



'Empathy robot' Reeti, made in France for use in health care. In a new book, Eric Topol wants to see medics themselves freed to provide compassion to patients.

MEDICINE

AI and the new medicine

Thomas R. Insel learns how artificial intelligence can put the heart back into health care.

So much has been written about artificial intelligence (AI) that any new book on it can struggle to create a signal amid the noise. There are volumes hyping AI as the fourth industrial revolution, others decrying it as the greatest threat to modern society and many calling for AI to become less artificial and more intelligent.

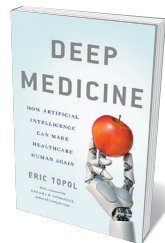
Now, Eric Topol, a cardiologist and director of the Scripps Research Translational Institute in La Jolla, California, adds his voice. *Deep Medicine* summarizes hype and threat, then takes us to a place where no one else has gone: a future in which AI helps to re-establish empathy and trust between doctors and patients.

Topol's thesis, expressed in the subtitle, is that AI "can make healthcare human again". The task is formidable because AI, which has transformed how we seek information, how we shop, how we connect to each other, has had comparatively little impact on health care. The effects thus far — electronic medical records, data collection for billing and the development of high-tech procedures such as robotic surgery — seem to have made health care decidedly less human. Can AI reverse this trend and heal the doctor-patient

relationship? Or will it exacerbate the problems of technology, but with devices that replace more humans and destroy privacy? Topol takes an optimistic view.

Deep Medicine provides a broad survey of how AI is applied in medicine. The obvious applications build on what algorithms do best: pattern recognition. We learn how AI is being applied in radiology to read X-ray films, in pathology to identify tumour cells and in dermatology to diagnose skin lesions. Topol describes a similar approach in ophthalmology, where algorithms can detect diabetic retinopathy, and in cardiology, where AI is beginning to uncover cardiac arrhythmias such as atrial fibrillation by tracking data from wrist-based sensors.

More unusual is AI's deployment in mental health care, through robots that can read mood from shifts in voice and facial



Deep Medicine:
How Artificial
Intelligence Can
Make Healthcare
Human Again
ERIC TOPOL
Basic (2019)

expressions, an approach pioneered by the new field of affective computing. And Topol sees as inevitable algorithms that can integrate data from online behaviour (such as patterns of typing or scrolling), sensors, the medical literature and clinical records. His argument is that AI will inherit the tasks best done by machines, leaving humans time to do what they do best — providing compassion and being "present" for patients.

But this survey, for all its promise, is still mostly a promise. As Topol admits, there are few controlled trials in this field. Most of the research is at the stage of algorithm validation by technology companies, and we still lack examples of AI improving outcomes in the real world of clinical practice.

We are in the first act of what will probably be a five-act play. The characters are clear: technology giants Google, Baidu, Alibaba, Apple, Amazon, IBM and Microsoft, along with hundreds of health-tech start-ups in the United States and Europe — including my own — and more than 130 medical AI companies in China. The problem is evident: health care has become a massively expensive enterprise that no longer serves the needs of doctors and patients. In wealthy

ESP/UG VIA GETTY

countries, the costs continue to grow without commensurate improvements in outcomes. In poorer regions, the lack of health-care workers becomes unsustainable as the population and its needs expand. And the setting for this play is appealing: a sea of data from online behaviour, sensors, smartphones, genome scans, imaging, lab tests and clinical records. If data are the new oil, health data — which Topol describes as between six and ten times as valuable as financial data — are the refined petroleum that AI can inject into diagnostic and treatment decisions.

But big data is not the same as good data. For most health-care questions, we might not have the information to find a solution. For instance, we recognize the role of social determinants in health but rarely collect data on them. And even if the data were optimal, the algorithms accurate and the diagnostic process improved, would doctors choose to be present? Would they be educated to be empathetic and compassionate? *Deep Medicine* wrestles with these questions, recognizing that technology is about tools, whereas medicine is about a person-to-person bond.

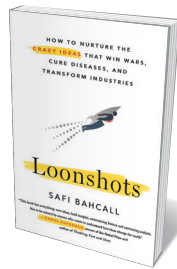
This is Topol's third popular-science book. The first, *The Creative Destruction of Medicine* (2011), focused on sensors and sequencing as a pathway for digitizing medicine. The second, *The Patient Will See You Now* (2014), described how practice could be transformed by empowering people with their own health data. Like these, *Deep Medicine* is about technology and health care, but it evolves surprisingly towards the values of the past while imagining the tools of the future. When Topol describes how medicine has changed since his training four decades ago, one feels his regret that technology has not improved things. He addresses that by bringing together the deep phenotyping of digitized medicine, the engagement of the empowered patient and the analytical power of AI to improve the doctor-patient relationship.

I appreciate Topol's willingness to recognize that these are early days. He invites us to dream about what the AI future could look like, while reminding us that we need to be drivers, not just passengers, if AI is to serve patients and clinicians rather than payers and tech monopolies. Much of what he has written will soon be outdated in this fast-moving field, but his argument for using technology to bring care back to health care is timeless. ■

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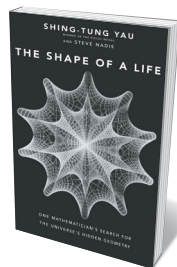
Books in brief



Loonshots

Safi Bahcall ST MARTIN'S (2019)

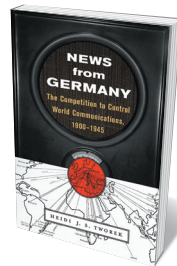
History is riddled with seemingly crackpot ideas that led to massive breakthroughs. How can we ensure that such “loonshots” are nurtured? In this witty, invigorating exploration of human behaviour and discovery, physicist and biotechnology entrepreneur Safi Bahcall argues that it's all about “phase transitions”: group dynamics that govern how a team snaps from dismissing to embracing a new concept. Drawing on examples from traffic jams to the James Bond film franchise, Bahcall shows how structure, size and communication govern groups' capacity to “engineer serendipity”.



The Shape of a Life

Shing-Tung Yau and Steve Nadis YALE UNIVERSITY PRESS (2019)

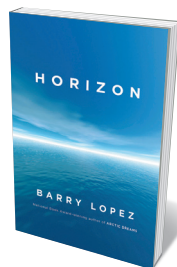
For decades, mathematician Shing-Tung Yau — a winner of the 1982 Fields Medal — has been central to the cross-fertilization between modern mathematics and physics. His work in geometry, for instance, underlies much of string theory. This volume, co-authored with science writer Steve Nadis, is an intimate account of Yau's life, and includes frank responses to his critics. It ends with a twist: Yau does not believe that the Poincaré conjecture — the most important question in topology in the twenty-first century — has truly been settled.



News from Germany

Heidi J. S. Tworek HARVARD UNIVERSITY PRESS (2019)

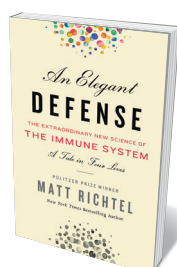
This riveting technological chronicle dispels two myths: that the digital era spawned information warfare, and that twentieth-century global communications was largely Anglo-American. From 1900 to 1945, reveals historian Heidi Tworek, Germany strove mightily to achieve world power through news agencies, spoken radio and wireless, urged on by figures from Weimar Republic foreign minister Gustav Stresemann to Nazi propagandist Joseph Goebbels. A chillingly timely cautionary tale, demonstrating that once elites destroy democratic institutions, a free press cannot prevent further disintegration.



Horizon

Barry Lopez KNOPF (2019)

Subtle, monumental, rich, spare: this opus by acclaimed writer Barry Lopez contains and transcends contradictions. A reflection on journeys with researchers, into history and across continents, it uses six sites as loci for scientific and philosophical musings, as Lopez sorts sea-floor organisms in Antarctica, sifts soils with archaeologists in the High Arctic, hunts hominin remains in Kenya with palaeontologist Kamoya Kimeu and contemplates the “cultural detonation” of Aboriginal peoples in Western Australia. Above all, he asks what, amid existential crises, we seek beyond the horizon's line.



An Elegant Defense

Matt Richtel WILLIAM MORROW (2019)

The immune system is less war machine than peacekeeping force, seeing off viral and bacterial disruption to keep the body safe. But what if that balance shifts? Award-winning reporter Matt Richtel examines the scientific and human realities of immune anomaly through four case studies. Jason Greenstein, for instance, struggled with terminal Hodgkin's lymphoma, his immune system ‘duped’ by cancer. Through these harrowing accounts, Richtel interweaves the research history — a relay race involving immunologists Élie Metchnikoff, Peter Medawar and Anthony Fauci, among others. [Barbara Kiser](#)