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"Current Trends And Role Of Physics In Medical And Biomedical Education To Improve Quality Of Life"

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ABSTRACT

The human body is made up of a number of biophysical systems that act in unison. Any disruption to this rhythm may cause the systems to collapse, eventually terminating the functions of the entire organism. Medical Physics will help us maintain a better understanding of the biophysical aspects of the human body as well as the diagnostic and therapeutic facilities available. Medical Physics will assist us in maintaining a higher standard of living for humans.

The purpose of this study is to highlight the importance of medical and biophysics education while also establishing various categories for a general educational process. There are two types of education considered: traditional schooling and higher education at the university level. The needs for the educational process of Medical Physics specialists and Medical Physics users are outlined in this area, as well as public education, which consider several aspects of considerable significance to society.

Medical Physics users and professionals need to keep up with the latest developments in the field. Adequate investment in infrastructure, as well as collaboration among professionals and educational institutions, allows for the most effective use of new diagnostic and therapeutic approaches.

Keywords: Medical physics, conventional, public, and education '

INTRODUCTION

Medical and Biophysics is a branch of physics that studies the vast uses of physics in medicine. The majority of these applications may be traced back to two late-nineteenth-century discoveries. Röentgen discovered X-rays in 1895, and Becquerel discovered radioactivity in 1896. Both of these findings resulted in major changes in the way medicine was practiced as a result of their discoveries Since then, X-rays have been utilized to create photographs of the inside of the human body and to cure cancer, with radionuclide's also being utilized for both objectives. Thomson's discovery of the electron in 1897 had a huge impact on medicine, resulting in the invention of electro-medical instruments.

The development of faster speed imaging systems, electronic amplification devices, scintillation cameras (1958), ultrasonographic devices (1962), enhanced high capacity X-ray tubes, and rapid film processing occurred in the first seventy years after these findings

(1956).

However, the rapid development of computers has accelerated even more, allowing technologies such as computed tomography (1972), magnetic resonance imaging (1980), and interventional fluoroscopy to be developed, allowing the technology to be used in more routine work.

Furthermore, the Cobalt-60 machines (1951) and Linear Accelerators (1952) [1, 2, 3] ushered in the therapeutic use of radiation. In emerging nations, medical physics education is progressing, and many medical and biophysics departments are being built.

However, under some circumstances, the following questions arise: Are these universities producing qualified Medical Physicists for the country? The American Association of Physicists in Medicine (AAPM) defines a qualified Medical Physicist as "an individual who is competent to practice independently one or more of the sub-fields of Medical Physics, which include Therapeutic Radiological Physics, Diagnostic Radiological Physics, and Nuclear Medicine Physics is the teaching provided to medical students at these institutions adequate? Is anything being done to inform the public about the many radiation risks? Finally, given the budgetary limits that most developing countries face, how can this be accomplished?

MATERIALS AND METHODS

We'll try to answer the questions above in the sections that follow. The educational process is separated into two areas to accomplish this: -

1. Traditional education, which is further subdivided into two types:

A) Medical and Health Physicists, as well as Biomedical Engineers, are examples of medical physics professionals.

B) Public education is primarily focused with informing the public about many facets of society.

1-A. Conventional education of Medical Physics professionals: -

Medical Physics experts' traditional education includes the following: -

The process of becoming a Medical Physicist is much more organized today than it was previously. Prior to the 1970s, after completing a doctorate degree in Physics or a physical science, the most frequent route to enter the field was through on-the-job training with little or no specific course work.

Gradually, though, in the 1970s and 1980s, graduate Medical Physics programmes began to emerge. The AAPM established a commission to approve such programmes in the mid-1980s [3]. Medical, Health, and Biophysics, as well as Biomedical Engineering, are offered as postgraduate courses at numerous universities. In most cases, a B.Sc. in Physics or Engineering is required, while some universities also require a B.Sc. in Chemistry or Computer Studies.

The postgraduate course's major goal is to provide appropriate information on physics in medicine, followed by intense instruction in the stringent requirements of instruments in v arious clinical circumstances. This would result in the desired sort of hospital physicist, one who has a scientific view and is willing to apply it to a wide range of situations encountered in his profession, rather than one who has absorbed a large amount of material through formal courses, [4].

The suggested curriculum for a postgraduate degree in Medical and Biophysics, which might take 1-2 years, can be broken down into three basic steps:-

Step 1: - the fundamental courses, in which the student is exposed to several medical and biophysics specialties. These are some of them:

Nuclear and Radiation Physics, Radiobiology, Radiation Dosimetry and Regulations, Medical Electronics and Instrumentation, Neurosciences, Optics and Laser, Audiology, Electromagnetism, Signal Processing and Interpretation, Ultrasound, Magnetic Resonance Imaging, Image and Data Processing, and other fields are covered.

Biochemistry, Physiology, and Anatomy lectures should be included in the basic courses. This will help students grasp Radiobiology and Neurosciences by giving them a greater grasp of the human body. Statistics and at least one computing language should be included in the course. It is debatable whether Biomechanics and Rehabilitation should be included in the Medical Physics course.

These disciplines are thought to be solely necessary for the Biomedical Engineering concentration at some universities. Others look at a Medical Physicist's broad responsibilities, which include clinical support, teaching, and research. This necessitates a thorough understanding of the biomechanical features of the human body, as well as the potential for system failures and the maintenance process.

Medical physicists can thus pass on enough information to medical students and biomedical engineers.

Step 2: - In-depth studies: At this stage, students are required to select three or four topics to study in depth. During this level, more laboratory work and hospital training are required. At this stage, where the learner analyses and elaborates various technical issues, problem-based learning might be used.

Step 3:-After that, the student enrolls in a hospital placement for one or two years before taking a test to earn a license to work in a hospital's Radiation department. Those Medical Physicists who wish to pursue a career in education will require further training in teaching skills as well as a brief introduction to various medical terminologies, as they may be required to instruct Medical Physicists.

The infrastructure is the most significant barrier that developing countries confront when establishing a Medical Physics department or launching an educational programme. Qualified teaching staff, laboratories, and a neighboring teaching hospital are all part of the plan to provide the essential training. All of this necessitates a significant financial investment in the educational process.

A proper training programme for the teaching personnel is required. Because of the improvement in medical technology, this training should not be limited to college school; continuing education and training are essential to keep the Medical Physicist current. This will, without a doubt, benefit schooling.

Medical equipment is exceedingly expensive, and a single university's ability to provide all of the essential equipment for all of the units in a Medical Physics department is considerably above its capabilities. The following is a summary of the proposed solution:

1. Formation of national Medical and Biophysics Societies: These societies should connect with other regional and international societies and funding bodies.

2. Establishment of excellence centers: - specialized in one or two disciplines and capable of providing all facilities for these disciplines. These facilities should work together by exchanging personnel and training students.

3. Experimental work documentation: - to compensate for a lack of experimental tools. Installing the equipment, performing calibrations, quality assurance and quality control tests, troubleshooting and maintenance, handling radioactive materials, and so on should be recorded on video tapes and CDs and made available to students in audio-visual laboratories as part of their practical sessions.

Computational simulations of various diagnostic and therapeutic tools and their applications could also be included in the practical sessions.

As a fundamental medical discipline, physics plays a significant role. The body is a collection of systems that operate according to physical rules. This covers things like vision, hearing, smelling, liquid and gaseous exchanges, temperature variations and regulation, electric field potentials, viscoelastic qualities of muscles and tendons, excretion, and so on.

Understanding these occurrences lays the groundwork for diagnosing and treating health problems. Furthermore, because the genesis of all life systems is a physico-chemical system, physico-chemical laws can be used to describe it. Medical and paramedical personnel today routinely employ advanced diagnostic and therapeutic equipment, necessitating a basic understanding of the equipment's mechanics.

Physics of the human body, as well as Radiobiology and the uses and hazards of non-ionizing and ionizing radiation, are suggested Medical Physics topics for faculties of Medicine, Pharmacy, Physiotherapy, Nursing, and Radiography. In this process, many instructional strategies should be used.

In addition to the previously mentioned recorded videotapes and CDs, these comprise lectures, laboratory work, and trips to various centers of excellence, hospitals, and clinics. Courses at the postgraduate level should be more focused on specialties.

Radiobiology and radiation protection training should be completed by doctors and technicians working in Radiology, Oncology, Nuclear Medicine, or Radio pharmacy departments. Those who plan to concentrate in ophthalmology will require a deeper understanding of optics and lasers, among other things.

Workers in the industrial field may be exposed to significant amounts of radiation while performing tasks such as industrial radiography and sterilizing. The proposed courses are comparable to those listed for the various medical schools.

As demonstrated, Medical Physicists can play an important role in educating Medical Physics users. Understanding the needs of this group allows for more effective use of the subject. Involving experts from various fields in the educational process is thus strongly advised. The best use of the centers of excellence in the various institutes improves the quality of the programmers.

Education for the General Public: -

Public education should raise public awareness of important issues. To avoid unnecessarily raising public anxiety, it should be capable of answering questions and providing solutions to the highlighted risks.

We hear a lot about protests against the construction of nuclear power plants, despite the fact that, under normal operating conditions, they produce massive amounts of electricity while emitting fewer pollutants than coal or fuel power plants.

It is estimated that replacing a 1000 MW coal power plant with an equal capacity nuclear power plant saves 7 million tons of carbon dioxide and 30 000 tons of sulphur dioxide, as well as large amounts of nitrogen dioxide and dust, from being released into the atmosphere each year [5].

It could thus help to protect the environment by reducing the greenhouse effect, global warming, and acid rain caused by these gaseous discharges.

Mobile phone and microwave oven dangers: The degree of individual choice involved in a risk will influence how the risk is perceived. These perceptions are based on a misunderstanding of the actual risks.

For example, the fact that most people believe they are 'in control' of smoking and drinking explains why these risks rank low on the public's comparative scale, despite the harm that these activities are known to cause [6].

Mobile phones: Many people, including children, use mobile phones. Microwave ovens are widely used in many homes for quick food preparation. Radiofrequency radiation is used in both techniques. Because the radiation produced is below the ionising frequency, the fields cannot damage DNA molecules via the direct quantum effect and thus cannot cause cancer via the direct hit effect.

This is not to say that DNA cannot be damaged or cause cancer through indirect effects such as intermediate chemicals or accumulated quantum effects. Many studies have been conducted to determine the harmful effects of microwave radiation on the human body, but the results are inconclusive, [7].

Excessive use of mobile phones has been linked in some studies [8,9,10] to an increase in the incidence of brain tumours as well as disruption of memory and learning sites in the brain. According to these studies, it impairs concentration and calculation and can cause mood swings.

It also interferes with human immunology by impairing white blood cell ability to fight infectious diseases by interfering with the immune system's electromagnetic communications. Mobile phones have also been linked to a decrease in the effectiveness of anti-asthmatic drugs and a delay in recovery from the illness.

The effect is much more severe in children because their nervous and immune systems are still developing and thus more vulnerable to changes in the DNA. People are not only using mobile phones to make phone calls; the advanced features that have been added to these phones have enticed people to use them for other purposes as well.

They are used as alarm clocks, which necessitates placing them close to the brain even during sleep hours, and to listen to the radio, with the earpiece plugged in for hours. The effects of these radiations worsen with time. Public education should be used for the following purposes:

• Encourage people to stop doing these things and to limit their exposure time.

• Prevent people from using cell phones near infants, especially in cars, where the steel body amplifies the radiation.

• Opp Microwave ovens: Every microwave oven has a magnetron, which is a tube in which electrons are influenced by magnetic and electric fields to produce microwave radiation at around 2450 MHz Microwave radiation interacts with food molecules. With each wave cycle, the polarity of all wave energy shifts from positive to negative.ose the construction of cell phone towers near homes and schools.

Millions of times every second, polarity changes occur in microwaves. Polarization occurs in food molecules, particularly in water molecules. Microwaves agitate molecules, causing molecular friction, which heats the meal. This unconventional method of cooking degrades food quality by forcing food molecules to distort and transforming cooked foods to solids.

This peculiar method of cooking degrades food quality by forcing food molecules to distort and transforming cooked components into hazardous organotoxic and carcinogenic compounds. Food cooked with microwave ovens caused significant alterations in blood samples taken from subjects in certain trials.

These alterations include a drop in all hemoglobin and cholesterol levels, as well as a drop in lymphocytes, all of which indicate deterioration. Hair loss, appendicitis, cataracts, and reproductive issues have all been found to be more common in people who eat microwaved food on a regular basis.

Radiation leakage could occur if microwave oven doors are slammed shut. This can lead to a variety of side effects, such as headaches and dizziness, skin cancer, cataracts, birth defects, temporary sterility in men, blood disorders, cardiovascular problems, memory loss and central nervous system damage, interference with some pacemakers, and a decrease in immune system [11,12] Competence.

Medical doctors, health and medical physicists, and nutritional experts should convey to the public the following messages:

• Microwave food consumption should be kept to a minimum.

• Microwave ovens should be used with extreme caution. Avoid slamming doors, which may result in radiation leakage over time, as well as overcooking food, which can reduce food quality.

• Metal jewellery and eyeglasses should not be worn near RF-emitting electronic equipment, even if the level is below the established safe value. Jewelry or eyeglasses can act as a conductor, resulting in a shock or burn.

Risks of ultraviolet radiation (UVR) and fade-out creams: Another risk factor that many people overlook, particularly in developing countries, is the use of fade-out or whitening creams. Some of these creams contain higher concentrations of steroids, hydroquinone, and mercury oxide than are permitted by regulatory bodies.

In layman's terms, they make the skin whiter by depleting the melanin cells that cause the dark colour. In many countries, girls disregard or are unaware of the effects of these creams on vital organs and the skin. All they care about is looking prettier and being lighter in colour.

Damage to melanocytes, which contribute to the natural defense of dark-skinned people against UVR – the darker the skin, the less UVR sensitivity – is associated with a number of health risks. Solar lentigo, also known as liver spots, may be present on UVR-exposed skin in more than 90% of Caucasians over the age of seventy.

The ultraviolet region of the electromagnetic spectrum is located between visible light and X-rays. Because UVR has a limited penetration into the body, the skin and eyes are the most likely organs to be harmed by it. Several scientific bodies have thoroughly examined the health effects of UVR: Gezondheidsraad, 1993, UNEP/WHO/ICNIRP, 1994, ICNIRP 1999, and the advisory Group on Non-Ionizing Radiation AGNIR, 1995, 2001, [13].

UVR's harmful effects are determined by the length (duration) and frequency of exposure, the intensity of solar radiation based on latitude, and the skin's reactivity based on genetically determined constitutive skin colour and skin phototype. The distribution of light skin in areas with little UVR and darker skin in areas with more UVR is consistent around the world.[14]

This is extremely beneficial to humanity because if fair-skinned people avoided areas with high UVR levels, they would suffer from a variety of UVR-induced complications, as will be discussed later. Unfortunately, humans are dissatisfied with what nature provides.

Fair-skinned people want to develop a deep sun tan and, as it is often said, "look bronze." Dark-skinned people frequently use a variety of cosmetics to try to achieve a white complexion

To achieve their objectives, both types expose themselves to unnecessary high levels of

UVR. UVR causes a wide range of pathologic effects, including sunburn and pigment changes, as well as benign, premalignant, and malignant neoplasms. Photodamage is distinguished by a cluster of structural changes in the epidermis, the dermal-epidermal junction, and the dermis.

UVR has an impact on plastic surgery, such as photoaging, facial peeling, and scar hyper pigmentation. It also has an impact on the immune system, which is heavily reliant on the skin. Melanoma, basal cell and squamous cell carcinomas are among the long-term consequences.

UVR risks and fade-out creams: Another risk factor that many people overlook, particularly in developing countries, is the abuse of fade-out or whitening creams. Some of these creams contain higher levels of steroids, hydroquinone, and mercury oxide than those permitted by regulatory bodies.

Photographs of the terrible skin conditions caused by the misuse of such creams should be made available to the public. Advice should be given on the steps that can be taken to safely discontinue the use of such creams, as well as the protective attitude toward solar exposure that should be adopted.

The sun exposure precautions that must be demonstrated to the public, with a special emphasis on those who have already exhausted their skins through the abuse of bleaching creams, are as follows: -

• Avoiding outdoor activities whenever possible, especially when the UVR is at its peak (10 am-3 pm).

• Dressing appropriately and wearing broad-brimmed hats.

• Wearing sun glasses that filter out UVR to protect the eyes – UVR damages the cornea and causes cataracts.

• Eating foods high in vitamins A, C, and E, as well as beta carotene, such as carrots, tomatoes, green peppers, and oranges, to increase UVR tolerance.

Applying sunscreen to the skin. During the noon hour, apply sunscreen liberally and frequently. Furthermore, a higher sun protection factor SPF than that required for normal skin complexion is required because bleaching creams cause the skin to become more photosensitive. This could be quite costly.

• The educational programme should thus focus on changing the public's sun-exposure habits. It should also emphasise the importance of seeking medical advice before discontinuing use of these products. When some steroids are abruptly discontinued, they can have negative consequences.

Awareness of medical exposures: - It has been estimated that the diagnostic use of X-rays accounts for more than 90% of total population exposure to radiation [15]. The fact that radiation protection regulations are not strictly enforced adds to the problem in poor and rural areas.

The machines are not checked for scattered radiation on a regular basis, and the hospitals are made of clay rather than concrete. This exposes workers, patients, and co-patients to higher doses than the regulatory bodies recommend. It is not feasible to close these hospitals if they do not follow the regulations because this would deprive the villagers of very useful diagnostic tools.

The educational methods previously described–posters, role-plays, and so on–should be used to explain the following in simple terms:

• Keep a safe distance from the X-ray room when other patients are being irradiated.

• Inform the doctor or technician if you think you might be pregnant. Unless your doctor requests it, do not get an X-ray. The absence of pain does not imply that it is painless, and so on.

Medical Physics education for the general public is thus critical. Medical physicists, doctors, and students, with the help of various organisations and the media, can lead campaigns to educate society about all of these dangers. This should help to improve the general public's quality of life.

RECOMMENDATIONS

• Medical Physics should be included in the curricula of many colleges and universities.

• National, regional, and worldwide experts should be involved in the educational process from the start.

• Instead of multi-disciplinary departments, universities should develop centres of excellence in the many specialties of Medical Physics. Collaboration between these centres in terms of staff and student training is strongly suggested.

• To prevent information overlap, lecturers in Medical Physics must collaborate with instructors in natural and applied sciences.

• National Medical Physics Regulatory Bodies should be empowered, with ••Medical physicists, doctors, educators, governmental and non-governmental groups, and the media should all play a key role in public education. Everything should be discussed and reviewed by a council. cooperation from the IAEA and UNSCEAR.

• Quality control tests must be performed on diagnostic and therapeutic machines, and exposures must be justified and optimised.

Why Cell phone towers should not be located near homes or schools. This is in accord with the Stewards report's recommendations [16].

Medical physicists, doctors, educators, governmental and non-governmental groups, and the media should all play a key role in public education. A council should be formed to discuss and review everything that is going on in the sector, and public lectures should be given on a regular basis to keep the public informed.

• Cosmetics that have been sold should be tested, and those that do not meet the rules should be discarded.

• More resources should be allocated to medical physics education.

CONCLUSIONS

Medical Physics is an important subject in both formal and informal education. Collaboration between professionals in the sector and various educational institutes will ensure that advanced diagnostic and therapeutic facilities are used to their full potential. As a result, the quality of life will improve.

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