MISCONCEPTIONS REGARDING THE X-RAY PROFESSION

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Abstract: X-ray technicians constitute the third largest group among health care professions. Many people are unfamiliar with and unaware of the profession and the work areas and extensive options that it offers. Moreover, those who are acquainted with the profession and are interested in it, usually have a misconception about the nature of the work and the risks it involves. This paper aims to present a review of the literature that discusses the imaging profession as a field that is misconceived. The paper shows that there is shortage of X-ray technicians on the labor market. It explores whether this shortage is affected by the wide public's misconception about the X-ray technician profession regarding the following issues: engaging in a profession that involves ionizing radiation; making a decision about the choice of the profession; and temporarily misconceiving the profession during the COVID-19 pandemic for fear of being exposed to the virus at work. The literature review illustrates that except for a few countries, there is severe shortage of X-ray technicians on the labor market. The assumption is that this shortage is due to the misconceived image of the profession. This image is associated with a lack of clarity regarding the nature of the profession, its various study pathways and specializations and, mainly, the misguided information about the exposure and risks involved when working in an ionizing radiation environment. This perception has a strong impact on the decision to choose the X-ray technician profession and directly affects the low supply that exists today on the labor market.

Keywords: supply, misconception, decision-making. X-ray technician, COVID-19 pandemic.

1. INTRODUCTION

X-ray technicians are part of the para-medical staff in every medical institution. They belong to the medical imaging setup, together with radiologists,
nurses, and medical technologists. Within the framework of their job, X-ray technicians have to perform independently most complex diagnostic and therapeutic procedures that require a wide theoretical background, clinical training, technical skills, and high self-efficacy. The branches of imaging include: Ultrasound (US), Computerized Tomography (CT), PET-CT, Magnetic Resonance Imaging (MRI), X-rays, invasive radiology, radiotherapy, dental X-rays and mammography. Imaging tests constitute an essential and most central procedure that enables doctors from all fields to make a preliminary and accurate diagnosis in a wide variety of diseases and diagnosis situations in many areas, such as oncology, neurology, orthopedics, cardiology, and so on.

The world of imaging is increasingly developing in all areas of medicine. The technological development entails an increased demand for numerous imaging tests that are performed by X-ray technicians (Smith, 2007; Smith-Bindman, 2008; Vanckaviciene, 2014). The COVID-19 pandemic exposed in particular the distress of manpower and increased the workload in hospitals (Rahman Razu et al, 2021).

Choosing a profession is a complex process that is directly connected to the process of decision-making. Making decisions related to the choice of field of studies and profession is a complex and challenging process, and might cause many difficulties to the participants. This process is sometimes perceived as a stressful experience and might even evoke anxiety. The decision-making process is difficult by itself, the more so when it is affected by an insufficient and inconsistent information (Lipshits-Braziler et al, 2015).

One of the public’s misconceptions about the profession is associated with the risk of working in an ionizing radiation environment. The public understands that ionizing radiation is dangerous, projecting it directly onto a profession that deals with ionizing radiation. Hence, people perceive this profession as dangerous and risky and prefer not to learn it. The lack of knowledge or biased information has direct impact on the decision not to learn this profession as a career for life. This paper discusses the current perceptions of the imaging profession, based on the review of the literature.

2. LITERATURE REVIEW

Worldwide supply of X-ray technicians

The world of imaging that makes use of advanced technology for the purpose of diagnosis and therapy, is increasingly developing in all areas of
Misconceptions Regarding the X-Ray Profession

The demand for diagnostic imaging services is constantly growing, due both to the progress of technology that enables a wider variety of diagnostic options, and to the rising population age. Already today there is shortage of X-ray technicians on the labor market. The demand for a skilled staff of technicians for manning the positions in the medical sector is continuously rising. Hence, meeting the market demands in the next decade requires an increase of about 30% in the number of students who learn the profession already now (Smith, 2007; Vanckaviciene, 2014).

Furthermore, even prior to the COVID-19 pandemic, shortage of X-ray technicians was felt on the labor market. In 2019, radiology departments in the United States reported a 8.5% under-staffing of X-ray technicians, even without an updated survey of this issue. Managements of numerous hospitals indicated they had an insufficient number of technicians working full time (American Society of Radiologic Technologists, 2019; Laniaño, 2021).

Although the diagnosis of the COVID-19 contamination is microbiological, the imaging technologies (chest CT, chest X-rays, and chest MRI) play an important role in supporting the diagnosis, rating the severity of the disease, defining treatment guidelines, identifying risks, and assessing the reaction to the treatment. Imaging tests are actually the first line of diagnosis, since they are extensively and economically available.

Table 1. Comparison of X-ray technician profession between OECD member-states and Israel

<table>
<thead>
<tr>
<th>Professional Title and Identity</th>
<th>Israel</th>
<th>OECD member states</th>
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<td><strong>BA degree and Certification Diploma. The diplomas enable X-ray technicians to work in all the varied imaging professions. The curriculum is adapted to the curricula of most European Union countries (Soraski-Ichilov Hospital, n.d.).</strong></td>
<td>The degrees change from country to country of the European Union. Some of the countries have more than one title for various specializations. The generic title is “radiographer / radiotherapist” (Couto et al, 2017).</td>
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<p>| Wages | The average annual wages are NIS 157,482 (Salary Expert, n.d.) | There are considerable differences in the income levels between the private and public sectors (Frija et al, 2021). Average Base Salary in Romania - 53.636 RON/year | Italy - 41.992 € | Luxembourg – 71.202 € | Germany - 51.683 € (Salary Expert, n.d.) |</p>
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<th>Educational structures</th>
<th>Israel</th>
<th>OECD member states</th>
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<td>Three years studies in a program, combined with BA studies, and clinical training in X-rays and imaging school (Ministry of Health, 2022).</td>
<td>Most of the institutions offer BA studies. The duration of the programs ranges between 3 to 4 years, depending on the country (Couto et al, 2017).</td>
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<td>In %96 of the European Union member-states, the profession of radiography is regulated by law. Only in Romania it is not regulated. In 26 member-stages, professionals are required to register in a regulatory body in order to practice. 81% of the member-states require registration for the purpose of practicing. In Austria, Estonia, Poland, and Slovenia the registration is mandatory. In 4% member-states (The Netherlands) the registration is optional (Couto et al, 2017).</td>
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<td>Regulation of the profession</td>
<td>Failure to regulate the profession by law and the employment of X-ray technicians must not depend on the presentation of a certificate to the employee, until the profession is regulated by law (State Comptroller, 2015).</td>
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<td>Supply and demand</td>
<td>There is no updated database with the number of X-ray technicians who actually practice the profession, the forecast of their retirement and the prediction of new X-ray technicians joining the field (State Comptroller, 2015). Due to the technological development, more and more imaging technology machines are introduced to the market. Hence, the demand for employment is increasingly growing (Soraski-Ichilov Hospital, n.d.).</td>
<td>Dr. Jonathan McNulti (2018), President of the European Federation of radiographer Societies, argues that due to the lack of homogeneous education and curricula of X-ray technicians, about 50% of the societies that are members of this organization, do not have a sufficient number of X-ray technicians and the other half produces too many of them.</td>
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In Europe, there are varied and different titles, according to the specializations that each country attributes to the X-ray technician profession. The difference attests to several versions of the profession. European professional organizations define names of the profession in order to offer unification. Nevertheless, when the title is not homogeneous and international, this can reflect lack of homogeneity related to the body of knowledge, as well as to levels of autonomy and authority throughout the European Union. Moreover, there are differences between the countries as far as the acquired education is concerned. The observed differences might put in risk the mobility of professionals if these
regulations are different. X-ray technicians who have studied in one country, might not be able to work in another country (Couto et al., 2017).

Furthermore, in Europe, there are differences in the levels of wages between the private and public sector. This exacerbates the shortage of human resources in the public sector, causing many to leave the public sector and even the country (Frija, 2021).

Israel witnesses a development in the field of imaging that requires the training of professional and highly qualified workers. However, no specific BA in the subject of X-ray and imaging is awarded in Israel and the profession is completely non-regulated and open to everyone. This is due to the differences of opinion regarding the curriculum between the Ministry of Health and the Council for Higher Education (State Comptroller, 2015).

Thirty-eight countries around the globe have some kind of regulatory guidelines for radiology staffs, and the standards are dramatically changing from country to country. Today, 13 American States only have bills for licensing requirements or have no licensing laws at all. That implies that every person can perform sophisticated X-ray procedures merely after several weeks of training. These states are: Alabama, Alaska, District of Columbia, Georgia, Idaho, Kansas, Missouri, New Hampshire, North Carolina, North Dakota, Oklahoma, South Dakota, and Wisconsin (Collings and Nolen, 2002). Failure to regulate the law regarding this profession is a factor that harms the professional image. The non-regulation facilitates employing any person to operate the imaging machines without formal training. The non-conformity of the curriculum and the legal regulation of the X-ray technician profession, might lead of many different perceptions of this profession among the worldwide public.

The Choice of Profession

Choosing a profession is one of the most important and meaningful decisions in people’s life (Blustein, 2013). Different people have different preferences that guide them in the choice of profession, a choice that is affected by various factors that are partly associated with the quality of the work itself. One of the main factors that motivate people in the choice of profession is their personal preferences that describe how they imagine their work environment (alone/in a team, calm/dynamic, etc.); which training they have to undergo (long academic studies, short courses, or certificate studies); options of promotion and personal development; working conditions and wages.
Moreover, choosing a profession is a process in which people have to decide between varied pf alternatives. The decision-making is manifested by a set of considerations and comparison of the different professions, while collecting and processing information. Sometimes, this process involves uncertainty that partly relates to questions such as: Am I really interested in this particular field? Will I be admitted to the studies? Will I enjoy the studies? Will I succeed in the studies? Will I be satisfied with the work? and so on (Gati and Krausz, 1996).

The meaning that people attribute to their work is one of the considerations in choosing a profession. The meaning of work refers to people’s beliefs, values, and positions about the results of their work, as well as the roles or goals that it will add to their life. Career, work, and vocation are three ways by which people can relate to their work and even derive satisfaction from it (Nord and Brief, 1990). Furthermore, for certain people, work is a means of obtaining a funding resource for their leisure time, whereas others are not motivated only by economic gains but also of self-esteem, power, and influence. For people who view their work as a vocation, work is an inseparable part of their private life. It helps them in actualizing themselves, contributes to the general level and, hence, they invest a lot in it (Bella, 1987).

**Difficulties in choosing a field of studies and profession**

One of the difficulties in choosing a profession is due to the fact that people are not ready to make a decision. This lack of readiness can stem from unwillingness to make a decision now, believing that the choice of profession is for life. This is one profession that has to materialize all the expectations and, hence, this decision is accompanied by apprehension of making a commitment and of failing (Gati and Krausz, 1996).

Another difficulty is lack of information about the future profession. People do not know which factors should be taken into consideration in the decision-making process. For example: which skills are required for this profession? Are my skills suitable for this profession? In what am I qualified or unqualified? People have insufficient knowledge about themselves. They do not know what preferences and considerations are necessary for choosing a profession, e.g., insufficient knowledge about existing professions, what characterizes these professions, and what are the properties necessary for each profession (Gati and Krausz, 1996).

Inconsistent and unreliable information can also constitute a difficulty in choosing a profession. The existing information includes contradictions and discrepancies between objective and subjective information, between what people
think about themselves and what others think about them. Moreover, there are internal conflicts caused by people’s deliberation with themselves: difficulty to compromise on important considerations, i.e., training duration, distance from the place of studies, as well as a number of professions that equally interest people and they find it hard to decide. There are also external conflicts resulting from gaps between people’s own preferences and the preferences of the meaningful figures in their life, who are usually parents, friends, siblings, or any other person whose opinion is important. The conflict arises when the hesitating people prefer a certain consideration or choose a certain profession, but the meaningful figures have another preference (Gati and Krausz, 1996).

**Ionizing Radiation**

*Working in an ionizing radiation environment*

X-ray technicians’ work is both physical and mental. They daily life heavy weights, as well as cope with repetitive actions, long hours, difficult patients, demanding doctors, and others (Romano, 2012). By virtue of their work, X-ray technicians operate radiation-emitting equipment and, during their work, are at risk of exposure to ionizing radiation at different levels. This discourages the wide public due to the apprehension of working in an ionizing radiation environment.

Moreover, since the atom bombs on Hiroshima and Nagasaki and the accident in the Chernobyl reactor, the public is apprehensive of being exposed to ionizing radiation. As a result, and since there is some risk of exposure to radiation when working in the various imaging field, many studies have explored the relation between exposure to radiation during work and an increased risk of different types of cancer. Radiologists and X-ray technicians are the largest and first group exposed to artificial, manmade radiation within the framework of their occupation. Studies that monitored large population groups of radiation workers found a relationship between the duration of work in radiation environment and a growing risk to contract leukemia. Other studies investigated the relation to solid tumors but found no significant relation. Research findings showed that the increased risk was manifested among those who worked during the 1950s. At that time, the occupational exposure was higher and workers in this profession were unaware of protection against radiation as is common today (Shinji, 2004).

Additional studies conducted in earlier years, starting from the 1940s and up to circa 2010, found a relation between work in an ionizing radiation environment and an increased risk of various types of cancer (Steven, 2006; Wakeford, 2009).
Later studies of this field indicate that, undoubtedly, high-level radiation is dangerous and constitutes a considerable risk factor for the onset of cancer. Nor is there any doubt that radiation during childhood is a considerable risk factor. Nevertheless, it cannot be proven that the low radiation to which X-ray technicians are exposed during their work constitutes a considerable risk factor and increases the risk of cancer (Kitahara, 2018; Preston, 2016; Terrence, 2015).

This could be due to the X-ray technicians’ very low exposure to radiation during their work in recent years, compared to previous years. One of the factors that affect this change is the technological development of equipment in the last years that decreased the level of radiation emitted from the machines. Digital X-ray machines, three-dimensional processing of films, and radiation-reducing software were developed. For example, the new CT machines include a film processing software that allows a 40% to 60% decrease of the emitted radiation level, without damaging the quality of the results. Moreover, systems that reduce the radiation level by about additional 10% were installed (Waldermar, 2012).

Furthermore, today, there is a deeper epidemiological understanding of the way studies are conducted, neutralizing variables that might bias the results if they are not taken into consideration. For example, X-ray technicians who became sick with cancer, not because they were exposed to radiation at work, but because they smoked, had a history of cancer in the family, lived next to high voltage line, or other similar reasons.

**Living in an ionizing radiation environment**

From the day we are born, we live in an ionizing radiation environment. The ionizing radiation that naturally surrounds us is referred to as background radiation and it comes from four main sources: (i) cosmic radiation that reaches planet earth from particles that are outside our solar system. This radiation is higher when people live in a higher place or during flights; (ii) solar radiation that is mostly non-ionizing, emits also particles with high energy that reach the range of the ionizing radiation; (iii) natural terrestrial radiation sources in the ground, rocks, and various crops, mainly radioactive isotopes of Uranium and Thorium in the ground, and potassium in bananas and nuts; and (iv) Radon gas that is the product of Uranium dissolution, and constitutes about 50% of ionizing radiation to which people are exposed.

Background radiation differs from place to place over the globe and it is mostly affected by the composition of isotopes in the soil, as well as by the height of places of living. The background radiation in Israel, which comes from natural
sources, amounts to approximately 2mSv per year. For the purpose of comparison, the background radiation in Romania is 2.7mSv per year, in the United States about 6mSv annually, and the overall worldwide radiation is about 2.4mSv per annum (Israel Atomic Energy Commission, no date).

In some areas around the world, the background radiation is significantly higher than the average and it amounts to 100 times more than annual average radiation (e.g., Guarapari, Brazil; Kerala, India; Ramsar, Iran). People who live in areas with high background radiation emulate the occupational exposure in terms of exposure to low radiation levels over a long period of time, unlike short and high exposures that characterize areas of accident (such as Chernobyl). The question is whether background radiation in worldwide areas with high background radiation affect the incidence of cancer. This question cannot be answered unequivocally, yet many epidemiological monitoring studies conducted around the globe have not indicated an increase of cancer cases (Israel Atomic Energy Commission, 2011; Jolyon, 2009; Krishnan, 1999).

The annual average exposure of workers in an ionizing radiation environment is less than one millisievert (Haruz-Shitz, 2004). Much of the equipment operated by X-ray technicians does not involve at all the use of machines that emit ionizing radiation. For example: the ultrasound machine that functions by means of sound waves, and the MRI machine that functions by means of magnetic field (Geva, 2006). A relatively small part of the X-ray technicians’ work is performed in the field of radiation, like imaging in an operating theater where the staff uses a suitable protection equipment (Ministry of Health, 2015a).

**The public’s level of knowledge about ionizing radiation**

A study conducted in Jedda, Saudi Arabia, assessed the level of public knowledge about ionizing radiation, information sources available to the public, and the preferred sources of education. The participants were requested to rank their confidence with respect of their knowledge about ionizing radiation. They also answered questions about the perception of their risk, the source from which they received health-oriented information, and their preferred education method. Only 3% of the 244 participants “knew” about ionizing radiation. The participants over-estimated the risk of nuclear plants, since it was ranked as the source with the highest health risk, followed by medical sources (Nasr *et al*., 2019).

Another study that assessed the public’s knowledge and perception of ionizing radiation, was conducted in six locations in Vermont. Although the respondents had a level of high education that was more than the average, the study
showed many misconceptions about actual risks of exposure to ionizing radiation, particularly in the case of medical imaging tests. Consequently, health care professional will have a deep and positive impact on the public’s understanding of ionizing radiation (Evans et al, 2015).

Research findings show that there is a lot of defective and wrong information about “radiation and radioactivity” on the Internet. The Internet is the first choice of students who are searching information for their studies. Wrong information downloaded from the Internet can lead to misconceptions not only about these topics but also about scientific terms. Most of the information on the Internet has not been written by experts and the wrong information is copied from several other websites. Every person can create websites without checking the accuracy of the information (Sesen and Ince, 2010).

**Impact of the Covid-19 Pandemic on the X-Ray Technician Profession**

**X-ray technicians’ apprehensions of exposure to the COVID-19**

Like in other parts of the health care system, the COVID-19 pandemic has exposed and exacerbated the distress of imaging workers. The pandemic demonstrated the workloads that have been dramatically aggravated due to the increased use of CT machines for diagnosing the disease. An updated study shows that X-ray technicians are also apprehensive of the increased radiation resulting from the overuse of CT machines during the pandemic.

In Spain, the apprehension was examined among 546 X-ray technicians by means of questionnaires, and the findings indicated that the COVID-19 pandemic was perceived as a serious threat to their health. The workers were apprehensive of spreading the pandemic and transmitting it to members of their family, their colleagues, and their patients. During that period, the staff’s morale was lowered, there was insufficient contamination control, and the risk management was defective (Ruiz, 2021). Furthermore, the pressure and exhaustion of X-ray technicians were increased following the outbreak of the COVID-19 pandemic. This was due to the fact that health care workers were at an increased risk of contamination. The apprehensions, particularly of the unknown, the anxieties, tensions, and workload, greatly affected the X-ray technicians (Huang et al, 2020).

In South Africa, a study was conducted among 60 X-ray technicians who responded to an online open-ended questionnaire, describing their experiences during the COVID-19 pandemic. The thematic analysis yielded three topics: (i) new work flow and operations. For example: changes in the working environment,
the use of personal protection equipment, and social distancing; (ii) effects on workers’ well-being, such as stopping workers’ vacations; and (iii) X-ray technicians’ strength: the workers’ strength that was prominent during that period, the ability to adjust to a new and challenging way of working, dedication to the profession, expertise and skills, have all helped them to confront the new challenges (Lewis and Mulla, 2021). Understanding the impact of the COVID-19 pandemic on X-ray technicians will allow hospital managements, professional bodies, and educational institutions to re-assess the allocation of resources to this profession, training, policy, regulations, and so on.

**The COVID-19 pandemic as a factor affecting the choice of profession**

The outbreak of the COVID-19 pandemic entailed increased workload and contamination risks among medical staffs. Studies of this field illustrated that this affected the career planning of health care and medicine students, the choice of their future workplaces, and choice of their employment time. Findings showed that the number of students who preferred clinical medicine, public health, pharmacology, and dentistry had considerably increased after the outbreak of the pandemic. On the other hand, the number of students who chose nursing and medical technology had considerably decreased (Zheng et al, 2021).

**3. CONCLUSIONS**

This paper indicates a potential improvement of the supply of X-ray technicians in the medical sector, as a way of preventing an under-staffing crisis in the field of diagnostic imaging services.

a) Based on specialized literature and official statistics, the paper has shown a growing shortage of X-ray technicians in the medical sector. While the world of imaging is accelerating side-by-side with the progress of technology and the numerous options that enable an accurate diagnosis, the literature discussed in this paper illustrates three main issues related to the shortage of medical imaging staff: (a) There is a misconception about the X-ray technician profession, namely engagement in a profession that involves ionizing radiation;

b) There is a temporary misconception during the COVID-19 pandemic regarding the X-ray technician profession. This is due to exposure to the COVID-19 and to the frequent use of imaging machines for diagnosing the patients while working as X-ray technicians;
c) Countries differ in the curriculum and legal regulation associated with the X-ray technician profession.

The paper concludes that the issues discussed contribute to a misperception of the X-ray technician profession, which affecting the career planning of young people and decreasing the number of those who choose this field of study and work.

Since increasing the number of students in the field is needed in order to meet the demands of the market, the paper emphasize the urge to find appropriate marketing strategies meant to dispel misconceptions and raise awareness among young people who are at the stage of choosing their future profession and plan to enroll in higher education institutions. Thus, our future research will focus on understanding perceptions and proposing the marketing strategy.

REFERENCES


34. Soraski-Ichilov Hospital (n.d.) *School of Medical Imaging*, Retrieved from https://www.tasmc.org.il/Imaging/Pages/Imaging-School.aspx