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ORIGINAL ARTICLE

An Approach to Technology Development and Current Medical Practice

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Abstract

Background: An approach to technology development and the current medical practice.

Objective: To consider the many stages of medical-applied technological developments and its main consequences related to the current medical practice and speculate on future developments.

Methods: Assessment of historical publications and individual and metanalysis of comparative evaluation of old versus new techniques.

Results: Documentation of progressive improvement in diagnostic skill and therapeutics toward less invasive procedures along the last decades, since the introduction of the scientific medicine.

Conclusion: Progress has been unequivocally documented albeit an effort to maintain time-proven established previous technique is advised, especially in favor of stimulating a personal patient-physician relationship. (Int J Cardiovasc Sci. 2020; 33(5):457-461)

Keywords: Technology/trends; Medical Practice; Medical Education; Physician-Patient Relations; Patient Participation; Electronic Health Records/trends; Telemedicine; Robotics.

Introduction

Conceptually, technology refers to the use of engineering tools, usually instruments, techniques and methods aimed at reaching a problem solution. Humans have evolved with successful application of new technologies – the fire, the wheel, the writing, the press, steam machines, the electricity – that allowed the development of humanity through the renaissance and the Industrial Revolution, and more recently by progressive use of new resources based on scientific computation and telecommunication and cutting-edge technologies.

Although these technology achievements have enabled great progress of humanity, one should not forget that they also brought along wars with devastating destructive power, threatening life and planet survival.

Trepanation tools, for example, are prehistoric and thus it is conceivable that technology was developed and employed in health care at the time of human gathering and is intrinsically linked to the development of medicine.

In the 18th century, patient clinical examination, as depicted by iconic portraits of the time, illustrates a more contemplative attitude, limited to asking questions about patient's sense of well-being and examining the tongue. The second half of the 19th century was marked by what is considered by many the beginning of scientific medicine, where physical examination including abdominal palpation, listening to the chest sounds (approaching the ear to patient's thoracic wall), and percussion was surpassed by revolutionary techniques and tools including the stethoscope, the thermometer, the microscope, the X-ray and the electrocardiograph.[1]

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Since then, a tremendous growth of technological resources has been observed in medical practice, especially with the introduction of computational science. This allowed the processing of an enormous amount of data in a short period of time and its wide use in health care.

In parallel, contrary reactions have come up against each innovation, as a necessity to establish the best method.

For instance, referring to the change of the remote primitive medicine, when knowledge and teaching of clinical medicine was limited to memorizing disease names and the corresponding herbal treatment, to the more scientific medicine, the social writer and poet Samuel Coleridge, strongly criticized doctors "for debasing and blinkered somatism".

From then on, new graphic registry methods, imaging techniques, the ultrasound and nuclear magnetic resonance have emerged as auxiliary diagnostic methods. Also, a multitude of therapeutic possibilities have led to minimally invasive procedures, including optical apparatus resources with less damage in the access, and robotic instruments with more precision in tissue repair.

Current scenario of the use of new technologies: usefulness and potential problems

In several medical fields that technological innovations have amplified our ability to diagnose, scrutinizing structures largely inaccessible until recent past, coming to the intimacy of vessels and tissues.[2-5] For instance, a large part of the improvement in coronary artery disease survival is due to new therapeutic resources and preventive strategies.[6]

An analysis of trends of recent use of biotechnology in medicine[7] clearly reveals a trend towards grafts, devices, new diagnostic and therapeutic resources and access systems.[8]

Problems arise when one considers the escalating, sometimes stratospheric costs of implementation of technology, to the point where reimbursement by the payees may not be possible, compromising advances in other areas of social interest throughout the world.

Consequently, it is clear the need for regulatory agencies evaluating the use of new technologies regarding their reliability, advantages and disadvantages, ideally from the perspective of an uncompromised academical milieu, beyond financial interests and intellectual bias. Besides, there is the challenge of providing equal use of resources to all that need them.

This is obviously a difficult task to be accomplished in any part of the world at this moment, even in the most developed countries.

Problems with technology in the near future

After the application of computing to aid the war effort and banking activity, the use of computing science in medicine has increased. For example, the creation of electronic medical records has amplified the possibilities of data management.

Many scores were built to calculate the odds of development of certain condition and prediction of future events. It is somewhat curious to verify that these scores have not been implemented in all hospital institutions, with rare exceptions.[9]

Despite that, the general perception is that with advances in computational processes and its greater capacity of handling large amounts of data, with provision of answers in shorter periods of time, there will be a progressive implementation of these new resources in medicine in a near future.

According to a survey by the Global Summit Telemedicine and Digital Health, 82.6 % of physicians use digital technology nowadays; 78.6 % are favorable to the use of new platforms, such as the "WhatsApp"; and 60% of the health institutes and 50% of the hospitals in the USA use telemedicine.

A Cochrane systematic analysis[10] compared the benefits of telemedicine with personal contact in distinct groups or situations as summarized in Table 2. Although telemedicine was more advantageous in some situations, the difference was not significant.

On the other hand, the use of artificial intelligence requires an adequate understanding and positioning of

Table 1 – Current scenario of use of new technologies: usefulness and potential problems

Improvement in diagnoses
Improvement in prognoses: survival and quality of life
Additional costs
Reimbursement
AdequacyAccess

Table 2 – Cochrane metanalysis of the comparison of telemedicine versus personal examination

HF	**16 studies 5239 patients.**	
	Mortality in 6 months	no difference
	Hospitalization in 8 months	no difference
	Quality of life in 3 months	improvement
HBP	**4 studies 1770 patients.**	
	BP control	improvement
LDL	**4 studies 1692 patients**	
	Control	improvement
DM	**16 studies 2768 patients**	
	Glicated Hb	Improvement

physicians involved in patient care and representatives of the medical class, as the Federal Medical Council in Brazil.

In the last book published before his death, "Brief answers to the big questions", the scientist Stephen Hawking dedicates one chapter to the implications of the use of artificial intelligence in human activities and states: "Although the primitive forms of artificial intelligence have already been applied and seems to be quite useful, I don't see with optimism the creation of something that is capable of level or surpass us". The author reveals his thoughts about the profound implication of artificial intelligence in human disqualification. In Medicine, one of the fearsome questions is whether the robots and algorithms will replace physicians.

On February 7th 2020, the FDA released for commercialization a software called Caption Guidance, from Caption Health Inc. Compatible with currently available sonographers, the software uses artificial intelligence and allows for health practitioners, mainly nurses, to perform high-quality echocardiographic studies, similar to the ones obtained by echocardiographists using the usual system. However, cardiologists or echocardiographists are still required to write the final report. This is considered the first artificial intelligence equipment applied to cardiology, and others are already expected.

It is well known that artificial intelligence has already been applied to other areas of medicine, such as radiology, which broadened the use of this resource with teleconsults and an almost infinite number of examples validated by experts.

It is not possible nor is there any reason to limit the progressive application of artificial intelligence in Medicine.

There should be an appropriate approach to understand and define the physician's position in this challenge of technological innovation. We should consider that, since the first auxiliary methods introduced, such as the electrocardiography and the chest X-ray, the physician plays a crucial role in establishing the correct final diagnosis. Occasionally, it becomes necessary to complement information given by the physician in order to get a better technical-clinical correlation of data. This situation has been more and more common with the appearance of new technologies, specially imaging methods, but also in laboratory. In all cases the physician tries to make the best diagnosis, making sure that something deserving a more immediate attention is not missing in his evaluation.

Because it is in the genuine essence of practicing medicine the willingness to help the patient is the most important professional endeavor.

However, all of this considered, we should now take a look at the cost of technological advances as a means of departing the physical contact between the physician and the patient.

Since the less scientific medicine depicted by Lukes Fildes (Figure 1) when the physician without resources did not go beyond attentive contemplation - yet well appreciated - to the more contemporaneous physical examination, a connection and a ritual have been established between the physician and the patient, where there is a clear message of personal and meticulous care. This is usually valued by the patient as a basis for a confident relationship.

We should add that the current physical examination is ever more based on information that technology has helped to clarify, and thus more efficacious considering the better understanding of disease mechanism, signs and symptoms, and capable of constructing a clinical picture that will lead to a safer and more efficacious utilization of the next auxiliary steps.

This emphasizes the increasing relevance of patient examination, and the importance of the medical

Figure 1 – The Doctor by Luke Fildes.

Figure 2 – A child portrait of the medical examination in the current era

learning be based on this understanding.[11] However, there are big challenges ahead of us.

We must understand that the basic principle in Medicine, and the one that will always be kept, is the task of delivering health care to the ones in need. Society must understand this and protect this professional for its own good, despite the development of artificial intelligence, in addition to guarantee an adequate formation in good medical schools and proper work environment.

Recently, the mischaracterization of medical activity has been identified as a cause of burnout and suicide among young students and doctors, as well as seasoned doctors.

The portrait published in Lancet [12] of a child during her medical interview for some illness contrasts to what Lukes Fildes had documented in the past. The child observes the distancing of the physician from her and her parents, while researching in the internet or filling out electronic forms in the computer, rather than paying due attention to herself, the patient.

This misuse of the technology must be condemned.

Author Contributions

Conception and design of the research: Feitosa G. Acquisition of data: Feitosa G. Analysis and interpretation of the data: Feitosa G. Statistical analysis: Feitosa G. Writing of the manuscript: Feitosa G. Critical revision of the manuscript for intellectual content: Feitosa G.

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This article does not contain any studies with human participants or animals performed by any of the authors.

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