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ROBOTICS: The Ponderings of an Hospital CEO in The Netherlands

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Abstract

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Introduction

"For years, the world of medicine has been steadily advancing the art of robot-assisted procedures, enabling doctors to enhance their technique inside the operating theatre. Now US researchers say a robot has successfully performed keyhole surgery on pigs all on its own – without the guiding hand of a human. Furthermore, they add, the robot surgeon produced "significantly better" results than humans. The breakthrough is another step towards the day when fully automated surgery can be performed on patients".

A CEO of a Dutch public hospital contemplates about what he just read. This is disrupting news! It will have major consequences when this way of surgery becomes common good. It requires not only surgeons to rethink their profession but what is more important it requires a total new vision on healthcare in particular. The speed of development in the healthcare robot industry is impressive. How much longer does it take before developers find a way to transform robotic systems from being dependent to semi-autonomous to eventually, fully autonomous systems, like what he just read?

He also knows about the counter arguments, such as lack of empathy by robots and the fact that setting up a diagnosis and treating a patient are not linear processes. It requires creativity and problem-solving skills that algorithms and robots will never (?) have. Besides that, it requires huge investment requirements.

He however realized that robotization has another price, it forces hospital leaders in particular to rethink their business models and their purpose. The Dutch word for hospital, 'ziekenhuis' house for the ill, might be changed into a house for injured people: just like an automobile repair center. These people are "only" injured but not ill. They simply visit the hospital factory to be repaired. For the injuries automated robots could be a perfect tool. But not only for repair, through the regrowth of organs, replacement of damaged or diseased organs could also be an area of opportunity.

On the other hand, the question 'what is actually meant with the term ill?' pops up in his mind. Is a hospital a place of physically injured people only? Some people might have mental problems as well. Or a complication, a bacterial infection may cause a disease that requires a cure and sometimes longer hospitalization. Curing is something else than simply repair the body. Which role plays a robot in that case? What about the people that might need a human being instead of a robot?

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Healthy high income injured people want to be cured as soon as possible, private clinics stepped into that market. These clinics have enough investment possibilities. Does that mean that robotization is for commercial hospitals only? Should a public hospital refrain from this way of automation and focus more on wellbeing on health care only?

He decides to call some other CEO's colleagues in the area to have a round table discussion about this important topic…

Hospital history and concept development

Hospitals from its origin have a religious foundation: Buddhists, Christians and Muslim have been amongst others religion laying the foundation of what nowadays is called an hospital.

History

"The evolution of the hospital is traced from its onset in ancient Mesopotamia towards the end of the 2nd millennium to the end of the Middle Ages. Reference is made to institutionalized health care facilities in India as early as the 5th century BC, and with the spread of Buddhism to the east, to nursing facilities, the nature and function of which are not known to us, in Sri Lanka, China and South East Asia. Special attention is paid to the situation in the Graeco-Roman era: one would expect to find the origin of the hospital in the modern sense of the word in Greece, the birthplace of rational medicine in the 4th century BC, but the Hippocratic doctors paid house-calls, and the temples of Asclepius were visited for incubation sleep and magico-religious treatment. In Roman times the military and slave hospitals which existed since the 1st century AD, were built for a specialized group and not for the public, and were therefore also not precursors of the modern hospital. It is to the Christians that one must turn for the origin of the modern hospital. Hospices, initially built to shelter pilgrims and messengers between various bishops, were under Christian control developed into hospitals in the modern sense of the word. In Rome itself, the first hospital was built in the 4th century AD by a wealthy penitent widow, Fabiola. In the early Middle Ages (6th to 10th century), under the influence of the Benedictine Order, an infirmary became an established part of every monastery. During the late Middle Ages (beyond the 10th century) monastic infirmaries continued to expand, but public hospitals were also opened, financed by city authorities, the church and private sources. Specialized institutions, like leper houses, also originated at this time. During the Golden Age of Islam the Muslim world was clearly more advanced than its Christian counterpart with magnificent hospitals in various countries".

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Modern Hospital

"A hospital, an institution that is built, staffed, and equipped for the diagnosis of disease; for the treatment, both medical and surgical, of the sick and the injured; and for their housing during this process. The modern hospital also often serves as a centre for investigation and for teaching. To better serve the wide-ranging needs of the community, the modern hospital has often developed outpatient facilities, as well as emergency, psychiatric, and rehabilitation services. In addition, "bedless hospitals" provide strictly ambulatory (outpatient) care and day surgery. Patients arrive at the facility for short appointments. They may also stay for treatment in surgical or medical units for part of a day or for a full day, after which they are discharged for follow-up by a primary care health provider. Hospitals have long existed in most countries. Developing countries, which contain a large proportion of the world's population, generally do not have enough hospitals, equipment, and trained staff to handle the volume of persons who need care. Thus, people in these countries do not always receive the benefits of modern medicine, public health measures, or hospital care, and they generally have lower life expectancies".

Development

Hospitals have developed from an housing facility (Dutch word: 'Ziekenhuis' (House for the Sick)) towards a treatment centre. First diagnosis is done in such a way that treatment is expected to be successful. One can discover a trend that the 'housing' function of the hospital disappears and focus is more and more concentrated on surgery. Bedless hospitals means higher 'turnover'. The modern hospitals transform into a lean and mean operation driven by the forces of the market (see next paragraph). Curing can be outsourced in order to give the hospital the possibility to focus on it is core business… The question though is: what is its core business?

Dutch health care system in transition

In the Netherlands an hospital is considered as secondary care. Since it is expensive one does not want unnecessary use of the (public) hospital facilities. For that purpose the general practitioners (primary care) play an important role within the Dutch health care system. They function as gate keeper. Last but not least the academic hospitals, offering most specialized

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and expensive hospital services is considered as tertiary care, only when secondary care is not able to come to effective health care solutions.

"Insurers negotiate with providers on price and quality and patients choose the provider they prefer and join a health insurance policy which best fits their situation. To allow patients to make these choices, much effort has been made to make information on price and quality available to the public. The role of the national government has changed from directly steering the system to safeguarding the proper functioning of the health markets. With the introduction of market mechanisms in the health care sector and the privatization of former sickness funds, the Dutch system presents an innovative and unique variant of a social health insurance system. Since the stepwise realization of the blueprint of the system has not yet been completed, the health care system in The Netherlands should be characterized as being in transition". Many measures have been taken to move from the old to the new system as smoothly as possible. Financial measures intended to prevent sudden budgetary shocks and payment mechanisms have been (and are) continuously adjusted and optimized. Organizational measures aimed at creating room for all players to become accustomed to their new role in the regulated market. As the system is still a "work in progress", it is too early to evaluate the effects and the consequences of the new system in terms of accessibility, affordability, efficiency and quality. Dutch primary care, with gatekeeping GPs at its core, is a strong foundation of the health care system. This is an attempt to control public spending. Limited innovation budgets because of lean and mean philosophy and thinking might prevent successful introductions of robotics in health care.

Gatekeeping GPs are a relatively unusual element in social health insurance systems. The strong position of primary care is considered to prevent unnecessary use of more expensive secondary care, and promote consistency and coordination of individual care. It continues to be a policy priority in The Netherlands. The position of the patient in The Netherlands is strongly anchored in several laws concerning their rights, their relation to providers and insurers, access to information, and possibilities to complain in case of maltreatment. In terms of quality and efficiency of the health care system, The Netherlands is, with some notable exceptions (e.g. implementation of innovations such as day surgery and electronic patient records), an average performer when compared to other wealthy countries".

Rationale behind the Dutch healthcare system

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"The Dutch healthcare system regulates healthcare provision for the population of 17.5 million. The government's primary responsibility is creating the conditions for good public health, while people are personally responsible for their health and wellbeing. The government enables people to take care of themselves and supports them if they are unable to do so either on their own or with help from friends and loved ones or other people in their network. The four objectives underpinning the Dutch healthcare system are good public health, with high-quality care that is available and affordable to all, both now and in the future. In order to achieve these objectives, the Netherlands maintains a system of regulated (managed) competition. The government sets the rules with which new and existing players must comply in order to enter the healthcare market, there must always be sufficient care available and the care provided must be regulated. This is how the Dutch government guarantees the quality of public health in the Netherlands and the quality of the care provided. In order to guarantee solidarity, the government determines that everyone, by paying taxes, pays their share of curative and long-term care, irrespective of how many people use this care themselves. In order to keep the increase in healthcare expenses in check, the government enters into what are known as 'outline agreements' with the sector; these agreements contain terms on the maximum increase in healthcare expenses. Within these agreements, the main players determine the price, quality and service of the care, based on supply and demand; these players are healthcare purchasers, healthcare providers, and the general public".

Key players in the Dutch healthcare sector

"Healthcare purchasers, healthcare providers and the public together comprise the three main players in the Dutch healthcare system: Who fulfils the role of healthcare purchaser depends on the law in question. The 352 local governments are responsible for this under the Social Support Act, Youth Act and, to an extent, the Public Health Act. Health insurance providers act as the purchasing party under the Health Insurance Act. In 2021, the Netherlands is home to a total of 10 health insurance groups, which includes several health insurers. Under the Long-Term Care Act, there are a total of 31 healthcare administrative offices that act as purchasers. The main players operate in three 'markets':

Healthcare purchasers

The first of these, the health insurance market, applies exclusively to the Health Insurance Act. Private individuals can decide every year from which health insurance provider they want to purchase their health insurance. Health insurance providers compete on aspects such as price

or policy terms. The insured package is the same for the entire population. The other two markets are relevant to all healthcare laws in the Netherlands.

healthcare providers

In the healthcare procurement market, health insurers, healthcare administrative offices and local governments decide with which healthcare providers and under what terms and conditions (within the rules set by the government) they purchase healthcare.

the public

Finally, members of the public operating in the market for health providers decide from which healthcare provider they would like to receive care. If they choose a provider with which the healthcare procurement organization has not signed a contract, it sometimes happens that their care is not, or not fully, covered by their policy".

The future

In general, Dutch healthcare performs well, but there are major bottlenecks in parts of the system. To guarantee quality and accessibility, care must be sustainable in terms of financial means, personnel and public support. However, these three dimensions of sustainability are under increasing pressure due to developments such as an aging population, the emergence of new healthcare technology and an increase in the number of chronically ill people.

Robotic surgery

Robotics for Medicine and Healthcare

"Robotics for Medicine and Healthcare is considered the domain of systems able to perform coordinated mechatronic actions (force or movement exertions) on the basis of processing of information acquired through sensor technology, with the aim to support the functioning of impaired individuals, medical interventions, care and rehabilitation of patients and also to support individuals in prevention programmes.

The field of Robotics for Healthcare is driven by the expectation that robots will be able to play an important role in helping societies to cope with a number of the big challenges and trends of the next decades. The application of robotics in healthcare is in many areas a young but promising field with different segments that are progressing at different speeds. Only a few

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products have reached the stage of large-scale market introduction, the real measure for successful innovation. Many applications are still very expensive.

In many instances, it is quite difficult to identify the reasons for discontinued and unsuccessful projects, since multi-dimensional factors like legal issues, regulations, enabling technologies, social acceptance and unforeseeable disruptive incidents play key roles.

The first commercial products (ROBODOC, CASPAR, ACROBOT) on the market may serve as a signal for a greater development to follow, as the potential added value of robots in healthcare will be fully recognized. The market is expected to grow, as the following examples indicate. The U.S. market for prosthetics, orthoses and cosmetic enhancement products is expected to increase from $6.8 billion in 2005 to $10.8 billion in 2010, at an AAGR (average annual growth rate) of 9.9%. Powered wheelchairs could reach a market volume of a little over $1 billion by 2013 in the USA and Asia alone. Smart medical capsules may even take over the whole market for classic colonoscopy screenings as prices for smart medical capsules will drop below the current $450 per unit. From the side of the stakeholders, e.g. patients, doctors, hospitals, care institutions, health insurance companies and authorities, it appears that most of them see the developments as very interesting for the future, but very few of them show an urgent drive to switch to these new applications right now. Suppliers play a rather supporting role, but patient involvement in research and development is (too) little. Although government is not considered a key player in this area, governmental funding for related R&D is crucial".

Robotics Surgery and limitations

"Robotic surgery continues to diffuse across an increasingly broad range of surgical procedures. However, concerns have been raised that robotic surgery is more costly and may be no more effective than other established operative approaches, such as traditional laparoscopic minimally invasive and open surgery. With respect to costs, for example, robotic surgery has been associated with episode costs as much as 25% higher compared with laparoscopic surgery. There are also concerns about the rapid growth of robotic surgery in areas with limited evidence to support its use and little theoretical benefit or clinical rationale (eg, inguinal hernia repair). The US Food and Drug Administration (FDA) recently issued a warning against the use of robotic surgery for the treatment of breast and cervical cancers. In their communication, they expressed concerns about the lack of epidemiologic data characterizing the use of robotic surgery in real-world practice settings. Current estimates are

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limited to single-center studies, device manufacturers' financial statements, and claims data, which may be inaccurate owing to unreliable coding".

Health care robotics and ethical concerns

Replacement and its implications for labour

Are robots introduced to solve problems in healthcare and elderly care, or are they introduced to save money by replacing human care givers by robots, and to help robotics research and industry? For instance, in research concerning the development of robots for the elderly, robots are often presented as a response to demographic challenges. But are such technological solutions the main or only way we should tackle these challenges? And if there is truth in the suspicion that robots will replace humans, which problems exactly would they solve, and is robotics really a threat to employment? More generally, what are the consequences for healthcare work? For example, do robots and ICTs threaten "care craftsmanship"?

De-humanisation and "cold" care

An important fear in discussions about robots in healthcare is that robots may replace human care givers, and that this may not only put these people out of job, but also remove the capacity for "warm", "human" care from the care process. It is highly doubtful, for instance, if robots could ever be empathic or have emotions. Robots, it seems, are not capable of a "human" kind of attention and care, whereas healthcare seems to involve more than some "behaviours"; humans have various social and emotional needs, which are not necessarily met by giving them a robot. "Machine care" sounds cold and mechanical. There is the concern that elderly people are abandoned, handed over to robots devoid of human contact. Cold care might be good in the operation room but cold care for patients with Alzheimer disease could be disastrous. More generally, do machines in care "objectify" care receivers? Do they objectify care givers (see also the previous point)? What do we mean by good healthcare? Do we have good healthcare today, without even considering robots? Is good care possible in the context of modernity?

Autonomy.

Not all health care robots are autonomous robots. For instance, surgical robots are remote controlled by the surgeon. Yet health care research often aims to give more autonomy to the

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robot. An important term in the field, for instance, is autonomous systems. Autonomy means here that the robot is designed to carry out tasks without continuous human guidance and assistance, preferably in an unstructured environment. This development could lead to a future scenario in which robots would replace human care workers, for instance if care robots take over the work of the human nurse. As indicated before, this is ethically problematic. But even if robots in healthcare did not entirely replace human care workers, there is still the question how autonomous (in the sense of doing tasks on its own, unassisted by humans) the robot would be and should be in the context of the interaction and the care, and how autonomous it should be in the sense of operating without human supervision. For example, if robots are used in therapy for children, should the robot be supervised (and if so in what way) and what exactly and how much should it do without direct human intervention?

Role and tasks

Related to the previous point is the question regarding the role of the robot in the particular care process. Even if humans are still part of the care process, what exactly should the role of the robot be (and the role of the human)? What tasks can and should be delegated to robots? And in general: should they assist or take over human tasks? When and where should they do what?

Moral agency

Robots do not seem to have the capacity of moral reasoning or, more generally, of dealing with ethically problematic situations. Hence when a moral problem arises within the human–robot interaction and within the healthcare situation, there seems to be a problem: the robot is given (more) autonomy, in the sense of doing tasks by itself without human intervention, but does not seem to have the capacity of moral agency: it can do all kinds of things, but unlike humans does not have the capacity to reflect on the ethical quality of what it does. Some philosophers therefore propose to build-in a capacity for ethical reasoning, whereas other philosophers deny that this is possible or think it is insufficient for dealing with complex ethical issues in healthcare. On the other hand, maybe the robot's lack of moral agency is not a problem as long as humans are involved and included in the process. Again the issues of autonomy and role are raised.

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Responsibility

This issue raises again the question regarding the autonomy and role of the robot and the human and, more generally, regarding human–technology relations. How does the introduction of robots (re-)shape ethical responsibilities? If the robot takes over human tasks, who is responsible for these tasks? What should be the new distribution of responsibility, when robots take over some tasks? Does it mean that humans remain responsible (assuming the robots cannot be morally responsible), and if so, how can they exercise this responsibility if they have not direct control over the robot (if they do not continuously intervene) or even do not supervise the robot?

Deception

If robots are used as ''social'' companions and are given other roles which encourage social–emotional involvement of the humans (e.g. elderly people or children), is this not a case of deception, and if so, is this deception justifiable?

Trust

In so far as the robot acts autonomously and human care givers withdraw from the care process (to some extent at least), can the robot be ''trusted'', or is this term not applicable to robots? Should we only talk about reliability? Or do ''social'' robots raise the issue of trust? Shall we ''trust'' giving patients, elderly people, and children ''in the hands of the robot''?

Privacy and data protection:

Robotics research and use of robots in healthcare raise questions about which data are collected, how they are stored, who has access to them, who owns them, what happens to them, and so on.

Safety and avoidance of harm.

Robots should not harm people and be safe to work with. This point is especially important in healthcare and related domains, since it often involves vulnerable people such as ill people, elderly people, and children''.

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Epiloque

The CEO's thinking has developed. The topics for the round table are clear now. According to him, the discussion should follow the following steps that should functions as a filter. And it should not be a freely brainstorming event. It should result in a clear business case.

(S) Suitability

First of all the roundtable participant should discuss the suitability of robotic systems within their hospital environment. Which application really solves a problem. It might save time as the robot is faster, the robot produces better quality, is less dependent, is more flexible, more sustainable and is cheaper..

(A) Acceptability

If an application area and its robotic use is suitable the question remains whether is it acceptable. The likely return of investment? Discussions about the opinions and reactions of the various involved stakeholders. Discussions and decisions about the level of risk should also take place. Last but not least the concerns about the ethics involved should also be covered. Although some might be discussed during the suitability session from a functional perspective. A robot could give elderly accompany but what is the objective behind the application: is it a timesaving argument or is the robot simply better in "loving"?

(F) Feasibility

Last but not least the economy of the application should be discussed. The business case. Does is work in practice, can the strategy be financed, do people with the required skills exist, can they be trained, can other required resources be obtained and integrated in the process of the operating system?

The CEO realizes that this is not just a simple discussion. In order to make this work, he decides to make the discussion more practical and focus on just one case: prepless colon capsule technology. He will produce a document what will serve on the one hand as

information's package and on the other hand as an agenda for the roundtable discussion following the SAF scheme… a lot of work!

He starts to read "Colorectal Cancer and Polyp Detection Using a New Preparation-Free, Colon-Scan Capsule: A Pilot Study of Safety and Patient Satisfaction" an important source to start off…