

Preface

We cannot solve problems by using the same kind of thinking when we created them.
Albert Einstein

Professional health care services that we have become accustomed to are essentially products of technological breakthroughs. Advancements in medicine, such as microwave tomography for breast cancer screening, MRI-guided treatment of prostate cancer and biomedical innovations, such as new 3D, 4D and “5D” in vivo imaging technology, are beginning to facilitate the delivery of reliable tests and rapid diagnostic data. There are several emerging technologies on the horizon.

For example, a recent EU report about the nano-technology roadmap towards 2020 (Joint European Commission, 2009)¹ points to both clinical and economic factors and the beneficial impact of this emerging health technology in regards to diagnostics (e.g., in vivo *imaging* and in vitro *diagnostics*), drug delivery (e.g., *nano-pharmaceuticals* and *nano-devices*), and regenerative medicine (e.g., *cell therapies* and *smart biomaterials*). Emerging *nano-technology applications* are beginning to play a more central role in diagnostics, as they are enabling easier, cheaper, and more sensitive options at the point of care. Thus, medicine is adjusting to the new world of particles at the nano scale, and nano-technologies will become more interesting for health providers as they are cleaner and consume less energy. Nano-technologies, however, require innovative, trans-disciplinary visual knowledge in mixing together different solutions and for them to work efficiently and safely. This fact is underscored in the organisational and human dimension, known as *nano-technique*.²

Pharmoeconomics is another emerging research-driven enterprise that pursues ground-breaking work directed towards a new generation of more effective medicines that account for how patients’ individually unique genetic compositions affect their responses to medicines. Before the existence of *pharmacogenetics tests*

¹http://www.etp-nanomedicine.eu/public/press-documents/publications/etpn-publications/091022_ETPN_Report_2009.pdf Retrieved May 25 2012

²Nano-technique is a term used to describe the human skills involved in executing tasks and facilitating activities on the nano-scale. While nano-technique implies a collection of social and organisational principles, it does not necessarily involve nano-technology but often does.

as modern diagnostic instruments, physicians were restricted in tailoring medications to individual patients' needs and could only make estimates regarding certain symptoms.

Hi-tech innovations have transformed and modernised the entire field of health care delivery with applications ranging from *computerised medical records* and *gene-based diagnostics* to *pharmacy robots* and *image-guided robotic-assisted surgery*.

r-Health = r-Curing and r-Caring

The fact that service robots create new organisational circumstances and novel managerial responsibilities within which new inter-professional and client-expert affairs emerge was something that I pursued in earlier work (Wasen et al. 2002; Wasen 2004). For more than a decade, I have researched and empirically explored the various ways in which health care organisations form, and in turn are formed by, the broad rise of emerging robotic technologies and the new relationships that they create in *r-Curing* and *r-Caring* activities. Some health care fields are experiencing paradigmatic shifts because of robotic technologies, which create entirely new forms of work and interaction among health care staff, which in turn require entirely new professional visual knowledge.

The term *r-Curing* is used to describe curative treatments that combine the use of robotic technologies with the application of evidence-based medical knowledge. An area in which *r-Curing* has excelled in medical practice is the use of new *3D*, *4D*, and “*5D*”³ imaging systems in surgery to model and view the patient's body, replacing much of the physical examination and the gentle human touch (see [Chap. 2](#) in this volume). Such state-of-the-art *r-Curing* systems serve as artificial extensions of the surgeon's body and fundamentally change ancient surgical techniques. The consequence is that humans and their new robotic artefacts become inseparable from each other, i.e., they become ‘*amalgamated*’. Thus, the well-defined boundary between the individual user and the robotic technology becomes blurred. In the scientific community, the future *human/technology convergence* is increasingly discussed in terms of how *bio-robotics* is empowering human capacity. Bio-robotics provides new treatment options and human capacities; *bionic limbs* and *exoskeletons* are examples of such emerging health technologies.

³ These visualisation paradigms are specified as follows by Wasen and Brierley in [Chap. 2](#) of this book; “3D imaging is defined as three visual dimensions. 4D imaging is three visual dimensions plus time. 4D imaging can also be combined with functional transitions (i.e., following radioactive tracer isotope through the body in positron emission tomography). 4D imaging plus functionality is defined as “5D” imaging.”

r-Caring applications include multi-purpose care-giving robots and how these robots may assist caregivers in their day-to-day work. This trend signifies a move in society towards increased ‘self-care’ and patient choice in the elderly care setting, in which elderly patients make shared decisions regarding their treatment options. This development marks an important point of change but also creates new issues in how to organise care delivery. For example, how does the uptake of new “self-care” technologies and smart robotic devices open up the conventional in-house hospital domain and the traditional structures of medical expertise to new, unconventional external and non-clinical markets and patient-grounded work?

While the distinction between health services and care services, or the distinction between professional expertise and patient self-knowledge, are worthwhile considering in understanding how today’s elderly care institutions are organised, there will most likely emerge hybrid crossovers in the wider public and private arenas that will link together the two traditionally separate forms of health activities and expertise—*caring* and *curing*.

Self-Organising Nanobots in Nano-Medicine

The modern hospital has become a digitalised “global shop” anchored in a *hybrid cloud-based cyberorganisation*. In future robotic health organisations, most of the electronically mediated communication will be integrated in real-time transmissions of self-generated patient data within cloud-based infrastructures and hybrid networks, which not only will be linked but also pre-analysed in the cloud before they reach a health specialist. The notion of such hybrid smart networks underpins society’s characterisation of the future *e-Health* and *m-Health* (Mobile Health) systems, and r-Curing and r-Caring add additional dimensions in what I refer to as the “*new scales of organisation*”.

New directions in health robotic technologies are expected to emerge in the coming decades that could take the minimally invasive surgical paradigm and other health care paradigms to a new level: more precisely, to the micro-scale and nano-scale. While nano-manufacturing has taken significant leaps in recent years in different business domains, nano-medicine and nano-biotechnology are new areas to advance the exploration and treatment of the human body. Because of an increased miniaturisation in such medical procedures, and by using the body’s natural force (that is, the flow of bodily fluids such as blood), micro-robots and nano-robots equipped with sensor technology will be able to navigate in the human body. These robots would not only navigate but also repair selected organs either automatically or guided by experienced physicians. If the situation allows, these nano-bots would not work alone but in a decentralised fashion in multi-robots teams. Swarms of such tiny robots could cooperate and delegate tasks among themselves. Moreover, these nano-bots could also continually and autonomously supervise the patient’s body, for example, to assist damaged organs—thereby monitoring the patients day and night.

Indeed, with the advent of self-organising nano-bots probing layers not visible to the eye, organisational activities will increasingly unfold on the micro-scale and nano-scale. We need to get accustomed to the idea that r-Curing and r-Caring is about emergence of new purposeful forms of work, which function in parallel on different scales of complexity and operability. These new forms of work activities range from nano-bots that self-organise their work and collaboration activities on the nano-scale inside the patient's body, to meso-level activities between entire populations of professionals in hospitals or work carried out in situ between a hospital and a home-based care setting.

It will be imperative to track the broad effects of emerging robotic technologies and new r-Curing and r-Caring services as they are mobilised across the health system. Health care robotics is a novel and exciting technology-enhanced domain at the moment, but it does not solve every problem. We need a combination of solutions.

Why Do We Constantly Need More Pioneering Knowledge?

We need to produce more *innovative knowledge* and deliver more practical solutions in the health care field. Health technology management is a young, cross-disciplinary field. This research aggregates the results and monitors the effects of numerous technological trends, and its multi-layer analysis of in-depth cases allows access to transformative events across different levels within health care systems. A task for scholars is to balance enthusiastic claims for emerging technologies and to place such claims into perspective in the health technology management field. It is vital to remember that health technology is not an end in itself but merely a means to realise the betterment of health and socio-economic prosperity. Providing critical perspectives entails examining how health professionals use technology on their own terms and how they bridge the gap between real-life opportunities and clinical problems involved in managing the complex delivery of health care services.

As technological change is accelerating and affecting the entire health care field, so is professional medical expertise dependent on constantly updating the reservoirs of *visual knowledge*. There is a need to retrain and develop new expertise in many areas of health care following the introduction of new image-guided technologies. For patients as well as health managers and policy makers, professional visual knowledge and medical expertise becomes valuable first if it is made useful and appropriately applied in real-life settings. This book shows that health care processes will improve only if individuals are committed to developing their skills and knowledge; work methods are appropriately changed and thoroughly reconsidered in organisations; and state-of-the-art technologies are entirely incorporated into the hospital or the patient's home environment.

Health professionals are not adequately equipped to solve today's and tomorrow's problems with yesterday's answers and conventional methods. Indeed,

because the health care organisation's environment is constantly changing, so too are knowledge, models, and theories in a *temporal* and *fluid state*. Yesterday's best practices and delivery models for highly functioning health care systems may prove to be inadequate to meet today's circumstances and tomorrow's new challenges.

There exist a plentiful amount of great anecdotes of Albert Einstein's life and scientific endeavours. One in particular comes to my mind:

One day during his tenure as a professor, Albert Einstein was visited by a student. "The questions on this year's exam are the same as last year's!" the young man exclaimed. "Yes," Einstein answered, "but this year all the answers are different".⁴

While many fundamental questions and concerns remain in the health care field, the answers have clearly changed, not least because of the impact of rapid technological change in business and society. The message is quite simple; we constantly need more innovative knowledge driven by *creative processes of serendipity*.

Change Management in Health Care: Novel Technology, New Organisation?

Change management seeks an orderly transition towards new modes of process change in health delivery and, more generally, organisational renewal. Change management therefore necessitates carefully considered, mindfully integrated, and meticulously calibrated measures and plans that fit into the broader organisational structures and professional cultures. Any emerging technological innovation will inevitably lead to transformations in most or all of the work tasks situated at an organisational level, among professionals collaborating at a group level, and at an individual level within a doctor's interactions with a patient. Regarding change-management initiatives, it is vital to remember that technology is not the universal solution for improving health care processes. However, emerging health technologies will continue to be vital enablers of many innovative knowledge-driven, process-change initiatives.

Clearly, not all long-standing institutional, economical and social problems can be solved by merely adding new technical fixes and technological devices. Exploring the emergence of today and tomorrow's prevalent *health care management* dilemmas and challenges (demographical, organisational, managerial, technological, medical, political, etc.) will inevitably entail cross-disciplinary research which, in turn, includes a wider and deeper spectrum of viewpoints to find more safe, efficient, and economically viable solutions. The need to embrace

⁴ "Albert Einstein Anecdotes—The Gold Scales" <http://oaks.nvg.org/sa5ra17.html> Retrieved May 25 2012.

the challenges and benefits of emerging health technologies goes hand-in-hand with the need to transform the present institutional structures of health care delivery and to rethink traditional patient–doctor relationships. To fully optimise the use of any technological device, the first step is to understand that novel health technologies allow new forms of work in treating patients, and they create new spaces of curing and caring. In short, health technologies enable new *social* and *material relationships*. However, exchanging antiquated technologies for modern ones almost always means changing work processes and the conventional knowledge and expertise that are required to carry out old tasks with old technologies. In other words, adapting to more advanced and complex technologies requires more-advanced, knowledge-intensive services in health care. Adapting to new technologies also requires that the end-users accept them (rather than resist them) and demonstrate a willingness to engage in training programme so that they better can understand both the new work tasks and the technologies.

Who Is This Book For?

This book compiles a variety of viewpoints on transformative technological change and its limits in health care institutions. These viewpoints are theoretically informed and empirically based, and the authors tackle some of the most pressing issues health professionals face today. Moreover, the book comprises diverse and cross-disciplinary contributions, ranging from organisational behaviour and change/innovation management literatures to theories in science, technology and society and models of technology acceptance. The book is intended for scholars in the cross-disciplinary field of *health technology management*. This book is also a useful resource for students in graduate and postgraduate programs, including the Master's program in Health Management and Public Health (MBA/MPH).

This volume contains chapters that report cutting-edge cases of emerging health technologies. This book seeks to explore emerging health care technologies such as image-guided surgical robotics, pharmacy robots, visualisation methods (3D, 4D & “5D”) and home telehealth management systems and their acceptance in the workplace but also, more generally, their special role in business and society. The book describes the emerging relocation of innovative knowledge and expertise within health care organisations and beyond, such as in the patient's home environment. The relocation of certain knowledge areas from physicians to patients in self-care management or the reconfiguration of health care expertise from one health profession to another are examples of topics developed in this book.

Here, as I see it, r-Health, m-Health and e-Health services can have a significant impact on the manner in which health care delivery models are implemented through cost-saving frameworks. Health technologies are increasingly being used, for example, in robotic-based (r-Health) applications (Chaps. 2 and 3) and in teleconsultation in e-Health and m-Health applications either between physicians or between patients and doctors (Chaps. 4 and 5). These technologies allow health

care professionals to effectively reach far beyond the current service offerings, providing new methods for communication, diagnosis, and treatment.

In the years ahead, there will be an increasing amount of preventive self-care initiatives and associated devices that inform patients of their health conditions (see [Chaps. 4](#) and [5](#) in this volume). Some of the authors in this volume focus on disruptive, game-changing health technologies that are reforming the practice of health care. Teleconsultation and homecare, for example, result in less travel time for both patients and medical practitioners. Hence, today's health care providers need to prepare increasingly technologically savvy citizens, who can perform an increasing number of diagnostic tasks using innovative self-care technologies in their home environments. Clearly, emerging health technologies are a cornerstone of tomorrow's efforts to address these challenges. The emerging technologies offer health care institutions and management new systems for delivering health care services.

Emerging Health Technology
Relocation of Innovative Visual Knowledge and
Expertise

Wasen, K. (Ed.)

2013, XVII, 124 p. 9 illus., Softcover

ISBN: 978-3-642-32569-4