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The Social Role of Healthcare Technology

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Abstract

Defined as "the drugs, medical equipment, health-care procedures, supportive systems, and the administrative systems that can tie all these disparate elements together", medical technology can be considered one of the most important supply factors influencing the complex processes inside and outside of health care system. As it is shown in different papers, technology trends are impacting the future of healthcare, being more social than ever before. Health care itself became the most significant items of social public expenditure. At the community levels, the social networks are useful in sharing information about certain diseases, so can be considered as an important part of the educational process of patients and their caregivers. At the individual levels, medical technology can improve the quality of life in many circumstances by playing its role in prevention, treatment, cure and rehabilitation in chronically health conditions like breast or ocular prostheses. In these last cases, the social role of medical technology is associated with the social role of body image, when targeting of social comparisons for physical attributes. The aim of this paper was to make a review of these issues, adding some personal thoughts derived from personal professional experiences.

Keywords: medical technology, social role, chronic health conditions, quality of life.

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Introduction

Medical Technologies (MTs) are variously defined. One approach is *based on processes* and defines MT as a wide range of healthcare products used to diagnose, monitor or treat a disease or medical condition, intended to improve the quality of healthcare provided to patients by earlier diagnosis and less invasive treatment options and reduction in length of stay and recovery time (AdvaMed, 2009). Another definition is *based on structure*, MTs being understood as "medical services, medicines, medical or surgical instruments and techniques used in healthcare, and the organization and support system in which such care is provided" (INAHTA, 2009). This definition offers a broader exploration of how MT influences and shapes the behavior of patients with chronic diseases in social and family context (Merrel & Doarn, 2011). This approach is in line with the European Union (EU) policy on public health aiming to identify options to optimize the response to the challenges of chronic diseases that can be achieved through a dialogue with the interested parties – patients, professionals, taxpayers and healthcare providers -, taking into account "e-health and the contribution that can be attributed to other relevant policy areas (employment, housing, education and disabilities) in order to improve the strategies, technologies and support to enable active aging in good health "(Council conclusions "Innovative approaches for chronic diseases in public health healthcare systems" in the *Official Journal of the European Union* 2011 / C 74/03).

In a wider context, medical technologies include medicines, medical devices and biotechnology products, surgical procedures/techniques, development of organizational structures, and interventions aimed at changing health behavior.

Methods

The main goal of this research was to select, synthesize, discuss and present the current relations between medical technologies and their social role or impact at community and individual level. The study is based on a synthesis of the literature on this topic, including books, articles and online resources, and authors' own experience. The latter is materialized by the presentation of some clinical cases in which the use of MTs were a treatment option that lead to a significant increase in quality of life. The information contained in this article is related to the macro-level social impact and role of MTs, and how their use helps individuals integrate into society. The authors present some of the most popular medical technologies and their benefits to society, without neglecting some of the controversial aspects related to the use of new medical technologies.

Results and discussion

Some facts about the evolution of medical technology

Medical technology used before and during the time of Hippocrates will not be tackled. Much later, a crucial step was the discovery of antibiotics and disease prevention through vaccination (1978 - the last smallpox death), the introduction of insulin to treat diabetes, sphygmomanometers, and the list could continue. Later, the first medical devices arose from innovation and research. In the nineteenth century, Hermann von Helmholtz invented the ophthalmoscope, Manuel Garcia the laryngoscope, and Willhelm Röentgen the X-ray. All these discoveries, improved over time, became a common "presence" in medical practices and hospitals. The development of MTs was a natural result in response to the increasing therapeutic exigencies (expressed as correct and early diagnosis, low length of stay and, sometimes, the costs, rapid recovery, minor side effects) from both patients and physicians.

Closer to our days was the application of ultrasound in medical practice, well known for its usefulness in obstetrics and gynecology. Visualization of the fetus in 3D has always been a concern of many researchers in different fields (technical and medical, biophysics): (1) Tom Brown (Glasgow, 1973): developed a "multiplan" scanner, working for Sonicaid Ltd.; (2) Kazunori Baba (1984, Japan): collaborated with the Department of Biomedical Engineering, University of Tokyo, being the driving force in the development of commercial 3D ultrasound systems in Japan; in 1992 he published the first book on ultrasonography in obstetrics and gynecology, that included chapters on 3D ultrasound; (3) Mery Eberhart (1995, Germany): demonstrated the usefulness of orthogonal multiplanar imaging; (4) Donald King (1990, Columbia University, USA) described other approaches and algorithms for 3D spatial registration and visualization of position and orientation of real time ultrasound images; (5) Centre for Emerging Cardiovascular Technologies at Duke University (1991): developed a matrix array scanner that could image cardiac structures in real-time and 3D ; (6) Working Group at National Cheng Kung University Hospital (Taiwan, 1992): 3D visualization of fetal face, cerebellum and spine; this group was the first to describe 3D visualization of fetal heart, although they could only visualize static images; (7) von Ramm & Smith (1994): developed an improved scanner that provided good resolution of up to 20 cm; the team has developed state-of-the-art medical ultrasound imaging, capable of processing signals from multiple real-time sections in; it became commercially available in 1997; (8) Merz (1995) demonstrated the usefulness of multiplanar orthogonal imaging as well as surface and transparent views in the diagnosis and confirmation of fetal surface and skeletal abnormalities, such as cleft lip or multiple complex malformations; (9) Medical Imaging Group,

University Hospital in London (1996) published independent researches on 4D fetal echocardiography (motion 3D) (Kurjak *et al.,* 2000).

The increased availability of 3D ultrasound was possible due to the favorable economic and scientific context (rapid advancement in computer technology and decreasing cost of microprocessor electronics). 3D ultrasound has proved useful in: (1) diagnosis of heart and vascular diseases; (2) tumor processes (including their vasculature and tumor invasion); (3) prenatal diagnosis of fetal malformations and abnormalities. "Artificial eye" or ocular prosthesis has an older history, evolving from models made of silver or gold (16th century) to glass ones (the1940's) and modern ocular prostheses made of synthetic materials; it is used for reasons of cosmetic appearance and increasing the autonomy of patients with visual dysfunction of various causes (bionic eye incorporates microchips and stimulating electrodes). Another direction in MT development is represented by breast prostheses or breast implants, used in cosmetic surgery (50 years have passed since the first breast enlargement using silicone implants, the second most popular form of cosmetic surgery after liposuction, used by 1.5 million women in 2010) or breast prosthesis after breast cancer surgery. There are over 500,000 technologies, grouped into 20,000 generic groups. These generic groups are classified into 16 categories of products.

Socio-Economic and Socio-Demographic Impact

The radical political and institutional changes in the recent decades together with the economic and social ones have also resulted in technological changes, obvious not only in industrialized countries. Although the factors impacting the demand for healthcare services are difficult to quantify, it can be said that these changes have resulted in increased public expectations with respect to the quality of healthcare (better, faster services), along with diversification of provided services (their costs have increased). In most developed countries all citizens are entitled to publicly funded basic medical care. As a result, health financing is a significant part of public expenditure. So, the relationship between advances in medical technology, health outcomes and health expenditures is obvious. The use of MTs has an obviously positive effect on health and quality of life: lifespan and the number of years lived without disability increase, and citizens become more responsible with regard to their contribution to social development for a longer period of time. This way they contribute to the effectiveness and sustainability of health systems. Production of medical technologies contributes to the economic growth of a country. For example, in the European Union medical technology industry employs over 500,000 people, the market being estimated at 100 billion euros. The continued development of MTs has clearly defined directions, namely improvement of the existing ones (a product is replaced by an improved version on average at 18 to 24 months) and creating new products to meet the unmet

health needs. In this respect, it is remarkable that due to the constant flow of innovations and well-established set of regulations, European Union medical technology industry ranks first in the technical fields, with more than 10,000 patent applications filled in 2012, accounting for 7% of the total number of applications. New technologies are available to the people 3-5 years earlier in EU compared to Japan and 3 years compared to USA.

The increase in average life expectancy has led to "population aging". "People everywhere are living longer, based on global averages; a girl who was born in 2012 can expect to live to around 73 years, and a boy to the age of 68. This is six years longer than the average global life expectancy for a child born in 1990", according to World Health Statistics 2014. The factors behind this phenomenon are complex, but the role of MTs is obvious by decreasing the infant mortality rates and offering better solutions for treating ill people. We refer here to antibiotics and vaccines, chemotherapy and radiotherapy (resulting in increased cancer survival), and medical devices used to perform efficient therapeutic interventions and reduce physical disability. A complete list of technological advances that have affected medical costs is almost impossible to do, there are a few more relevant, such as: revascularization for coronary artery disease, renal replacement therapy for kidney failure, bone marrow (stem cell) transplantation, joint replacement, neonatal intensive care, diagnostic imaging. For example, prenatal tests are able to tell with a high level of accuracy whether or not a baby has Down syndrome or neural tube defects. This test gives future parents (the mother) the option of therapeutic abortion, act with important ethical and psychosocial implications. In obstetric practice ultrasound may reveal fetal sex. In some countries, such as India, where cultural tradition and economic factors favor the preference for male newborns (boys are "productive" in economic terms, while for girls parents must provide a dowry), ultrasound would lead to high abortion rate of female fetuses. Therefore, a law that prohibits the purchase and use of ultrasound equipment for fetal sex determination was authorized (Blihr, 2009).

Table 1. *Life expectancy in some selected countries, 2013*

Men			Women		
Rank/Country		Life expectancy (years)	Rank/Country		Life expectancy (years)
1	Iceland	81.2	1	Japan	87.0
2	Switzerland	80.7	2	Spain	85.1
3	Australia	80.5	3	Switzerland	85.1
4	Israel	80.2	4	Singapore	85.1
5	Singapore	80.2	5	Italy	85.0
6	New Zealand	80.2	6	France	84.9
7	Italy	80.2	7	Australia	84.6
8	Japan	80.0	8	Republic of Korea	84.6
9	Sweden	80.0	9	Luxembourg	84.1
10	Luxembourg	79.7	10	Portugal	84.0

*Source: *World Health Statistics 2014, available online http://www.who.int/media-centre/news/releases/2014/world-health-statistics-2014/en/*

Anyone can say that expenditure generated by healthcare technology will increase, but this incremental trend is depending on the size of the population and its health status. Other contributors to health care expenditure are changes in third-party payment, personal income growth, prices in the health care sector, administrative costs and defensive medicine and supplier-induced demand (Congressional Budget Office, Washington, 2008).

Role of medical technologies and body image

"The totality of how one feels and thinks about one's own body and appearance" is one of the definitions which describe body image (Price, 1990). Based on the results reported by some experimental studies, it has been demonstrated that, apart from education, skill level and intelligence, how you look physically (attractive people) influences the level of income, although there are not enough scientifically proven data to explain inequalities between the "good looking people" and those who are less endowed by nature in this respect. Physical appearance has an influence on each of us, affecting core self-evaluations, income and financial strain (Judge, Hurst & Simon, 2009). These authors explain the relationship between beauty and money through a secondary relationship of two other variables: education - school teachers can be more supportive when it comes to children with at least an average degree of attractiveness; this support increases their self-esteem and self-confidence. With the increasing economic inequalities, students are tempted to give more importance to physical appearance. Individual variability in physical and mental characteristics has a considerable importance on the differences between people in terms of socioeconomic success.

If physically intact people are concerned with improving their appearance in line with fashion, cultural norms specific to a particular community or occupation they wish to practice (the well-known expression 90-60-90!), for people with various disabilities caused by illnesses or accidents ideal is to improve/replace these "defects" by using medical technologies. In our opinion, the desire to be physically "normal" involves two aspects: on the one hand, to be able to accept yourself as you are and the underlying disease becomes more tolerable when you feel that you are "whole"; on the other hand, you are more readily accepted by society if you are not "stigmatized", social integration being much easier. Despite the huge progress in knowledge and science, more strict laws and more organizations against discrimination are still needed, one criterion of discrimination being physical appearance. Two of the most "visible" physical disabilities are the absence of one eye (or severe visual impairment) or the change in body image (in females) following mastectomy for breast cancers. Breast cancer is the most

common malignancy in women worldwide. In the socioeconomic developed countries, both in Europe and the USA, it accounts for 15-20% of cancer deaths in women (National Cancer Institute, 2014). The incidence rate of breast cancer is higher than its mortality rate as a result of increased survival. Breast cancer is the most common form of cancer in European women.

There are 464,000 new cases diagnosed in 2012, accounting for 29% of cancers in females and 13% of all cancer cases. Standardized incidence rate: the highest rates are in Belgium; the lowest rates are in Bosnia Herzegovina; Romania ranks 80 (worldwide); United Kingdom ranks 6th in Europe. Immediate reconstruction reduced the psychiatric morbidity assessed 3 months after operation, predominantly in women with unsatisfactory marriages. Women who underwent reconstruction had more freedom of dress and were less likely to be repulsed by their own naked appearance than women who did not undergo reconstruction. Sexual and social morbidity were not affected. Breast reconstruction after mastectomy is oncologically safe and is associated with high satisfaction and improved psychosocial outcomes. Loss of an eye and adjusting to life with a prosthetic eye can be very challenging for the individual, affecting his or her quality of life. Disfigurement associated with this chronicle situations causes intense mental, psychologically and emotional problems. Due to the advanced medical technology many treatment options are available, one of them being the ocular implant; the results are good, but its price may be prohibitive for potential patients (Siddesh & Chandra, 2010).

Social importance of medical technology assessment

Medical technologies have developed strongly since 1960, and their assessment was developed in 1970 for economic reasons (cost reduction or justification). Medical technology assessment (MTA), as a systematic study of the effects and consequences of using a particular technology in a defined context, aims to produce objective knowledge for decision makers about the benefits, costs, and harmful/undesirable effects, so that the healthcare system to rely on relevant evidence recommending or refuting their use. Economic evaluation methods are well defined, based on mathematical models, while for social and ethical impact assessment these are not fully described, and there is no generally accepted method. Evaluation reports differ substantially from one agency to another (INHT - International Network of Agencies for Health Technology Assessment, composed of 36 members/ organizations/ a network of 55 agencies). The ethical and social issues debated and analyzed are mainly related to screening for rare metabolic diseases (phenylketonuria) prenatal/fetal screening for structural and chromosomal abnormalities, invasive treatment of coronary artery disease, rehabilitation of children with cerebral palsy (Autti-Rämö & Marjukka, 2007).

Technological innovations have created a fissure between health care service requests and available resources, causing inequalities and leading to hierarchized and prioritized health care needs. From the clinical point of view it is not clear how to quantify the benefit-risk relationship before using a particular technology, or in case of indication expansion/extension (e.g.: technologies used for *in vitro* fertilization or those used in patients with chronic kidney disease). MTA can be performed from many angles, depending on the needs to be met: patients, professionals (medical staff and decision-makers). MTA can be performed in collaboration with the patient, healthcare professionals and decision-making political institutions. MTA performed in collaboration with patients is important to determine their expectations and preferences (most often, patient's point of view is insignificant or highly selective). The application of a new technology should be done with public participation in decision making, and the assessment should go beyond stakeholder's perspective for moral reasons: life and health are significant human values and new technologies contributing to these values are (potentially) relevant to everyone. The introduction of new technologies also has an impact on already existing technologies. Prioritization would impede the principle of equity. Moreover, the initial benefits of MTs are often different or modified at the time of use, and risks may occur in specific patient categories.

The views of the beneficiary are not always taken into account as originally stated. There are ethical and moral dilemmas related to the selection of candidates when the resources are limited (ethics and morals of the selection criteria), as in patients with end-stage kidney disease who can benefit from dialysis. There are moral and social issues related to life-support technologies (when, how much, to whom), hence the redefinition of death. There are times when the unavailability of certain technologies locally leaves the patient or doctor with no choice, or when a particular technology has very specific uses, the field of application being clearly defined. Both doctors and patients feel captive in a care system that is uncoordinated and, more importantly, unresponsive etc; the most important detail is that each party sees the others as the source of a solution, ignoring or not being aware of the role they could play in the general improvement of the organisational climate (Cojocaru, 2012).

People with chronic diseases or conditions achieve their autonomy through various relationships in the unique life context - social interactions, sharing of thoughts, feelings, concerns and habits, negotiating autonomy in daily activities and in their relationships with family, friends and work colleagues (Damian *et al.*, 2013). Factors influencing autonomy are health status/associated disease, treatment, knowledge (about the disease), experience and skills, personal approach, family patterns, type of relationships with others, history/experience of life, social context (Moser *et al.*, 2010).

Self-management of chronic diseases increasingly relies on MTs that monitor behavioral and/or biomedical parameters, improving or reducing disabilities or handicap. These technologies are integral part to the psychosocial aspects of daily life and social integration is positively associated with overall health and well-being of a person (Gammon, Christiansen & Wynn, 2009; Klassen & Washington, 2008). The impact of health technology use can be approached from at least two perspectives, namely: (1) predominant focus on health outcomes following the use of technologies (e.g. blood glucose monitoring devices) and (2) sociocultural context developing / shaping / adjusting MTs (Gammon *et al*., 2009). In this context we can talk about the development of "patient-centered" technologies. MTs can change the lifestyle, not being easily accepted by some groups of people (e.g. people with hearing loss who already have a specific culture, and who are forced to join the "normal" people) indicating a difference between *effects and outcomes*. At the interface between technology and society, there are two views on technology assessment process. In the first case, technology is not considered good or bad, being value neutral (a means to pursue chosen ends) - the dominant view in MTA. In the second case, the moral dimension of new technologies is considered a secondary consequence, being revealed in health policies when data from assessments have to be implemented and integrated into healthcare practice - ethics is related to application/implementation.

Conclusions

All the innovation and advances registered in medical technology have their role for contributing to enabling people to be active inside the community and in their workplace for a longer period of time. In the meanwhile, technology also has the capacity to produce efficiencies in the health sector. It is important to understand and to explain the relationship between health outcomes and health expenditures in connection with these advances. It is difficult to assess all the indirect, unintended, or unanticipated effects (good or wrong) on individuals or on social or health systems. Like all the other technical discoveries, medical technology could be used in a beneficial way, or on the contrary, could have harmful effects upon society. Despite all these benefits of medical technologies, we cannot ignore the evidences showing that life style is the major contributor to our length and quality of life.

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