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Healthcare innovation — experiences from the Netherlands

Fredrik Boer

Leiden University Medical Centre,
Albinusdreef 1, 2333, ZA Leiden, The Netherlands

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Healthcare delivery is challenged because of the increasing burden of costs as a result of technological developments and in many countries also as a result of aging. In order to keep healthcare accessible we must innovate not only in the medical possibilities but also in the way we deliver healthcare. Opportunities lie in technological innovation, digitalisation, patient centred care, business development and the paradigms we use in healthcare. Digitalization plays an important role, as this enables use to use information throughout the care process. Digitalisation starts with the use of electronic health records. Furthermore, eHealth makes it possible to involve the patient in his own care by shared decision making, self management and home monitoring. Digitalisation can also improve care through decision support systems, developing predictive tools through machine learning and artificial intelligence. Good care requires that information can be shared between healthcare providers and thus data must be exchangeable between systems — interoperability. Next to digitalisation other improvements play an important role such as value based medicine, that puts the value of care for the patient first, development of new organisation of healthcare and new (cheaper) business models.

Keywords: innovation, digitalisation, information technology, electronic health records, eHealth.

Introduction

In many societies the demography is substantially changing from a broad base of young age groups to a society with a significant number of older people. The change of the composition of the population is the result of a decrease of the birth rate and the increase of life expectancy. This change of the composition of the population had significant societal effects, since it also affects the composition of the working force as proportionally more people belong to the inactive population. This forces the governments to an increase

of the age on which people can retire as the costs of pensions are a too large burden for society.

Ageing comes with ailments. Although people become older, they also life longer with diseases. Often they have more than one disease resulting multimorbidity. As they become older and older, they will frequently be admitted to the hospital, where they will occupy the beds of the emergency departments and often they are difficult to dismiss if they cannot return to their homes. Thus they block beds for other, planned admissions. In the Netherlands this phenomenon leads to overburden of the hospitals, particularly in the area of Amsterdam, but all regions have to deal with these problems.

Ageing is a cause increase of healthcare costs, but technological and medical innovations is even a larger source of growing costs. Particularly the costs for new medication used for the treatment of cancer, auto immune diseases and rare diseases outgrow the available budgets. But also advanced techniques for surgery, such as robotic surgery, increase the costs of healthcare. The explosion of costs has led to captions of available budgets for hospitals, care homes and family doctors in the Netherlands. This forces the healthcare providers to increase efficiency while maintaining a high level of quality. To some extent innovation of treatment, the use of digitalisation and eHealth, the stimulation of self-management by patients, and new business models of treatments stimulate this increase of efficiency.

Opportunities for improvement

Modern medicine experiences an explosion of knowledge, resulting in a better understanding of the aetiology of diseases, the characterisation of individual diseases, improved diagnostics and new treatment modalities. High throughput facilities for genomic research have decreased the price of full characterisation of the DNA available the individual civilian, enabling the risk stratification of diseases. Cancers can be characterised by these techniques so treatment can be individualized. Pluripotent stem cells can be used for therapy, for instance for the treatment of drug-refractory angina pectoris. Genetic profiles can aid in the individualisation of drug treatment. Precision surgery, minimal invasive treatment and new technical solution have led to a decrease of the surgical trauma, resulting in an decrease in hospital length of stay, faster recovery and an increase of eligibility of frail patients for surgery. These medical and technological innovations do not only increased costs, but also decrease societal costs as the treatments are more effective and more personalized.

Opportunities not only lay in the improvement of medical and medico-technological innovation but also in the digitalisation, patient centered care, new business models of delivering healthcare and new paradigmas such population health and lifestyle modification (Fig.). These subjects are the scope of this article.

The digitalization of healthcare

Digitalization of healthcare provided for ample opportunities to increase the quality and efficiency of healthcare. With digital connections healthcare becomes available for far more people, care can also be delivered at home, and providers can increase their reach far beyond the walls of the hospital. The abundance of data can increase the opportunities

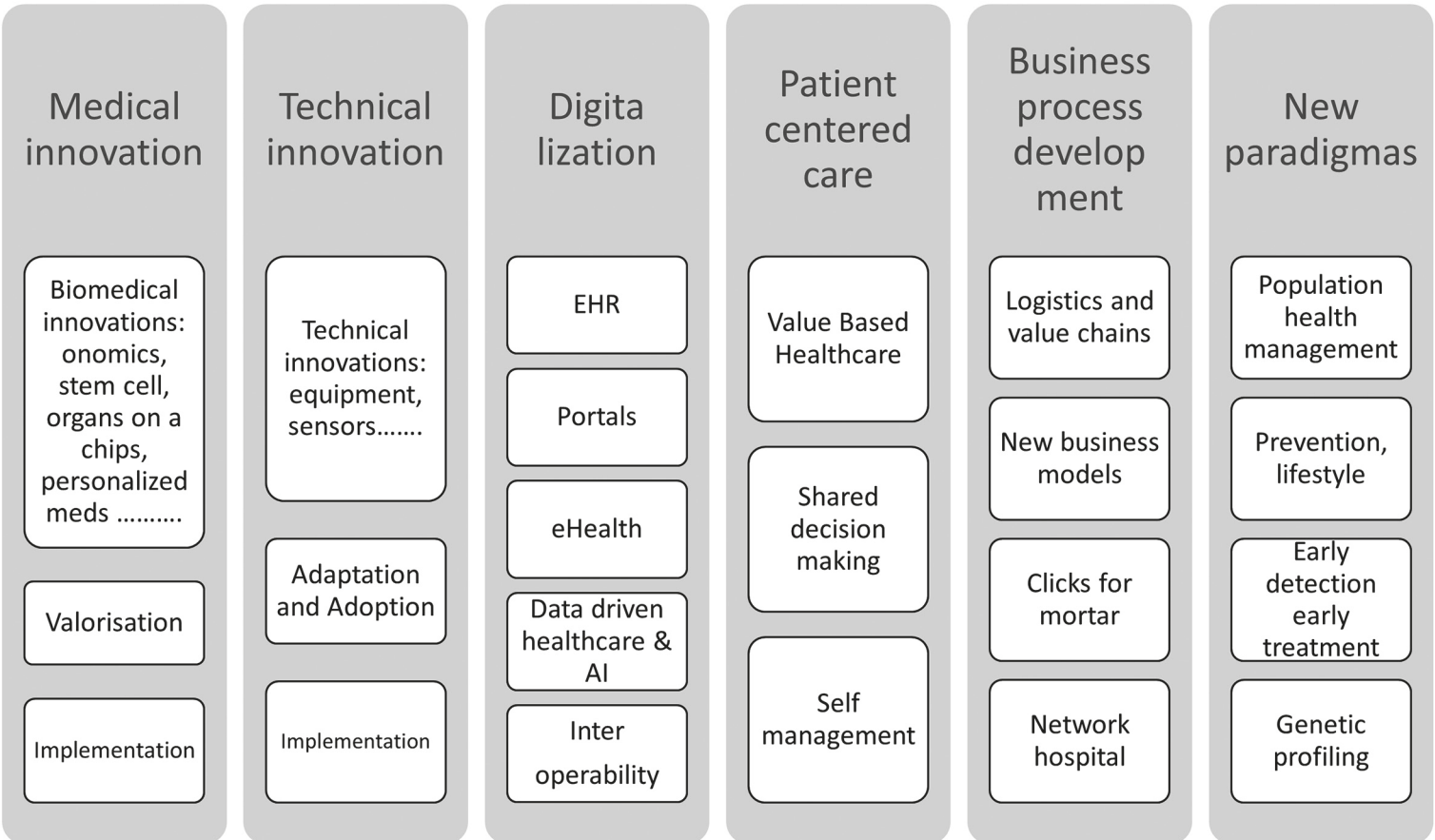

Fig. Scope of healthcare innovation. Based in part on Djellal [20]

for quality improvement through analysis of results. And smart techniques like machine learning and deep learning can lead to predictive models, not only for populations but also for the individual patient.

The emergence of electronic patient record

An important starting point for the digitalisation of eHealth was the introduction of the electronic health record (EHR). Although already partly present in the sixties of previous century, emergence of the EHR gained wider spread in the beginning of the twentieth century. In the Netherlands the family doctors were the first to introduce the medical record in their practice. Hospitals followed one by one in the last 10–15 years. Currently all hospitals and family doctors in the Netherlands employ a EHR.

A remarkable development was the emergence of the integrated EHR. In our hospital the EHR is not only used by the doctors, but also by the nurses, physiotherapist, dieticians and other paramedics involved in the patient. Furthermore, all services are organised in the same software. Radiology and lab measurements are ordered, medication is prescribed, hospital visits and operations are planned, diagnoses are coded and letters are written in the same software. This is the integral EHR, which gives all involved in patient care the same digital environment. All vital information is available to all involved, like medication, previous history like diagnosis and operations, known allergies, and agreed limitations to treatment. Sharing that information throughout the hospital makes healthcare safer and often also more efficient as other file data is shared between doctors. Think of simple things like length, weight or blood pressure, lab results and radiology reports already performed or clinical notes (in our system reported in a twitter like style called life report).

There are also downsides to leaving the paper file. As the EHR spreads, more and more doctors complain about the amount of computer screen work they have to do, up to complaints of burn out symptoms [1]. After the introduction of an EHR productivity in the clinics often goes down, because the doctors simply cannot keep in pace with the time required for an consult due to the increase of computer time. Usually this improves somewhat with time but usually never returns to the previous levels. Doctors hate the use of structured fields in the EHR, since they feel that this never can fully document the patient, so they often prefer the text fields that gives them full freedom. To the regret of those who need structured data, for instance the colleagues that depend on correctly entered medication data or the previous diagnoses and operations. Some hospitals introduced the clerk, an administrative worker, that assist the doctor in the consulting room with the registration of the consult and who will fulfil other tasks like ordering and requirements for the insurance [2; 3]. Our experience with clerks is more negative as they need extensive training and can only assist in smaller tasks. We feel that more advantages are to be obtained from improvement of EHR design, automation of tasks and speech to word techniques.

eHealth

An interesting result of introducing the EHR was the possibility to disclose the medical information to the patient through the internet. This so called portal gives the patient insight in the current information in the EHR, as specific information is made available.

Usually these are medication, lab results, radiology reports, conclusion and policy notes in the files, previous history and appointments. In our hospital we have added to the portal the patient pathway, shown as a metro map, that shows the appointments as stops of the metro line, where additional information is given that helps the patient to understand what will happen in that appointment. In specific care pathways (like oncology pathways) the patient will also find stops where additional data is given about the disease or treatment, stops where a questionnaire must be filled in and so on. We have observed that the use of the portal is greatly stimulated if it is fully integrated in the work of the department and the work becomes fully digital. This is one of the requirements of successful eHealth implementation — a change of work as performed instead of eHealth as an add-on technique which usually results is more work for the healthcare providers and therefore a loss of interest for this new methods [4; 5]. In the Netherlands hospitals and family doctors are stimulated by subsidies to disclose the information in the EHR through portals.

eHealth is more than portals. The use of apps in the medical process is steadily increasing, next to the consumer apps that are used to improve lifestyle. The number of medical apps is far over 100,000 and most of them do not fulfil the minimum requirements of trustworthy use. The biggest issue is absence of prove of efficacy. But eHealth can be very useful in for instance mental health [6], support in asthma or chronic heart disease. Any app will require a knowledgeable healthcare worker that monitors the performance of the patient, gets involved when things do not seem to go well, support the patient in self-management. The wise use of apps can help the patient to become more independent, can increase the reach of the healthcare provider beyond the walls of the hospital and may result in improved and more efficient care, for instance by decreasing unplanned admission to the hospital.

Other modalities in eHealth are distant monitoring where the patient is monitored at home, such as pacemaker function, blood pressure monitoring or saturation. Patients can be contacted through video over the internet, so that patients can show their operation wounds. These techniques are used for monitoring patients with chronic conditions like heart failure, postoperatively after cardiac or pulmonary surgery or after an acute episode after heart infarction. This developments can lead to a virtual hospital where there are few or no beds and patients are mostly at home. Hospitals can use these techniques to increase their reach for instance for diseases where they specialize on with patients coming from great distances. Or for regions with low population density such as in Finland, China or Russia. In countries with a dense hospital distribution, as in the Netherlands, the development of virtual care is hampered.

Data science and artificial intelligence

While the advantages of the electronic health record and the business case for the EHR are still debated, the advantages may build on the use of the digitized data for data science and artificial intelligence. Until now the development of medicine relied on developments in the laboratory, clinical trials and sound clinical work of the doctors, the emergence of data science and artificial intelligence may prove an next revolution in health care. We already know that more that the biggest advantages in the daily use of the integrated EHR lay in decision support systems, especially if combined with electronic prescription systems [7–9]. These decision support systems are often build upon known

protocols or known interaction between drugs, patients and preconditions. Data science can help detect new relations between data, using the force of large numbers of patients, computer power and smarter software. With the development of artificial intelligence the impact goes even further, as opportunities for better predictions and task automation may occur. Radiological images, pathology slides and patient electronic medical records are being evaluated by machine learning, aiding in the process of diagnosis and treatment, augmenting the physician's capabilities [10]. The promise of AI in medicine are big, but the as with eHealth the value must be studied with the same rigor as the introduction of new drugs. Furthermore, the human and ethical use of AI in medicine must be further developed to guarantee safe and sound medicine [11].

Interoperability

Interoperability is the ability of different information systems, devices or applications to connect, in a coordinated manner, within and across organizational boundaries to access, exchange and cooperatively use data amongst stakeholders, with the goal of optimizing the health of individuals and populations. Interoperability consists of organizational, sematic, structural and fundamental interoperability [12]. Organizations have will have to decide how they will cooperate and organize their processes (organisation), how they will build the texts or codes that will have to shared (semantics), how they will structure the messages they will exchange (structure) and finally they have to agree on interoperability requirements to exchange between systems (fundament). Exchange of information is the weakest link in the Netherlands, as all the information systems were developed for use inside a policlinic or a hospital alone. This makes transfer of information often very cumbersome and frequently the fax is still used to send information from one healthcare provider to the next. The government in the Netherlands is stimulating all healthcare providers to assume common languages and adopt the same standard for health information exchange, but this will cost still a few years before information exchange is fully digital. Any organisation that still needs to acquire an information system should target on solutions with data exchange in mind and build straight from the bottom on the system to this requirement! Data exchange is simply a too valuable good to be ignored, since it directly affects patient safety. Think of all the risks of medication errors that result from incomplete medication verification if a patient is admitted to the hospital or the risk of double medication in the policlinics if one doctor does not know what has been prescribed by his colleague in another medical centre. Interoperability is not well developed across Europe, with the Nordic countries as a positive example, where more data can be exchanged throughout the health system.

Patient centred care and value based medicine

There are various definitions of what patient centred care is, but they all reserve a central role for the patient view point on the care that is provided and the role the patient can take in the processes. One approach comprises the organization of care around the patient, using the optimization of access and throughput times, (self) services to the patient and the humanity of care as the focus for developments. Another approach centres around the concepts of informed or shared decision making, self-management and taking

the lead in one's own care process. Evidently these concepts prove their value especially in chronic care, where the patient habituates to his chronic condition and can develop the necessary skills to become more in control of the management of the disease and the doctor can attain more the role of a coach of the self-management performed by the patient. Similarly the patient can play a more active role in diseases and treatments where the patient has options and choices. This concept is further developed in the concept of value based medicine.

Teisberg and Porter stated that competing on the quality of care and the value for the patient will improve care and will be a method to contain the costs [13–15]. No longer the quality of care is defined by the technical qualities like 5-year survival rate or disease free interval of the financial aspects like length of stay of total costs of care. In value based care there is a focus on the goals of the patient, the quality of care as experienced by the patient and value of care. The value is calculated as the quotient of quality for the patient and the costs. A important part of their concept is that both quality and costs are calculated well beyond the acute phase of the disease and treatment and also beyond the border of intramural care. Thus also the impact of treatment, side effects and losses due to treatment, return to a normal social life and to work, return of disease and additional treatment are included in the equation. Further parts of the concept are the treatment in a multidisciplinary team beyond the borders of intramural care (the IPU), systematic measurement of outcomes (including the patient reported outcome measurement), and later the introduction of bundled payments (that are shared between the partners in the IPU that integrates the separate units where care is delivered) and expanding the centre to a biggest patient group to increase the business by competing on the quality of care that is gradually proofing its self. Fundamental to value based health care is the presence of a solid information platform that allows evaluation of all necessary aspects of the care provided, not only the outcome data, but also financial and process indicators. This of course becomes more challenging if partners beyond the walls of the organisation are involved. This also hits to the theme of interoperability.

The concept of value based healthcare is embraced by a part of the hospitals in the Netherlands, particularly the academic hospitals, but it is still at an early stage of development. Whether the concept leads to better and more efficient care still needs to be proven.

New business models and process improvement

Hospitals can often improve on the efficiency of these processes. There is rapidly increasing field of research in hospital logistics that puts science under the practical aspects of patient planning applying operations research in the medical field [16]. New business models can be found in new cooperation in a care pathway, where parts of the care pathway are provided by new healthcare or service providers. For instance, chemotherapy can be given by a mobile nurse from a care organization instead by the hospital in the ward of the policlinics, thus decreasing the burden for the patient. It remains to be seen if this change can be cost effective, adequately safe and suitable for every patient. Another example is the surveillance of patients with chronic conditions, such as asthma, which can lead to more patient comfort, lesser travelling for the patient and possibly better patient compliance to therapy, lower acerbation rate and less emergency admittance to the hospital [17]. Hospitals can deliver distant care to patients as part of their digital strategy, in which

they invest more in eHealth than in building new compounds. Currently there are healthcare providers that make telehealth their business, changing to virtual care, such as *Mercy Virtual Care center* [18]. If a hospital provides care by interacting with different healthcare providers outside the hospital to provide a full service, for instance limiting their role to an intervention and leaving the other aspects of care to other provider, such a hospital can be considered to be a network hospital. In the concept of network healthcare it is assumed that advantages can be obtained if the healthcare providers deliver to the patient what they are best at. But there are worries about the integral quality of care, serious issues around interoperability of information and thus continuity of care information, safety issues particularly around medication, risks of delays between healthcare providers and the overall ability of patients to understand the care process.

New paradigms in healthcare

Healthcare providers are usually oriented on patients and patients enter the industry once they become ill. Thus the problem of disease is understood in terms of pathogenesis, disease models, diagnostics and treatment modalities. But there are determinants of health that are outside the present scope of the usual providers, that are not addressed and that can lead to epidemics of modern life, such as the occurrence of adult onset diabetes which in a large number of cases it attributable to a unhealthy life style, lung cancer and other cancer forms that are largely attributable to smoking. According to the WHO determinants of health include the social and economic environment, the physical environment and the persons individual characterics [19]. New paradigms in healthcare are dealing with these sources of health and disease. Population health management is directed at detecting risk groups, developing interventions to improve the health of the population and thus preventing the growth of the diseased population. Often intervention are aimed at changing lifestyles that are unhealthy. Other intervention are aimed at the other factors that determine the health of the population. Despite all efforts people can develop disease and early detection in an early stage of the disease may allow for early interventions, resulting in a lesser burden of the disease for the patient and possibly lesser costs for the society. Genetic profiles may help to detect the individuals at risk.

Conclusion

Healthcare is experiencing many challenges, particularly due to the exploding costs. This is a development that is visible throughout the whole modern world. The application of digital possibilities can aid in the resolution of these challenges, next to other ways of delivering healthcare. Since our understanding of the determinants and disease has significantly increase there is a solid base to develop new approaches of health in society. Civilians, health authorities and political entities can use these insights to improve the health of their population. Innovation can help to reach the quadruple aims of healthcare: better health of the population, better patient experience, lower costs of care and a better well-being of the care team.

References

1. Marckini D. N., Samuel B. P., Parker J. L., Cook S. C. Electronic health record associated stress: A survey study of adult congenital heart disease specialists. *Congenital Heart Disease*, 2019, vol. 14, pp. 356–361.
2. Howell E. E., Bessman E. S., Rubin H. R. Hospitalists and an innovative emergency department admission process. *J. Gen. Intern. Med*, 2004, vol. 19, pp. 266–268.
3. Freed D. H. Hospitalists: Evolution, evidence, and eventualities. *Health Care Manag. (Frederick.)*, 2004, vol. 23, pp. 238–256.
4. Eden R., Burton-Jones A., Scott I., Staib A., Sullivan C. Effects of eHealth on hospital practice: synthesis of the current literature. *Australian Health Review*, 2018.
5. Morquin D., Ologeanu-Taddei R., Watbled L. Using Healthcare Work Process Modelling in Hospitals to Increase the Fit Between the Healthcare Workflow and the Electronic Medical Record. *Studies in Health Technology and Informatics*, 2017, vol. 235, pp. 393–397.
6. Batra S., Baker R. A., Wang T., Forma F., DiBiasi F., Peters-Strickland T. Digital health technology for use in patients with serious mental illness: a systematic review of the literature. *Med Devices (Auckl)*, 2017, vol. 10, pp. 237–251.
7. Black A. D., Car J., Pagliari C., et al. The impact of eHealth on the quality and safety of health care: a systematic overview. *PLoS Medicine*, 2011, vol. 8, e1000387.
8. Garg A. X., Adhikari N. K., McDonald H., et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: a systematic review. *JAMA*, 2005, vol. 293, pp. 1223–1238.
9. Robertson J., Walkom E., Pearson S. A., Hains I., Williamsone M., Newby D. The impact of pharmacy computerised clinical decision support on prescribing, clinical and patient outcomes: a systematic review of the literature. *Int. J. Pharm. Pract*, 2010, vol. 18, pp. 69–87.
10. Mintz Y., Brodie R. Introduction to artificial intelligence in medicine. *Minimally Invasive Therapy & Allied Technologies*, 2019, vol. 28, pp. 73–81.
11. Kulikowski C. A. Beginnings of Artificial Intelligence in Medicine (AIM): Computational Artifice Assisting Scientific Inquiry and Clinical Art — with Reflections on Present AIM Challenges. *Yearbook of Medical Informatics*, 2019.
12. *What is interoperability?* Available at: https://www.himss.org/library/interoperability-standards/what-is-interoperability (accessed: 01.07.2019).
13. Teisberg E. O., Porter M. E., Brown G. B. Making competition in health care work. *Harv. Bus. Rev.*, 1994, vol. 72, pp. 131–141.
14. Porter M. E., Olmsted Teisberg E. Redefining Healthcare. *Creating Value-Based Competition and Results*. Boston, Massachusetts, Harvard Business School Publishing, 2006.
15. Kaplan R. S., Porter M. E. How to solve the cost crisis in health care. *Harv. Bus. Rev.*, 2011, vol. 89, pp. 46–61.
16. Hulshof P. J., Boucherie R. J., Hans E. W., Hurink J. L. Tactical resource allocation and elective patient admission planning in care processes. *Health Care Manag. Sci*, 2013, vol. 16, pp. 152–166.
17. Farzandipour M., Nabovati E., Sharif R., Arani M. H., Anvari S. Patient Self-Management of Asthma Using Mobile Health Applications: A Systematic Review of the Functionalities and Effects. *Applied Clinical Informatics*, 2017, vol. 8, pp. 1068–1081.
18. *Mercy Virtual*. Available at: http://www.mercyvirtual.net/ (accessed: 30.10.2019).
19. *The determinants of health*. Available at: https://www.who.int/hia/evidence/doh/en/ (accessed: 30.10.2019).

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Author's information:

Fredrik Boer — MD, PhD; f.boer@lumc.nl