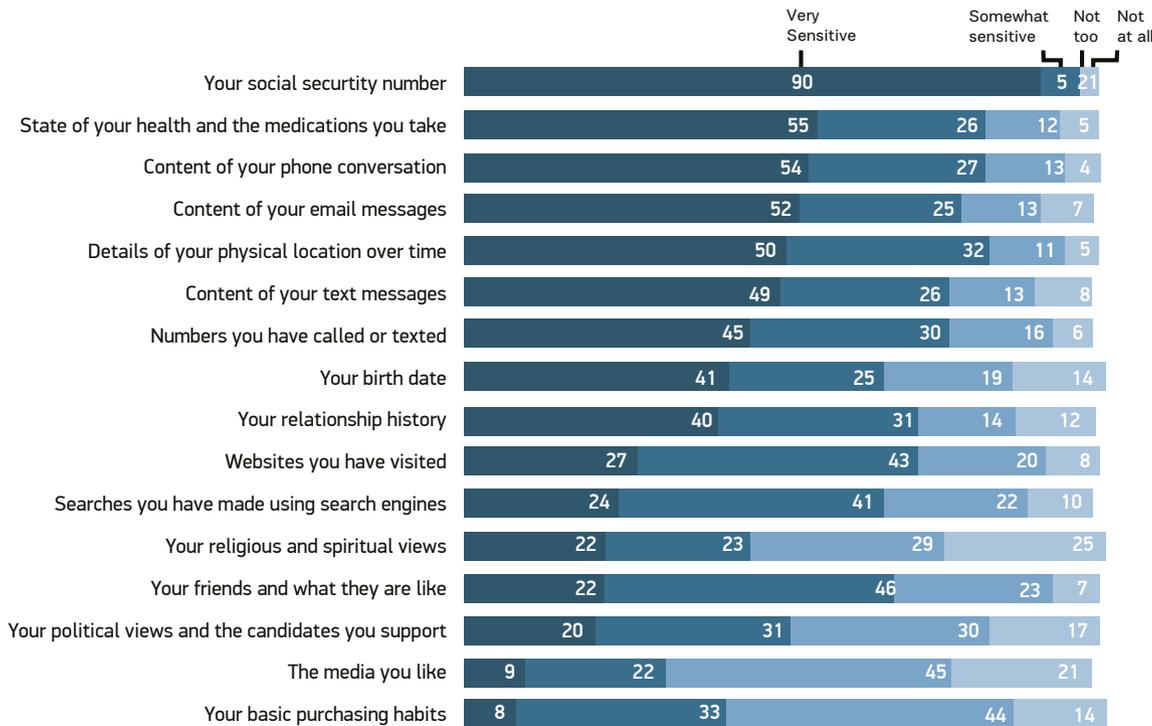
### Who trusts the information?

Pharmaceutical supply chains are faced with immeasurable issues, in the meanwhile, from the top to bottom of their distribution, to take measures that will prevent contaminated drugs and errors in the mixture of drugs until they are ready and placed for sale in retail drug stores and pharmacies. According to a recent World Health Organization report, counterfeit drug production has been increasing; the top three countries where threats originate are India at 31%, UAE at 31% and China at 20% (Robles et al. nd).

A few years ago, there were serious incidents in Paraguay and Pakistan when a large number of patients were administered cough syrups containing contaminated agents while they were in the hospital. Although these incidents affected many people, manufactures and the hospitals were unaware and unable to provide tracking to the original sources of this supply chain. Despite the severity of the contamination, the complicated routes of the data could not allow officials to locate the precise factor of infections in order to provide timely treatment to the infected patients. Information asymmetry leads to ubiquitous consumption ratios and inescapable influences due to unknown nature of the structure, so that traceability is recognised as an imminent requirement in order to recall and clear the tainted drugs from the

### Social security numbers, health info and phone conversations among the most sensitive data

% of adults who report varying levels of sensitive about the following kinds of info



Source: Pew Research Privacy Panel Survey, January 2014, N=607 adults, ages 18 and older.  
PEW RESEARCH CENTER

entire distribution channels.

Pharmaceutical giant, Novartis has started to experiment with the use of Blockchain technology since 2016, even at the early stages of Proof of Concept, in an effort to demonstrate an imagined future with IoT harnessing services, storing temperatures and the ability to locate and identify counterfeit ingredients inside supply chain provisions.

Having the data to track elements of the distribution chain like the spots where the delivery truck has been routed through for example, or how and when the products are delivered to the final vendor will help to increase the accuracy and minimise the margin for outside tampering of products. Besides, the tamper-proof Blockchain database guarantees increased quality of trust compared to the current mostly handwritten documentation records while securing preventive storage against intentionally malicious attempts.

### Who insures your healthcare security?

Medical insurance provides access for financial support while you are making payment with negotiating discounted prices and in some cases supported from third party payers and government healthcare systems. However, the insurance process gets more complicated through a series of identification and assessment requirements within each specific payment coverage and the potential of accepting or denying a patients claim. Currently, most insurance contractors spend significant time intervals, even when the patient has been diagnosed with a clear and acceptable healthcare symptom, because of congested administrative processes; and the patient is left to wait until the needed verification in order to receive treatment.

Healthcare data is continuously being refined through beneficiaries to be able to provide more

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accurate information yet needs to be rethought by minimising the effect of human error. This entire verification system costs both in financial and human resources capital to complete, maintain and manage. Blockchain technology provides the tools to help decompose these complex procedures, improving the shortage of information and data, replacing them to integrate data flow in a single operation.

Actually, new healthcare organisation alliances have started out between groups of insurance providers. UnitedHealthcare and Humana, Optum, Quest Diagnostics and MultiPlan are now launching Blockchain pilot programmes, helping out payers to tackle complex bureaucracies within their organisations. These programmes focus on improving data quality and eliminating the administration procedures, to pursue cost efficient operation.

“ A DECENTRALISED  
BLOCKCHAIN PLATFORM THAT  
CONNECTS HEALTHCARE  
FACILITIES, RADIOLOGISTS  
AND AI ALGORITHMS, ENABLES  
RADIOLOGISTS TO PREVIEW  
AND PURCHASE VERIFIABLE  
ALGORITHMS ”

According to healthcare IT news, insurance providers have received similar requests from dozens of payers. It takes a lot of time and money to reach out to providers on each 90-day cycle. Congested calls and emails delay those inquiries, heavy access traffic jams.

In this pilot, alliance members curated information to be shared, confirming the overlapping with other provider's data and highlighting the need to prevent the duplication of processes within each of them.

### How to deal with patient images?

Medical imaging information is sensitive and crucial for both diagnosis and treatment. The patient retains ownership of the imaging data, and has secure individual rights against any service provider failing to protect the data from risk of leaking or malicious manipulation. In the US, the Health Insurance Portability and Accountability Act (HIPPA) defines the rule of privacy and medical data security; respectively

enterprises need to follow this enforcement, in terms of administrate privacy and medical data (Edemekong et al. 2018).

In 2015, there was a massive hacking incident that leaked more than 3.9 million patients' medical information nationwide by EHR vendor Medical Informatics Engineering. In this case, the electronic healthcare record vendor was suspected to be in violation of HIPPA rules and other state regulations, and held accountable for the breach of records including radiology patients.

In this case, the electronic medical record vendor was in direct violation of the process of operation to store information, and handle sensitive patient data. The problem becomes worse since there is already a shortage of radiology subspecialists in the US to maintain sufficient services. According to the Merritt Hawkins figure the number varies from the 2016 ACR Commission on Human Resources Workforce Survey in the article published in Diagnostic Imaging showing 28% of the radiology workforce is 56 or older (Kaplan 2016). In both cases, though, a significant number of radiologists are nearing retirement age. It is evident that there is a need for more resources to improve service delivery.

In order to solve this issue, the MDW project, a decentralised Blockchain platform that connects healthcare facilities, radiologists and AI algorithms, enables radiologists to preview and purchase verifiable algorithms to enhance their practice. Radiologists gain compensation once their report is accepted. This results in lower costs giving radiologists the ability to access high quality expertise.

There is a lack of talent to manage the current medical system structure. As such, it is unable to sustain the needs of healthcare overall and imaging in particular. These issues can be resolved with new technology like Blockchain. Blockchain databases can help secure the environment by following the regulatory requirements and by only distributing encrypted information more efficiently.

### Who is aggressively betting on healthcare Blockchain?

From PwC's 2018 Global Blockchain survey, 49% of global healthcare companies have started Blockchain pilot programmes (PwC Global Blockchain Survey 2018). Even though this survey was conducted within a limit of 74 healthcare enterprises, other evidence suggests there is an increase in healthcare trials using Blockchain pilot programmes.

From the healthcare perspective, it tends to combine health privacy data with payment or other financial access. Some companies explore the technology as an alternative to the traditional process that requires endless paperwork and human centric enforcement. Blockchain companies are making a move to explore the potential of the healthcare market, adding significant value by cost cutting and providing simplified overall management.

### How to build a decentralised operation system in healthcare?

In terms of healthcare areas, a decentralised network facilitates private data transformation from a centralised database to the individual end user or owner of the data, the patient. In accordance with the growth of health-tech and medical-tech innovation, data ownership has certainly come on the table, and solutions to tackle the sovereignty issues of ownership and privacy will ultimately be provided by new platforms. As a result, architectural concepts will have to be changed while information ownership and individual control will rely on the effective operation of these platforms.

Basically, when it comes to the application of Blockchain, it is important to involve all the stakeholders, visualise a consensus algorithm and incentive structure, and choose an appropriate governance and maintenance model. It is also important to consider some risks in advance that could possibly have an impact on governance or breach the rules.

However, the entire mechanism differs from the number of audiences and stakeholders; moreover, consensus algorithms influence the management block scales in consequences. Regardless of the technical aspects, government regulation is going to enforce Blockchain modeling unless it conflicts with enacted items on existing laws. Data privacy is controversial and on the table in a constant attempt to 'synchronise' governance and technology innovation. Ultimately, Blockchain systems will be utilised as

certification credits in order to prove data accuracy.

For example, the American Drug Supply Chain Security Act (DSCSA) outlines the steps required to build an electronic and interoperable system, capable of identifying and tracing prescription drugs distributed in the US market (Drug Supply Chain Security Act FDA). In order to protect consumers from contaminated products and otherwise harmful incidents, companies need to adhere to legal frameworks set in place for distribution. However, regulatory requirements are not the same between multilateral nations, so that it is now necessary to develop solutions such as Blockchain pipelines with the potential to securely service international healthcare delivery systems.

In conclusion, Blockchain is a decentralised database, potentially a tool that will be widely implemented in the next generation of our society to disrupt traditional healthcare ecosystems. However, we still have to fill knowledge and experience gaps by empirical operation and trials in various areas to determine how this technology can be further applied in healthcare and imaging as a natural extension.

From industry and government viewpoints, the inclusion of multiple stakeholders is the key element, even at the stage of discussion because Blockchain solutions must combine each player of the healthcare continuum if they are to produce meaningful value. ■

### KEY POINTS



- ✓ Data ownership discussion becomes more serious by harnessing Blockchain-based operations
- ✓ Accurate traced information secures customer protection under the regulations
- ✓ Single pipelines are more cost effective than congested current operations
- ✓ First experiment, second create the standard, third follow with operation



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# Blockchain for radiology

Key areas where Blockchain has the potential to spark a revolution & increase quality while decreasing healthcare cost.

Blockchain is an exciting new technology that promises to address many problems that exist within the current framework in radiology. We discuss three key areas where Blockchain can potentially spark a revolution and increase quality while decreasing healthcare cost.



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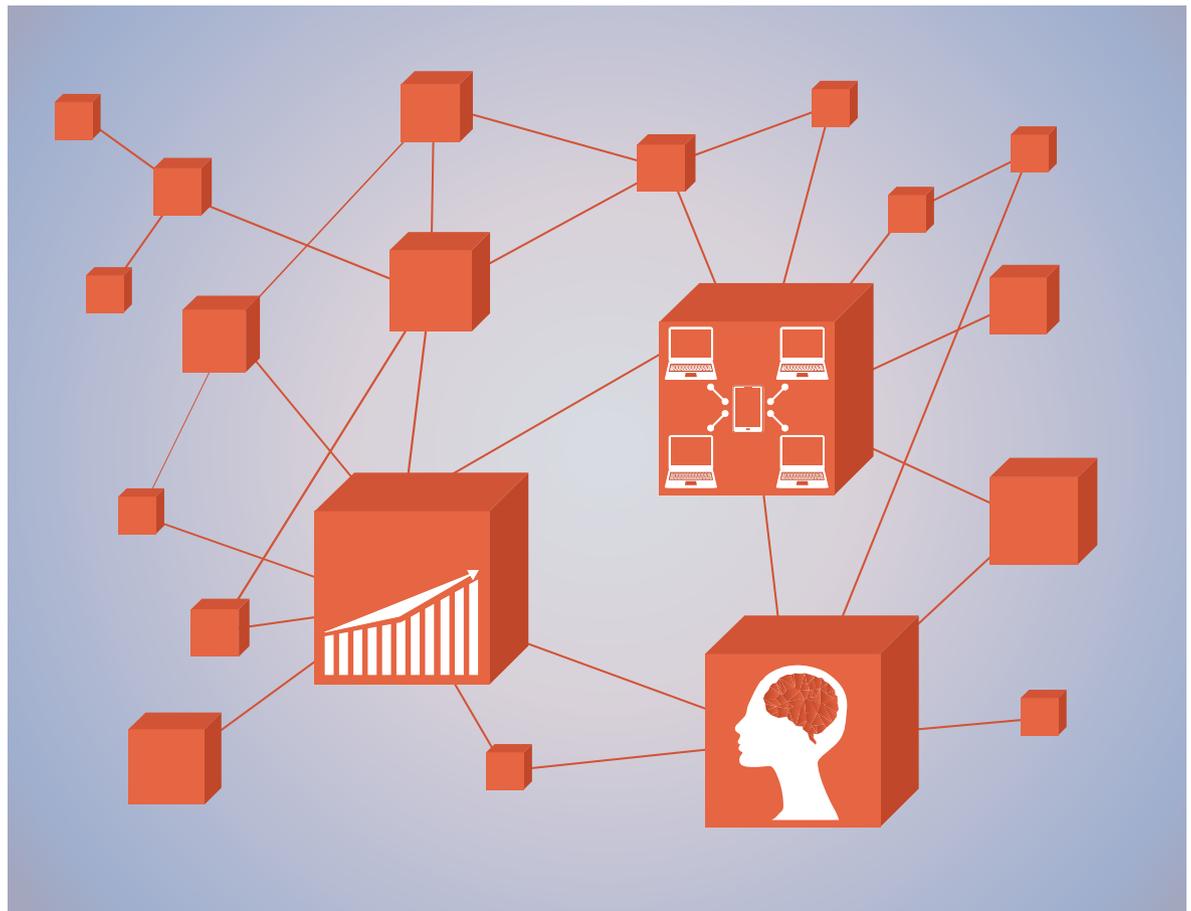


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**B**lockchain technology is an exciting new technology that promises to address many problems that exist within the current framework in radiology. The radiology economic model is ripe for disruption with the possibility to eliminate profit-focused intermediaries to better connect the referring clinician and radiologist. Data sharing between radiologists and their referring clinicians is key to improving the quality of radiology reports – radiologists cannot

read blind. Finally, the rise of AI is imminent and has brought the need for massive amounts of good data for training. Blockchain can help create the needed datasets and support the continuous evaluation and improvement process needed by AI.

## Economics

The practice of radiology is in crisis. Rampant commoditisation of radiology has resulted in a race

to the bottom in terms of quality in the name of decreasing cost and decreasing turnaround times for busy, Diagnosis Related Group (DRG) capitated emergency rooms and hospitals. The entire economy is based on cranking through as many patients as possible in as little time as possible. The practice of radiology and indeed healthcare in general has become a factory, a factory in which both doctors and patients are exploited for monetary gain by private equity and large consolidated hospital systems.

“THE PRACTICE OF RADIOLOGY HAS BECOME A FACTORY IN WHICH BOTH DOCTORS AND PATIENTS ARE EXPLOITED FOR MONETARY GAIN”

The question of quality also looms large in today's high-volume environments. One could put in normal radiology reports without looking, but that is unacceptable. But how little looking is really 'not looking'? During training, we are taught to always use an unchanging mental system, such that we do not miss anything on any scan. In practice, radiologists still often miss, misinterpret or fail to mention findings, most of no clinical consequence, some with significant consequences. This is not because of a lack of a system or that the radiologists in question are incompetent, it is because radiologists look too fast, and in the worst case, are financially incentivised to look too fast.

Additionally, one could just describe imaging findings without giving a differential or helping the clinician interpret these findings in any way. This approach treats radiology as akin to laboratory test, which it plainly is not. Radiologists make critical decisions on every scan outside of simply reporting findings. Carefully constructed language in the report reflects our confidence in our findings and their clinical significance. Yet, again due to lack of time and sometimes due to sheer burnout from volume, radiologists will often just describe the findings, give a pro-forma differential, and offer no customisation to patient's unique presentation or symptomatology. Unstructured, often unreadable reports pervade this space, where the referring clinician often just reads the impression without really understanding

the details. Legally speaking, this is fine, but the unhelpful radiology report that ends with 'clinically correlate' is a running joke in the clinical community.

Finally, there is the erosion of the doctor-doctor relationship between the radiologist and the referring clinician. These conversations often lead to major changes in the report or lead to major clarifications that directly affect patient care. However, the radiologist increasingly has little incentive to engage in these conversations and has less time to actually have a fruitful conversation. Time spent talking is time spent not reading another scan, and more time spent at the office finishing work.

Ultimately these issues are caused by profit-focused intermediaries whose incentive is to create the situation where every clinician is working as hard as possible to increase RVU and billing. Quality is an afterthought or a regulatory necessity. The business of radiology is ripe for decentralisation, as the diagnostic radiologist can work from any location and indeed could be in any part of the world. With the right structure, a blockchain-based decentralised teleradiology system would completely disrupt the industry by eliminating adverse incentives and creating healthy competition between radiologists to provide timely, quality reads, and competition between clients to pay for these reads.

Imagine a system whereby any client, whether it be a large hospital system or small imaging centre, does not need to negotiate pricing with any vendor. Instead, the client need only use open-sourced software and standards to connect to a decentralised Blockchain-based system that gives them direct access to individual radiologists, each of whom have set pricing for their reads, credentialing information, speed and quality metrics. Other software built on top of the system can automatically send studies to particular radiologists based on this public data. Reporting times, referring physician feedback and quality scores can be immutably stored on the Blockchain. Clients who need faster reads would need to pay more to compete for radiologist attention. Similarly, radiologists who are faster, have a sub specialisation or have higher quality can potentially charge more for their services. This kind of competition leads to a healthy ecosystem where incentives are aligned towards better value and optimisation along the quality, cost and timeliness dimensions. Versions of such a system have also been proposed or have reached partial implementation and are also worth a read (Patel 2018); (Reinsmith 2017); (MDW

n.d.). There are several issues that need to be solved before such a system can become a reality. First, most large hospital systems have draconian credentialing requirements that include submission of paper documentation of licensing and other information in order to be credentialed at a hospital to provide services. Private imaging centres are more agile in this respect and may be the first target customers. In addition, in the United States, medical licensing requirements differ from state-to-state and maintaining a 50-state license is close to impossible for a single person. These functions would also need to be decentralised and outsourced in order for the system to function. Privacy is another major issue, though solvable. For example, it is a given that each client already has their own storage. The Blockchain could simply store an encrypted access link with unique keys provided only to the radiologist to whom the case has been assigned. No patient information need actually be stored on-chain. Indeed, storing vast amounts of information on-chain is not efficient as the chain size can exponentially increase causing increased computational resource needs to run the Blockchain.

While simple in concept, the implementation can become highly complex as anyone who has run a teleradiology company can attest. However, these kinds of solutions are needed on the road to decentralise healthcare economics, align incentives and ultimately drive value optimisation.

### Data sharing and quality

When we talk about health data siloes, one must acknowledge the elephant in the room: medical imaging. Radiology is not only siloed with respect to the data availability and data sharing but the radiologists themselves are often cut off from the patients for whom they are reading a scan. Due to lack of actual interaction with the patient the radiologist often has to deal with vague symptom descriptions such as “pain,” which is often entered more for the purposes of successful billing than for actual accuracy. The quality of communication in radiology requisitions is in alarming decline (Wassermann & Straus 2018). Without an appropriate background the quality of the read suffers and ultimately results in poor patient outcomes. Often, the common advice is: why not call the ordering physician? Unfortunately, while this seems like the obvious solution the main problem is time. As already mentioned, radiologists are extremely time-limited, but so are the referring

clinicians, due to the same factory mentality.

While there have been trends towards value-based practice for healthcare in general there seems to be little movement for incorporating this for medical imaging. Programmes such as Merit Based Incentive Payments System (MIPS) have taken first steps but do not address the important issue that the radiologist is essentially blinded to the patient history and treated like a lab technician rather than a doctor. The radiologist needs to be patient-centric not image-centric. But this can only be done through effective and easy data sharing between institutions.

Much has been discussed regarding Blockchain-based EMRs and there is already great momentum around storing and accessing EMRs on the Blockchain (Dubovitskaya et al. 2018). Coupled with algorithms designed to show relevant data to the remote radiologist, the radiologist would have enough data to connect the dots in order to provide a better quality read. In addition, if any follow-up recommendations are given, these recommendations can also be stored and validated on the Blockchain.

“CHANGES CAN BE ACCELERATED WITH BLOCKCHAIN TECHNOLOGY WITHOUT THE NEED FOR EXPENSIVE, PROFIT-FOCUSED INTERMEDIARIES AND ADMINISTRATIVE STRUCTURES”

Additionally, through implementing smart-contract based value-based models and payment systems, we can not only create novel quality metrics, one can also directly incentivise the improvement of these metrics in a trustless, decentralised manner that reduces burdensome administrative cost and complexity that generally come with value-based payment programs. For example, quality metrics could include referring provider and patient satisfaction, compliance with MIPS criteria, structured reports, extent of report editing, number of correctly protocolled exams, appropriate follow up in concert with ACR guidelines, among others (Heller 2016). Blockchain can do all this in complete transparency without the added administrative costs burdening implementations today.

## The rise of artificial intelligence (AI)

Whether we like it or not, AI is coming. The extent of its impact on the practice of radiology and radiology training is yet to be seen. That said, if one looks at mammography (arguably the simplest of the modalities to write and train an algorithm or AI for), it has already undergone a fundamental change due to the introduction of computer aided detection of anomalies on breast mammograms. Radiologists most often use the system as a second reader and evaluate every one of the false positives detected by such systems for the elusive true positive, but the impact on sensitivity for suspicious lesions is significant. Most likely, as AI interpretation of images becomes more and more common, the combined human and machine approach will be the wave of the future throughout radiology. Radiology will eventually morph into not only how to interpret images but how to use the various AI systems for maximum value.

The problem here is dependable data that is distributed, secure, available and constantly updated. To train the best deep learning networks, one needs as much good data as possible. Otherwise, often rare events will not be reliably detected without extensive feature engineering and the influence of selection bias will affect the generalisability of the final product. Because we often lack insight into deep learning models, biases can be insidious and become dangerous. Unlike mammograms, the number of possible pathologies increases exponentially on other modalities, increasing multifold the computational complexity, and therefore the needed data and training time. After initial training, the next major step is a continual improvement process where the AI constantly evolves using real-world data. This is where decentralised, trustless data sharing can have a major impact. A Blockchain-based AI can not only learn from shared data from multiple institutions,

designers can track and evaluate its learning by looking back or simply replaying the chain, giving more insight and greater human oversight on AI decision making. True and false positives and true and false negatives as determined by users and validated on the Blockchain by other radiologists on the network can eventually create the kind of large dataset needed to train complex systems.

## Conclusion

Provision of healthcare in the United States and elsewhere will undergo a fundamental change in the next 20 years as the current downward spiral of value changes. Market solutions that align incentives to provide that value will ultimately lead to optimisation along the quality, cost and timeliness dimensions. In addition to fundamental economic changes, the shift to value-based incentivisation will require creation of novel models. Finally, AI is bursting onto the scene and the need for massive amounts of good data will drive efficient, decentralised methods of data sharing and training dataset creation. All of these changes can be accelerated with Blockchain technology without the need for expensive, profit-focused intermediaries and administrative structures. ■

## KEY POINTS

- ✓ Economics - Key economic factors in the practice of radiology render it ripe for decentralisation
- ✓ Data Sharing – Data sharing between radiologists and their referring clinicians can be enabled by blockchain technology
- ✓ AI – The rise of AI has brought the need for massive amounts of good data for training. Blockchain can help.



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# Blockchain and GDPR compliance for the healthcare industry



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## Permissioned blockchains for healthcare data sharing management

In times of rising concerns about data privacy among services providers and consumers, the arrival of the new GDPR alongside cutting-edge technologies can help to better act and benefit the healthcare industry.

Concepts like traceability, compliance, access control, and risk control and assessment have always been of utmost importance for the healthcare industry. Not only from an economic point of view but also because the associated involved responsibility and management are difficult to handle.

Over the last years, researchers have identified many use cases within the Blockchain ecosystem to tackle such problems. Moreover, patient data management, clinical trials, and even drug traceability are currently being studied as use cases for Blockchain (Quora 2018), posing new challenges for a promising 2019.

One of the biggest challenges has to do with the arrival of the new European General Data Protection Regulation (GDPR), which came into force in May 2018. The GDPR was introduced to protect and empower EU citizen's data privacy and to better deal with the asymmetry between organizations that handle and work with personal data and individuals control over their data. In this context, some principles or rights conferred by the regulation such as the right to be forgotten may clash at first with the usage of distributed ledger technologies (DLT), due to their permanent nature. To correctly assess the risks related to the GDPR-DLT relationship and to better determine how the two of them can be used together to address existing problems, common ground and clear definitions should be established first.

To start with, a distributed ledger is a type of data structure which is replicated, shared, and synchronized

across multiple devices that may operate geographically distant from each other. In this scenario, governance over the data in a distributed ledger is achieved using a consensus mechanism among the parties that hold a copy of the ledger. In this context, consensus refers to a protocol that ensures that parties agree to a specific state of the system as the valid one.

According to the definition given by the Hyperledger project, a distributed ledger relies on three essential components:

- A data model that captures the current state of the ledger.
- A language of transactions that can change the ledger state.
- A protocol used to build consensus among participants around which transactions will be accepted, and in what order, by the ledger.

With the above in mind, a Blockchain can be defined as a type of DLT with specific characteristics that differentiate it from other types of distributed ledgers. It is an append-only ledger organized as a chain of blocks that relies on a peer-to-peer network to perform its management, updates and operations. Roughly speaking, blocks are merely containers for transactions and they can be linked to an existing chain of blocks allowing it to grow. As a data structure, a Blockchain has two distinctive features which are block timestamps and hash pointers that link the last block of the chain to the previous one in such a way that any modification made on a block compels

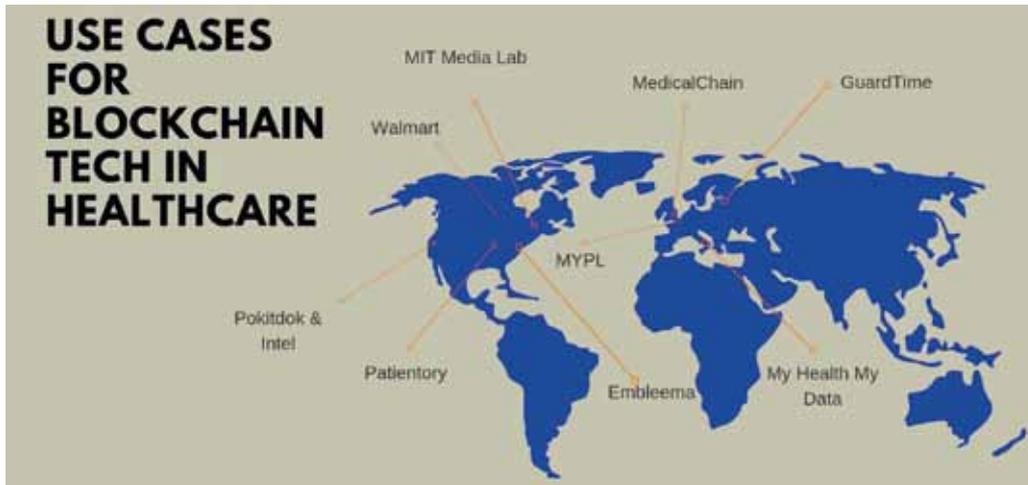


Figure 1. Use cases for blockchain tech in healthcare. (Hello tomorrow, 2018)

the regeneration of the following blocks in the chain.

Together, timestamps and hash pointers can provide a tamper-proof capability to a Blockchain and this, in turn, allows it to achieve a high level of security thanks to the immutability guarantees of its data structure. This immutability feature makes the Blockchain suitable for accounting, financial transactions, and asset ownership management and transfer. For instance, the idea of the so-called “Internet of Value” (Leonard 2018) is based on those use cases.

Alongside immutability, a very close concept is that of compliance. Since it is possible to create tamper-proof (or immutable) records using a Blockchain even in scenarios where parties may not fully nor partially trust each other. This also makes a Blockchain suitable for attestation of compliance. A Blockchain can be very useful when one needs to attest compliance, for example, in relation to the manipulation of certain data.

Another relevant aspect is that of the Blockchain's network being permissionless (open, everyone can join) or permissioned (closed, permission is needed).

In scenarios where partially or fully trusted parties want to work together or need from each other, a permissioned Blockchain is better suitable. In such scenarios, since parties are known to each other, they can be identified and thus can be granted or revoked with permission.

Permissioned Blockchains have contributed to the Blockchain adoption in closed ecosystems and business applications. Some examples include the PlasticTwist project that creates a new circular economy based on an ERC20 cryptocurrency implemented on the top of a permissioned ledger to encourage plastics recycling across Europe and the joint effort

between Maersk and IBM to develop TradeLens, a supply chain system supported by the permissioned Blockchain Hyperledger Fabric.

Moreover, the European Blockchain Observatory and Forum has published a technical report which recommends, in case of needing to store sensitive data, to use private and permissioned Blockchains. In particular, achieving privacy is very challenging and the current absence of mechanisms to keep user's privacy in permissioned Blockchains is turning highly relevant.

Illustrating such a possible scenario, MyHealth-MyData (MHMD) is a project carried out by a consortium of companies that connects hospitals and research centers in Europe to enable the sharing of medical data (from medical records to radiology images) in a private Blockchain network. MHMD is a European project with the ambition to become the first research data network focused on linking organizations and individuals to the health ecosystem. This initiative encourages hospitals to pseudonymize their data for research while giving individuals control of their health data. MHMD wants to become the reference data “marketplace”, providing verified information to value networks in the health ecosystem.

MHMD is a scenario in which the proposed blockchain (private and permissioned) grants the possibility of sharing any kind of sensitive health data example: behavioral data, clinical data, biological data, imaging data (CT, ultrasound, MRI, X-ray, scintigraphy), bacteriological / parasitology data, IoT data among others. (Hello Tomorrow 2018)

Here, the health ecosystem which is composed of European citizens, hospitals, research centers and businesses is faced with two contradictory

requirements. On the one hand, the principle of open science defined by the European Commission as a new approach to the scientific process based on cooperative works, sharing and using all available knowledge at an early stage in the research process with new ways of diffusing knowledge by using digital technologies and collaborative tools (European Commission 2018). On the other hand, the GDPR regulation and its application to health data compliance.

“HEALTH DATA RELATES TO PHYSICAL OR MENTAL HEALTH, PAST, PRESENT OR FUTURE, OF A NATURAL PERSON THAT REVEAL INFORMATION ABOUT THE HEALTH STATUS OF THAT PERSON”

In order to succeed, however, challenges arising from the GDPR must be addressed. A major one is to enforce the privacy of the citizens while allowing the organisations to continue their clinical research (public interest) and to respect the law. Since GDPR, health data has a more precise definition, health data “relates to physical or mental health, past, present or future, of a natural person that reveal information about the health status of that person.” (Aumage 2018)

Due to this and the introduction of new individual’s rights such as the right to be forgotten, one has to be very careful with the immutability property of a Blockchain, when dealing with personal data. To solve these paradoxical matters, in-depth analysis

and evaluation of the data cycle have to be carried out to correctly understand how to attest compliance at the same time as being able to empower citizens over the control of their own data.

MHMD’s approach to this is to ensure that looking at the transactions stored on the Blockchain it is impossible to know the parties involved in a transaction (i.e., unlinkability) nor the concerned data. This property increases the overall level of privacy of the resulting system. For this purpose, a privacy-preserving consensus algorithm was designed based on PBFT (Liskov s.d.), so-called “proof-of-privacy”, that relies on Okamoto-Schnorr’s blind signature scheme (Tatsuki Okamoto s.d.). This, together with the fact that the data lifecycle is managed through a catalog in a way that it can be indexed and referenced in the Blockchain by storing a hash value of the indexed data items. This process allows the MHMD Blockchain to maintain the records of available data and its associated history without the need to record the private data itself, the latter remaining off chain. Using one-way cryptographic algorithms to describe data and transactions results in an anonymous ledger, which also prevents from statistical inference to locate data or individuals thanks to k-anonymity like models. Following two years of intense prototyping, a GDPR-compliant permissioned Blockchain is now under deployment in pioneer hospital and research centers in Europe, to validate the concept. ■

## KEY POINTS



- ✓ Blockchain and the European General Data Protection Regulation.
- ✓ Permissioned Blockchains.
- ✓ Solutions based on “proof-of-privacy” for the Healthcare industry.



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# Healthcare 2019: the year of the Big Data Blockchain

An in-depth discussion of how Big Data Blockchain solutions address the complex data needs of the healthcare industry.

Big Data Blockchains are solving the industry's security and scalability challenges and hold the potential to transform all facets of the healthcare industry: from decision support to patient empowerment to data sharing and operational improvement.

The healthcare industry generates a ton of data. Large, complex, diverse, highly regulated, messy data. And while EMRs have traditionally sat at the epicenter of all this data, the industry is beginning to recognise that the data we traditionally think of as healthcare data – that is, a person's medical record – is only one part of a person's overall health profile. Their social, environmental and behavioral profile is just as important in determining which medical interventions will work best for them. In addition, each person is part of a community, and each person in that community has valuable information that can help healthcare providers make better decisions.

Going into 2019, the healthcare industry finds itself faced with a multifaceted challenge: how to bring together all of this large, complex, messy data; how to securely make it available to providers, decision support tools and AI algorithms, researchers and other stakeholders; how to give consumers visibility and control over how their data is used; and how to achieve all of this without running afoul of data privacy and security regulations.

## Blockchain may be the answer.

Yes, Blockchain is the technology behind cryptocurrencies such as Bitcoin. However, its utility extends far beyond the financial sector. Efforts are underway to deploy Blockchain-based data networks to energy, education, real estate, agriculture and more. For the healthcare industry, Blockchain includes a number of attributes that are particularly useful for managing

healthcare data. In particular, it provides a level of transparency and trust that can help healthcare systems gain better control over how data is shared, with whom, and under what circumstances. And the industry is taking notice: according to a 2018 report by PwC Health Research Institute, 49% of global healthcare companies are developing blockchain solutions ([pwc.com/us/en/industries/health-industries/health-research-institute/blockchain-in-healthcare.html](http://pwc.com/us/en/industries/health-industries/health-research-institute/blockchain-in-healthcare.html)).

In the last 12 months, over 100 companies have been founded with the goal of developing healthcare data sharing services using Blockchain. Most of these solutions use Blockchain only as an access log and permission management system; the actual health data is stored and managed using traditional centralised databases and data warehouses. While this limited use of Blockchain does improve transparency and patient control over data sharing, it does not provide the necessary scalability to support global interoperability and compliance. And perhaps most importantly, data on these systems is still shared using 1:1 data integrations and transfer protocols, making it nearly impossible to recall previously-shared data and comply with GDPR and other "right to be forgotten" laws.

## Bringing data onto the chain

BurstIQ, a Denver-based startup, was the first Blockchain company to successfully develop and commercialise a Blockchain protocol that addresses these



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challenges. The company, founded in 2015, recognised the inherent limitations of standard Blockchain protocols and understood that, in order to achieve truly global interoperability, they would need to start from scratch. The result is a unique, Blockchain-based Big Data platform that enables large, complex data to be stored, managed, shared, analysed and monetised on a secure, HIPAA-compliant Blockchain. Their platform is specifically designed to enable global interoperability, bringing together data from any source onto a Big Data Blockchain network that uses specialised smart contracts to manage everything from person-to-person data sharing to national regulatory enforcement. The company has commercialised the platform with large health systems, health information exchanges (HIEs), independent software and service vendors (ISVs), governments and government agencies.

So far, BurstIQ is the only Big Data Blockchain that has achieved commercial success at the enterprise level. Their success has been driven by strong partnerships with health systems and Big Data companies. One such company is Australia-based Image Chain, the first online marketplace for dermatology-related images and associated medical data. The company is using BurstIQ's Big Data Blockchain platform to enable providers and researchers to securely access a treasure trove of images and data that can help them make better clinical decisions and discover new medical breakthroughs. And as part of BurstIQ's global network, they are able to supplement their marketplace with complementary data sets that add value and deepen insights. Most importantly, Image Chain is placing people at the centre of that process – providing individuals with the power to control if and how their data is available on the marketplace and to participate in the monetisation of their data.

For radiology and other imaging-related specialties, Big Data Blockchain and global data marketplaces like the one being offered by Image Chain offer an opportunity to significantly broaden medical knowledge and reduce operational costs. By connecting images and videos to complementary patient and population-level data sets, providers and researchers are able to use machine intelligence and AI tools to reveal correlations and trends – leading to improved diagnostic accuracy and more personalised, effective treatments. In the future, Big Data Blockchains will enable companies to offer low-cost radiology and pathology services with near real-time turnaround speeds. These interpretation services rely on Blockchain's consensus and

mining algorithms to allow radiologists and pathologists to remotely view and interpret images through a global decentralised network, without compromising patient privacy or accuracy of the interpretation.

### The future of health is Blockchain

The implications of Big Data Blockchain for the global healthcare industry are enormous. Instead of being relegated to the periphery, Big Data Blockchain allows people to operate at the center of the value stream – controlling how their own data is used and monetised. Big Data Blockchain enables interoperability and data liquidity to be achieved on a global scale. It allows regulatory compliance to be automated and adaptable at both a corporate and governmental level. Business intelligence departments, decision support tools, AI engines and other intelligence systems can gain access to new data sets, forming a comprehensive and longitudinal view of clinical, operational, environmental, social and other data. It eliminates the slow and manual processes that have become standard practice for provider credentialing, prior authorisations and claim adjudication. It enables and enhances real-time analytics and intelligence algorithms. It allows data to be managed with far greater specificity, control and accountability. It opens the door to new research collaborations and medical discoveries, greater individual empowerment and engagement, and global health access and equity.

Like all cutting-edge technologies, Blockchain is continuously evolving; both the technology and the market will continue to develop over the next five to ten years. As the technology evolves, early adopters like Image Chain will be well-positioned to lead the market and shape global Blockchain standards. And companies like BurstIQ are proving that Blockchain is ready for the healthcare industry today and will likely become critical infrastructure in the future. ■

## KEY POINTS

- ✓ Blockchain holds the potential to transform how the healthcare industry delivers care, and how individuals access care, on a global scale
- ✓ Traditional Blockchain models offer incremental benefit, but the future of Blockchain in healthcare is being delivered through Big Data Blockchains
- ✓ Early adopters are proving the value of Blockchain and gaining market traction



# UNBLOCK THE CHAIN

## WHY HEALTHCARE NEEDS BLOCKCHAIN

**\$250**

billion is spent to process 30 billion healthcare transactions per year.

**86%**

of mistakes in healthcare are administrative.

**400,000**

people die per year because of these mistakes.



**80%**

of medical errors involve miscommunication.

**3** of every **10**

tests are reordered because the information cannot be found.

**30%**

of visits don't have patient charts.

**20%**

of malpractice claims involve missed or delayed diagnosis

Source: <https://iii.hm/qnd>



## BENEFITS OF BLOCKCHAIN

- ✓ Better management of healthcare data
- ✓ Patient-centric health records
- ✓ Faster transaction processes
- ✓ Lower administrative costs
- ✓ More effective healthcare analytics
- ✓ More efficient supply chain
- ✓ Improved protection of patient identity
- ✓ Greater security and trust of data integrity
- ✓ Reduced medical errors
- ✓ Improved care quality
- ✓ More empowered patients

Source: <https://iii.hm/qly>

## APPLICATION IN HEALTHCARE SMART CONTRACTS

An excellent way to ensure patient compliance



Doctor recommends treatment solution



Patient agrees to doctor recommendation



A smart contract is created and placed in the patient's wallet



Patient performs actions which are tracked by wearables



If the patient fulfills the smart contract they are rewarded; if not they are penalised.



Source: <https://iii.hm/qm0>

## MEDICAL RECORDS



Doctor creates a patient record.



Patient gets a unique ID called a hash.



The ID gets a list of approved users.



Doctor creates an order which goes on patient record.



Patient shares his records with another remote physician.



Through Blockchain, the remote doctor receives data through a secure URL.



Remote doctor gives diagnosis without any face-to-face interaction.



Chain is updated so everyone knows who did what and when.

Source: <https://iii.hm/qm1>

## IMPLEMENTATION CHALLENGES

**Blockchain is still an immature technology in healthcare**

Security still remains a concern in terms of patient data

**Switching to advanced technology that Blockchain would need means higher costs for healthcare organisations.**

Lack of common standards and regulations for Blockchain applications poses a challenge for a highly-regulated sector like healthcare

**Need for increased coordination for proper implementation of Blockchain applications.**

Source: <https://iii.hm/qm2>

# How can automation improve outpatient care while reducing costs?

## The new role of hospitals and the triple aim challenge

Rather than being an unaffordable luxury, automation can quickly deliver an impressive return on investment.



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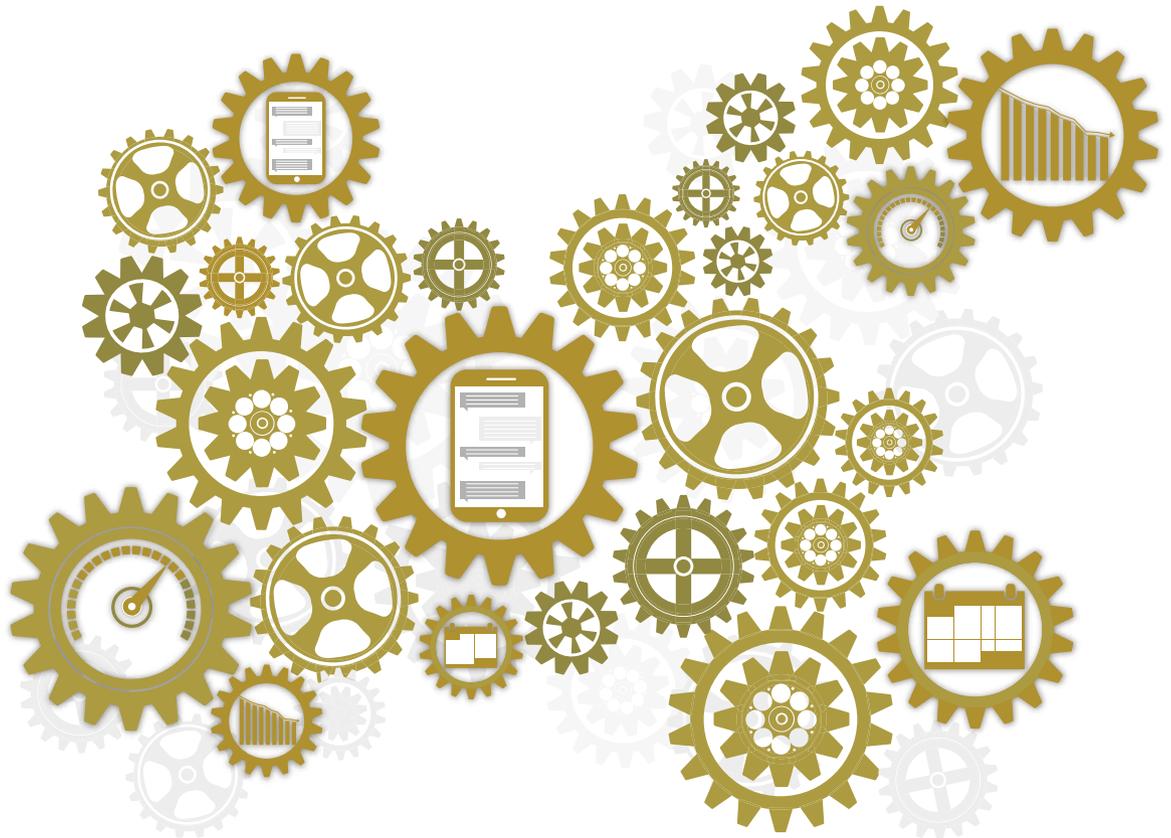


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The list of advanced technology and automation in healthcare is growing, from using Amazon Echoes to provide adult social care ([paconsulting.com/our-experience/argenti-using-technology-to-drive-social-care-transformation/](https://paconsulting.com/our-experience/argenti-using-technology-to-drive-social-care-transformation/)), to automating

genome sequencing. Automation improves quality, decreases costs and reduces human error. It's an especially valuable tool as healthcare systems focus more attention on patient outcomes—a practice referred to as value-based care. Yet the opportunities of automation aren't well understood, slowing

the pace of adoption.

Healthcare often sees automation as a luxury—very few healthcare organisations are exploiting the benefits that automation has to offer. In fact, only a few of the UK’s 152 acute National Health Service (NHS) Trusts have started to use new forms of automation such as robotic process automation. But as it has the potential to reduce staffing costs and improve quality and efficiency, more organisations should see it as a valuable opportunity during this time of financial challenges. Robotic solutions for finance and human resources functions, for example, can be launched quickly and rapidly generate a good return on investment and improve insight into process performance.

While these technologies have clear application in the back office, some of the biggest benefits of automation may be for front office processes such as outpatient appointment management.

“CREATED CAPACITY FOR 80 ADDITIONAL HOURS OF OPERATIONS AND 430 OUTPATIENT APPOINTMENTS A MONTH”

### Improving the booking process

Automation is perfect for improving the booking process, which in many Trusts is a cumbersome, manual process. For example, a software robot could gather empty slots and clearly present them to schedulers for rebooking. Or it could automatically move patients from a cancelled clinic to the next suitable available one based on defined rules. We’re developing such a smart booking system with an NHS Trust with the aim of improving appointment attendance.

### Speeding up customer service

Chatbots are more advanced than ever and are being used by a variety of businesses around the world. So why not replicate this in healthcare? A patient with a query about their outpatient appointment could initially speak to a chatbot that handles all basic questions by following rules. When there are more complex problems, or instances where the patient wants to speak to a person, the chatbot transfers them to the human team. We have seen the effective use of chatbots in apps such as Your.

MD, which is taking the idea further by using AI and machine learning to provide personalised health information. It uses algorithms trained on validated medical literature, allowing the chatbot to learn common symptoms and provide care recommendations to the patient.

### Managing capacity more effectively

By looking at historical data around peak times for appointments, the use of advanced analytics, where the system is automated to examine large data sets to generate recommendations, can tell when and where healthcare organisations are likely to need more capacity. Organisations can then tweak the capacity to ensure the most people are helped in the most cost-efficient way. PA Consulting applied this in recent work at Hillingdon Hospitals NHS Foundation Trust ([paconsulting.com/our-experience/saving-10-million-by-managing-time-and-resources-with-care/](https://paconsulting.com/our-experience/saving-10-million-by-managing-time-and-resources-with-care/)) New software was used to improve systems for scheduling surgery and booking outpatient clinics by giving a clearer view of the time and capacity available. This created capacity for 80 additional hours of operations and 430 outpatient appointments a month.

### Bring automation to healthcare

Looking at outpatient processes through the lens of automation highlights immediate opportunities in the front and back office. Rather than being an unaffordable luxury, automation can quickly deliver an impressive return on investment. ■

## KEY POINTS

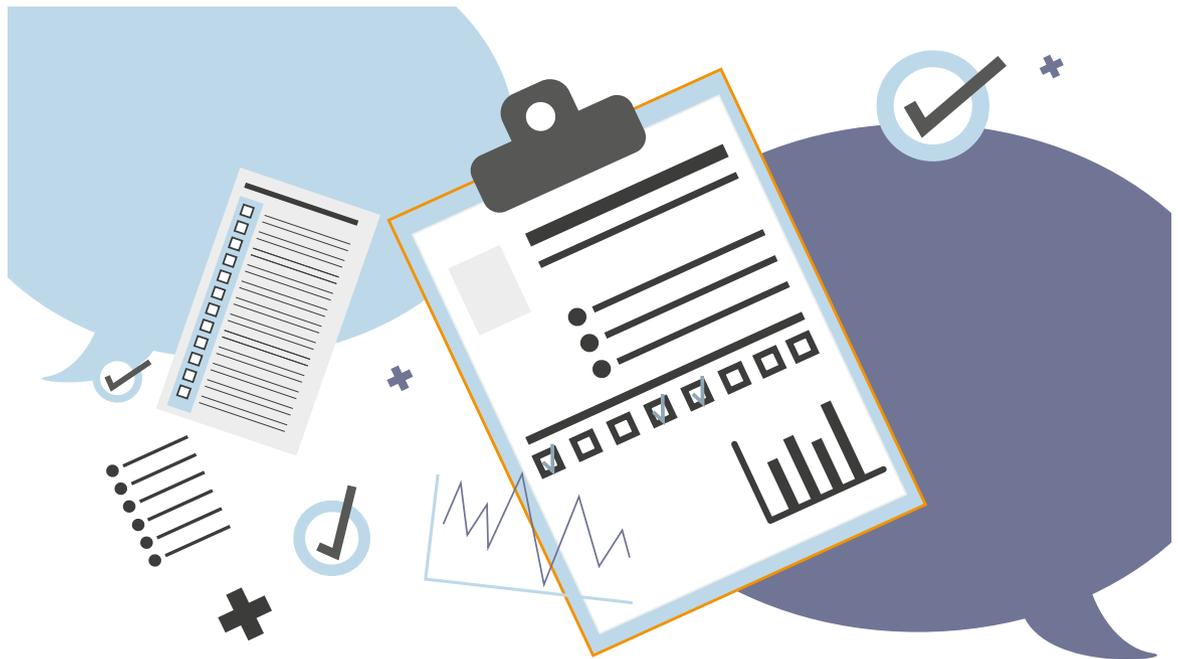


- ✓ Automation can improve outpatient care while reducing costs. It is an especially valuable tool as healthcare systems focus more attention on patient outcomes
- ✓ Looking at outpatient processes through the lens of automation highlights immediate opportunities in the front and back office
- ✓ Rather than being an unaffordable luxury, automation can quickly deliver an impressive return on investment

# Patient responsibility for following up on test results



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A risk manager recently asked for guidance on the patient's responsibility in following up on the results of tests that have been ordered.

In our response, we note that providers are responsible for reviewing and following up on the results of the tests they order. That responsibility typically includes ensuring that results that require involvement of patients or action on their part are communicated to patients. However, ECRI Institute recommends reporting all test results to patients, including results that are normal or not clinically significant.

Clinicians' responsibility for following up on test results should be clearly outlined in organisational policies and procedures, and backups should be designated. Organisations also typically have protocols for how and when different kinds of tests or different kinds of results (eg normal, abnormal, critical) need to be communicated to the responsible clinician and to the patient. See the resources at the

bottom of this email for more information on general practices for test result reporting and tracking.

Policies and procedures may outline the means of contacting patients and the number of attempts that are required; if that is in place, it is very important that providers follow those steps. But even if the provider follows the policies and procedures, other factors specific to the situation may come into play (eg multiple modes of contact that are outdated). The provider should make all possible attempts to contact a patient with a critical or abnormal result, which may include enlisting the help of local authorities or contacting homeless shelters. Attempts and results of those attempts (eg voice mail greeting indicating that the organisation had reached the correct person, mail returned) should be documented. Providers can also ask patients to verify or update their contact information on every visit.

When patient action is recommended, it's a good idea to "close the loop" and seek (and document)

confirmation from the patient that the result and recommendation were received. Some organisations ask whether the patient has taken necessary follow-up steps, and some offer help in scheduling appointments with other providers when necessary.

If a patient was informed of his or her test results and recommended actions but failed to take those actions, contributory or comparative negligence may be a possible defence (legal counsel can determine which defence strategies are optimal in each specific case). Patients may argue that they were not informed of the results and recommendations—because of factors such as those discussed above, for example. The defence may have a particularly large burden to overcome if the provider's actions or inactions, which will be scrutinised, failed to conform with organisational policies and procedures. But again, the inquiry doesn't necessarily end with policies and procedures. A related question is whether the provider made it clear what the patient had to do and why the patient had to do it. Health literacy strategies can help providers communicate with all patients about the purpose and significance of tests, test results, recommended follow-up, and actions patients should take.

All of these principles bear on the use of patient portals to communicate test results. Because clinicians are responsible for following up on test results, providers should actively reach out to patients to communicate test results, rather than simply inform them that test results will be available through the patient portal once they're processed. Provider involvement is also necessary to place the result into context. For example, even if patients have access to their results, they might not know how to interpret them or what they should do in response.

What about using an automated process to notify patients that results are now available in the patient portal—for example, having the system automatically email the patient when a test result becomes available? Although automated processes might conceivably supplement other forms of communication with patients regarding test results, they might not be sufficient means of notifying patients of test results in and of themselves. What if the patient is not computer savvy or has no or limited access to a computer? What if the patient's email address is outdated or the email is caught in a spam filter? The brave new world of electronic communication underscores the importance of closing the loop and confirming that the message, however it is



ECRI Institute, a nonprofit organisation, dedicates itself to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for 50 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research.

ECRI's focus is medical device technology, healthcare risk and quality management, and health technology assessment. It provides information services and technical assistance to more than 5,000 hospitals, healthcare organisations, ministries of health, government and planning agencies, voluntary sector organisations and accrediting agencies worldwide. Its databases (over 30), publications, information services and technical assistance services set the standard for the healthcare community.

More than 5,000 healthcare organisations worldwide rely on ECRI Institute's expertise in patient safety improvement, risk and quality management, healthcare processes, devices, procedures and drug technology. ECRI Institute is one of only a handful of organisations to have been designated as both a Collaborating Centre of the World Health Organization and an evidence-based practice centre by the US Agency for healthcare research and quality in Europe. For more information, visit [ecri.org.uk](http://ecri.org.uk)

communicated, is received. Ultimately, if a patient fails to take prudent actions in response to a test result, suffers injury because of it, and sues, it might be hard to successfully defend the case if the patient portal was the only means used to communicate the test results to a patient.

Note: The recommendations contained in Ask ECRI do not constitute legal advice. Facilities should consult legal counsel for specific guidance and develop clinical guidance in consultation with their clinical staff. ■

# Better outcomes through clinical decision support

How can a clinical decision support system help to achieve measurably better healthcare outcomes?



**Dr. Peter Thorausch**  
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“The Collaboratory” reflects the transformation through collaboration that Abbott wants to ignite by working in partnership with clients. Abbott supports healthcare organizations to overcome their challenges and materialize their future state vision, by breaking down the silos and barriers that exist today in healthcare. The results of a global study show the contribution expected from labs to facilitate this transformation as shown in the data points below. By leveraging their data and teaming up with other services and stakeholders, labs can shift from being a manufacturing facility to a decision support engine, helping the decision making across the system and achieve measurably better healthcare performance.

With advancements in medical research and technology breakthroughs happening daily, doctors and clinicians must remain on top of latest medical guidelines, patient historical and holistic information to reduce unwarranted variations, improve patient outcomes and reduce costs.

The Limbach Group is a leading private provider of laboratory services in Germany, with more than 6,000 staff and 32 laboratories. MVZ Cottbus, the group’s laboratory, serves four hospitals and a rehabilitation center, and provides diagnostic services for a population of more than 1 million people. Burdened by the extensive employee-hours needed to process and analyze laboratory data, MVZ Cottbus, in partnership with Abbott, recently completed phase 1 of a project to establish how the use of Abbott’s AlinIQ Clinical Decision Support (CDS) solution could: 1) standardize the application of clinical guidelines and evidence-based medicine, 2) improve clinician test-ordering practices, 3) save laboratory time and resources,

and 4) improve the quality of reports provided to clinicians. According to Dr. Peter Thorausch, co-founder and CEO “A huge part of our time is spent processing and analyzing data and writing reports. Being able to automate much of this work – and providing guidance to the requesting clinician – will lead to smarter, leaner and quicker diagnostics and ultimately adding real value to the services we provide.”

“ BEING ABLE TO AUTOMATE MUCH OF THIS WORK WILL LEAD TO SMARTER, LEANER AND QUICKER DIAGNOSTICS ADDING REAL VALUE ”

After 3 months, the MVZ Cottbus phase 1 of the project demonstrated that AlinIQ CDS was able to provide recommendations to improve test ordering and identify secondary diagnosis and comorbidities. The implementation of CDS live has the potential to improve patient outcomes, materialize operational efficiencies and achieve cost savings. Additionally, with just the 70 rules created by MVZ Cottbus and Abbott in this phase, AlinIQ CDS not only recommended testing and provided results interpretations for the four ICD/DRG targeted conditions, but also for other conditions that originally were outside the scope of the project. These results show the benefits that AlinIQ CDS can deliver for healthcare organizations. Beyond that, AlinIQ CDS flagged potential co-morbidities for further investigation, which could have a significant impact in terms of optimizing patient treatments and improving reimbursement coding for the organization.

For phase 1 there were 2 main objectives chosen:

**1** By targeting 4 main conditions (COPD, AMI, Pneumonia, AF) see if AlinIQ CDS could improve test ordering based on patient's initial diagnoses. For example, for a patient with a diagnosis of COPD, Cottbus wanted to identify cases where diagnostic tests related to COPD were not ordered.

**2** By targeting 5 diagnostic procedures for renal, thyroid, diabetes, anemia, and lipid diseases – demonstrate that AlinIQ CDS could identify secondary diagnosis and comorbidities as well as Interpreting results and providing relevant recommendations.

12,395 randomly selected cases were analyzed by AlinIQ using the 70 rules and the following results could be identified:

**1** As per the 1st objective 338 cases were identified corresponding to the 4 main conditions. 100% of the cases received interpretation reports including proper ICD/DRG coding and testing ordering recommendations.

**2** As per the 2nd objective 4,616 recommendations were provided linked to the 5 diseases (renal, thyroid, diabetes, anemia, and lipid diseases).

#### Terminology:

Rule = Structure responsible for implementing and automating algorithm steps; ICD= International Statistical Classification of Diseases and Related Health Problems list by the World Health Organization; DRG= Diagnosis Related Group is a system to classify hospital cases into groups;

Disease = The term "disease" broadly refers to any condition that impairs the normal functioning of the body

Following the success of phase 1, AlinIQ CDS has now been integrated with the laboratory's database and live data streams at MVZ Cottbus to enable real-time analysis and reporting. Prior to commencing this phase, Abbott trained the staff to ensure a smooth transition and the team worked to review the results of the phase 1 and adjust the CDS rules before the system went live with reports and comments for the physicians. Additional work is ongoing to evaluate the strategic, operational and financial impact of AlinIQ CDS in a live setting, comparing performance metrics against the baseline benchmark. In the future, MVZ Cottbus will be able to expand the reach of AlinIQ CDS to other clinical use cases, disease states and laboratory locations. Additional data streams will be integrated to enrich the clinical information available and enhance the generation of patient-specific recommendations. ■

**93%**  
OF HOSPITAL EXECUTIVES  
BELIEVE THE LABORATORY CAN  
IMPACT HEALTHCARE IT AND  
ANALYTICS

**77%**  
OF DOCTORS WOULD  
VALUE THE LAB PROVIDING  
ADDITIONAL INTERPRETATION  
TO SUPPORT DIAGNOSIS

For further information please talk to our experts at the Abbott booth during Arab Health or MEDLAB 2019, get in touch with a local Abbott representative, or send an email to [wired@abbott.com](mailto:wired@abbott.com).

Applications will be accepted until  
**February 4<sup>th</sup>, 2018**



### Why you should apply

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6<sup>th</sup> VBHC Prize Event with Prof. E. Teisberg, PhD  
April 18, 2019 | The Netherlands

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# Encouraging health app use with seniors

## Prevention, patient autonomy and use of digital goods

A digital health coaching platform offers sustainable support of the elderly population to improve their mental, emotional and physical fitness.

The German healthcare system is still one of the best in the world. Nevertheless, for many years the contribution of healthcare to society has still largely been interpreted through the framework of cost reductions. Increasingly, however, the willingness of the involved actors to improve healthcare in the sense of a holistic, patient-oriented understanding is growing. This is now being addressed in more and more social debates under the heading of “value-based healthcare” (Porter 2010). Here, the quality of service provision is placed in relation to its costs and thus the so-called “value” of a health service for the individual is evaluated (Lehr et al. 2016).

Recently, support has also increasingly been given to measures in the field of prevention that make a value-oriented contribution to promoting self-help and patient autonomy (Landry 2015, Boulos 2011). This is reflected in the adoption of the German Prevention Act, which came into force in its essential parts on 25 July 2015, thereby increasing support for health self-help (Albrecht 2016). The German Social Code Book V (§1) also states that health is the duty of every individual: “The insured are jointly responsible

for their health; they should contribute to preventing the onset of illness and disability and to overcoming their consequences through a health-conscious lifestyle, early participation in preventive health measures and active participation in medical treatment and rehabilitation”.

“CONSUMERS ARE MORE OPEN TO TECHNOLOGICAL INNOVATIONS THAN INSTITUTIONS, WHICH CLEARLY SETS THEM APART FROM MOST HEALTHCARE PLAYERS”

Value-based healthcare requires the cooperation and joint responsibility of all institutional and private actors involved in care. The human being, ie the consumer of the health service, is placed at the centre of attention. Thereby, more and more people want to actively commit themselves to their health. This can also be clearly felt in the healthcare market, as more and more essential impulses in the design of new health products emerge from the consumer side.



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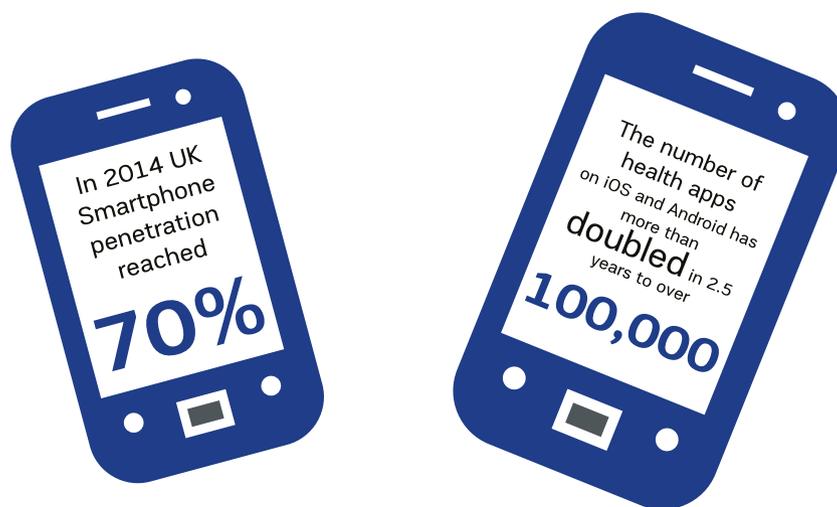


Figure 1: Usage of mobile technology in healthcare is growing and is becoming more pervasive. Source: Deloitte, Connected health, 2018

Consumers are more open to technological innovations than institutions, which clearly sets them apart from most healthcare players. This openness also corresponds to a “cultural change towards a more sovereign and active shaping of one’s own health actions” (Knöppler et al. 2016).

Consumers in the healthcare market are demanding digital goods, including those in the field of prevention (Figure 1). They are assigned to the so-called “second health market”. According to general understanding, the second health market comprises, in particular, over-the-counter medicines and individual health services, fitness and wellness, health tourism as well as, to some extent, sports, leisure, nutrition and housing. In addition, digital goods are also becoming increasingly important as a preventive instrument in the first health market. The first health market comprises the area of “classical” health care, which is largely characterised by statutory health insurance and private health insurance, including long-term care insurance, and to a lesser extent by employers (ie continued payment of wages in the event of illness), the state (ie contributions to health insurance) and other social insurance institutions.

Overall, there are increasing efforts on the part of the players to assume the remuneration for digital goods for the insured (Albrecht 2016). Nevertheless, the sluggishness of institutional providers means that digital goods still play a subordinate role in the first health market compared to the second health market, which is why the dynamic development of digital

health services has so far been observed predominantly in the second health market. Thereby, digital health applications (so-called “mHealth”) range from simple solutions to complex medical applications (Figure 2).

In view of the fact that the lifespan in Germany has increased by well over ten percent in the relatively short period of 40 years, due in part to medical progress and significantly better working, living and housing conditions, the market is set for steady growth in health apps. The proportion of people over 65 in the total population will rise from 21% today in 2030 to over 29%. According to the Federal Statistical Office, the number of people in Germany who are 65 years and older already amounts to almost 17 million. Nowhere else in Europe is this share as high as in Germany, at 20.6%.

### Digital applications address the challenges of best agers

The market development outlined above represents a great opportunity for innovative digital solutions such as online platforms and health apps. Young people in particular are demanding digital goods in the form of health apps, as these promise immediate positive effects on the improvement of their health. Increasingly, health apps are also experiencing increasing demand among senior citizens, as older people are becoming more technology-savvy and, for their part, interest in technology-supported health services is steadily increasing.

The elderly become ill more frequently and for

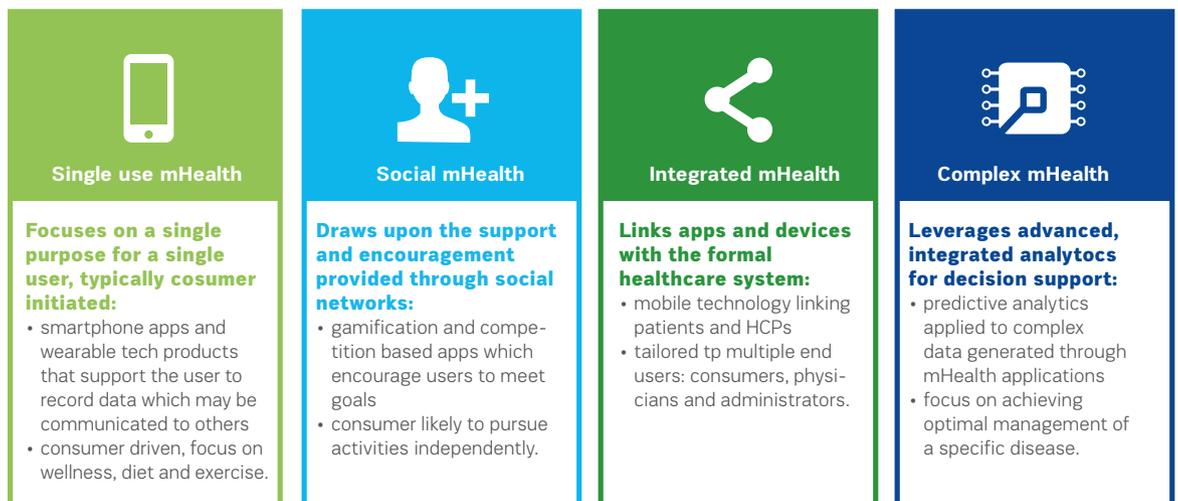


Figure 2: Categorisation of digital health applications. Source: Four Dimensions of Effective mHealth, Deloitte US Center for Health Solutions, 2014



**Figure 3:** proVITALcoach platform: concept, stakeholders and outcomes for patients and the healthcare system. Source: proVITALcoach

longer periods of time and often suffer from several illnesses simultaneously. The psychological stress associated with this can promote the occurrence of depression. These include particular burdens such as fears of loss related to one's own identity, one's own professional role as a result of relinquishing a professional career, changes in family circumstances (eg when children leave home), independence and one's own life (ie the inevitability of one's own death). Cognitive abilities also change over the years.

**proVITALcoach: Digital coaching platform for the elderly population**

People in old age are subject to strong changes, which require a high degree of change management. This and the associated physical and psychological challenges require completely new coping competences, which are adequately addressed by proVITALcoach through a holistic concept for the maintenance and improvement of mental, emotional and physical fitness. proVITALcoach sets itself the goal of enabling older people, their relatives and nursing staff to take effective measures and make necessary adjustments for the maintenance of the health of senior citizens. The extension of the so-called "health span", ie the life span in good physical and mental health, is particularly important. proVITALcoach strives for this through the following measures:

- Building, maintaining and improving physical fitness and reducing over- and under-exertion

- Building, maintaining and improving mental and emotional fitness

The functional scope of proVITALcoach is aimed to be expanded by psychological components using current neuroscientific findings applied in the form of guided self-tests, checklists and tasks derived from them. Furthermore, for the extended version of proVITALcoach a superior coaching concept including a coaching guide will be developed. The objective here is to help people already in earlier age groups to actively shape ageing and to achieve a fulfilled life through a positive assessment and attitude towards ageing and the associated changes in their lives.

In addition, proVITALcoach addresses digital information exchange between the user of the application and an optional authorised person who looks after the user. The software including various coaching mechanisms will remind the user and help him to perform certain activities (eg taking medication, fitness exercises), thus supporting elderly people in their everyday life.

**Positioning and target groups**

According to a Bertelsmann study published in 2016 (Knöppler et al. 2016), proVITALcoach is assigned to the group of health services to promote indirect intervention and thus strengthen self-efficacy, adherence and security. proVITALcoach is realised by means of an online platform in connection with a health app. In addition to the intelligent technology,

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proVITALcoach includes professional coaching (Figure 3).

proVITALcoach addresses the following primary target groups:

- The elderly who take the initiative to contribute to their own health and fitness.
- Caregivers and family members who look after or care for elderly.
- Institutions (associations, nursing homes, retirement homes, other inpatient facilities, etc.).

The secondary target groups of proVITALcoach are:

- People with disabilities and chronic illnesses.
- All fitness enthusiasts who value comfortable operation, coaching and safety.

“ DEDICATED “BEST AGERS” STAY HEALTHIER AND ACTIVELY CONTRIBUTE TO A HIGHER “VALUE” IN HEALTHCARE ”

### Results and discussion

proVITALcoach, a multifunctional personalised mobile health app positioned in the second health-care market, combines features and programs developed by personal, fitness and health coaches to support best agers and their potential caregivers. The psychologically relevant content will be implemented in the form of guided self-tests and checklists and will be developed together with psychologists applying recent neuroscientific findings. Self-tests and checklists serve to assess the psychological health status of the user and to automatically develop a coaching concept using intelligent and tested rules. This serves as a basis for development of personalised tasks, memories and fitness programs and thus extends the health app in the sense of a holistic, value-oriented approach for the elderly population.

As part of the coaching concept, proVITALcoach will also develop a coaching guideline that will guide qualified coaches beyond the application of the health app to support the elderly in the challenges and opportunities of old age. The health app functions as a core technological element and will be sold individually as a digital good via an app store, as well as embedded in personal and/or media-supported coaching. proVITALcoach thus contributes to increasing “value” by improving self-preventive measures for seniors, contributing to cost reductions in the health care system. Caregivers can support their caregivers and family members their elderly relatives by creating appropriate compliance tracking programmes.

The primary focus on elderly users and caregivers allows them to truly focus on elderly unique needs of this generation and their families. Dedicated “best agers” stay healthier and actively contribute to a higher “value” in healthcare. Elderly people who are not used to mobile technologies are encouraged by their children to get in touch and benefit from the solutions offered and their user-friendly applications. ■

### KEY POINTS



- ✓ Healthcare consumers are increasingly demanding apps to monitor their care and bolster engagement
- ✓ Apps are more prominent in the second health market than in the first health market
- ✓ proVitalcoach helps the elderly adapt to physical and psychological changes as they age
- ✓ More health savvy consumers assist the healthcare system in the long term



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# A patient's journey is likely to include surfing the web: how can we help?

## Internet and people with mental disorders

A “whole patient” can be a person with schizophrenia, who is also an internet user and searches for mental health information online.

Between 2000–2018 the internet has grown by 1,052%, with about 4.2 billion people surfing the Web (Internet World Stats 2018). In Europe, about 81% of citizens use the internet at least once per week (Eurostat 2018). The number of internet users who search for health and mental health information online has been growing. About 89% of Americans (Pew Research Center 2018) and approximately 51% of European internet users (Eurostat 2017) search for health information online. It is apparent that the internet has influenced how we search and gather health information and how we generally conduct our day-to-day lives.

People with mental or substance use disorder comprise between 13 to 22% of the global population (Ritchie and Roser 2018), which is approximately 1.1 billion people. Among this population, 21 million are diagnosed with schizophrenia. As a consequence of the global trends, people with mental disorders, including those with schizophrenia, use the internet similarly to the general population (Schrank et al. 2010; Kalckreuth et al. 2014; Miller et al. 2015; Athanasopoulou et al. 2017). About 80% of people with psychiatric conditions are internet users (Kalckreuth et al. 2014). They use the internet for health information seeking, email exchange, social media, web 2.0 use (Miller et al. 2015; Athanasopoulou et al. 2017), and to communicate with peers and health professionals (Miller et al. 2014; Schrank et al. 2010). However, does this population easily find and understand the health information retrieved online?

Studies focusing on mental health and internet use are important, since there is a literature gap in exploring internet use by various populations of

mental health patients. We face a period of economic crisis, and since schizophrenia is a costly disease, affecting people of working age, there is an urgent need for governments to effectively meet their citizens' health needs, while at the same time to minimise direct and indirect health-related costs (Tajima-Pozo et al. 2015). The ‘whole patient’ approach focuses on understanding the patient holistically—as a patient, as an internet user who searches for health information in order to feel empowered, as a friend who wants to connect online, etc. By understanding patients' needs, skills and attitudes, for example, towards the internet, healthcare professionals can use this knowledge to support their patients better and more affordably, as internet connection has minimal cost. One of the main components of the ‘whole patient’ approach is the exploration of the patient's information and communication preferences. For example, how someone is seeking for information or how someone prefers to exchange online information with a peer or health professional.

### Lessons learned from people with schizophrenia spectrum disorders

In a study performed in two distant European countries (Greece and Finland) (Athanasopoulou et al. 2017), we aimed to explore internet use patterns, attitudes and eHealth literacy among adults with schizophrenia spectrum disorders (SSD). We found that:

1. About one third were never internet users, a few were previous internet users, and more than half were current internet users. More than half of the internet users in each country group used the



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internet for health-related purposes, such as to search for health-related information, communicate with health professionals about health-related issues, and communicate with other users about health-related issues

2. Previous and current internet users had moderate scores in ehealth literacy. This could mean that it is very likely they could not find, access and evaluate online health information accurately
3. The majority of internet users accessed the internet from home, had an email address, used it at least once per day, and used it for web 2.0 activities (ie watching videos, social networking and/or dating websites)
4. More than half of internet users accessed the internet for health-related purposes (ie to research health-related information, communicate with health professionals about health-related issues, communicate with other users about health-related issues)
5. More than half searched for online health information; most consider it always or most of the times easy to locate the website they wanted and the most prevalent problem that complicated their internet use was their difficulty concentrating for long periods
6. For the Finnish group, top health information sources were face-to-face contact with medical professionals and the internet. On the other hand, for the Greek participants face-to-face contact with medical professionals and pharmacies were perceived to be the most important sources of health information.

### Conclusion and future initiatives

In order to support the “whole patient”, who happens to be an internet user, various sectors and stakeholders need to cooperate, eg organisations, ICT experts, administrators, educators, even the average internet user. However, the most important role is that of the healthcare professional who comes in contact with the patient (found to be the most important

source of health information in both groups), then pharmacists and the internet. First, mental health professionals should realise their important role in educating their patients about their diagnosis and providing them with reliable health information. Second, health professionals (and pharmacists) could be trained and then show their patients how to judge which online (mental) health information is reliable, in order to assess the reliability and trustworthiness of the information they find online. Luckily, the significance of health literacy is growing as it has received prompt attention by the World Health Organization Region of Europe (M-POHL Network 2018). In addition, strengthening integrated care and multidisciplinary work, especially in primary and community health care (primary health care professionals and pharmacists) is very important, especially for countries with fewer resources and weak primary care systems, including Greece (Tsiachristas et al. 2015). Third, (mental) health organisations could organise continuing education ehealth programmes, since people with SSD need education and training in order to acquire the essential skills to find, read, and understand online (mental) health information. Last, online campaigns to raise awareness about the importance of sharing accurate mental health information could be useful. ■

### KEY POINTS



- ✓ The internet has changed the way we search for (mental) health information
- ✓ People with mental disorders search for (mental) health information online
- ✓ ehealth literacy is the important skill to search, find and understand the health information you can find online
- ✓ High levels of eHealth literacy can support patients to find and understand the online health information they access
- ✓ Health professionals can support patients in finding reliable health information online



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# Patient safety culture

## Radiographers' perceptions

Research to evaluate radiographers' perceptions about patient safety culture in Portuguese public and private imaging facilities found that overall perception is positive but the safety culture dimensions rating should guide culture development of safety culture improvement action plans.

**P**atient safety is defined as the avoidance of unintended or unexpected harm to people during the provision of healthcare. It is a process whereby an organisation makes care delivery safer to prevent healthcare users from being harmed by the effects of their services, thereby reducing the risk of unnecessary harm to the minimum acceptable (National Health Service 2004). While imaging facilities have become more effective they have also become more complex, with greater use of new technologies. Thus, patients should be treated in a safe environment and protected from avoidable harm.

The National Patient Safety Agency's *Seven steps to patient safety, the full reference guide* identifies the steps it considers essential to ensure patient safety: safety culture, lead and support professionals, manage risk in an integrated way, promote reporting, engage and communicate with patients and the public, learn and share safety lessons and implement solutions for harm prevention (National Patient Safety Agency 2004).

Patient safety is a core dimension of the quality of care provided. Unfortunately, in Portuguese healthcare institutions, there is still a lack of adequate knowledge regarding all the aspects of the organisational safety culture, which are essential for the implementation of effective measures to avoid and prevent errors and incidents that occur from the provision of healthcare to patients (Sousa 2013).

There is a need to promote a culture of safety in all areas of healthcare services, reflecting a collective consciousness related to values, attitudes, skills and behaviours that determine commitment to health and safety management, and to look at incidents not simply as problems, avoiding blaming those professionals who make unintentional mistakes, but seeing the situation as an opportunity to improve healthcare quality (Costa 2014).

Since radiographers in the performance of their duties are fundamentally involved in promoting,

maintaining, monitoring or restoring patients' health, the healthcare process is subject to the occurrence of incidents and adverse events that should be recorded and reported (Portuguese Health Portal 2011).

In Portugal in 2012 the General Directorate of Health (GDS) made available to all healthcare professionals and citizens the National Incident and Adverse Event Notification System (NIAENS). NIAENS is an anonymous, confidential and non-punitive management platform for incidents and adverse events occurring at healthcare facilities. The notifications are analysed to identify patterns and trends on patient safety and to develop solutions to avoid such incidents, based on Standard No 008/2013 of 05/15/2013 (GDS 2013).

**“IN GENERAL, RADIOGRAPHERS HAVE A POSITIVE PERCEPTION ABOUT PATIENT SAFETY OF THEIR DEPARTMENTS”**

It should also be considered that the imaging department is an area that favours the appearance of errors, especially due to the multiplicity of the techniques used, the various professionals involved and the complexity of the whole circuit involving examinations, associated with a rational use of human and economic resources, and the current organisational culture (Brandão et al. 2011; Pereira 2013). In addition, the fear of becoming victims of medical error may lead patients to avoid medical care, leading to a worsening of their health status (Pereira 2013).

Given the above, and considering the constant development of imaging departments and the search for continuous improvement, the main goal of this study was to evaluate radiographers' perceptions about patient safety culture in nationwide public and private imaging facilities and to compare them in order to identify the positive aspects of safety culture of each department and make improvement suggestions.

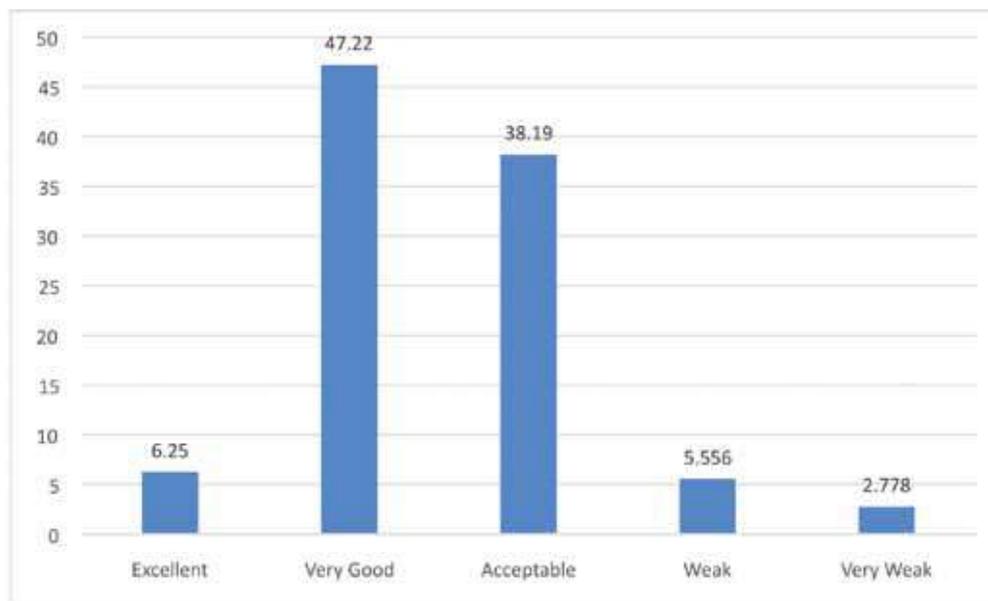


Figure 1. How radiographers classified the patient safety culture (%).

## Web-based survey of Portuguese radiographers

For this study, a web-based survey composed by a sociodemographic characterisation was added to the translated and validated Portuguese version of the *Hospital Survey on Patient Safety Culture (HSOPSC)* ([ahrq.gov/sops/quality-patient-safety/patient-safetyculture/hospital/index.html](http://ahrq.gov/sops/quality-patient-safety/patient-safetyculture/hospital/index.html)) and made available to all radiographers who wished to participate at a nationwide level.

The sociodemographic data included professional experience (years), the nature of the imaging facility (public or private), geographical area, weekly working hours and the professional category (band).

The HSOPSC was composed of 52 questions/items grouped into twelve dimensions evaluated on a five-point Likert scale, which evaluates 3 main components (organisational culture, safety culture and reported errors). The original items have been validated by the Agency for Healthcare Research and Quality (AHRQ) for the USA hospital setting and Factor analysis resulted in the following 12 factors (dimensions):

- D1 Teamwork across units
- D2 Supervisor/manager expectations and actions promoting patient safety
- D3 Organisational learning – continuous improvement
- D4 Hospital management support for patient safety
- D5 Overall perceptions of safety
- D6 Feedback and communication about error
- D7 Communication openness
- D8 Frequency of event reporting

- D9 Teamwork within units
- D10 Staffing
- D11 Hospital handoffs and transitions
- D12 Nonpunitive response to error

The final sample was composed of 144 radiographers (27.78% from private imaging departments and the remaining 72.22% from public facilities). Data was also divided according to the six main regions of Portugal: 13.89% from Algarve, 6.94% from Alentejo, 27.78% from Lisbon, 14.58% from Central region, 34,72% from the North region and 2.08% from the islands.

This study followed the ethical considerations of research. Respondents were free to exercise their right to participate and answer the questionnaire at their will. Information obtained is solely for research purposes and is held with utmost confidentiality. Anonymity of both the respondents and hospitals/clinics were honoured in the study to protect the data and names of the subjects. The data gathering was done accordingly and to the convenience of the institutions without hindering their daily operations. For data analysis, Statistical Package for the Social Sciences (SPSS) V.23 was used.

## Results: how do radiographers perceive patient safety culture?

The internal consistency of the questionnaire assessed by the Cronbach's alpha was excellent ( $\alpha=0.927$ ). Only 9 radiographers classified the patient safety culture as excellent, whilst 68 radiographers classified the safety culture as very good and 55 classified it as acceptable

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(Figure 1). The remaining participants classified safety culture as weak (8) or very weak (4).

It should also be noted that an expressive number of 58 radiographers did not file any error in the last 12 months in the risk management system.

To identify the differences between public and private imaging facilities, t-student-test was used and it was verified that for the private facilities some dimensions scored statistically higher than in the public sector, namely in Teamwork across units ( $p=0.03$ ), Hospital management support ( $p=0.013$ ), Feedback and communication about error ( $p=0.008$ ), Teamwork within units ( $p=0,001$ ) and Hospital hand-offs and transitions ( $p=0.00$ ).

To verify the differences between the geographical areas, the Kruskal Wallis test was used and no statistically significant differences were found ( $p>0.05$ ).

A Pearson correlation test was performed to verify the existence of relationships between the degree that defines the safety culture of the imaging facilities and the organisational culture, safety culture and reported errors. Regarding the organisational culture, there are three significant negative correlations between the dimension referring to Teamwork across units ( $r = -0.554$ ;  $p = 0.000$ ), Organisational learning ( $r = -0.636$ ;  $p = 0.000$ ) and Teamwork within units ( $r = -0.517$ ;  $p = 0.000$ ). There is also a significant moderate negative correlation between the Hospital handoffs and transitions ( $r = -0.363$ ;  $p = 0.000$ ) and a significant weak negative correlation with respect to the Staffing ( $r = -0.201$ ;  $p = 0.015$ ).

In relation to the safety culture there are three significant negative correlations between the dimension Supervisor/manager expectations and actions promoting patient safety ( $r = -0.554$ ,  $p = 0.000$ ), Hospital management support for patient safety ( $r = -0.525$ ,  $p = 0.000$ ) and Overall perceptions of safety ( $r = -0.595$ ,  $p = 0.000$ ).

Relative to reported errors, there are two significant negative correlations with the dimensions Feedback and communication about error ( $r = -0.531$ ;  $p = 0.000$ ) and Communication openness ( $r = -0.520$ ,  $p = 0.000$ ); and two significant moderate negative correlations between the dimensions Frequency of event reporting ( $r = -0.444$ ,  $p = 0.000$ ) and Non-punitive response to error ( $r = -0.343$ ;  $p = 0.000$ ).

### Conclusion

Safety culture has received increasing attention in the recent past. This can be seen when healthcare facility members prioritise safety and when this becomes

part of their professional culture. From this increase in awareness, a strengthened safety culture will allow safer patient care.

In general, radiographers have a positive perception about patient safety of their departments. Despite this perception, in some dimensions, there are failures, more evident in the areas of Feedback and communication about errors and Staffing. The first weak dimension results from the cultural sense of error as a reason for punishment instead of an opportunity for improvement. The second weak dimension results from the concern regarding the number of hours worked, which was considered to be excessive by the participants.

It is noteworthy that private healthcare imaging departments have significantly higher scores in several dimensions of patient safety, which allow us to conclude that the investment in patient safety was higher or at least more evident in this sector.

Adverse events are not reported frequently, and almost half of participants revealed that they have not fulfilled any error report. This does not mean that the errors did not occur, but it means that they were not relevant, which shows that this awareness for safety improvement must be developed or participants were afraid of revealing them. Despite the existence of some weaker dimensions, the overall safety perception of radiographers is positive. ■

### KEY POINTS



- ✓ Radiographers have an overall positive perception of patient safety culture in most of the evaluated dimensions
- ✓ Core areas such “Feedback and Communication about errors” and “Staffing” are negatively listed by radiographers and should be further analysed
- ✓ Manager support for patient care is scored higher in private radiology facilities than in the public sector
- ✓ Safety culture dimensions rating should guide future development of safety culture improving action plans



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# A multimodal system for the diagnosis of breast cancer: the SOLUS project



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SOLUS is developing a multimodal breast imaging system involving diffuse optics and ultrasound.

The SOLUS project develops a novel multimodal system that significantly improves the characterisation of breast lesions.

**B**reast cancer is one of the most common cancers in the world. It is estimated that about one in eight women in Europe will develop breast cancer before the age of 85 (International Agency for Research on Cancer 2018; Curado et al. 2007). The chances for survival increase substantially upon early diagnosis of breast cancer, so the availability of diagnostic tools with a high sensitivity and specificity is vital.

The International Agency for Research on Cancer has confirmed the effectiveness of mammographic screening in reducing breast cancer mortality (Lauby-Secretan et al. 2015). Unfortunately, such screening programmes return a significant number of false positive cases (Lancet 2012). These require further examination, such as additional imaging or invasive procedures such as biopsies. Approximately 50% of positive breast screening outcomes turn out to be false positives, meaning that a large number of additional examinations could have been avoided.

These additional examinations not only have a negative impact on the patient's quality of life, they also represent a high economic burden. Thus, there is a clear need for an affordable point-of-care system with a high specificity to improve the in-depth characterisation of breast lesions.

This article summarises the rationale behind the SOLUS project whose aims are the development of a multimodal breast imaging system involving diffuse optics and ultrasound.

## Ultrasound

Ultrasonography (US) is the first-choice technique

to assess the morphology of breast lesions and guide breast biopsies. Based on the morphological features of a lesion, a distinction between malignant and benign lesions is possible using the Breast Imaging Reporting and Data System (BI-RADS) (Mendelson et al. 2003). BI-RADS provides standardised terminology to describe and assess breast lesions, as well as recommendations for further follow-up.

“ THE SOLUS PROJECT IS DEVELOPING AN INNOVATIVE, MULTIMODAL TOMOGRAPHIC SYSTEM, COMBINING DIFFUSE OPTICS, US AND SWE, TO SUPPORT THE IN VIVO DIAGNOSIS OF BREAST CANCER ”

BI-RADS category 3 are considered benign lesions, with a very low rate of malignancy. However, BI-RADS category 4 covers a wide range of lesions whose malignancy status is less predictable.

The diagnostic results of conventional US are frequently unsatisfactory. Improved characterisation of lesions might allow better BI-RADS categorisation and decrease invasive follow-ups.

## Shear wave elastography

Recently, shear wave elastography (SWE) has been introduced as an advanced US technique. SWE provides a quantitative and reproducible

measurement of tissue stiffness. Tissue stiffness can serve as a marker of malignancy, as malignant tissue generally contains more extracellular matrix, increasing its rigidity. A recent meta-analysis has evaluated the performance of SWE for the diagnosis of breast cancer (Liu et al. 2016). The specificity of conventional US was 55%. The combination of SWE and conventional US resulted in a specificity of 80%.

This is a promising increase, but further improvement in specificity is desirable to achieve a significant reduction in the false-positive rate.

### Diffuse optical imaging

Optical imaging is an appealing candidate as a method complementary to US. Optical imaging methods can give insight into tissue composition, which US is unable to do.

With diffuse optics, a form of optical imaging, it is possible to measure the light absorption and scattering properties of tissue. The absorption and scattering properties of light at different wavelengths provides information about tissue structure, composition and functional blood parameters, such as haemoglobin concentration, oxygen saturation, and water and lipid content. Diffuse optical imaging can probe tissue to a depth of a few centimetres, which makes it suited for the non-invasive diagnosis of breast cancer.

Cancerous breast tissue is typically characterised by high haemoglobin and water content, while lipid content is correspondingly low. High scattering has also often been detected in malignant lesions (Durduran et al. 2010; Leff et al. 2008). These observations all correlate with known changes associated with tumour development, such as neoangiogenesis, alterations of stromal components and increased extracellular matrix deposition.

Collagen can also be measured using diffuse optics. Alterations in the composition of the extracellular matrix are well-known aspects of pathological breast conditions and a causal link between collagen and tumour formation and progression has been established (Luparello 2013). Thus, information on the collagen content in breast tissue could provide useful information for breast lesion classification.

Pioneering research on the optical characterisation of tissue by the Politecnico di Milano, Italy, has recently shown encouraging preliminary results that collagen may be even more crucial than haemoglobin concentration in the differentiation between

malignant and benign breast lesions (Quarto et al. 2014; Taroni et al. 2009; Dalla et al. 2015; Konugolu et al. 2012).

With diffuse optical imaging using multiple extremely short light pulses at different wavelengths, a complete optical characterisation of tissue is possible in a single measurement. However, its spatial resolution is a well-established limitation. To better exploit the information from diffuse optical imaging, and to overcome its limited spatial resolution, morphologic data obtained from other imaging modalities, such as mammography, MRI, PET or US, have been used to provide so-called prior information for the diffuse optical tomography reconstruction, or for combined imaging to provide anatomical landmarks.

Contrary to conventional x-ray mammography or PET, US does not involve the use of ionising radiation and does not have many of the disadvantages of these modalities (complexity, high cost, size of equipment, long examination times, use of contrast agents, limited patient acceptance). This makes US an ideal method from which to derive anatomical information and to complement diffuse optics.

### The SOLUS project

The SOLUS project is developing an innovative, multimodal tomographic system, combining diffuse optics, US and SWE, to support the *in vivo* diagnosis of breast cancer. Our multimodal system will improve the classification of breast lesions, more specifically the discrimination of lesions that are borderline between benign and malignant (BI-RADS 3 vs. 4a). These presently have high false-positive rates.

Combining diffuse optics with US can be achieved via the development of a portable, cost-effective, non-invasive, point-of-care diagnostic tool.

The SOLUS project is exploiting innovative photonics concepts for the development of new components. By employing diffuse optics with a small source-detector distance and a time-gated approach, the SOLUS system will achieve unprecedented sensitivity, spatial resolution, and depth penetration, thereby providing effective, diagnostic information on tissue composition and functional blood parameters to complement the anatomical information and characteristics of tissue stiffness provided by conventional US and SWE, respectively.

We are developing an innovative photonics module, called a smart optode to perform the diffuse optical tomography. The smart optode

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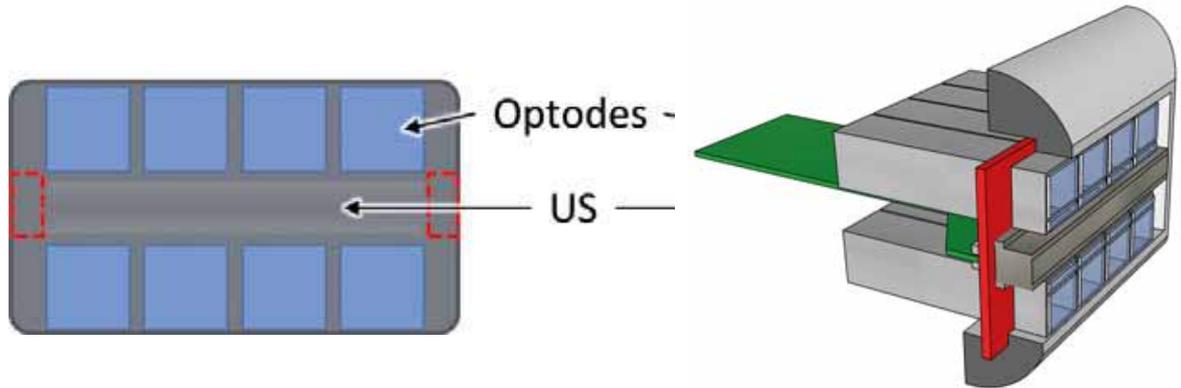
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Left: front of the multimodal probe with the eight optodes in two banks of four, with the ultrasound transducer in the middle. Right: mockup of the multimodal probe.

includes a novel laser driver and newly developed detector and acquisition electronics. The smart optode itself will be small in size (measuring about 1 cm<sup>2</sup> at the front). Multiple smart optodes will be combined with a conventional US transducer into a multimodal probe capable of carrying out diffuse optical tomography as well as US and SWE measurements all at once.

This multimodal probe is at the heart of the SOLUS system for high-specificity, multi-parametric breast imaging and diagnosis of breast cancer.

The examination procedure will be very similar to current standard US practices. This facilitates acceptance by both patients and clinicians.

A more comprehensive characterisation of breast tissue, a higher diagnostic specificity, and reduction in the number of invasive follow-up examinations are expected.

After assessment of the specificity, sensitivity and spatial resolution of the system in laboratory trials, we plan to validate the SOLUS system in real clinical settings. A pilot clinical study on patients with benign and malignant breast lesions (20 each) has been designed to demonstrate the overall feasibility of the proposed approach, the practical usability of the multi-modal instrument, and at the same time to provide insights into the real diagnostic advantages that can be achieved.

### Impact of SOLUS

The SOLUS system will achieve substantially improved breast cancer diagnosis, leading to a reduction in unnecessary biopsies and decreasing the economic burden on our healthcare systems.

The system will also allow more effective treatment and therapy management. New and improved therapy response prediction and monitoring enable personalised decision-making, therapy planning and optimisation for each patient. This also contributes to a significant decrease in the total cost of breast cancer diagnosis.

“ SOLUS WILL SUBSTANTIALLY IMPROVE BREAST CANCER DIAGNOSIS, LEADING TO REDUCTION IN UNNECESSARY BIOPSIES & DECREASING THE ECONOMIC BURDEN ON HEALTHCARE SYSTEMS ”

### Conclusion, first results and achievements

The project partners are currently finishing the development of the components for the system.

The overall design of the smart optode has already been completed. Subcomponents of the smart optode, such as the compact laser driver and the time-gated single-photon detector, have been developed and are currently in the final stages of testing prior to their integration.

Furthermore, phantoms and protocols for performance assessment have been completed.

Work on the integration of the multimodal probe is currently ongoing. The practical ergonomics of the probe are very important, so special attention is being paid to feedback from our collaborating

clinicians on this aspect.

Highly automated image processing and reconstruction algorithms are being developed and tested with promising early results. These use anatomical information from US for the reconstruction of the diffuse optics measurements. Additional software for the operation of the entire system is also under development.

Ultimately, the multimodal probe will be incorporated into an existing, commercially available ultrasound system from project partner SuperSonic Imagine.

### Facts, figures and acknowledgement

The SOLUS project is coordinated by Prof. Paola Taroni from the Politecnico di Milano, Italy. It started in November 2016 and will conclude in October 2020. The consortium brings together physicists, engineers, clinicians and industry partners to develop the SOLUS system for improved breast cancer diagnosis. The consortium consists of nine partners from five European countries:

- Politecnico di Milano, Milan, Italy
- CEA-Leti, Grenoble, France
- SuperSonic Imagine, Aix-en-Provence, France
- Vermon, Tours, France
- University College London, London, UK
- Micro Photon Devices, Bolzano, Italy
- Ospedale San Raffaele, Milan, Italy

- European Institute for Biomedical Imaging Research, Vienna, Austria
- iC-Haus, Bodenheim, Germany

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### KEY POINTS



- ✓ A high number of breast lesions, detected by screening programmes, are false-positives.
- ✓ Better discrimination between benign and malignant breast lesions is necessary to reduce the number of unnecessary procedures and the economic burden.
- ✓ Optical imaging methods provide an excellent addition to conventional ultrasound imaging.
- ✓ The SOLUS project is developing an innovative, multimodal tomographic system, combining diffuse optics and ultrasound to support the in vivo diagnosis of breast cancer.



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# The evolution of left ventricular assist devices

## Cutting-edge therapy at a high price

Left ventricular assist devices (LVADs) have transformed the treatment landscape of heart failure. As the number of implants continues to increase, clinicians will have to integrate dedicated programmes in their clinics and be actively involved in the care of patients on LVAD support.



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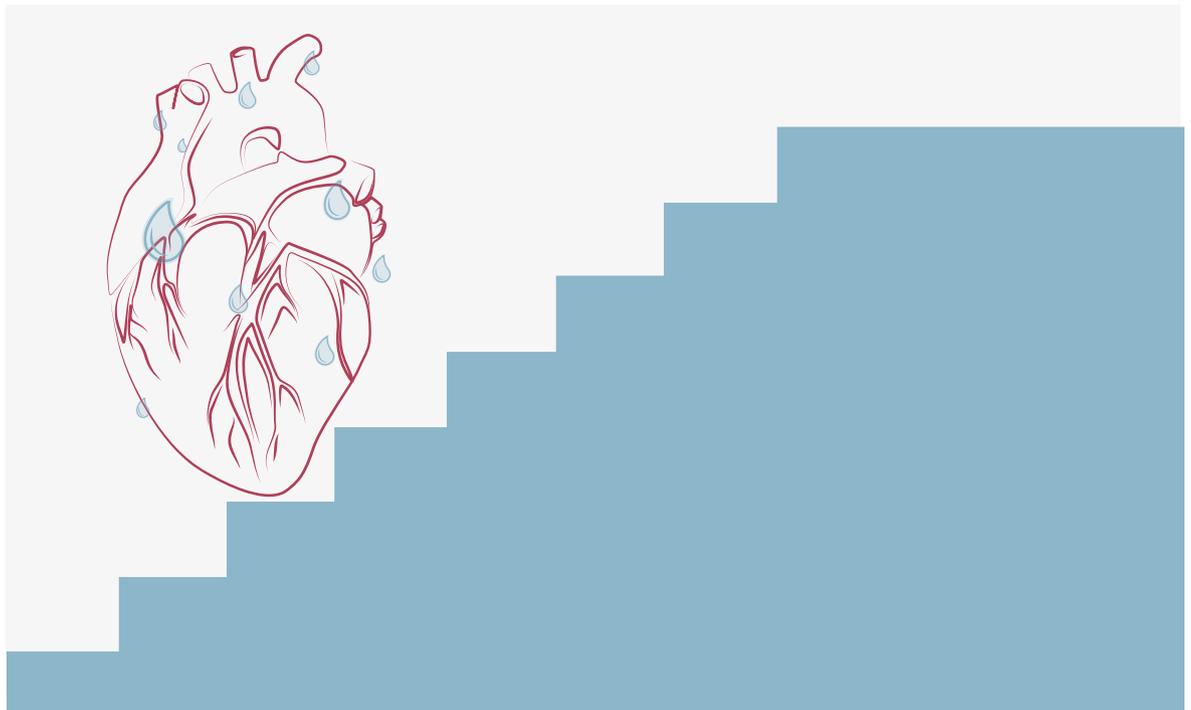
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**H**eat failure is one of the most common cardiovascular conditions worldwide. The estimated prevalence of heart failure is increasing at epidemic proportions. By the end of 2014, 6.5 million Americans  $\geq$  20 years of age had been diagnosed with heart failure. This prevalence is projected to increase to  $>$  8 million by the year 2030. (Heidenreich et al. 2013). Data from the NHLBI-sponsored CHA, ARIC and CHS cohorts indicate that heart failure incidence approaches 21 per 1000 people older than 65 years (Huffman et al. 2013). The total costs for HF are projected to reach \$69.7 billion by 2030, which represents an increase of 127% from 2012 (Benjamin et al. 2018).

Approximately 50% of heart failure patients

have reduced ejection fraction, and 10% of these patients experience refractory heart failure symptoms (New York Heart Association functional class IIIb to IV, Stage D), yielding an estimated cohort of 200,000 to 250,000 patients. These patients are typically referred to cardiac transplant centres, where they undergo evaluation to determine their candidacy for heart transplantation. The short- and long-term outcomes following cardiac transplantation have been exceptional, with a median survival of 10.7 years (Stehlik et al. 2011). The major limitation to cardiac transplantation has been the insufficient donor supply, which is currently limited to approximately 2,500 hearts annually in the United States. Obviously, transplantation is not available

for the majority of patients with advanced disease. Fortunately, mechanical circulatory support with the implantation of cardiac assist devices has emerged as a novel therapeutic option for patients with refractory symptoms despite optimal medical and conservative treatment.

### Left Ventricular Assist Devices

Left ventricular assist devices (LVADs) have revolutionised the management of patients with advanced heart failure, providing an alternative to heart transplantation. LVADs were initially implanted as a bridge to transplant, aiming to reduce the high mortality rates among hospitalised patients awaiting donor hearts. However, the paucity of donor organs alongside a substantial increase in the burden of comorbidities and the ageing of the heart failure population has put the focus to non-transplant surgical therapies for advanced heart failure. LVAD therapy was shown to improve survival and quality of life, either as a bridge to transplant or as a destination therapy (Slaughter et al. 2009; Aaronson et al. 2012). Following FDA approval for destination therapy (DT) in 2010, LVAD implantations have rapidly increased. The proportion of patients allocated to DT increased from 19.6% during the period 2008-2010 to 45.7% of all implants in 2014. The miniaturisation of devices, the evolution of device technology and the improvisation of the operative techniques as well as better patient selection and complication management have led to a significant improvement in survival rates. The 8th Inter-agency Registry for Mechanically Assisted Circulatory Support (INTERMACS) report on > 20,000 LVAD implantations from 2006 to 2016 announced 1-year survival of 81% and 2-year survival of 70% (Kirklin et al. 2017). Nowadays, LVAD therapy constitutes an established treatment option for well-selected patients with advanced heart failure. As a result, the number of transplant and non-transplant centres integrating LVAD programmes in their facilities is rapidly expanding, and a further increase in device implantations is anticipated in the near future.

### Economic impact of LVAD on healthcare

Despite these advantages, LVAD therapy is accompanied by a disproportionately high resource consumption and has an immense economic impact on the healthcare system. This results from the frequent hospital readmissions, the broad spectrum of severe device-related complications and the

need for a dedicated team of qualified healthcare workers in order to ensure appropriate long-term care in the outpatient setting. Previous analyses have demonstrated that LVAD was accompanied by volatile increases in healthcare expenses, compared to heart transplantation. Compared to non-bridged heart transplant recipients, receiving an LVAD as a bridge to transplantation increased survival, with greater associated cost (range, \$84964 per life-year to \$119574 per life-year for high-risk and low-risk patients, respectively). Open heart transplantation increased life expectancy and was cost-effective (8.5 years with <\$100000 per quality-adjusted life years [QALY] relative to medical therapy), but LVAD either as a bridge to transplantation (12.3 years at \$226 000 per QALY) or as destination therapy (4.4 years at \$202000 per QALY) was not cost-effective (Alba et al. 2013; Baras et al. 2016). These conflicting interests are reflected to an ongoing dialogue between healthcare policymakers, hospital leaders, and front-line clinicians, aiming to counteract healthcare disparities in a cost-effective manner and improve clinical outcomes of this devastating disease.

“LEFT VENTRICULAR ASSIST DEVICES (LVADS) HAVE REVOLUTIONISED THE MANAGEMENT OF PATIENTS WITH ADVANCED HEART FAILURE, PROVIDING AN ALTERNATIVE TO HEART TRANSPLANTATION”

Under these circumstances, clinics pursuing to initiate LVAD programmes are confronted with a challenging environment and have to take into consideration various aspects of this exceptional mode of therapy before moving to capital investments. In general, an LVAD programme is considered a challenging endeavour with regard to receiving funding, administrative support, and local acceptance from affiliated institutes and healthcare providers. Hereafter, we summarise some aspects from our own experience:

- Ideally, an LVAD programme should be part of an interdisciplinary heart failure unit consisting of a cardiology and a cardiac surgery department with an adequate number of potential LVAD candidates.

- Considering the multi-organ manifestations of advanced heart failure and the broad spectrum of non-surgical interventions indicated in this patient cohort, the candidate centre should be able to provide interventional and surgical cardiac procedures, cardiac electronic device implants and intensive care. A dedicated outpatient clinic is part of the required infrastructure in order to provide high-quality care of the ambulatory patients on the long term.
- The physician leadership team is the core of the LVAD project. An experienced heart failure cardiologist and a cardiothoracic surgeon with expertise in mechanical circulatory support should supervise all aspects of device implementation, including patient selection, staff training, quality controls, and cost-effectiveness.
- A qualified team of surgeons, heart failure cardiologists, and nurses familiar with the complexity of LVAD therapy should be of high priority. Two VAD coordinators should oversee the entire process from candidacy to follow-up care and take on administrative and organisational tasks. Staff training in special skills and familiarity with psychosocial, technical and pharmaceutical issues is of paramount importance for all parties. Rehabilitation physicians should be part of the caring team and stay interconnected with the implantation clinic if not regionally located.
- At last, an in-hospital heart transplant programme or a transplant centre affiliation is vital for patients who are or may become eligible for bridging therapy and should be offered transplantation candidacy. Participation in a palliative care network or at least an

on-site consulting service should be available for the end-of-life care of LVAD patients.

LVADs have transformed the treatment landscape of heart failure and are now adopted for long-term ambulatory support of patients with advanced disease. As the number of implants is anticipated to rise, clinicians in administrative positions will be surged to integrate dedicated programmes in their clinics and be actively involved in the care of patients on LVAD support. Consequently, all aspects of this mode of therapy will have to be considered, in order to provide optimal care at a reasonably acceptable cost. ■

## KEY POINTS



- ✓ LVADs have revolutionised the management of patients with advanced heart failure
- ✓ LVAD therapy improves survival and quality of life, either as a bridge to transplant or as a destination therapy
- ✓ An LVAD programme should be part of an interdisciplinary heart failure unit consisting of a cardiology and a cardiac surgery department
- ✓ The physician leadership team is the core of the LVAD project
- ✓ An in-hospital heart transplant programme or a transplant centre affiliation is vital for patients who are or may become eligible for bridging therapy



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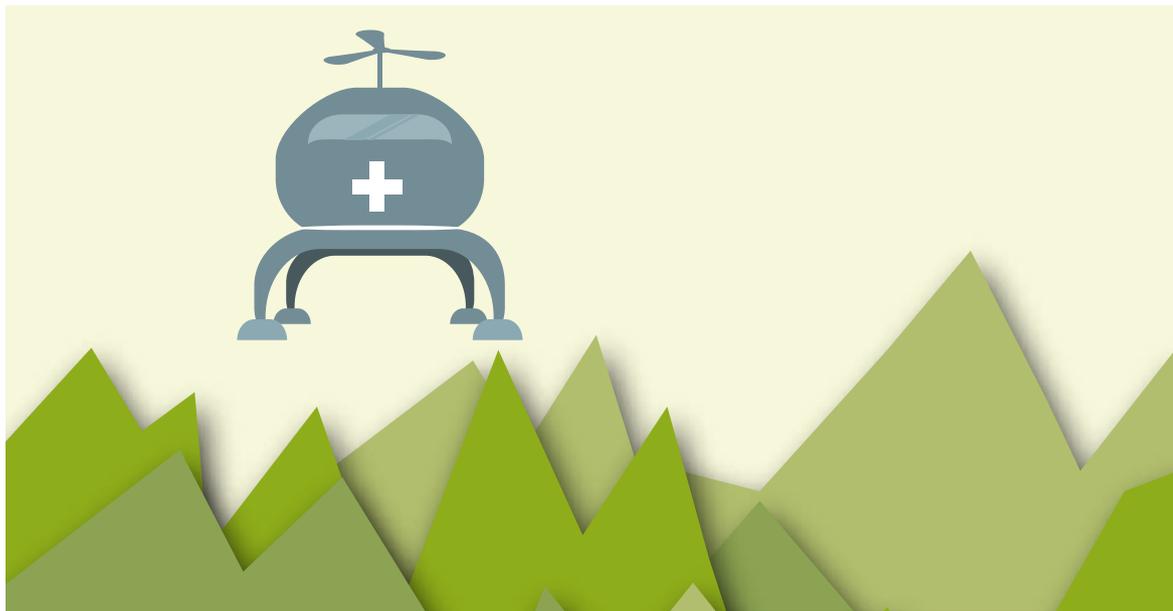
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# Transforming lives a drone delivery at a time

Rwanda leading the way with life-saving drone tech

Rwanda shows how rapidly-developing drone technology can improve healthcare infrastructure at a national scale.



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In late 2016, the Government of Rwanda entered a Public Private Partnership with automated logistics company Zipline to deliver blood and medical supplies, becoming the first country to deploy drones at national scale. Based out of Half Moon Bay in Silicon Valley, Zipline is operating in Rwanda in partnership with Gavi, the Vaccine Alliance and UPS Foundation.

The current first phase of the partnership is with 21 hospitals in the southwestern region of the country, reputed for its rugged mountainous terrain, making access to hospitals difficult, especially during the rainy season.

As of December 2017 the partnership told a compelling story: over 3,200 on-demand deliveries by SMS text message had been made, predominantly to serve postpartum haemorrhaging mothers. When an order is made, the drone leaves Zipline's warehouse facility within 12 minutes, dropping the supplies in a designated zone of the hospital in a biodegradable package. Upon fulfillment delivery the hospital staff

is notified by SMS text message.

Today Zipline's deliveries save the National Centre for Blood Transfusion an estimated 20 percent, compared to costs of the prior delivery mechanisms, and is integrated to the National Hemo-vigilance system to support monitoring and forecasting for the blood distribution cold chain – the network for critical and perishable medical products.

The use of drones has addressed a number of challenges including slow response time to remote hospitals (about two hours to deliver blood) and improved resource management, including refrigeration facilities and delivery vehicles.

Within the next two years the partnership with Zipline will expand to the Eastern region of the country. In the long term the Government is looking to explore the use of drones for other opportunities such as delivery of vaccines, medicines, lab samples, supplies for artificial insemination of livestock and other essential and lifesaving products.

### Laying the foundation

With few benchmark examples, in 2016 when the Government of Rwanda embarked on this partnership, stakeholders from various Government institutions (Health, ICT, Aviation and Infrastructure) focused on strong collaboration to establish the appropriate policy and regulatory frameworks for drone delivery. In addition to this, awareness programmes were carried out in communities across the country, to ensure the acceptance of this new technology.

“THESE PARTNERSHIPS WITH ZIPLINE MAY SERVE AS MODELS FOR OTHER GOVERNMENTS LOOKING TO UNLOCK THE POTENTIAL OF DRONES IN IMPROVED HEALTHCARE DELIVERY”

The public private partnership model was imperative to ensure maximum impact and the ability to sustainably scale the project. Eighteen months later, as Zipline deliveries increase, and as the industry grows, key actions have been taken to foster investment and innovation in drones, including the adoption of performance-based regulations.

Earlier this year Jean de Dieu Rurangirwa, Rwanda’s Minister of ICT noted that: “As we look to the future, we will continue to put in place the infrastructure and policy frameworks that accelerate the adoption of emerging technologies to transform people’s lives.”

### Capacity building

The Government of Rwanda recognises that working with technology pioneers like Zipline presents an opportunity, not only to improve service delivery to its people, but also to spur innovation and multiplier effects as a result of employing Rwandans. In fact technology is a pillar of the country’s plan to become a knowledge-based economy by 2050.

A cornerstone of the partnership with Zipline is that the company employs Rwandans and ensures the diffusion of technical knowledge in the development and operation of their drone technology. Today over 95 percent of the staff are locals including pharmacists, engineers, nurses and biotechnologists.

As drone innovation and other technologies continue to play a pivotal role in delivering quality healthcare to Rwandans, the Government of Rwanda and Zipline entered a new partnership to establish

a training institute for drones to serve as a regional Center of Excellence.

### A model

Rwanda’s experience is a demonstration that it is possible for Government to collaborate with the private sector to harness technology to benefit its citizens. In 2017 the Government of Tanzania entered a partnership with Zipline to deliver blood and medical supplies.

These partnerships with Zipline may serve as models for other governments looking to unlock the potential of drones in improved healthcare delivery. This is especially true for environments with inadequate transportation and road infrastructure, resulting in increased costs for distribution, and hampering the cold supply chain management to healthcare facilities.

Every context shall be different, but a clear vision; appropriate governance (policy and regulatory frameworks) and an emphasis on developing local capacity have proven to be paramount. It is also important for policy-makers to actively engage with a diverse set of stakeholders in order to maximise the benefits of adopting drone technology to transform their healthcare systems and improve their citizens’ lives. ■

### KEY POINTS



- ✓ Rwanda and Silicon Valley company Zipline entered into a PPI on drone cold chain delivery of medical supplies in late 2016
- ✓ The network serves 21 hospitals in the rugged southwestern region of the country
- ✓ Orders are made with text and take no more than 12 minutes to deploy
- ✓ Within 12 months, 3,200 on-demand deliveries had been made, primarily to postpartum haemorrhaging mothers
- ✓ As part of the agreement with Zipline, 95% of network staff are Rwandans
- ✓ The technology supports the country’s ambitions to become a knowledge-based economy by 2050
- ✓ Zipline is expanding to the eastern part of Rwanda



The **European Health Management Association (EHMA)** will be holding its **Annual Conference in Espoo, Finland** from **17 – 19 June 2019** on the theme of **‘Health Management 2.0’** in collaboration with the Helsinki University Hospital (HUS) and the National Institute for Health and Welfare, Finland.

The three days will give participants the opportunity to learn about the challenges, new skills, share ideas and acquire effective practices on health management. This will be an excellent opportunity to network as the conference will bring together educators, researchers, managers and health professionals from Europe and beyond.

Different format sessions from **abstract presentations** and **panel debates** to “in conversation with an expert” and coaching sessions will provide you with insights, new ideas and knowledge that is needed in order to make the shift to 2.0 happen.

They will cover areas of **leadership, skills and competencies, innovation, planning.**



For more information about the Call for abstracts and the registration, please visit [www.ehma2019.org](http://www.ehma2019.org)

# Heat Waves: a climate change challenge to hospitals' resilience

The scientifically based forecast of more frequent devastating natural disasters is coming, and so is the need for a proactive attitude against the related risks. Hospitals and healthcare systems should get engaged in such activity.



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## Scientific evidence of the relation between natural disasters and climate change

It is becoming a constant in our daily life the call for attention from the media to climate-related natural disasters. Until recent years, important institutions such as the Intergovernmental Panel on Climate Change (IPCC) were encountering scepticism when they, as early as in 2001, were underlining that “there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities” (IPCC Climate Change 2001). The main argument against this conclusion was the lack of scientific evidence of the relation between anthropogenic activities and global warming, the main cause of climate change.

The European Parliament's Environment, Public Health and Food Safety Committee requested a study representing the uncertainty, or the diplomatic prudence, of that period among policymakers. The study was titled “Climate Change and Natural Disasters: Scientific evidence of a possible relation between recent natural disasters and climate change.” The conclusion was: “with or without climate change, physical damage from extreme weather is increasing in Europe ..... with climate change having made certain extreme events more likely and the likelihood that it will be even worse in the future, it is prudent an adequate response” (Anderson and Bausch 2006).

The scientific evidence of the cause and effect relationship between climate change and natural disasters is now irrefutable. It has become, in fact, the basis of relevant public initiatives such as the Conference of Parties (COPs). Specifically, the 21st COP, held in December 2015 in Paris, concluded with the important “Agreement on Climate Change Mitigation.” Actions and scientific studies followed. In 2017 the European

Environment Agency gave evidence to a new policy approach with the publication on “Climate Change adaptation and disasters risk reduction in Europe” (EEA 2017). International scientists have formed important organisations, such as the World Weather Attribution ([worldweatherattribution.com](http://worldweatherattribution.com)), working since 2015, and focusing on “research and develop scientific tools and methodologies to perform timely and robust assessments of whether and to what extent human-induced climate change played a role in the magnitude and frequency of extreme weather events.”

The growing evidence coming from the scientific society of climate change as mostly produced by anthropogenic behaviour has still to face some doubt or even the implicit denial. The United States, relevant nation, has recently declared to cease all participation in the initiatives foreseen by the above mentioned Paris agreement.

The scientifically based forecast of more frequent devastating natural disasters is coming, and so is the need for a proactive attitude against the related risks. Hospitals and healthcare systems should get engaged in such activity. Climate change is, in fact, responsible for major health problems.

## The area and focus of the article

Climate change has produced and is producing two types of different impacts: the “long-term” and “immediate” disasters.

Without disregarding the need of our awareness and concern for the destruction of the Australian coastal reef, the progressive desertification of North-East Africa, the icebergs melting and glaciers shrinking, we will focus on the geographic framework of Europe and the risks associated with it.

Healthcare systems should mostly be concerned with immediate impact. These were identified in the article

“Increasing risk over time of weather-related hazards to the European population” (Forzieri et al. 2017) as:

- Extreme heat waves
- Cold waves
- Increased precipitation and flooding
- Storms and high winds
- Related events such as landslides and fires

We aim to focus on the extreme heat waves, because of their relevance in giving evidence to the new needs of social and health care and consequently of appropriate consciousness in a hospital’s management and staff, medical or otherwise, planner and designer of health facilities about:

- The importance of health systems collaboration with policymakers for impact reduction in the new reality of climate change-related risk of natural disasters
- The community value of healthcare infrastructure resilience, as part of a strategic system
- The potential of hospitals in enhancing public understanding and community preparedness

“ THE SCIENTIFIC EVIDENCE OF THE CAUSE AND EFFECT RELATIONSHIP BETWEEN CLIMATE CHANGE AND NATURAL DISASTERS IS NOW IRREFUTABLE ”

Scientific studies and climate modelling have indicated that the measures to counteract climate change could not have, in the best of the circumstances, a relevant short-term impact; consequently, we are very likely to experience in the near and medium future an increase in extreme weather events. Also, the sceptics that human causes have given the greatest contribution to the rising of temperatures are admitting that the disastrous natural events will keep increasing in number and also in severity.

The concern among the public policymakers is becoming more evident, and new strategies suggested, envisaging the need for more systemic approaches and visions that start in finding the most efficient measures for adaptation to climate change and natural disaster reduction.

**Heatwaves: a nasty enemy**

Heatwaves are difficult to define and classify. In fact, in addition to magnitude, how rapidly they hit, and duration, there are multiple local conditions and factors influencing their perception and impact. This makes

it difficult to compare different reports and studies.

For our article, we will refer to the definition proposed in the report “The social impacts of heat waves” issued by the public “Environment Agency” dealing with the protection of the environment in England and Wales, which considers heat waves as periods of “anomalous heat that generate a societal response” (McGregor et al. 2007).

This definition is relevant for our work, posing the accent on the effects on society, which are the ones that can or will determine the pressure on hospitals, with the increased need for care.

The heat wave of 2003 that involved a large part of Europe, with its dramatic effects had stimulated some attention to this natural risk. However, to date, heat as a social hazard connected to climate change is still not sufficiently understood and studied. Some of the possible reasons lay on social factors. The few studies available, give evidence to the fact that outcomes of mortality and morbidity, infrastructures failures and even criminality as a consequence of heat waves, are marked by a heavy social component, ie they are much higher in the poorest areas of cities, where in fact, the impact of heat waves are more extreme and longer lasting. An article of January 18, 2018, in an Australian web-paper, reported the social un-preparedness on coping with heat waves in spite of being Australia’s deadliest natural hazard (Gissing and Coates 2018).

This could happen in Europe, where the heat waves and parallel drought facilitate bush and forest fires. In England, the major heat waves coincided with diffused drought, and they all had in common high ozone level, the combined effects of which are reported potentially lethal. The most advanced climate model has been predicting increases in heat waves frequency, intensity, and longer duration.

The new report of IPCC that is starting to be made public keeps very high the guard against the natural hazard, including heat waves, also in their relation with drought and wildfires.

World Weather Attribution has published at the end of July 2018 a detailed study on “the heat waves in Northern Europe,” confirming that all Europe has been kept under the potential risks of natural disasters, with an increased number and duration of heat waves.

**Vulnerability to heat**

As underlined before, the vulnerability to heat for a human being is a component of many factors, depending on:

- level and the duration of the exposure to the hazard

- age, health conditions of the person
- home situation
- environment characteristics and conditions

An interesting comparison comes from the study dedicated to the social impact of heat waves.

Summary of health-related threshold temperatures and mortality rates above threshold (McGregor et al.)

Among studies dealing with the vulnerability of persons, evidence-based in qualitative terms, the organisation Physicians for Social Responsibility (PSR 2018) indicate the following levels in the difference of susceptibility:

- The elderly who suffer from poor health
- The elderly in general because of diminished ability to regulate body temperature
- Babies and young children
- Pregnant and nursing mothers
- Those chronically ill with pre-existing cardiovascular, respiratory, neurologic, and psychiatric conditions, or obesity.
- Outdoor workers
- People who abuse drugs and alcohol
- People without access to air conditioning
- Urban populations as city environments generally have temperatures some degrees warmer than country areas. More frequently in urban areas, there are situations of poor housing, connected very poor economic situations

After the devastating effects in many parts of Europe of the 2003 and 2005 hot waves, more studies were developed focused especially in giving scientific evidence to the connections between natural disasters and health.

In the part dedicated to heat waves of “Global and planetary change,” the authors underline that the impact on health increases when extreme daytime temperatures combine with warm night-time temperatures, high humidity and light warm winds for several consecutive days. They define two types of impact on human health related to strong and extreme events according to specified thresholds of thermal stress and duration (Amengual et al. 2014). This has specific importance for hospitals preparedness for those events. In this regard, it needs to be stressed that the lack of sufficient and comparable studies leaves several aspects still unclear, important especially for hospitals preparation and awareness.

It also needs to be acknowledged, as said before, that the impact on mortality, morbidity, community disruption depends from the social situation (eg age structure), epidemiologic situation (eg general situation

of the community health) geographic, environmental, urban conditions. The advancing of the knowledge also put in the picture the difference between this natural disaster and others, such as floods, the impact of which is evident almost immediately.

Heat waves can produce effects that come out slowly and/or could be incremented by other factors in subsequent times. From the studies available, heat waves can be divided into those that have a:

#### Direct impact on health

- **Immediate**, that is requiring direct hospitalisation and/or emergency home services
- **Time delayed**, needs for hospitalisation or other forms of help and assistance grow and become necessary in a progressive way
- **Demanding more studies and evaluations**, which is the case for the effects on mentally ill persons or for types of violent behaviour

#### Direct impact on healthcare infrastructures

- **Electricity systems** that could fail under high demand inside the hospital or in the community
- **Other systems** such as water, medicines, space for services,
- **Emergency vehicles** and staff requested for the services inside and outside the hospital

It is also necessary to consider the possibility of other events which, as mentioned, are happening as a consequence of the heat wave, such as fires and the sufficient critical conditions of temperature and humidity following the heat wave.

The health problems that could be more likely related to heat wave include:

- Cardiovascular problems,
- Respiratory problems
- Heat strokes, with the rise of temperature, delirium, convulsions, and coma that can result in death
- Milder effects such as rashes, cramps, heat exhaustion

Among the long-lasting effects of stress exacerbated by heat there could be:

- Increase in symptoms of mental illness
- Increase in violent behaviour
- Higher risk of suicide and homicide

The side events that could develop and have developed in some instances are the explosion of fires, with consequences that could go from many victims and destruction of the environment and build urban areas, to minor destructions, but intoxications and problems with animals.

## Hospital as a strategic institution

The set of issues that we have only partially highlighted poses serious questions to people working in hospital structures, in all capacity, but especially the managers and technical staff who are involved in keeping the functionality of their structures, responding to the needs of their communities and performing the necessary services.

- Functionality Preparedness

This is the first step for preventive management. Disasters' managers say: the moment that the disastrous event happens, it is too late to get ready. Acting with the community and all the staff, in the framework of the general Strategic Plan of Prevention and Mitigation of the Community, and other superior territorial levels of Government, the crucial elements of prevention have to be put in place, according to the major disasters that the community could be suffering. The necessary preparation has to be programmed and realised immediately after general consensus and roles agreement.

The hospital can and should be one of the points of diffusion of information toward the community, through its staff, the patients and their families and specific diffusion events.

The internal preparedness should focus on:

- Managing massive presence of people at the hospital, some for treatments, others for searching for relatives or simply for general information. A list of available psychologists should be made. Among the studies produced, it is worth mentioning the European project IPPHEC (Improving Preparedness to give Psychological help in Hospital in case of massive emergency Crises). This international study, directed by the Italian Ministry of Health, produced guidelines, addressed to cases of terrorism, but certainly should also be considered for natural disasters (EAHC 2010).
- Control of technical systems, first of all of the electrical, water, waste disposal, the supply of essential medicine and food.
- There are no tools prepared, up to now, with regard to resilience, providing measures as for other aspects (eg fire or seismic norms for prevention in new hospitals constructions)

One of the aspects needing in-depth studies is "redundancy," ie the evaluation of which are persons, medicines, equipment and services that are absolutely necessary to have the possibility of alternative sources of supply for guaranteeing the continuity of the hospital activity. Getting to the specific of heat waves, the first consideration to make is:

- If there is a potential risk of fire related to its area of catchment and the structure has been selected, for example, to be the reference in case of persons severely burned, the hospital will have to prepare ad hoc specific structures.
- To prepare adequate plants is crucial for energy supply. It has happened in several instances, that the hospital did not have access to energy for several days, without even the possibility of receiving fuel for producing its own energy. The updating of storages based on different energy production is essential, possibly eliminating diesel motors for such use.
- The other essential resource, water, also has to be a priority in case of a heat wave, also for medical needs, de-hydration being one of the possible major problems

## What lies ahead

The social aspects deriving from heat waves impact are important. We have stressed how poor people are more likely to suffer from heat waves, not to speak of the marginalised part of society. The technical dimensions are also of relevance, since health facilities, first of all, hospitals, are and will remain strategic pillars in support of the social fabric for adaptation and mitigation.

It is, therefore, necessary that we prepare staff as well as health facilities about all aspects: medical, social and technical, against extreme risks of natural disasters, and start addressing the one risk that has not received sufficient attention: heat waves. A follow-up analysis will be dedicated to highlight the technical factors that need to be tackled in order to have hospital prepared for heat extremes, in the certainty that preparedness against heat waves risks, will assure to the hospitals the capacity to cope also for other climate change related potential disasters. ■

## KEY POINTS



- ✓ There is a scientifically-proven link between natural disasters and climate change
- ✓ Heatwaves are a growing threat to vulnerable populations
- ✓ The hospital can operate as a strategic institution to mitigate impact of extreme



## REFERENCES

For full references, please email [edito@healthmanagement.org](mailto:edito@healthmanagement.org) or visit <https://iii.hm/r17>



## MICHAEL A.E. RAMSAY

CHAIRMAN - DEPARTMENT OF ANESTHESIOLOGY AND PAIN MANAGEMENT, BAYLOR UNIVERSITY MEDICAL CENTER, U.S.

TOP QUOTE FROM ZOOM ON PROFILE:

“The hospital should be the safest place for our patients and yet mistakes and infections occur that should not. It takes leadership from the top down to create the “Culture of Safety” that must exist.”

See more at: <https://iii.hm/qnz>



## KARIM BOUSSEBAA

SENIOR VICE PRESIDENT & GENERAL MANAGER OF CT AND AMI, PHILIPS, U.S.

TOP QUOTE FROM BLOG

**‘What imaging trends will impact radiology departments in 2019?’**

“We are already starting to see AI augment the radiologist’s role in tangible ways, such as improving operational efficiency and diagnostic confidence, and we can only expect that momentum to continue in 2019 and beyond.”

See more at: <https://iii.hm/qo0>



## DANIELA PEDRINI

VICE PRESIDENT, INTERNATIONAL FEDERATION OF HEALTHCARE ENGINEERING

TOP QUOTE FROM THE BLOG

**‘Climate change and healthcare architecture’.**

“The enormous challenge presented by climate change-related problems, leads to the need for safer hospitals, in terms of physical structure and for proactive institutions in the battle against this environmental situation.”

See more at: <https://iii.hm/qo3>



## MATTHEW GIERC

HEAD OF MARKETING, 3AG SYSTEMS, CANADA

TOP QUOTE FROM BLOG

**‘How nurse scheduling can be the difference between satisfaction and burnout’.**

“Ensuring fairness, consistency and uniformity in scheduling is not just a nice thing to do, but it can help your organisation get the most from your nurses.”

See more at: <https://iii.hm/qo2>

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