Rohrbeck Heger Reports

The Future of Digital Healthcare

7 Disruptive Trends to Watch Towards 2030

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Keep your finger on the pulse

7 trends to track into the decade to come

In the next 10 years or so, emerging technologies such as quantum computing, AI, and ever-more sophisticated sensors are poised to transform the healthcare sector. From the promise of treating disease via virtual reality, to the perils of medical data gone astray, **disruptive drivers of change are just around the corner, waiting to break through.**

What will the future of digital healthcare look like in 2030? From our research in the field, our Rohrbeck Heger foresight analyst team has selected the **top 7 disruptive trends that will define the healthcare sector in the next decade**. These trends will fundamentally change many aspects of medical care, whether it's how we diagnose and treat illness, research and develop drugs, or understand our own bodies and how best to live a long and healthy life.

"The physician must be able to **tell the antecedents, know the present, and foretell the future** — must mediate these things, and have two special objects in view with regard to disease, namely, to do good or to do no harm."

— Hippocrates

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#1

Precision Medicine

Just as a mixologist or barista can conjure up a cocktail or coffee to suit your personal specifications, so too will your healthcare provider be able to assess your medical profile and deliver a course of treatment tailored exactly to your needs. This is precision medicine's vision: leveraging bioinformatics to deliver the right therapy at the right time for each and every patient.

Precision medicine, also known as personalized care, describes a **new standard of medical care** wherein prevention, diagnosis, and treatment of an individual patient is **informed by their unique profile**: a combination of their genetics, medical history, lifestyle, and other variables. After all, no patient is the same as any other, and yet, medicine often employs a one-size-fits-all approach.

With the support of emerging tools such as a patient's digital twin (a software-based representation that taps into a patient's entire medical history), as well as improved interoperability of various data sources (lab results, public health data, real-time vitals collected by a wearable), it will become easier than ever to form a very **comprehensive, personalized approach** to treatment and care.

Consider chemotherapy: despite improvements, this cancer treatment still harms healthy cells. Emerging **mRNA cancer vaccines** (used as therapy, not prevention) act as personalized "biological software" to train a patient's immune system to fight their particular brand of cancer. By analyzing a tumor sample and the individual's DNA, **this vaccine is made specifically to teach the individual's body to eliminate sick cells, only**. Aided by AI and software, this development process happens quickly, ready to deploy within just a few weeks.

Other healthcare developments also help to **power the push to precision healthcare**. For example, Roche launched the AVENIO Edge System to simplify and automate next-generation genome sequencing. Improved accuracy and speed mean a deeper understanding of the genetic mechanisms linked to various diseases, which can then be mapped onto a patient's own genetic profile.

One particular challenge to the deployment of precision medicine is that **it will only be truly effective once it's been integrated throughout the entire medical system.** Until general practitioners, academia, the private sector, and public health authorities are all on board, its efficacy can only go so far. But while the integration of these fragmented data systems may slow it down, there's no stopping it: **powered by digital capabilities, precision medicine will define the future of healthcare.**

#2 Digital Twins

Imagine a future when your doctor could accurately predict your unique response to a course of treatment by running tests on your personal avatar. A time when this digital twin, fed data by the wearable on your wrist, alerts you and your healthcare provider at the earliest signs of disease. Well, that time is now: these technologies already exist. Once they're widely adopted, digital twins are set to revolutionize medicine.

Digital twins, when used in a healthcare setting, **map human physiology in silico** (digitally, on a computer or in a computer simulation). These avatars (of an organ, individual, or larger populations) incorporate multidimensional data sets about the biological systems they represent, including genomic sequencing, physiological attributes, or lifestyle characteristics. As sensor technology has grown more sophisticated, wireless connection more widespread and reliable, and computing power stronger, comprehensive collection of real-time health data has exponentially increased. **By feeding data into a digital twin model, practitioners and researchers can generate, test, and evaluate hypotheses**, all without using a human being or animal. Not only does this lower costs, it also enables safer experiments to be conducted at a quicker pace, **bringing life-saving therapies to market on an accelerated timeline.**

Digital twins will also enable doctors to **diagnose a disease at its earliest sign**, before symptoms even arise. This is what happened to Anna, a colorectal cancer patient in remission whose digital twin – an aggregate of her healthcare data – caught the signs of early-stage metastases in her liver. Her story, a remarkable diagnostic achievement powered by Siemens' AI-Pathway Companion, is only the tip of the iceberg. As this technology develops, digital twins are poised to become the future standard of ever-increasingly personalized and precise care.

Launched in 2018, MED²ICIN is another digital patient modelling tool whose goal it is to **merge unstructured and distributed health data into one digital patient image.** This digital representation of an individual is distinctively comprehensive, **enabling a more holistic approach to care**. By combining various data (analog records, hi-res scans, family history, lab test results), it provides a more complete picture of someone's health in order to better diagnose and treat them.

Moving beyond the realm of individual healthcare, digital twins will also **aid researchers and students**. Consider the Living Heart Project's mission to establish a common foundation for cardiovascular medicine in silico: For those researchers who develop medical devices, or for students who are in clinical training, tools such as the Living Heart Project's accurate and personalized human heart models may feature prominently in their everyday work and training.

#3

VR/AR Healthcare Applications

From convenient and effective treatments for PTSD, OCD, and other mental illnesses, to tools that reduce error during complex neurosurgeries, the simulated worlds of virtual reality (VR) and the superimposed enhancements to "real life" of augmented reality (AR) will continue to broaden the horizons of possibility for patients and practitioners alike.

While virtual reality (VR) and augmented reality (AR) may call to mind humorous videos of headset-wearing people stumbling around a room, the healthcare applications emerging from these technologies are anything but trivial. There is enormous potential for use by both practitioners and their patients, chiefly in two ways: by enabling **remote and enhanced execution (and practice) of medical procedures**, as well as serving as a **vehicle for treatment.**

Before a surgery, there's sound reason to prefer the steady hands of a surgeon who's "done this before" – after all, practice makes perfect. Increasingly **incorporated into medical education and training**, VR applications enable surgeons-to-be to perform steps on a virtual patient in a simulated operating theater. While training exercises in virtual surroundings don't necessarily map one-to-one with "real life" procedures, VR applications are currently unlocking a world of teaching tools that are not only **more economical** (requiring less supervision and resources) but also instrumental in **preventing life-threatening errors**.

The benefits of these immersive, synthetic worlds are not limited to students. Seasoned **practitioners can walk their patients through planned steps** in advance of a procedure, a feature that distinguishes Precision VR, a software built for surgeons from the company Surgical Theater. In addition to improving surgeons' preoperative plans, their products even include AR functionalities that can be used during surgery, **superimposing patient scans over actual organs** during a procedure.

The development of VR/AR applications as **more economical and effective treatments for various illnesses** is also well underway, indicating enormous potential. Oxford VR reports a 68% reduction in patient fear after treatment with their **immersive psychological interventions**. Karuna Labs has designed simulations that merge physical therapy, cognitive neuroscience, and pain psychology to support patients in their **pain management**. Neither of these therapies necessitate that patients travel to a clinic for treatment, **expanding the possibilities for remote care**.

Virtual and augmented reality: what's the difference?

- Virtual reality (VR) immerses a user in a simulated 3D world via wearables such as headsets.
- Augmented reality (AR) employs aspects of VR by superimposing information onto live, real-world video.

Both concepts **engage sight, sound (and even touch or smell) to create an illusion** of particular surroundings. In the coming decade these technologies will become easier to use, more realistic, and less costly.

#4

Digital Therapeutics & Diagnostics

Concerned that your ageing parent keeps forgetting to take their meds? There's an app for that. Looking to fine-tune your nutrition so you can ward off a family history of heart disease? There's an app for that, too. Your partner seeks ways to practice cognitive behavioral therapy and better manage panic attacks? You guessed it – there's an app for that, as well – and soon, your doctor might even be able to prescribe it.

Digital therapeutics refers to **high-quality software-based interventions** that help prevent, treat, and manage various health conditions. Ideally these products would **require rigorous review and approval** from regulatory bodies in order to substantiate any claims of safety and efficacy. Such legal oversight would ensure that software therapeutics are grounded in evidence-based treatments, bolstered by both clinical studies as well as results from real-life outcomes.

While it's possible that a digital therapeutic product might be used independently, often this software is **implemented in tandem with other treatments such as medications, clinician support, or other medical devices**. Digital therapeutics are especially useful to augment or complement treatment for conditions whose treatments are **dependent upon behavior**, such as diabetes, respiratory diseases, or mental health disorders. Such products coach and support patients in managing their symptoms via mobile devices, apps, or VR. If shown to be especially effective, **could such scalable, non-pharmaceutical interventions reduce or even eliminate the need for medications** for these indications?

Consider University of Oxford-based gameChange VR, which designs **software to help people with psychosis** manage anxiety in everyday situations. These interventions are delivered via **VR headset**, relying on **automated psychological therapy** to immerse patients in sophisticated simulations that help them better manage challenging situations in real life.

How soon will such therapies make their way into health insurance schemes and gain widespread popularity? In some places, it's already happening: to date, **Germany's Federal Institute for Drugs and Medical Devices has already approved 29 digital health applications for reimbursement** by the country's public health insurance. These products treat various indications from tinnitus or insomnia to generalized anxiety disorder and nicotine addiction.

Currently generating an annual revenue of $3.4 billion, the global digital therapeutics market is projected to reach $13.1 billion by 2026, increasing at a compound annual growth rate (CAGR) of 31.4%.

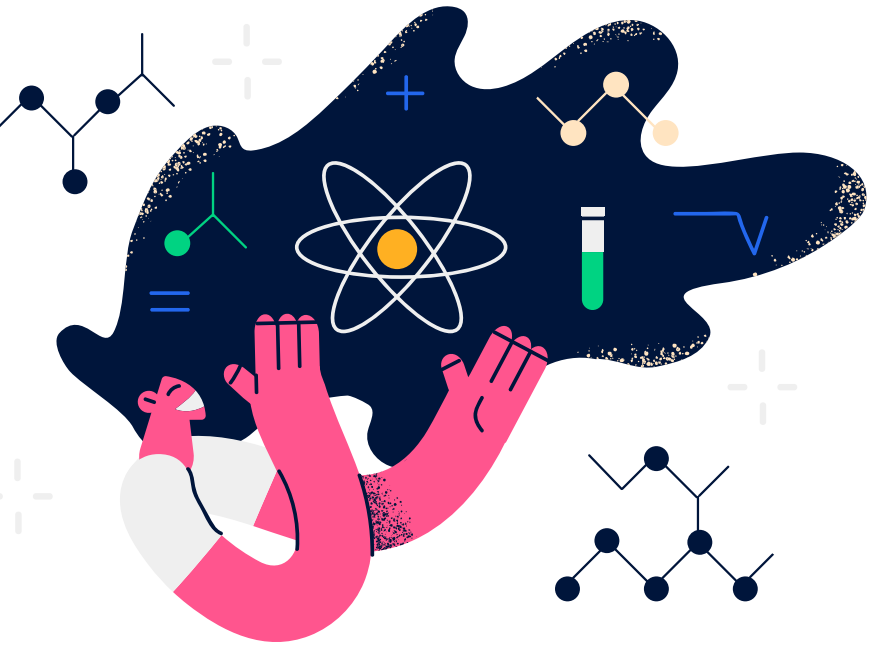
#5 Computer-Aided Drug Design

The development of drugs has always relied on trial-and-error experiments, but thankfully we've come a long way from swallowing a plant, saying a prayer, and seeing what happens. New advances in computer-aided drug design mean that lab-based drug discovery and development are getting better results, faster and at a lower cost.

Computer-aided drug design (CADD) leverages both **chemical-molecular and quantum computing strategies to search for potential therapeutic chemicals**. While using computers for drug discovery has been around since the 1960s, today's and tomorrow's **advances in artificial intelligence and quantum computing herald dramatic changes** to the drug discovery and design process.

Today's drug development relies mostly on high-throughput screening (HTS), which automatically tests many different chemical or biological compounds to find the right "fit" for a specific target. New CADD capabilities, combined with the aforementioned quantum computing power, mean that such real-world drug development can be done partially in silico, **a digital alternative to today's HTS.**

Advancements in CADD tools and techniques can be applied to many stages in the drug discovery process, **supercharging iterations of custom compounds** and determining a promising chemical candidate, faster. Pharmaceutical company Boehringer Ingelheim, a leader in computer-aided drug design and in silico modeling, is the first of its kind worldwide to partner with Google for this purpose. BI's Quantum Lab merges its digital expertise with Google's prowess in quantum computing and algorithm development. Also noteworthy: government agency Innovate UK recently awarded quantum computing company SEEQC a £6.85m grant to build a full-stack quantum computer for multinational pharma giant Merck, to accelerate its drug design as well.



Speed-dating for chemical compounds

Find the perfect match, but make it a billion.

Researchers at USC Dornsife, led by Vsevolod Katritch, have developed a virtual method that sorts through "molecular puzzle pieces" to generate compounds that "click" into drug targets on proteins. This new computational technology, known as V-SYNTHES, enables scientists to screen billions of chemical compounds more effectively and in a fraction of the time of other existing algorithms.

#6

Patient Data Ownership

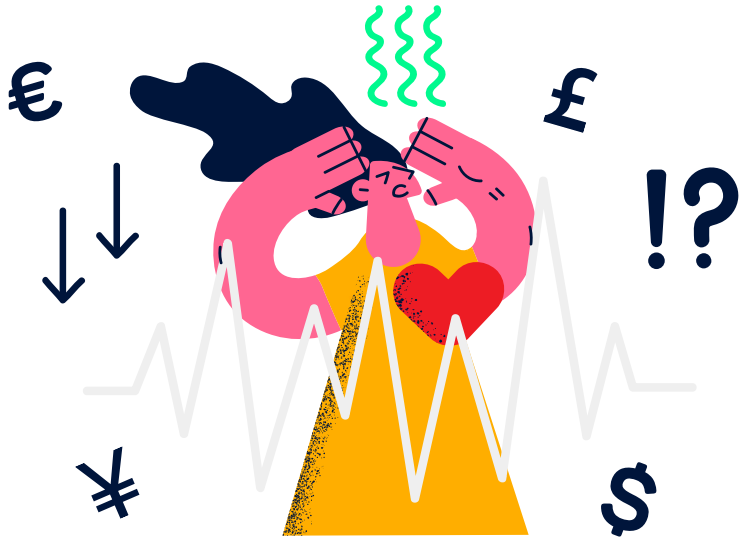
The global data economy is booming, and healthcare is no exception. Companies, healthcare systems, governments, medical professionals, and patients themselves each claim ownership of health-related data, begging the question: who, if anyone, should get a slice of the pie?

The age of big data in healthcare is well underway. Due in part to the proliferation of IoT (Internet of Things) devices, ubiquitous and more reliable connectivity, and advances in sensor technology, healthcare data is also sourced from electronic healthcare records, biobank collections, and pharmaceutical or diagnostic companies. This exponential development in data-collecting capabilities means that **the challenge for both public and private entities is not so much *collecting* the data as *extracting value* from it. What are the best ways to manage, store, interpret and apply this information?**

While big data is undoubtedly one of the key drivers of a future defined by ever-more precise and personalized care, the use of data in healthcare applications raises some complex questions: **who owns healthcare data? How can it be kept secure and trustworthy? And who stands to benefit from its use?** Just as the sheer amount of health data is growing, so too is its value: the total revenue in global big data analytics in the healthcare market is reported to reach an estimated **USD 79.23 billion by 2028 – that's a CAGR of 28.9% over the next six years.**

The ethical use of big data in healthcare is an especially complex topic. On the one hand, access to aggregated healthcare data, from genome sequencing databanks to public health records, is **essential for the development of many of the emerging breakthrough healthcare applications**, such as digital twins or computational drug design. These developments promise not only to improve efficiencies, help solve complex health problems, predict new diseases, or cut costs while increasing profit – they also ultimately mean better health outcomes for patients. On the other hand, there are **concerns about both data privacy and security, as well as the monetization of said data**.

If healthcare data is a needed asset, how might **laws and regulations** regarding patient privacy rights need to be amended in order to allow for this? How can **patient information be protected** despite data collection, which is necessary for knowledge creation? Besides these questions of governance and ethics, there are also more practical considerations, such as **data interoperability** between various systems. One thing would appear true, though: **data is precious**. Essential and valuable for the future of healthcare, it still warrants careful protection and thoughtful wrestling with important questions.



Is healthcare data a public good?
Who can claim ownership?
Who stands to benefit from its use?

#7

Artificial Intelligence

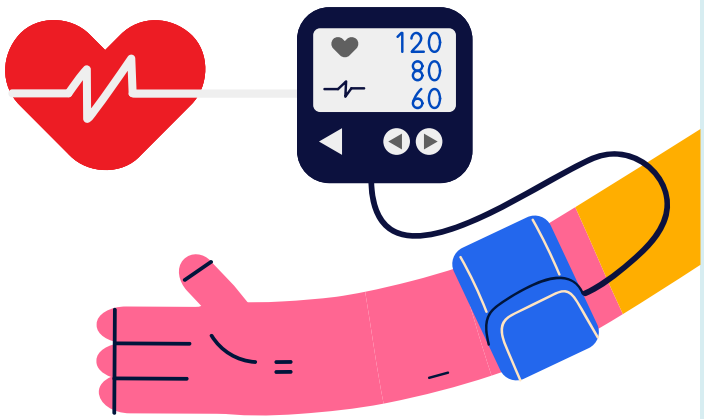
Artificial Intelligence (AI) already has an established role in different corners of the healthcare space and will only continue to grow in importance. The usual concerns – algorithm bias, data protection, and the trustworthiness of conclusions reached by a machine – grow only more critical when decisions can mean the difference between life and death.

With the increased digitization of healthcare practice comes enormous amounts of medical data. To sift through this information and extract insights that help all stakeholders – researchers, doctors, individual patients, and others – AI and its machine learning capacities are essential. Most, if not all of the top disruptive trends outlined in this report rely upon AI: from computer-assisted drug design to digital therapeutics. **AI, when deployed to parse vast troves of medical data, is the foundation of the capabilities digital medicine will unlock in the coming decade.**

At the moment, AI is mostly used in two areas of medicine that generate large amounts of data, namely **imaging analysis** (CT scans, MRIs and the like) and **clinical decision support software**. The latter aggregates various sources of data to help doctors make the best decisions (course of treatments or medications, for example) for their individual patient. As for the analysis of medical imaging, not only can algorithms **assess far greater volumes of images** than their human counterparts, but they can be trained to **identify aberrations indistinguishable to the human eye**, thereby increasing accuracy. One emerging example of this is its use in **in-vitro fertilization**. Whereas before it fell to clinicians to manually examine images of embryos at various moments in their development, AI capability can process a much larger volume of images faster, and more accurately assess their viability. This input informs the clinician's decision as to which embryos are most likely to take, increasing the likelihood of a successful pregnancy for the patient and their family.

One of the biggest challenges facing AI's widespread adoption is its **lack of transparency**. How does an AI arrive at its decision? Why should a doctor (let alone a patient) trust a machine to make medical decisions for them? Would an algorithm make a diagnosis by itself? Medical practice requires a capacity for self-criticism and nuance, and an ability to account for uncertainty – can an AI do this, too? At the moment, **the medical community is still establishing standards for incorporating AI into its practice on a wider scale**.

In addition, questions about data privacy remain – to train AI, you need data and tons of it. **How can the sanctity of patient privacy be maintained?** And who, if anyone, owns this medical data? These pressing questions will become ever-more crucial to address: as health systems digitize, artificial intelligence will be an integral part of the future of medicine, supporting the increased precision and personalization of care.



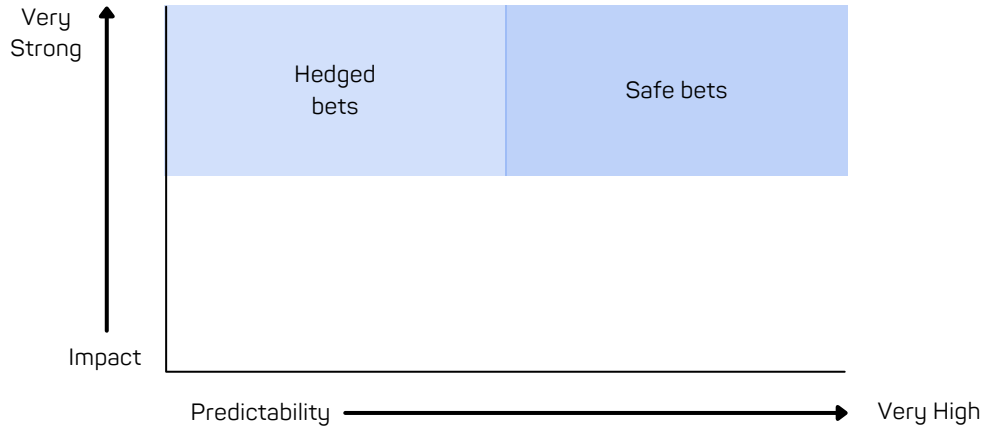
Managing Trends

The first step? Identify what really drives change.

The future-proof SMEs and multinationals that work with Rohrbeck Heger **scan widely** for trends and **strictly manage** them. To do so, they typically use a tool such as a **trends radar** to visualize, prioritize, and finally feed relevant trends into their strategy and innovation activities.

How do these teams evaluate a wide range of identified trends, in order to filter them? Information is everywhere, so it is especially crucial to make sense of "trend overload" and **distinguish between what's noise and what really matters.** One method we use is a straightforward mapping exercise where we evaluate trends based on two parameters: impact and predictability. By assessing a series of trends using the following questions, you can then map them onto the chart below.

- **Impact**: will this trend have a strong or negligible impact on your industry?
- **Predictability**: How confident are you that the impact and timing of this trend can be predicted?
  - If you think the trend is very difficult to predict, that it could materialize in many different, mutually exclusive ways, and 'if and when' it will persevere is unclear, choose 'Very low.'
  - If you only see one way, and have strong evidence of when the impact will be at its peak, choose 'Very high.'



As you can see, those trends that fall within the ranges of strong impact/high predictability are considered "safe bets" and can be integrated directly into your strategy. Those that fall into the "negligible impact, low predictability" area in the grid, a.k.a. "hedged bets," require more research before committing to their development.

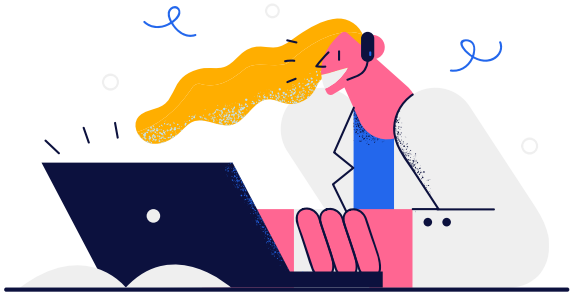
Making Foresight Work for You

Is it time for you to future-proof your business? Let us help.

The healthcare industry is standing in front of a decade of major change. When a trend such as quantum computing in drug design breaks through, or digital therapeutics really take off, this could significantly disrupt the current business models of major players in the sector. Businesses that start preparing today will benefit strongly in some years' time.

Those who systematically scan for change and identify opportunities and threats will be able to enter attractive markets early and then move on when the competition catches up. **A combination of agile, creative, and systematic methods are needed to take you further in understanding the complex environments of the future.** Through working with major clients in the healthcare industry and other sectors, Rohrbeck Heger has built a strong reputation in equipping innovation and strategy teams with a skillset and methodology to encourage a culture of collaboration and the adoption of a future-forward mindset for success.

Success in innovation rarely comes overnight. Take the first step on your foresight journey and speak to one of our experts.



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