

RRD PROJECT (RADIOLOGY RED MASK). ARTIFICIAL INTELLIGENCE IN THE HEALTHCARE ENVIRONMENT? WHERE SHALL TECHNOLOGY DIRECT US TO?

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ABSTRACT

Will medical radiologic technologists be replaced by sophisticated Software? Will they become robots? Will they become like the worker in the film "Modern Times" by Charlie Chaplin? This paper has the scope of evaluating the relation between medical radiologic technologists and "AI" (artificial intelligence in medical radiology). The figure of radiological technologist has a great importance for the necessary collaboration in the environment of a ward where there are great responsibilities from a medical and legal point of view. The Technician is responsible for carrying out the examination correctly: therefore, the level of qualified skills of the technologist is value added. As a matter of fact in the light of working at full capacity and the pressing requirements of the doctors of the wards, the technologist represents, especially in hospital structures not linked to universities, the most valid assistant for medical radiologists. Their ability of identifying anomalies compared to the norm during the examinations, allows to direct the doctor towards a correct preparation and, consequently, interpretation of the examination which is being performed. We believe that the introduction of Artificial Intelligence in diagnostic imaging does not absolutely hinder the figure of the medical radiologic technologist.

INTRODUCTION

Will medical radiologic technologists be replaced by sophisticated Software? Will they become robots?

Will they become like the worker in the film "Modern Times" by Charlie Chaplin? This paper has the scope of evaluating the relation between medical radiologic technologists and "AI" (artificial intelligence in medical radiology).

Role of the Medical Radiologic Technologist

A medical radiologic technologist is a qualified healthcare professional who is authorized to perform, with a medical prescription, alone or together with other healthcare-workers, any type of intervention which requires the use of both artificial and natural sources of ionizing radiation, thermal energy, ultrasounds, and electromagnetic radiation in addition to the interventions for physical or dosimetric protection. The professional is also responsible for the proper functioning and the daily maintenance of the machinery they are accountable for.

The main fields in which the professional can specialize in are: diagnostic imaging, radiotherapy, nuclear medicine, and health physics.

In order to be able to practice this profession one must be listed in the Registry of Radiologic Technologists, the Technical Health Professions, or Prevention and Rehabilitation, organized in provincial or interprovincial basis (<http://www.tsrm.org/>).

There is a deontological code for medical radiologic technologists (reviewed in 2007) available on the

website of the National Federation of Registered Medical Radiologic Technologists where the principal regulations can also be consulted. A medical radiologic technologist always operates closely with a medical radiologist, a medical radiotherapist, a nuclear physician or a health physicist. (1)

Is the Role of Medical Radiologic Technologists Changing?

As one can observe in the work of Antonio Di Lascio(2), a medical radiologic technologist, "the role of professionals has changed," in these years, starting with the Legislative decree, DL. 502/1992, we have witnessed a process of deep compliance of the Italian National Health Service, originating from the law L.833/1978, to respond to the requirements deriving from new discoveries and diagnostic-therapeutic opportunities, necessary in order to give practical responses to the changed socio-cultural and demographic context. In this setting, the professional activity has considerably changed, requiring more expertise from professionals and this in terms of value, quality, knowledge, talent (personal and professional), possession of capability and ability, also with the transfer of auxiliary logics, based on complementary tasks, to independent settings. As reported in the article on the website "www.giornalesanita.it", in some operative contexts, for the nature of the services dispensed, a highly qualified profile is required for a medical radiologic technologist, as in the case of the so called "special practice," which requires heavy doses for the patient (...). We can easily affirm that the role of the

medical radiologic technologist has already changed because of the considerable needs imposed by the scientific and technological developments which have characterized, in these years, the world of diagnostic imaging. (3)

Growing use of Artificial Intelligence AI: Man and Artificial Intelligence⁽⁴⁾

We have always wondered why artificial intelligence was created and if its role was to aid the work of people or to substitute them entirely. The scope in the use of artificial intelligence is not only development and progress, but also to build, invent and create intelligent beings, “highly gifted” ones (5); this concept was already introduced by A. Einstein (6), as can be deduced from one of his observations: **“one day machines will be able to solve all the problems, but none of them will ever be able to pose one.”** Therefore, machines should not substitute people, but cooperate with them. The clear distinction between person and machinery (7) can be traced back to the nature of rationality and irrationality: while a person is an irrational being, machinery is not. Some years ago there was confusion in relation to this distinction. A person lives of sentiments, emotions, and manages to be rational only when there is no affection and it is not by chance that besides its brain, a person’s main organ is its heart (8). Machinery instead makes no distinction; it is rational with no ifs and buts. Its main organ is its engine; its brain is a set of combinations, of wires and metal which confer its identity to it. Machinery does not have bonds nor affections, but it is the most extraordinary work created by mankind; and according to some, the last brilliant and extraordinary creation of man.

Does being able to take decisions in the least time possible mean taking a better decision? That is to say: “Can persons and machinery be put on the same level? What is the relation that exists between them? How can the interest of both be balanced? Both computers and brains (9) are able to assimilate notions, elaborate, and if needed, give a response to them. But there is a difference; computers lack mental faculties, but thanks to complex algorithms they can produce a detailed and precise solution.”

Artificial Intelligence and the Healthcare Sector⁽¹⁰⁾

It is not easy to give a precise and detailed definition of Artificial intelligence (AI), it embraces various aspects and disciplines: if we had to speak of the artificial intelligence of the 50s we would be speaking about the possibility of creating “heavy” machinery which resemble persons; today, for AI we intend the ability to draw information from these “thinking” machines contributing with modern research. Research in all fields, from the most employed, namely the penal sector (because machines are used for investigative ends) to the medical area, which today, because of the Covid-19 emergency, is the most debated. In relation to this last area, how useful can artificial intelligence be? Thanks to these thinking machines it is possible to understand, in a few minutes, if a person has contracted Covid-19 even if there is a negative swab. In an interview of Dr. Quattrocchi,⁽¹¹⁾ the importance of these machines has been pointed out together with that of all other instruments made available to save the “life of humans” in the case of

this healthcare emergency. The ‘Policlinico Campus Bio-Medico’ is the first hospital in all Europe to use the system of artificial intelligence, adopted months ago by China, to discover who is affected by Covid-19 pneumonia, in record time, independently from the fact of having symptoms or not. As a matter of fact, there are persons who, in spite of having a negative pharyngeal swab, have a considerable pulmonary part affected which corresponds to the typical symptoms of Covid-19. Therefore, in reality, artificial intelligence performs the same task of a professional radiologist; what distinguishes them is the immediacy of the results. This system is, in fact, faster, it manages to evaluate images with complex algorithms but in a quicker way. But then, could artificial intelligence substitute persons? If it is more rapid and quicker than a specialist, shall the diagnosis be more reliable? Machinery is able to offer accurate answers in a short time; however, will they be able to distinguish if it is a case of a simple pneumonia or pneumonia from covid-19, but you can never think that the work of a professional could be replaced by the one of a machine. Some studies demonstrate how a machine can offer us excellent results which the specialist alone, without the aid of these machines, wouldn’t be able to give us. If we just think about the help that these machines have given specialists for the identification of pulmonary micro nodules which are difficult to recognize and measure. Therefore it is also merit of “machine learning” if some lives have been saved. This does not and absolutely bring into question the career and skills of a specialist, but it makes us understand that the whole system, correctly balanced, can produce excellent results.

Teleradiology⁽¹²⁾

Medical radiologic technologists carry out the technical part of this practice: they verify the consistency between the medical case and the proposed radiological investigation; they perform the examination, they evaluate the image/graphic of the test taking on the responsibility; they send them to the doctor in remote, in order to have the medical report (taking on responsibility for the correspondence and the right registration); they provide the correct and complete filing in the PACS (Picture Archiving and Communication System) of all the images taken.

Medical History: Medical radiologic technologists collect information of medical history for the diagnostic procedure in order to obtain better images and collecting it in an activity report useful for its traceability in time. From an operative point of view, there is the awareness that whenever a radiologic examination is justifiable, medical radiologic technologists are authorized to perform the examination autonomously.

Medical Radiologic Technologists Reference Point for Patients: Psychological and Technological Evaluation

We know well how important it is for the medical operator to create an understanding relation with the patients. Let’s see in detail what understanding/empathy means and how operators can improve their understanding and develop the ability of “being understanding”. Empathy is a way of understanding what another person is feeling. The word derives from Geek *empathia* and it was

used to indicate the emotional relation of participation developed between the author/poet and the audience. In human sciences, empathy means an attitude towards the others characterized by an effort of intellectual understanding of the other person, with the exclusion of any other type of personal emotional attitude (liking/aversion) and any other moral judgement. In common use, it is the attitude to be completely available/helpful towards another person, ready to give them our complete attention. (13)

What has Changed for Medical Radiologic Technologists During Covid-19

The Covid-19 emergency has confirmed the role of radiology as indispensable for the diagnosis and assistance of patients in Emergency, Intensive Care and in Infectious Diseases wards. When a patient is admitted into hospital even medical radiologic technologists are involved, they are responsible for the use of diagnostic technologies and necessary examinations for the first clinical diagnosis. For example a chest x-ray allows for a first medical orientation of the patient and can direct the diagnosis towards diverse causes of pulmonary pathologies correlated or not to the infection of Covid-19 at the patient's bedside, in ordinary wards or in intensive care, is a valid instrument for monitoring developments of respiratory diseases and their eventual complications (...) (14)

Medical radiologic technologists are a point of reference for all the personnel in the Radiology Area, they prepare the patient for the examination procedure, guarantees the use of the equipment, carries out the examination with protocols shared with the Medical Radiologist and lastly, activates the procedures for the sanitification of all diagnostic instruments.

The Covid-19 pandemic has therefore deeply modified and enhanced the activity of medical radiologic technologists necessary in order to assure strict protection and safety measures: for this reason we feel the need to thank all medical radiologic technologists for their commitment, skills and strong sense of responsibility which they have put in play for the safety of patients and other professional figures. (15)

Possible Future Scenarios for Radiology

The EU (European Union) commission has classified "Radiographer" as an intellectual-scientific profession. ESCO (European Skills/Competences, Qualifications and Occupations) has classified the work of Medical Radiologic Technologists as an intellectual and scientific profession and no more among those of the intermediate techniques. After years of work on behalf of the EFRS (European Federation of Radiographer Societies), this is a great step for this profession. This indicates a growing authority and a distinct professional identity of this profession which, in Italy is represented by 28.000 Medical Radiologic Technologists. This profession has grown considerably, including itself in the treatment procedure of the patient and filling up the National Health System with competence and awareness of its responsibilities. Furthermore we are witnessing a significant evolution of the organizational and welfare elements resulting from the objective occurrence of some characteristics/events such as the aging of the fragile population with chronic-degenerative diseases, to which we can con-

nect the constant scientific and technological evolution. In the immediate future, the Health System will have to face many challenges (sustainability, equity, appropriateness, efficacy, efficiency, consent) and facing some problematic cruxes in order to mitigate the achievements of the system's objectives. Investing in the medical professions allows us to favour a professional system able to support and satisfy the requirements of the services and the population respecting normatives in force, and other professional figures.

Professional Development: What is it Exactly?

A significant example to be used as reference comes from an important epochal changing moment: digitalization of images in radiology. In Italy, the first realization of an indirect digital image- a brush- at the Radiology Institute in Bari was in 1977 and it provoked amazement together with apprehension for the impoverishment of the responsibilities of medical radiologic technologists: «it wasn't necessary to carefully choose the technical parameters anymore: would the computer do

that?». Nothing of all this, instead, the computerization of images in radiology has literally "exploded" the competences of the technicians.

Just to cite the more concrete advantages:

1. It has allowed a more exact computation, relative control and certification of the dose and consequently its progressive reduction, because lower values of exposure are sufficient in order to
 1. form an image;
 2. It has allowed to leave behind the costly and for certain aspects dangerous chemical processing of images;
 3. It has made computer literacy necessary for medical operators;
 4. It has allowed medical radiologic technologist to concentrate purely on the medical part of its actions; the proof is the possibility to integrate formally professional action working on the RIS-PACS(16) systems.

Another considerable and concrete possibility of global professional development of medical radiologic technologists consists in the fact that carrying out an examination of diagnostic imaging is not a passive moment for the patient, but a moment of guided active participation in order to achieve the best possible technical result. (17)

RRD (Radiology Red Mask)PROJECT

For the scope of a project which compares AI associated with diagnostic imaging software and the role of Medical Radiological Technologists, that is the person who has the task to use them.

Both roles have been carefully examined, in a time where the Covid 19 pandemic has brought to the attention of the medical world, software able to diagnose, in very short time, pneumonia CAT images caused by infection of Sars Cov 2. In the course of our detailed study we have therefore compared the advantages of the use of performing machinery with the figure of the technologist, trying to speculate that in the future, machinery will completely replace a person, as has already happened, for example, for the road toll booths, for the collection of some types of medical



Fig. 1 e 2

examinations, and for digital payments portals (e.g. banks, post offices, hospitals). As an outcome of every confrontation in specific situations, each one in a different setting, the end result is that AI will hold a supporting role for diagnosis, but it will never be able to entirely substitute persons. After a careful consideration on AI and its relation with the work of medical radiologic technologists, together with our hospital engineers, we have designed a project which can help technologists in their daily working routine. In digital radiology, already for a long time, the availability of specialist software, such as “BONE SUPPRESSION(18)” o “AUTO LUNG NODULE DETECTION(19)”, that are used respectively for the suppression of the bone and a better visualization of the pulmonary parenchyma and for the highlighting of pulmonary nodular formations. These frames are inserted after the acquisition of the images and do not need a repositioning of the patient. On the basis of what already exists in the market, we have thought of a filter, which can aid medical radiological technologists in their activity, and which defines the bone outline of the metamer under study with a red line.

The scope is to immediately mark the profile of the cortical in order to evaluate:

- A blurred radiographic projection (double line)
- A dubious fracture (interruption of the cortical); in this case one can focalize the following radiographic projections in the region interested.

Maschera RED LINE.

The mask should develop itself, on the basis of the grey scale observed by the detector, after the radiography. The cortical results more radiopaque compared to the spongy bone and well differentiated

from air which is radio transparent. This would allow to quickly focalize the attention on a specific point, and rapidly carry out further focused projections in case of interpretive doubts. Moreover, to the end of the optimization of doses, the system can help reduce to the minimum necessary, because often there is the tendency to perform an extra projection (e.g. Oblique for the peroneal malleolus in traumas deriving from a sprained ankle) and it is necessary to call back the patient. Since it is a software, you can't be 100% certain of the result, but in a context where time is little, it can be a useful aid to medical radiologic technologists and, consequently, to the medical radiologist, in the view of a good working practice.

FINAL CONSIDERATIONS

The figure of radiological technologist has a great importance for the necessary collaboration in the environment of a ward where there are great responsibilities from a medical and legal point of view. The Technician is responsible for carrying out the examination correctly: therefore, the level of qualified skills of the technician is value added. As a matter of fact in the light of working at full capacity and the pressing requirements of the doctors of the wards, the technologist represents, especially in hospital structures not linked to universities, the most valid assistant for medical radiologists. Their ability of identifying anomalies compared to the norm during the examinations, allows to direct the doctor towards a correct preparation and, consequently, interpretation of the examination which is being performed. We believe that the introduction of Artificial Intelligence in diagnostic imaging does not absolutely hinder the figure of the medical radiologic technologist. First of all, it cannot replace the medical radiologic technologist from a human being point of view, especially for what concerns the relation with the patients. Secondly, ma-

chinery works through protocols while human beings can maintain their performance even in situations which are not standard and which can be unexpected. In these situations, only the figure of the technologist can keep a cool head in order for things to work out. Last but not least, the technologist sees to the correct execution of the examination and guides the artificial intelligence towards simplifying the diagnosis for the medical radiologist.

We believe that diagnostic imaging can have a further and considerable development in the future, given the speed with which technological progress and its application in the radiological field advances. In this

context, the figure of the technologist with continue to play a pivotal role, particularly as an intermediary between the patient and the medical radiologist; technologists, for the role they hold in the diagnostic course of the health system, is becoming always more available towards the communication needs of the patients which are growing day by day in surgeries and hospitals. Artificial intelligence will hold a supporting role for the diagnosis but it will never be able to completely replace mankind, which differently from machines, has an additional weapon on its side: the capability of dreaming.

NOTES

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