BIOMEDICAL WASTE MANAGEMENT AND RADIATION EXPOSURE, ROLES OF RADIOLOGY WITH MEDICAL PHYSICS TEAMS; REVIEW

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Abstract:
The Quality, Safety, And Regulatory Compliance Of Medical Imaging Modalities Are Closely Related To The Primary Responsibility Of A Medical Physicist, Which Falls Under The Category Of Patient Care. In Order To Accurately Measure Any Physical Amount, A Unit Is Often Required. The International Commission On Radiation Units And Measurement (ICRU) Is Responsible For Conducting Periodic Reviews And Updates Of The Ideas In Radiation Physics That Pertain To Quantities And Their Units. These Concepts Are Essential For The Management Of Radioactive Waste. Within The Work Area, The Radioactive Waste Needs To Be Recognized And Separated Into Several Categories. The Collection Of Solid Radioactive Waste Should Be Done With Garbage Collection Bins That Are Operated By Foot And Have A Polythene Lining That Is Disposable. For The Collection Of Liquid Waste, Polythene Carboys Should Be Used. It Is Strongly Recommended That Radioactive Waste Not Be Collected In Glassware. Before Deciding On The Method Of Disposal, Each Package Is Inspected And Tagged According To The Amount Of Activity Associated With It.

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DOI: 10.53555/ecb/2022.11.6.72

Introdcution:

A Significant Quantity Of Garbage Is Produced By Healthcare Facilities, And This Waste Is Regarded As Potentially Dangerous Due To The Inherent Possibility That It Might Spread Illness. On A Daily Basis, Hospitals Produce An Average Of Between 0.5 And Two Kg Of Garbage For Each Bed That Is Occupied [1]. According To Estimates, Around 85 Percent Of The Trash That Is Produced Is Not Dangerous, Approximately Ten Percent Is Contagious, And Five Percent Is Non-Infected Yet Harmful. An Increased Awareness Of The Risk Associated With Incorrect Management Of Biological Waste And The Necessity To Develop And Execute Strategies For Safe And Sustainable Ways Of Waste Disposal Has Been Brought About As A Result Of The Rising Trends Of HBV And HIV Infection [2].

Patients, Physicians, And Staff Members In A Variety Of Disciplines, Such As Radiology, Interventional Cardiology, And Surgery, Are Concerned About The Impact Of Radiation On Their Protection. It Is The Radiation That Is Released During Fluoroscopic Operations That Is Responsible For The Highest Radiation Dosage That Is Administered To Medical Personnel. Radiation From Diagnostic Imaging Modalities, Such As Computed Tomography, Mammography, And Nuclear Imaging, Are Very Insignificant Contributions To The Cumulative Dose Exposures Of Healthcare Staff. On The Other Hand, Any Exposure To Radiation Offers A Potential Risk Not Just To Patients But Also To Those Who Work In The Healthcare Industry [3].

With The Intention Of Minimizing The Potentially Detrimental Effects Of Ionizing Radiation, Radiation Shielding Works To Decrease The Amount Of Radiation Exposure That Is Not Essential. When It Comes To The Realm Of Medicine, Ionizing Radiation Has Evolved Into An Indispensable Instrument That Is Utilized For The Diagnosis And Treatment Of A Wide Range Of Medical Disorders. The Cumulative Doses Of Radiation That Patients And Medical Personnel Get Over The Course Of Their Lifetimes Have Increased In Tandem With The Development Of Its Usage. Fluoroscopic Imaging, Which Employs X-Rays To Get Dynamic And Cinematic Functional Imaging, Is The Source Of The Majority Of Radiation Exposure That Doctors And Other Medical Professionals Experience. To Lessen The Amount Of Radiation That Medical Personnel And Patients Are Exposed To, Formal Radiation Protection Training Is Beneficial [4]. Nevertheless, The Process Of Implementing Radiation Safety Norms May Be A Challenging One, And A Significant Number Of Interventionalists Do Not Get Formal Training On Radiation Dose Reduction During Either Their Residency Or Fellowship Requirements. The Adherence To Radiation Safety Requirements Is Particularly Low Among Doctors And Medical Personnel That Employ Fluoroscopic Imaging Outside Of Radiology Or Interventional Departments That Are Specifically Designated For This Purpose. A Wide Variety Of Medical Disciplines, Such As Orthopedics, Urology, Interventional Radiology, Interventional Cardiology, Vascular Surgery, And Gastroenterology, All Make Use Of Fluoroscopy. Having A Comprehensive Grasp Of The Dangers Associated With Radiation Exposure And The Methods That May Be Used To Reduce Doses Will Be Of The Highest Significance As The Prevalence Of Radiation Exposure Increases [5].

Review:

It Is Very Vital To Have A Fundamental Understanding Of The Science That Supports The Detrimental Effects Of Radiation In Order To Conduct An Analysis Of The Numerous Strategies That May Be Utilized To Protect Medical Personnel And Patients While They Are In The Hospital. According To The Electromagnetic Spectrum, X-Rays Are Composed Of Photons That Have A High Energy Level. X-Rays Are A Kind Of Electromagnetic Radiation. When Compared To Photons, Which Have Lower Energy, X-Rays Differ In That They Are Powerful Enough To Ionize Atoms And Shatter Chemical Bonds [6]. This Makes Them Stand Out From Other Types Of Radiation. As A Consequence Of This Ionization, Free Radicals Are Produced. Free Radicals Are Molecules That Are Chemically Active And Have The Ability To Induce DNA Damage In A Manner That Is Indirect. Medical Staff And Patients Are Both Susceptible To Being Exposed To X-Ray Radiation. This Can Occur Either By Direct Exposure To The X-Ray Beam Or Through The Use Of Scattered X-Rays And Both Methods Are Equally Effective. X-Rays Go Through A Process Called Scattering, Which Causes Them To Lose Some Of Their Energy. As A Consequence Of This, The Quantity Of Energy That Is Deposited In Tissues As A Consequence Of Scattered X-Rays Is Lower Than The Quantity Of Energy That Is Deposited Directly From The Source Of The X-Rays. It Is Possible To Represent Them In One Of Three Alternative Ways, Which Are As Follows: The Dosages Of Radiation. An Object Is Said To

Have An Absorbed Dose, Which Is Measured In Milligrams (Mgy), And The Quantity Of Radiation That Is Deposited In The Item Is Referred To As The Absorbed Dose. Millisieverts (Msv) Are The Units Of Measurement That Are Utilized To Signify The Equivalent Dosage. This Dose Is Established By Taking Into Consideration The Radiation Exposure That Is Specific To The Organ That Is Being Discussed, In Addition To The Organ's Susceptibility To Radiation. Millisieverts, Abbreviated As Msv, Are The Units Of Measurement That Are Utilized To Denote The Effective Dosage. This Dosage Is The Sum Of The Individual Organ Equivalent Doses That Are Supplied To The Entire Body. A Strong Understanding Of These Concepts Is Very Necessary In Order To Accurately Interpret The Dose Recommendations That Are Being Provided. An Exposure That Is Higher Than This Threshold, On Average, Over A Period Of Five Years, Has Been Associated To A One In One Thousand Probability Of Acquiring A Cancer That Is Fatal Throughout All Of One's Lifetime [7].

There Are Two Ways In Which Exposure To Radiation Can Have Biological Effects: Either As A Dose-Dependent Effect Or As A Dose-Dependent Probability. Both Of These Approaches Are Possible. When A Specific Exposure Threshold Is Exceeded, The Onset Of Dose-Dependent Effects, Which Are Sometimes Referred To As Deterministic Effects, Takes Place. The Term "Stochastic Effect" Refers To An Occurrence That Takes Place With A Specific Probability But Does Not Have A Predetermined Threshold At Which These Effects Become Active. One Example Of An Event That Happens With A Particular Probability Is A Dose-Dependent Probability, Which Is A Representation Of The Result. There Are A Number Of Deterministic Repercussions That Have Been Documented In The Fields Of Interventional Radiology, Cardiology, And Radiation Therapy. Some Examples Of These Consequences Are Radiation-Induced Thyroiditis, Dermatitis, And Hair Loss. There Are Moreover A Number Of Instances. The Detection Of Stochastic Repercussions, Which May Include The Development Of Cancer, May Place Some Years After The Radiation Exposure Has Taken Place. Keeping In Mind That The Cumulative Amount Of Radiation Exposure That An Organ Or Tissue Experiences Over The Course Of Time (The Lifetime Equivalent Dose) Is What Determines The Deterministic Effects Is Something That Is Extremely Important To Keep In Mind. In Contrast, There Is A Potential That A Certain X-Ray Might Cause DNA Damage, Which Would Eventually Result In The Formation Of Cancer. This Is A Possibility. An Illustration Of A Stochastic Effect Is Provided Here. One Can Observe A Link Between The Number Of X-Rays That A Patient Is Exposed To And The Probability That A Stochastic Effect Will Take Place. On The Other Hand, The Lifetime Equivalent Radiation Dosage Does Not Have Any Bearing On The Stochastic Consequences That We Are Discussing. As A Result Of The Fact That The Literature Is Based On Epidemiologic Data From Large Radiation Exposures At Doses That Are Far Higher Than What Is Utilized In The Medical Setting, It Is Challenging To Conduct Research On The Effects Of Long-Term Low-Dose Exposure To Ionizing Radiation. According To The Majority Of The Research That Has Been Conducted, Being Exposed To Medical Radiation May Result In A Minor Increase In The Probability Of Having Cataracts, Cancer, And Maybe Even Genetic Disorders [8].

The Amount Of Time Spent Being Exposed To Radiation, The Distance From The Source Of Radiation, And The Utilization Of Physical Shielding Are The Three Most Essential Factors Of Radiation Exposure Reduction. It Is Possible To Shorten The Duration Of The Exposure Using A Variety Of Various Kinds Of Approaches. Before Subjecting A Patient To Radiation, It Is Essential For The Technician Or The Physician To Make Appropriate Preparations For The Photographs That Will Be Taken. This Will Assist In Preventing Exposure That Is Both Unnecessary And Duplicated. The Patient Is Exposed To A Much Greater Quantity Of Exposure When Magnification Is Used; Hence, It Is Essential To Exercise Caution While Using Magnification. It Is Possible That Continuous Fluoroscopy, Which Is Often Referred To As Live Fluoroscopy, Might Be Beneficial For Better Understanding Anatomy During Treatments; Nevertheless, Standard Fluoroscopy Machines Take Around 35 Consecutive Photos Per Second. An Alternate Option That May Be Applied To Achieve Lower Exposure Is The Utilization Of Pulsed Fluoroscopy, Which Has The Capability Of Collecting Around Five Images Per Second Without Sacrificing The Quality Of The Imaging. In Conclusion, But Certainly Not Least, The Duration Of Exposure Must To Be Made As Short As Possible Wherever It Is Possible [9]. The Amount Of Exposure May Also Be Decreased By Increasing The Distance Between The X-Ray

Beam And The Component That Is Being Shot. This Is Yet Another Way That Can Be Applied. In Spite Of The Fact That The Image Intensifier Or X-Ray Plate Has To Be Positioned As Close To The Patient As Is Practically Practicable, The X-Ray Tube Ought To Be Positioned As Far Away From The Patient As Is Feasible While Still Guaranteeing That The Picture Resolution Is Enough. A Approach That Is Analogous To This One Might Be Implemented In Order To Cut Down On The Amount Of Time Spent Interacting With Medical Staff. An Inverse Square Law States That Radiation That Is Dispersed Is The Type Of Radiation That Is Encountered Regularly By Surgeons, Interventionalists, And Operating Room Staff During Procedures That Require Fluoroscopy. This Type Of Radiation Is Referred To As "Scattered Radiation." The Inverse Of The Squared Distance From The X-Ray Source Is Directly Correlated With The Following Reduction In Scattering Exposure Levels. This Correlation Establishes A Clear Relationship Between The Two Variables. It Is Possible To Lower The Exposure Levels Of A Member Of Staff By A Factor Of Four Just By Increasing Their Distance From The Source By A Factor Of Two. By Using This Simple Concept, It Is Feasible To Achieve A Substantial Decrease In The Amount Of Radiation Exposure That Is Received In The Workplace. It Is [10].

In Order To Accomplish The Objective Of Shielding Oneself From The Harmful Effects Of Physical Radiation, One Might Make Use Of A Wide Range Of Personal Protective Equipment (PPE). There Are Several Fluoroscopy Suites That Have The Capability Of Having Lead Acrylic Shields Suspended From The Ceiling. The Dosages That Are Administered To The Head And Neck Can Be Reduced By A Factor Of 10 When These Shields Are Utilized. There Is Also The Possibility Of Protecting Workers Working In Interventional Settings And Operating Rooms Using Portable Rolling Shields, Which Do Not Need To Be Installed. It Has Been Established That The Effective Radiation Dosage That Is Provided To Workers May Be Reduced By More Than 90 Percent When These Mobile Shields Are Deployed In The Optimal Manner. When It Is Not Feasible To Disguise Oneself Behind A Physical Barrier, It Is Advised That All Staff Members Wear Leaded Aprons For The Purpose Of Providing Protection. This Is Done Specifically For The Purpose Of Preventing Exposure To Lead. There Are Three Standard Thicknesses For Leaded Aprons: 0.25 Millimeters, 0.35 Millimeters, And 0.5 Millimeters. The Vast Majority Of States Require Their Employees To Wear These Aprons. Because They Cover A Larger Surface Area Than Front Aprons, Aprons That Wrap Around The Body Circumferentially Are Preferred Over Front Aprons. This Is Because Front Aprons Are Also More Common. The Transmission Rate Through Leaded Aprons Is Typically Between 0.5 And 5 Percent, Or Between 0.5 And 5 Percent. It Is Very Necessary To Use A Thyroid Shield In Conjunction With A Lead Apron When Working With Exposed Lead. Furthermore, It Is Important To Note That Our Patients Are Safeguarded By Personal Protective Equipment (PPE). Patients Should Wear Protective Garments In Areas Of Their Bodies That Are Not Being Photographed From The Outside, Regardless Of Whether They Are Receiving Traditional Radiography, Fluoroscopy, Or CT Scans. Prescription Eyeglasses That Incorporate Lead Should Have A Minimum Of 0.25 Millimeters Of Lead Equivalents In Order To Give Appropriate Protection For The Lens Of The Eye. The Piece Of Personal Protective Equipment (PPE) That Is Worn The Least In Numerous Studies Is Leaded Glasses, With Compliance Rates Ranging From 2.5% To 5% [11]. For This Reason, It Is Common Practice To Rank Leaded Glasses As The Item That Is Worn The Least. Specifically Concentrating On The Posterior Lens, Research Has Shown That There Is A Link Between Occupational Radiation Doses And The Development Of Cataracts In Persons Under The Age Of 50 Who Work In The Field Of Radiation Technology. This Association Was Shown To Be Significant. It Is Noteworthy To Note That The Opacification Of The Posterior Lens, In Contrast To The Opacification Of The Other Areas, Is Rather Exclusively Caused By Radiation Exposure. This Is Something That Should Be Taken Into Consideration. When Worn On A Regular Basis, Leaded Eyeglasses Have The Potential To Reduce The Quantity Of Radiation That Is Absorbed By The Lens By Ninety Percent. In Light Of The Low Percentage Of People Who Comply With The Requirement To Wear Leaded Eyeglasses, It Is Abundantly Evident That There Is Opportunity For Improvement. In Addition To The Appropriate Exploitation Of Leaded Aprons, It Is Necessary To Make Certain That The Equipment Is Kept And Tested In The Appropriate Manner In Order To Guarantee That It Achieves The Desired Level Of Operational Effectiveness. Performing Inspections On Lead Clothes At Regular Intervals Of Six Months Is The Best Way To Guarantee That They Are In Excellent Condition. In Addition,

Leaded Aprons Should Be Hung Rather Than Folded In Order To Decrease The Risk Of Breaking [12].

There Are A Variety Of Regulating And Accrediting Authorities That Impose A Number Of Requirements On Each And Every Radiology Department (2–4). These Criteria Are Placed On Each And Every Department. When It Comes To Imaging Modalities That Include The Utilization Of Ionizing Radiation, There Are Several Local, Regional, And National Regulations That Have Specific Criteria. This Is Especially True In The Case Of Imaging Modalities. A Medical Physicist Is Required To Undergo Periodic Examinations In Order To Maintain Their Certification Or Registration In Order To Be Able To Provide Imaging Services. This Is One Of The Requirements. The Medical Physicist Plays An Essential Role In The Process Of Conducting The Necessary Evaluation Of All Imaging Modalities. This Is Done For The Purpose Of Ensuring That The Radiology Department Or Hospital Is In Compliance With Regulations, As Well As To Obtain Or Maintain Registration Or Certification From The Regulatory Or Accrediting Authority For The Purpose Of Providing Patient Care. Regulatory Or Accrediting Authorities Are The Ones That Are Accountable For Examining The Different Imaging Modalities That Are Available. The Fact Of The Matter Is That Medical Physicists Frequently Participate In Regulatory Organizations As Consultants, As Well As In Accrediting Agencies And Professional Societies As Advisers, Members Of Task Groups, And Committee Members In The Process Of Establishing Image Metrics, Radiation Dose Limits, Magnetic Resonance Safety, Radiation Protection, And Other Topics That Are Related To These Areas [13].

When It Comes To The Team That Is Responsible For Conducting Acceptance Testing On All Imaging Modalities Prior To Their Deployment In Clinical Settings, A Medical Physicist Is An Essential Part Of The Team. When It Comes To Ensuring That Newly Acquired Modalities Are Well Within The Boundaries Of The Manufacturer, It Is Quite Necessary To Carry Out Acceptance Testing. In Addition, The Results Of This Testing Make It Possible To Establish Baseline Measures For The Purpose Of Making Comparisons In The Future. When It Comes To The Process Of Enhancing Imaging Techniques, The Medical Physicist Is Not Only Responsible For Ensuring That The Imaging Modality Is Safe, But Also For Playing A Significant Part In Describing The Different Features That Are Accessible With Imaging Modalities And That May Be Exploited In The Process [14]. As A Member Of A Team That Also Includes Radiologists, Administrators, And Technologists, The Medical Physicist Plays An Important Role In The Process Of Developing Specifications, Evaluating Bids On Specifications From Various Manufacturers, Providing Vital Reviews Of Various Features Recommended By Various Manufacturers, And Assisting In The Selection Of The Appropriate Imaging Equipment That Fits The Clinical Needs Of A Radiology Department. These Are All Tasks That The Medical Physicist Is Responsible For. Each And Every One Of These Responsibilities Is Carried Out Before Acceptance Testing. When It Comes To The Installation Of Imaging Equipment, Medical Physicists Collaborate With The Manufacturer To Ensure That Imaging Modalities Are Supplied On Time [15]. This Is A Major Function That They Play In The Process.

Conclusion:

When It Comes To The Radiology Department, The Medical Physicist Is Responsible For A Variety Of Important Functions.When It Comes To The Patient, The Primary Role Of The Medical Physicist Is To Make Certain That All Of The Necessary Precautions Have Been Taken To Produce Diagnostic Pictures Of High Quality Using The Imaging Modalities That Are Available, And That These Modalities Are Safe To Use In Clinical Settings (Including Radiation Protection, Radiation Safety, Magnetic Resonance Safety, And So On). The Clinical Team, Which Also Consists Of Radiologists, Technicians, Nurses, And Other Physicians, Benefits From The Unique Perspective That Medical Physicists Who Are Trained To Perform Diagnostic Imaging Bring To The Table. Patient Care, Teaching, And Research Are The Three Pillars That Make Up The Purpose Of A Radiology Department. The Crucial Function Of A Medical Physicist May Be Studied Through The Lens Of This Goal. Within Each Of These Missions, The Key Functions Of The Medical Physicist Are Investigated In Greater Depth, And References And Resources That Are Necessary For The Successful Completion Of Such Activities Are Offered. Despite The Fact That The Responsibilities That Have Been Outlined Are Applicable To Medical Physicists Working At University Medical Centers, With The Exception Of Research And, To A Lesser Degree, Teaching Activities, The Majority Of These Jobs Are Still

Applicable To Medical Physicists Who Are Employed As Consultants Or In Smaller Hospitals.

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