

# FUTURE SIGNS

*Trends that will Shape the Future of Healthcare*

With technology advancing rapidly, Medical Futurist **Dr. Bertalan Meskó** predicts the possibilities and pitfalls facing medicine and pharma.

*By Des Sampson*



For Dr. Bertalan Meskó, a clinical genomicist, biotech guru and Medical Futurist, there has never been a more exciting - or daunting - time in medicine. That's because the possibilities for clinical, social and personal advancements in healthcare and their impact on medicine and pharma – both good and bad - have never before been as unparalleled or unpredictable.

With groundbreaking technology and techniques like genetic sequencing, 3-D printing, A.I., wearable devices, IoT, nanotechnology, smart phones and robotics developing at dizzying rates, the pace of technological change in medicine threatens to outstrip the ability of practitioners and pharma to employ and apply those changes in healthcare and drug delivery.

## The Role & Rise of the Medical Futurist

After identifying the need for a revolutionary, interdisciplinary role at the forefront of medicine and biotechnology, Meskó decided to create a new profession – that of a 'Medical Futurist' – which combined his passion for medicine and research with his fascination of the future, science, technology and gadgets.

"Obviously, at the time, there was no profession like that, so there was only one solution: I needed to create a new one, to combine all my different interests. That's how I came up with the idea of being a Medical Futurist," reveals Meskó. "My long-term ambition is to improve healthcare globally and also improve the physician-patient relationship, by breaking down the ivory tower of medicine so patients and physicians are on the same level. To do this, we need to use disruptive technologies, like wearable devices, sensors and genomics, to help empower patients, while also educating physicians because I believe this technology can be utilized to inject a dose of humanity into medicine that is crucial to effective healthcare."

Consequently, Meskó's on a mission to bring disruptive technologies to the fore, by delivering over 500 presentations to leading businesses and organizations, including N.A.S.A. and the World Health Organization. He also regularly speaks at universities, like Harvard, Stanford and Yale, to ensure practitioners and students can utilize these breakthrough technologies in an efficient and secure way, advises pharma companies on future opportunities and challenges and educates e-patients about how to become equal partners with their caregivers, to ensure medicine's future remains bright, not clouded.

Additionally, he has set-up two websites and written two genre-defining books on the subject - [Social Media in Clinical Practice](#) and [The Guide to the Future of Medicine: Technology and the Human Touch](#), which offer incisive, illuminating insights into the technologies and trends he predicts will shape the future of medicine.



## Possibilities & Prophecies

According to Meskó, disruptive technologies – those inventions, innovations and advancements that are groundbreaking or exponential – will seismically shake up medicine and healthcare delivery, forever.

“Disruptive technologies may seem like science fiction, but they’re fact. They’re technologies that happen when something doesn’t just become a bit better, but a hundredfold better or a hundredfold cheaper to produce, while retaining their quality, security and usability,” he says. “The vast majority of these innovations, like sensors, scanners and wearable devices, are already being used in practical situations.

“It’s funny, because innovators in medicine have, for years, been trying to steal ideas from Hollywood movies but, in the future, disruption will be so commonplace [in medicine] that Hollywood will steal from us,” suggests Meskó excitedly.

Considering the breakthroughs and advancements already achieved, and the pioneering innovations in the pipeline, it’s easy to understand Meskó’s fervour. Some of these disruptive innovations and predictions include:

**Robotic Exoskeletons:** A wearable framework or skin that allows people to move, or walk after being paralysed.

**Cognitive Computers:** IBM’s Watson can analyse more than 20 million medical papers in seconds, to find the most relevant information, which can then be applied, in practice, by medical practitioners to help with the diagnosis and treatment of patients.



**Smart Devices:** Sensors in smart phones, wristbands and other smart devices can be used as field laboratories and, ultimately, future hospitals to screen blood, saliva, protein and urine samples or detect diseases and conditions, like malaria, HIV, cataracts and tumors through inbuilt or add-on sensors, allowing patients to become the pilot of their own health, using smart phones as the cockpit, or guide.

**Iknife:** Using sensors, the iknife can diagnose a patient's condition while they are being operated on.

**Nano-Robots:** Tiny robots which will 'live' in the bloodstream, to detect health parameters and any medical conditions before they develop, relaying this information to a smart phone.

**3-D Printing:** In the future, 3-D printers will be able to print living tissues, organs and cartilage, like livers, kidneys and ears, layer by layer, in a matter of minutes instead of hours, following recent breakthroughs using disruptive technology.

**Genetic Testing and Sequencing:** Undertaken at home, using inexpensive kits to screen saliva or blood, to determine any latent genetic mutations, allowing patients to reduce or prevent the likelihood of developing these conditions.

**Digital Tattoos:** Ultra-thin, 2- 3 microns thick tattoos with inbuilt sensors to detect any detrimental change in the body, which is then relayed to a smart device or computer.

**Embedded or Digestible Sensors:** These will measure vital signs and changes within the body, relaying this information remotely to patients and practitioners e.g. an edible, computer pill developed by Proteus Digital Health uses the body as its power source and tracks patient responses to medicine.

**Augmented Reality:** Digital contact lenses or glasses which allow practitioners to not only see real-life images but also gather additional information, via a digital feed, to allow physicians to prepare for an operation beforehand, by taking a virtual 'tour' of the patients body before actually operating on them. Can also be used for radiology, CT and MRI scans.

**Wearable Devices:** Headsets like Google Glass, smart watches and smart clothes can monitor vital signs, like the recently FDA-approved MiniMed 530G from Medtronic, which is a wearable, artificial pancreas that monitors blood glucose levels and injects insulin to a defined threshold.

**AI:** Potentially the biggest impact and biggest changes to our lives will come through AI, although full implementation is still decades away e.g. computer-aided interpretation of medical images, whereby scanned CT images are compared with expected appearances of organs or tissues to detect and highlight any distinct variation from the norm, including tumors or cancer.



## Future Shock: Predictions & Predicaments

Despite the remarkable breakthroughs in technology and their potentially life-changing effect on medicine, healthcare and pharma delivery, Meskó cautions that there are a number of factors that need to be addressed to ensure that this vision of a brave new world doesn't become a dystopian nightmare.

"If we let medical technology improve at the rate it's improving now, it could wash away the medical system as we know it and transform medicine into a business-based service without any kind of human interaction," he surmises. "I think neither patients nor physicians want that to happen.

"We have to be prepared," Meskó stresses. "We need to be aware of the technology that's coming, spark public discussions about the ethical considerations of using it and discover what kind of problems and challenges we'll face when this mind-blowing technological explosion hits us, which it will - much sooner than we think. If we're not prepared, it's going to be a very bad future for us, for medicine and for healthcare.

"That's why I tell organisers of the events I speak at that, on a scale of being cautious and shocking, I like to be more shocking because I believe I need to move people out of their comfort zone," he asserts. "Afterwards, I usually get two types of feedback: people are either incredibly amazed by the technological revolution in medicine, the opportunities it provides and can't wait to start using it, or - most commonly - they're scared, think I'm wrong, technology is an enemy and the digital jungle just makes their job as a physician more difficult, and their relationship with patients less personal.

## Practical, Philosophical & Ethical Considerations

**Development vs. Uptake:** The Disruptive Technology Revolution has been underway for only a few years but already there are dozens of inventions, emerging day-by-day, making it a struggle for practitioners, patients and pharma to keep up - especially as it typically takes years, if not decades, to implement a paradigm shift in medicine.

**Innovation vs. Regulation:** Technology will advance at a faster rate than the legislation and regulations needed to control these technologies. Consequently, if we do not prepare in time, chaos is likely as regulators are notoriously slow to adopt - and often avert - the early uptake of medicine. Therefore, regulators will need to become more open to new technologies, innovations and microbiology if they want pharma companies to come up with new drugs.

**Genetics vs. Ethics:** Genetic screening, sequencing and modification could allow wealthy or powerful individuals to develop beneficial biological and cognitive differences because they can utilise or afford to use disruptive technology for their health, well-being or personal development, while others can't. There is also the potential threat of bio-terrorism, from the modification of biological and genetic material, and the use of nano-robots.

**Patients vs. Practitioners:** Access to online information will empower e-patients, while disruptive technologies, like wearable devices, will offer patients the opportunity to test, manage and influence their own health from home, placing patients at the centre of the medical model.

**Proactive vs. Reactive:** Healthcare and pharma will become far more predictive and proactive, rather than symptomatic or reactive, as genomic sequences will likely be available, at birth, in the next 20 years, allowing practitioners and pharma to draw many more conclusions out of this data than currently. There will also be a need to become more open to new technologies, innovations and microbiology if they want companies to come up with new drugs.

## Pharma Chameleon

In the future - for pharma to remain relevant - its role and remit needs to change, according to Meskó, to reflect the technological improvements, scientific breakthroughs, societal expectations and medical advancements he predicts.

"Patients cannot do clinical trials themselves and physicians cannot come up with biotechnology inventions, or find new drug molecules, so we will still need pharma companies," insists Meskó. "But we will need them in a different way, because producing drugs will not be enough. Pharma will need to ensure patients and medical professionals

understand the medical problems confronting them and the solutions pharma companies can provide to these problems, by very clearly communicating the inventions they come up with and the technology they develop. Therefore, social media and future channels of communication will be much more important than today for pharma.

“Consequently, even though pharma is a rigorous, regulated and typically secretive industry, I believe the first big step that needs to be made – which will be made, by the braver companies - is an opening up of data, wherever possible,” he adds. “Without data sharing, pharma will not be able to draw good medical conclusions from all the information available, or reach the target audiences of the future.”

**Drug Trials & Testing:** Pharma will no longer test drugs on patients. Instead, it will use cognitive computers to test thousands of new drug molecules on billions of patient models, in seconds, or print-out 3-D tissues and organs to test drugs on, eliminating the need for drug trials on humans.

**Compliance & Adherence:** Compliance levels for prescription drugs currently stand at only fifty percent, which is incredibly inefficient given the time, effort and money it takes to create, refine and innovate a drug. The e-patient revolution, which will empower patients, could change this while embedded or ingestible sensors will remind patients to take drugs and feed back when they have, greatly increasing compliance. Drugs containing tiny sensors in a ingestible pill could also measure the digestion process of these drugs and how it is being metabolised in the body.

**Genomics:** With the use of super-computers, a new era will begin for pharma, with access to hundreds of millions of patients’ genomes and all the medical health data behind that. This will allow environmental factors and lifestyle choices to be considered in drug development, which will open doors to pharma companies to make new discoveries, based on this information.



**Drug Production:** Disruptive innovations, like 3-D printing, will initially allow simple drugs, with one ingredient, to be manufactured anywhere using readily-available blueprints. Ultimately, multi-ingredient drugs will be able to be produced. Such innovations could potentially put pharma companies out of business, if they're not ready or willing to counteract this threat by preparing themselves now for the future.

**Patents & Quality Control:** If simple drugs, containing a few ingredients, are able to be manufactured at home, using 3-D printers, without any intervention or moderation there will be potential issues surrounding breach of patents and quality control. The implications for pharma and public health of these unregulated 3-D printed drugs are potentially catastrophic.

**Crowd-funding & Crowd-sourcing:** Through crowd-sourcing and crowd-funding, a drug prototype could be 3-D printed simply and cheaply in home or field laboratories, rather than incurring the high manufacturing costs of labs. This will make drug development more democratised, allowing innovative ideas to originate and develop anywhere, including impoverished and underdeveloped areas. Consequently, transforming an idea into a product won't be dependent on traditional investors or pharma companies bank-rolling it, but on the quality and originality of an idea attracting crowd-sourcing and crowd-funding investment.

## Final Thoughts...

Based on Meskó's predictions, the future's not necessarily bright, nor clear for medicine, healthcare and pharma. But it could be, if his warnings about the impact of disruptive technologies are heeded. If so, his final predictions about the nature of medicine may well become reality too.

"I think in 20 years time, everything will be about the patient," he surmises. "Patients will be at the centre of medicine - they will be able to measure anything, like blood markers, genomic data, vital signs and brain activity, all at home using very cheap, very small, very comfortable devices, and whenever something bad is happening then they will receive a notification through a smart phone or digital contact lens.

"Healthcare will also become more personalised, based on genomics, so that highly customized options can be implemented for patients. But that can only happen if patients are empowered and physicians engage with them and embrace disruptive technologies," insists Meskó. "If we can make patients disruptors - the 'hackers' - of the healthcare system, and equal partners with the caregivers, that will be the biggest turnaround in the story of medicine.

"These are the ways I am trying to change medicine, myself, globally," he concludes. "But I cannot do that alone; I need people to join me in this challenge. I think, in a way, we all need to become a futurist, for ourselves, sooner rather than later - either as a patient or medical professional, by being perfectly up-to-date and using diverse channels accurately, because this way you can make your own decisions about your future health."

<sup>1</sup>Meskó has launched two websites: [www.medicalfuturist.com](http://www.medicalfuturist.com), which provides daily news about the future of medicine, and [www.webcina.com](http://www.webcina.com), the first online service to curate medical social media resources for patients and professionals, which offers a free, online Social MEDia Course that focuses on Social Media in medicine. He's also the founder of the award-winning medical blog, [www.sciencerooll.com](http://www.sciencerooll.com), creates weekly reports about global trends in medicine, healthcare and disruptive technologies.

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