icpm 2022

INTERNATIONAL CONFERENCE ON PHYSICS IN MEDICINE

Creating Awareness of Medical Physics in Cancer Care

26-27 May 2022
Dhaka, Bangladesh

25 Year Anniversary of BMPA

Bangladesh Atomic Energy Commission

Bangladesh Medical Physics Association

SOUVENIR

INTERNATIONAL CONFERENCE ON PHYSICS IN MEDICINE
ICPM-2022

26-27 May, 2022
Dhaka, Bangladesh

<http://www.icpm-bmpa.com/2022 >

Venue:

Atomic Energy Centre, Dhaka

Organised by:

Bangladesh Medical Physics Association (BMPA)

Bangladesh Atomic Energy Commission (BAEC)

Message from Chief Guest

Dr. Md. Azizul Haque
Chairman
Bangladesh Atomic Energy Commission

It is indeed a great privilege and honor for me to write this message for "International Conference on Physics in Medicine, ICPM-2022" jointly organized by "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron" Project of Bangladesh Atomic Energy Commission and Bangladesh Medical Physics Association (BMPA). After COVID-19 pandemic situation it is really a great pleasure to see such a scientific program by physical participation of resource persons from home and abroad.

The theme of this conference Creating Awareness of Medical Physics in Cancer Care' has substantial relevance with contemporary demand of knowledge in Medical Physics to ensure quality treatment of cancer by radiation therapy. I am hopeful that the researchers in areas of Medical Physics, Biomedical Engineering will keep growing in Bangladesh and enrich this sector with the latest advancement in this field.

I am confident that this unique cross-disciplinary conference will create an opportunity for stimulating discussions for the participants with emphasis on scientific rigor, educational and training opportunities and professional development.

The government is committed to serve the people by benefitting from the latest development of science and technology, especially through peaceful utilization of ionizing radiation. In this regard, Bangladesh Atomic Energy Commission is implementing several ADP projects for the development of healthcare using advanced nuclear technology

I convey my warm wishes to Bangladesh Medical Physics Association (BMPA) for their Silver Jubilee celebration and hope this association will continue rendering platforms to present application of Physics in Medicine with latest trends.

Sincerely,

Dr. Md. Azizul Haque

Message from Special Guest

Prof. Dr. Swapan Kumar Bandyopadhyaa
Director Cum Professor, Radiotherapy
National Institute of Cancer Research & Hospital
Mohakhali, Dhaka

It is a genuine pleasure and precious opportunity for me to write this message sharing my excitement about the "International Conference on Physics in Medicine, ICPM-2022" May 26-27, 2022, Dhaka, Bangladesh organized by "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron" Project of Bangladesh Atomic Energy Commission and Bangladesh Medical Physics Association (BMPA) in participation of experts and professionals from home and abroad.

Applications of Physics in Medicine have become an important issue for healthcare to the people. In radiation therapy, ionizing radiation is used to treat a wide variety of cancers through external-beam radiotherapy or brachytherapy. Research and development in the field of Medical Physics are essential formaintaining and improving the success of the treatment. This conference is, therefore, providing an opportunity from which we can explore necessary responses for promoting research which will hopefully help us to combat cancer.

Under the leadership of Her Excellency Prime Minister Sheikh Hasina, the health sector of Bangladesh is marching forward along with all other sectors that play a crucial role for public service. National Institute of Cancer Research & Hospital (NICRH) has taken a comprehensive approach to tackle cancer in respect to prevention, diagnosis, treatment and survivorship since its inception. This institute has already made great strides in offering leading-edge technologically advanced treatment with a compassionate touch. But to uphold the advanced level of treatment there is no other alternative but to incorporate qualified Medical Physicists in the team that work for this vital disease.

This conference is surely going to help improve the practice of Physics in enormous sectors of Medicine in our country from the perspective of education, scientific development and professional growth. I, therefore, look forward to finding out the outcome of this conference. Also I don't want to miss the opportunity to congratulate Bangladesh Medical Physics Association at their 25th anniversary of establishment.

I wish the success of this conference.

Prof. Dr. Swapan Kumar Bandyopadhyaa

Message from Conference Chairperson

Professor M Aminul Islam, PhD
President
Bangladesh Medical Physics Association

It is a great pleasure for me to welcome all the delegates and participants from home and abroad to the International Conference on Physics in Medicine 2022 organized by Bangladesh Medical Physics Association (BMPA) in collaboration with Bangladesh Atomic Energy Commission.

The theme of this year's conference is: Creating awareness of Medical Physics in cancer care. Radiation therapy remains an important component of cancer treatment with approximately 50% of all cancer patients receiving radiation therapy during their course of illness; it contributes towards 40% of curative treatment for cancer. This is a global scenario. However, In Bangladesh, patients do not get optimum benefit of radiation therapy because of dearth of qualified medical physicists. As there is general lack of awareness of medical physics, this burning issue has never in focus. Bangladesh Medical Physics Association has been relentlessly striving to promote education, research and training in Medical Physics and constantly fostering interaction among professionals, scientists, academia and entrepreneurs.

As a part of above activities, this conference has been arranged so that the medical physicists can share their experience, research and expertise among themselves and with experts from abroad. This will stimulate education, research and professionalism of the present and future medical physicists in Bangladesh. We are trying to encourage the new generation to get interested in Medical Physics. In this conference there will be deliberations in Radiotherapy, Nuclear Medicine, Radiology and Imaging, Health Physics and related fields.

I wish all the experts and participants from home and abroad fruitful and stimulating sessions in the two-day-long conference in Dhaka. I hope that this international conference on Physics in Medicine will broaden the scopes and programs of Bangladesh Medical Physics Association in the years to come.

M Aminul Islam
Conference Chairperson,
ICMP-2022

Prof. Arun Chougule
President AFOMP
Chair ETC IOMP
Chairman IOMP accreditation Board
Member, Board of Directors IMPCB

I am delighted to note that Bangladesh Medical Physics Association (BMPA) founded in 1998 and one of important member of AFOMP is celebrating the silver jubilee of in 2022. My heartiest congratulation to the President BMPA and the members of BMPA for eventful journey of “25 years”. In last 25 years BMPA has contributed nationally and internationally for education & training of medical physicists and upliftment of medical physics profession.

To commemorate the silver jubilee of BMPA, an “International Conference on Physics in Medicine (ICPM-2022)” is being held during 26-27 May 2022 which is jointly organized by the Bangladesh Medical Physics Association (BMPA), the Department of Biomedical Physics & Technology, University of Dhaka and Bangladesh Atomic Energy Center (BAEC), Dhaka. My heartiest congratulations and good wishes.

The theme of ICMP-2022 “Creating Awareness of Medical Physics in Cancer Care" in very relevant as medical physicists play a large role in diagnosis and treatment of cancer and safe application of ionizing radiation in healthcare. The theme of ICMP-2022 is in tune with the theme of IDMP2022 “Medical Physics for sustainable healthcare”.

Just after the discovery of X-rays and radioactivity, they are being used for diagnosis and treatment of cancer for over 125 years, however in last three decades a remarkable progress has been made in cancer diagnostics with the advancement in diagnostic modalities such as Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), and Positron Emission Tomography (PET). The imaging technologies is essential for early and accurate diagnosis as well as guiding and monitoring the cancer therapy. The role of Clinically Qualified Medical Physicist [CQMP] is very important in delivering radiation to tumor and sparing the normal tissue/organs and therefore the education and training of medical physicists needs to be in consonance with the expertise required to handle the advanced technologies.

I am happy to note that organizers of ICMP-2022 have put huge efforts to make the scientific program of high standard and invited eminent scientists, academicians, industrialists, researchers, from both national and international level covering all aspects of Physics in medicine including Radiotherapy, Nuclear Medicine, Radiology and Imaging, Health Physics, Radiation Protection, Biophysics, Radiobiology, Biomedical Engineering, Telemedicine, Emerging Physics Techniques in Medicine, Education & Training in Medical Physics.

I take this opportunity to inform that AFOMP has started many awards and scientific activities, the details are available on the AFOMP website [www.afomp.org].

Once again on my own behalf and behalf of the AFOMP congratulate Prof R. M Aminul Islam President of BMPA and Chairman of ICMP-2022 and his team on Silver Jubilee of BMPA and good wishes for ICMP-2022. I am sure the participants will be benefitted from the deliberations.

Arun Chougule

Prof Arun Chougule

It is with great pleasure that I write to you on the occasion of the International Conference on Physics in Medicine being held in Dhaka, Bangladesh on May 26 - 27, 2022, organized by the Bangladesh Medical Physics Association. Physics in Medicine has contributed immensely in improving the diagnosis and treatment of cancer-related diseases. The roles of medical physicists are becoming more challenging with the introduction and advancement of imaging and therapy techniques such as CT, MRI, PET, IMRT, IGRT, Particle Therapy, etc. We must continue to progress and adapt in this dynamic environment.

I convey my personal greeting to the organization committee and congratulate them on taking responsibility for this conference and wish them a grand success.

Sincerely,

Salahuddin Ahmad, Ph.D., DABR, FACMP, FAAPM, FACR

Professor of Radiation Oncology, Director of Medical Physics,

Dosimetry and Medical Physics Residency, University of Oklahoma HSC

Oklahoma City, USA 73104

StephensonCancerCenter.org

Department of Radiation Oncology

800 NE 10th Street, SCC L100, Oklahoma City, OK 73104

P: 405.271.3016

Prof. Dr. Guyniun Kim
Department of Physics
Kyungpook National University
Daegu, South Korea

I am extremely delighted to know that Bangladesh Medical Physics Association (BMPA) is organizing an International Conference on Physics in Medicine (ICPM-2022), May 26-27, 2022, Dhaka, Bangladesh in a joint collaboration with Bangladesh Atomic Energy Commission (BAEC),Bangladesh.

The scientific program of this conference covers a wide range of issues related to dosimetry, Brachytherapy, External beam therapy, Treatment Planning, Nuclear Medicine, Quality Control and Quality Assurance, Radiobiology, Radiation Oncology, Radiation Protection, Advanced technology and emerging science in the field of Medicine. In particular, the applications of physics in medicine have been increasing in variety and quantity in the field of new diagnostic techniques and treatment modalities which involve a number of physicists in hospitals and their academic and clinical training suit to the demands of advanced technologies for the treatment of severe health problems like Cancer. Research in physics has contributed directly and indirectly to cancer therapy over the past century. Only months after their discovery, X-rays were used to treat a patient with breast cancer. Recent development of physics increases the ability of cancer remediation by various radiotherapy beams like proton, ion beams, Boron Neutron Capture Therapy (BNCT), Carbon therapy etc.

I am very happy to note that this conference will be attended by many Medical Physicist, Radiation Oncologist, Radiologist, Health Physicist, Scientists and academic physicist from home and abroad and it will provide latest scientific contents in the form of invited lectures, oral presentations and poster presentation with latest technology in the field of Medical Physics. There is no doubt that it will enhance knowledge and experience by sharing the new technologies in the development of Medical nuclear technologies.

On behalf of Kyungpook National University (KNU), Daegu, South Korea, I am pleased to congratulate the Physicist, Radiation Oncologist, Health Physicist and Scientist from home and abroad participating in the conference.

Gueinyun Kim

Prof. Dr. Guyniun Kim

Message from Conference Secretary

Dr. Md. Shakilur Rahman
Project Director
"Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron" Project
Bangladesh Atomic Energy Commission

It gives me immense pleasure and supreme happiness to welcome you all in this signature event of International Conference on Physics in Medicine (ICPM-2022), May 26-27, 2022, Dhaka, Bangladesh whilst Bangladesh Medical Physics Association (BMPA) is celebrating its 25th anniversary. This conference is jointly organized by "Establishment of Calibration and Quality Control Facilities for Radiotherapy, Diagnostic Radiology and Neutron" Project of Bangladesh Atomic Energy Commission and Bangladesh Medical Physics Association. Unbeatable contribution of Physics in Medicine especially in diagnosis, therapy and rehabilitation of cancer has created the scope for Medical Physics to take a crucial position in this branch of healthcare.

Radiation therapy, also known as radiotherapy, is one of the main treatments for cancer. Around two-third of the cancer patient require radiotherapy either alone or in conjunction with other treatment modalities. The development of Medical Physics and Technology augmented the detection and treatment of cancer to a greater extent of accuracy. For ensuring proper delivery of radiotherapy there should be no compromise with the quality assurance and quality control of the whole delivery system which can only be obtained by the knowledge of Medical Physics. In context of Bangladesh, the concept of this discipline has acquired a positive movement in recent years, as a result it can be expected that our country can provide with world class treatment for cancer through proper patronization of these professionals.

For fulfillment of vision 2041 put forth by present government, one way is to serve the people by providing with proper healthcare. To confront the increasing demand of radiotherapy facility the government has declared to establish radiotherapy centers in all divisional hospitals immediately and planned to open sub-center in district level in future.

This conference gladly welcomes the researchers to avail the opportunity to present their exploration in the vast field of application of Physics in Medicine. I hope that all participants in this program will find it enjoyable to be introduced with the latest development of science and technology in healthcare.

I would like to express my deep gratitude to the greatest Bengali Father of the Nation Bangabandhu Sheikh Mujibur Rahman for his incomparable leadership to achieve our independence.

Finally, I would like to covey my warm greetings and extend my best wishes to invited speakers, all participants and those who contributed to make this conference remarkable.

Shakilur Rahman

Dr. Md. Shakilur Rahman

International Conference on Physics in Medicine (ICPM-2022)

26-27 May 2022, Dhaka, Bangladesh

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Mrs. Nourin Arobi (BAEC)

International Conference on Physics in Medicine (ICPM-2022)

26-27 May 2022

Dhaka, Bangladesh

Venue : ***Atomic Energy Center, 4, Kazi Nazrul Islam Avenue, Dhaka***

Registration	:	Lobby of Atomic Energy Center
Inauguration	:	Auditorium, 1st floor, Atomic Energy Center
Plenary Session	:	Auditorium, 1st floor, Atomic Energy Center
Scientific Session (1A, 2A, 3A, 4A)	:	Auditorium, 1st floor, Atomic Energy Center
Scientific Session (1B, 2B, 3B, 4B)	:	Classroom, 1st floor, Atomic Energy Center
AGM (BMPA)	:	Auditorium, 1st floor, Atomic Energy Center

May 26, 2022

Registration	: 08:30 – 09: 25
Inauguration Ceremony	: 10:00 – 11: 30
Refreshment	: 11:30 – 12: 00
Plenary Session	: 12:00 – 01: 00
Lunch and Prayer break	: 01:00 – 02: 00
Scientific Session 1(A, B)	: 02:00 – 03: 15
Tea break	: 03:15 – 03: 30
Scientific Session 2(A, B)	: 03:15 – 04: 40

May 27, 2022

Scientific Session 3(A, B)	: 09: 30 – 11: 00
Tea break	: 11: 00 – 11: 15
Scientific Session 4(A, B)	: 11:15 – 12: 30
Lunch and Prayer break	: 12:30 – 02: 00
AGM (BMPA)	: 02:00 – 03: 30

Inaugural Ceremony

10-00: **Welcome Address**

Dr. M Monjur Ahasan, Conference Co-Chair & Vice-President, BMPA

10-05: **Address by Special Guests**

Professor Dr. Swapan Kumar Bandyopadhyaa

Director, National Institute of Cancer Research and Hospital, Bangladesh

10-15: **Award** to Professor Dr. Salahuddin Ahmad

for contribution in Medical Physics education, research and professional service in Bangladesh

10-25: **Invited Talk**

Professor Dr. Salahuddin Ahmad. Department of Radiation Oncology &

Director, Medical Physics and Dosimetry, The University of Oklahoma, USA

10-55: **Address by Chairperson**

Professor Dr. M Aminul Islam, President, BMPA.

11-05: **Address by Chief Guest**

Dr. Md. Azizul Haque, Chairman, Bangladesh Atomic Energy Commission

11-20: **Vote of Thanks**

Dr. Md. Shakilur Rahman, Conference Secretary and GS, BMPA.

ICPM2022 AWARD
FOR CONTRIBUTION IN MEDICAL PHYSICS
EDUCATION, RESEARCH, AND PROFESSIONAL SERVICE IN BANGLADESH

SALAHUDDIN AHMAD
is at present
Professor of Radiation Oncology &
Director of Medical Physics and Dosimetry &
Director of Clinical Medical Physics Residency
University of Oklahoma Health Sciences Center
Oklahoma City, USA.
IAEA Expert in Radiotherapy Medical Physics

Dr. Salahuddin Ahmad received his Ph.D. degree in Experimental Intermediate Energy Nuclear Physics from the University of Victoria/TRI University Meson Physics Facility in Canada in 1981. He completed postdoctoral training in Radiation Oncology Physics from Houston's UT MD Anderson Cancer Center in 1998.

Dr. Ahmad was a Lecturer of Physics at Dhaka University in 1978; a Commonwealth Fellow at the University of Victoria, Canada in 1978-1981; a Research Scientist at the University of Paris, France in 1982-1983; a Research Associate at the University of Saskatchewan, Canada in 1983-1984 and at the TRIUMF National Laboratory of the University of British Columbia, Canada 1984-1989; and a Research Assistant Professor of Nuclear and Particle Physics at the Rice University in Houston, Texas in 1990-96. Dr. Ahmad was Assistant Professor of Radiology in the Houston's Baylor College of Medicine in 2002-2004 and the Chief Physicist at Houston's Michael E. DeBakey Veterans Affairs Medical Center in 2002-2004. He then moved to Oklahoma and was an Associate Professor of Radiation Oncology (2004-2008).

Dr. Ahmad has co-authored 195 papers in peer reviewed international journals, 66 papers/book chapters in peer reviewed conference proceedings, 472 conference abstracts in Nuclear and Particle Physics, Instrumentations, Medical Physics and Radiation Oncology, has 26 invited presentations in national and international conferences and 76 seminars and colloquiums all over the world. Under his direct supervision 11 M.S. and 7 Ph.D. students got their graduate degrees. In addition, he was also a member of the Supervisory Committee for 6 Ph.D. and 35 M.S. graduating students.

Dr. Ahmad has been an Associate Editor of the Journal of Applied Clinical Medical Physics since 2005, Physics Advisory Editor of Medical Dosimetry in 2008-2018, Member of the Editorial Board of *Bangladesh Journal of Medical Physics since 2011*, and Journal of Medical Physics (Indian) since 2018. He was the Chairman of the Medical Physics Section of the Oklahoma State Radiological Society (OSRS), a chapter of American College of Radiology (ACR) (2009-2017), and a Reviewer for more than a dozen International Medical Physics and Radiation Oncology journals.

Dr. Ahmad is an ABR certified medical physicist and a member of the American Association of Physicists in Medicine (AAPM), American College of Radiology (ACR) and American Society for Therapeutic

Radiation Oncology (ASTRO). *He was the Bangladesh Liaison to the AAPM (2007-2012)*, Chairman of the American College of Medical Physics (ACMP)'s Continuing Medical Education Committee (2008-2011), a Chancellor of the ACMP Board of Chancellors (2006-2010) and has been an American Board of Radiology (ABR) Examiner of Therapeutic Radiologic Physics since 2016.

Dr. Ahmad became a Fellow of ACMP (FACMP) in 2010, of AAPM (FAAPM) in 2012 and of ACR (FACR) in 2017. The Varian-Editor in Chief Award of Excellence for an Outstanding General Medical Physics Article in 2010 went to him and his group.

Many of his activities were in Bangladesh. He gave invited presentations in 10 National/International Conferences/Meetings in Bangladesh. As an IAEA expert in the workshop arranged by Bangladesh Atomic Energy Commission (BAEC) and IAEA, in Dhaka, in December 7-9, 2017 he delivered 12 lectures, each for an hour duration. He was involved in various capacities with several international conferences in Bangladesh. He attended a meeting at the National Institute of Cancer Research and Hospital, Mohakhali, Dhaka as an AAPM Exchange scientist to exchange knowledge and experience of cancer treatment in US to physicists and radiation oncologists in Bangladesh.

Since 2008, Dr. Salahuddin Ahmad has participated in all international conferences organized by Bangladesh Medical Physics Association. He has been a member of the Advisory Committee of BMPA since January, 2020.

In 1974, Dr. Ahmad was awarded the Raja Kali Narayan Scholarship of Dhaka University, the highest academic honor of the university awarded to the best graduating students. He topped the list of all successful candidates (First Class First) both at the M.Sc. and B.Sc. (Honors) examinations in physics and in the entire university, all departments combined.

He topped the list of all successful candidates at the Higher Secondary Certificate (HSC) Examination in Dhaka Board, and in entire Bangladesh with record marks in 1971/72. The only exam where he did not stand first was SSC where he stood second.

He conducted and participated in many Radio and TV programs on Science, Sports and Education in Bangladesh (1972-78); worked as a News Monitor in Radio Bangladesh in Dhaka (1972); wrote many feature articles (around 100) on Science, Sports, Education and Mathematical Puzzles in the daily, weekly and monthly newspapers and magazines in Bangladesh (1972-78). A very popular TV science program entitled "Kintu Keno (But why?)" was conducted on many occasions by him in Bangladesh Tele Vision (BTV) (1975-78). As a First Class Boy Scout (1965-1969), he took leading roles in scout competitions. He was also an important member of the Bangladesh Sports Writers Association (BSWA) (1972-78).

He was a Founder President (1992-95), President (1998-1999; 2004-2005), and Life Member of Bangladesh America Literary, Art and Cultural Association, Houston, Texas and Founder President (1988-1990), Bangladesh-Canada Cultural Association of British Columbia, Canada.

Details of venues:

Venue-1: Auditorium, 1st Floor, Atomic Energy Center (AEC), 4/Kazi Nazrul Islam Avenue, Dhaka

Venue-2: Class Room, 1st Floor, Atomic Energy Center (AEC), 4/Kazi Nazrul Islam Avenue, Dhaka

Abbreviations: **IP** – Invited Paper, **KP-** Keynote Paper, **CP-** Contributory Paper, **PP-** Poster Paper

Plenary Session

Date: 26 May 2022, Thursday

Time: 12:00 – 1:00 pm

Venue-1: Auditorium, 1st floor, Atomic Energy Center

Session Chair: Professor Dr. M Aminul Islam *Co-Chair:* Dr. Md. Shakilur Rahman

Invited Talk

Speaker: Professor Dr. Guinyun Kim

Title: Measurements of Reaction Cross Sections of Various Medical Isotopes

(15 minutes + 5 minutes Q&A)

Invited Talk

Speaker: Professor Dr. Hosne-Ara Begum *(Ashoka Fellow & PHF)*

Title: Activities of TMSS Health Sector in Brief

(10 minutes + 5 minutes Q&A)

Invited Talk

Speaker: Professor Dr. Arun Chougule

Title: Medical Physics for sustainable healthcare- need of structured medical physics education

(20 minutes)

Session-1A

Date: 26 May 2022, Thursday

Time: 2:00 – 3:15 pm

Track: Radiotherapy

Venue-1: Auditorium, 1st floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Professor Dr. Salahuddin Ahmad *Co-Chair:* Dr. M. Jahangir Alam

Keynote Speaker: Dr. A.F.M. Kamal Uddin

Title: Past, Present and Future of Radiation therapy in Bangladesh

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes + 2 minutes Q&A for each paper

Paper ID	Title	Authors
CP-1	Dosimetric comparison of 2D, 3DCRT, IMRT and RapidArc in the treatment of Carcinoma of Brain Tumor.	M. M. Alam, K. R. Mani and M. M. Uddin
CP-2	Estimation of Jaw Transmission Factor of Medical LINAC Installed at Institute of Nuclear Medical Physics, BAEC	S. B. Amin, M. A. Shabuj, M. A. Hasnat, Masud Parvej, Samiul Alim, K A Khan
CP-3	Quality Control Results of a Medical Linear Accelerator by Analyzing PDD at Institute of Nuclear Medical Physics	M. A. Shabuj, M. A. Hasnat, S. B. Amin , Sarmin Sultana, M. M. Ahasan[2], K. A. Khan
CP-4	A Study about Wedge Factors: Physical and Enhance Dynamic Wedge for Clinac iX	M.A. Hasnat , Mst. Sarmin Sultana, Masud Parvej, Md. Jakir Hosen, Samiul Alim, Abdur Rahim, M M Ahasan
CP-5	Study on Breast Cancer Contouring for 3D-CRT at INMP	Rahima Akhter Sharmin, Md. Jakir Hossen, Fatema Tuz Zohra, Samiul Alim, M M Ahasan

Session-1B

Date: 26 May 2022, Thursday

Time: 2:00 – 3:15 pm

Track: Health Physics

Venue-2: Class Room, 1st Floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Professor Dr. Guinyun Kim *Co-Chair:* Masud Parvej

Keynote Speaker: Dr. Meherun Nahar

Title: Medical Exposure Control: Perspective on Risk Management and Compliance with Regulatory Requirements

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes + 2 minutes Q&A for each paper

Paper ID	Title	Authors
CP-6	Occupational Radiation Exposure among the Workers in Major Medical Practices of Bangladesh	Subrata Banik, M.M. Mahfuz Siraz, Shikha Pervin, Nazneen Sultana, Md. Zakir Hossain, Mohammad Sohelur Rahman and Selina Yeasmin
CP-7	Calculation and structural design parameters of radiotherapy bunker shielding at TMSS Cancer Center according to Bangladesh Atomic Energy Regulatory Authority guidelines.	M Motiur Rahman, M Habibur Rahman, Rubel Ahmed, S R Malik, M A Islam, A K M A Habib
CP-8	Real-time Radiation Monitoring around Square Hospital Campus, Dhaka and Estimation of Radiological Risk on Public	Shamima Sultana Mitu, M. S. Rahman, K. N. Sakib, M. M. Tasnim, S. Yeasmin
CP-9	The Mass Attenuation Coefficient and Half Value Layer of Some Locally Developed Madhupur Clay Based Composites Reinforced with Beach Sand and Minerals for X-ray in the Energy Range of 80kV to 200kV	M. Mahfujur Rahman, M. Shamsuzzaman, , Rahat Khan, M. S. Rahman, T. Siddiqua, R. A. Ramon, Mohammad Rajib, S. Sultana and Shakhawat H. Firoz
CP-10	Evaluation of Radiological Risk on Public around BSMMU & DMCH Hospital Campuses in Dhaka, Bangladesh	Md. Mostafizur Rahman, M. S. Rahman, H. R. Khan[1], S. Yeasmin
CP-21	First Case of Successful Radioactive Iodine Ablation in DTC Patient with End Stage Renal Disease and Experience of Exposure Dose Rate	Jasmin Ferdous, Fatima Begum, Enamul Haque, Md. Yousuf Abdullah and Md. Nahid Hossain

Session- 2A

Date: 26 May 2022, Thursday

Time: 3:30 – 4:40 pm

Track: Radiology

Venue-1: Auditorium, 1st floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Professor Dr. Mayeen Uddin Khandaker. *Co-Chair:* Dr. Md Nazrul Islam Khan

Keynote Speaker: Dr. Mohammad Kamruzzaman

Title: Biological individualization of radiotherapy- A translational approach

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes + 2 minutes Q&A for each paper

Paper ID	Title	Authors
CP-11	Estimation of Radiological Risk on Public around Ever Care Hospital Campus in Dhaka, Bangladesh	Salma Akter, M. S. Rahman, K. N. Sakib, M. M. Tasnim, S. Yeasmin
CP-12	Establishment of X-ray reference radiation for calibration of radiation protection devices and Monte Carlo calculation of Backscattering Factor (BSF) for personal dosimetry	R. P. Nupur, M. S. Rahman, M. A. Rahman[1] T. Siddiqua, N. M. Rasel, N. Arobi, H. M. Jamil
CP-13	Investigation of some regular x-ray imaging parameters in indicative radiography of four hospitals in Bangladesh	S. S. Rubai[a], S. Purohit[a], T. Siddiqua[b], M. S Rahman[b] and AKM M H Meaze
CP-14	Detection of Brain Hemorrhagic Stroke using Image Processing	Md. Imran Hossain Showrov, Md. Haidar Ali, Mohammed Asraf Uddin , Md.Shamimul Islam, Nayan Kumar Datta , Md. Shafiqul Islam

Session-2B

Date: 26 May 2022, Thursday

Time: 3:30 – 4:40 pm

Track: Dosimetry

Venue-2: Class Room, 1st Floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Professor Dr. Guinyun Kim *Co-Chair:* Dr. Shuza Uddin

Keynote Speaker: Professor Mayeen Uddin Khandaker

Title: In search of noble material for medical and industrial radiation dosimetry

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes + 2 minutes Q&A for each paper

Paper ID	Title	Authors
CP-15	Determination of dosimetric accuracy of newly installed Cobalt-60 teletherapy machine at SSDL, Bangladesh	M. A. Aziz, T. Siddiqua, H. M. Jamil, N. Arobi, M. M. H. Bhuiyan, S. Paul, A. K. M. M. H. Meaze, M. S. Rahman
CP-16	Measurement of Radiation Dose for Small Radiation Field with Various Radiation Detectors in ^{60}Co Beam	T. Akter, H. M. Jamil, T. Siddiqua, N. Arobi, S. R. Chakraborty, M. S. Rahman
CP-17	Outfield Dose Distribution and Risk Assessment of Measured Dose Using High-Energy Photon Beam (Co^{60}) – An Investigation by Alderson Rando Phantom	M. Z. Hossain, N. Arobi, T. Siddiqua, H.M. Jamil, M. M. H. Bhuiyan, A K M M. H. Meaze, M. S. Rahman
CP-18	Effective Point of Measurement (EPOM) of Some Ionization Chambers for High Energy	N. A. Mokta, M. S. Rahman, T. Siddiqua, S. Purohit, M. Kawchar, A. Patwary, A.K.M. M.H. Meaze
CP-19	Small Field Dosimetry of High Energy Electron Beam Delivered from Medical LINAC	Santunu Purohit, Md Shakilur Rahman, Md Abul Hasnat, AKM Moinul Haque Meaze

Session- 3A

Date: 27 May 2022, Friday

Time: 9:30 – 11:00 am

Track: Nuclear Medicine

Venue-1: Auditorium, 1st Floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Dr. Md. Nurul Islam *Co-Chair:* Professor Ferdoushi Begum

Keynote Speaker: Professor Dr. Shamim Momtaz Ferdousi Begum

Title: Scopes of FDG PET-CT Imaging in Patient Management: Six Years' Experience at NINMAS

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes + 2 minutes Q&A for each paper

Paper ID	Title	Authors
CP-20	Optimization of F-18 radioisotope production with "Cyclone 18/9 MeV IBA Cyclotron" installed at NINMAS	Md. Shohag Mia, Hasan Mehdi, Sanchoy Chandra Biswasarma, Md. Ariful Islam, Md. Jashim Uddin, Tanvir Ahmed Biman, Mohammad Anwar-Ul- Azim, Md. Nahid Hossain, Ferdoushi Begum, Md. Nurul Islam
CP-22	^{18}F FDG PET-CT in Recurrent Ascites- A Case Report	Fatema Tuz Zohra, Azmal Kabir Sarker, Juwel Hosen, Khairul Islam, Jakir Hosen, Rahima Akter Sharmin, Rayhan Alam, M M Ahasan
CP-23	Focus on ^{11}C labeled Choline Radio-pharmaceuticals by Cyclotron Technology at Institute of Nuclear Medical Physics	Rayhan Alam , M. Juwel Hosen, Fatema Tuz Zohra, M.B. Paul, Masud Parvej, M.M.Ahasan
CP-24	Evaluation of Beam Profiles between Physical and Enhanced Dynamic Wedges.	Bahalul Hasan, Masud Parvej, Abul Hasnat, Sarmin Sultana, Mokhlesur Rahman, Fatema Nasreen

Session- 3B

Date: 27 May 2022, Friday

Time: 9:30 – 11:00 am

Track: Biomedical Devices and Engineering

Venue-2: Class Room, 1st Floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Dr. Muhammad Abdul Kadir *Co-Chair:* Dr. Humayra Ferdous

Keynote Speaker: Professor Khondkar Siddique-e Rabbani

Title: Design and Development of Covid related Medical devices during Pandemic by groups at Dhaka University and BIBEAT Limited

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes + 2 minutes Q&A for each paper

Paper ID	Title	Authors
CP-25	Indigenous development of powered air-purifying respirators (PAPR) to provide safety to health care workers from airborne pathogens spread by patients	Istaqur Rahman , Hridi Prova Debnath , A K M Bodiuzzaman , K Siddique-e-Rabbani
CP-26	Development of a pulsed electromagnetic field (PEMF) based bioreactor for fabricating bone like substitutes	Md. Al-Amin, Md Arifuzzaman, Mohammad Moniruzzaman, Mannu Bardhan Paul, Khondkar Siddique-e Rabbani
CP-27	Assessment of the Condition of Pneumothorax Lungs using Anterior-posterior Electrical Impedance Technique	Md. Shariful Alam, S M Mostafa Al Mamun and Md. Adnan Kiber
CP-28	Comparison of Machine Learning Algorithms on Breast Cancer Detection	S. Saha , M. M. Rahman, M. Z. H. Majumder , A. Bhowmik, M. S. Alam, M. A. S. Haque

Session- 4A

Date: 27 May 2022, Friday

Time: 11:15 am – 12:30 pm

Track: Radiotherapy

Venue-4: Auditorium, 1st Floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Professor Dr. Zeenat Jabin *Co-Chair:* Dr. M. Jahangir Alam

Keynote Speaker: Professor Dr. Kazi Manzur Kader

Title: Present Day Radiation Oncology Towards

Intensity-Modulated Radiation Therapy (IMRT) – Bangladesh Perspective

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes + 2 minutes Q&A for each paper

Paper ID	Title	Authors
CP-29	Development a dose escalation of IMRT protocol of HN cancer patient based on SBRT treatment procedure	F Yeasmin, M J Alam, K F Kakolee
CP-30	Commissioning of Radiotherapy Treatment Planning System using CIRS Thorax Phantom	Md. Shoorjo Islam Khan, Rajada Khatun, Md. Mokhlesur Rahman, Md. Anwarul Islam, Shirin Akter, Ashrafun Nahar Monika, Md. Mahfuzur Rahman, M M Ahasan, Golam Abu Zakaria, Sultan Mahmud
CP-31	A new approach for determination of correction factor to make plane parallel and thimble chamber substitutable in dosimetry of photon and electron beam	M. Shahidullah, T. Siddiqua, H. M. Jamil, N. Arobi, M. A. Hasnat, M. M. Parvej, M. S. Sultana, M. M. H. Miah, M. S. Rahman
CP-32	Analysis of percentage depth dose for 6 and 15 MV photon energies of medical linear accelerator with CC13 ionization chamber	Md. Ahad Mia, Md. Shakilur Rahman, Santunu Purohit, SM Enamul Kabir and AKM Moinul Haque Meaze

Session- 4B

Date: 27 May 2022, Friday

Time: 11:15 am – 12:30 pm

Track: Nuclear Medicine and Health Physics

Venue-2: Class Room, 1st Floor, Atomic Energy Center (AEC), Dhaka

Session Chair: Dr. Debasish Paul *Co-Chair:* Mrs. Tanjim Siddiqua

Keynote Speaker: Dr. Shuza Uddin

Title: Measurement of accurate production and decay data of the non-standard positron emitter ^{86}Y for theranostic application in medicine

(12 minutes + 3 minutes Q&A)

Contributory papers: 8 minutes for each paper + 2 minutes Q&A

Paper ID	Title	Authors
CP-33	Radiation Monitoring of ^{60}Co Teletherapy Unit, SSDL, BAEC	H. M. Jamil, M. A. Aziz, T. Siddiqua[1], N. Aurobi, S. Paul, M. H. Bhuiyan, M. S. Rahman
CP-34	Noise Scenario in Rural Areas of Khulna City and Its Impact on Human Health	Kazi Rubaiyet Islam and Jolly Sultana
CP-35	Present status and future prospectus of PET-radiopharmaceuticals production facility at NINMAS of BAEC	Sanchoy Chandra Biswasarma, Mohammad Anwar-Ul Azim, Jashim Uddin, Md. Ariful Islam, Nahid Hossain, Md. Shohag Mia, Hasan Mehedi, Md. Alamgir Kabir, Mustafa Mamun, Md. Nurul Islam
CP-36	Rising Trend of Gastrointestinal Carcinoma and Role of PET-CT & Cyclotron: A Single Institute Experience	Papia Akhter, Tapati Mandal, Jasmin Ferdous, Pupree Mutsuddy, AB Siddique and Shamim M F Begum
CP-37	Determination of Radioactive Exposure at the PET-CT Facility of Institute of Nuclear Medical Physics	[1]Tanoy Saha , [1]Sheikh Shahrier Islam Shuvo, [1]Prashanta Roy [2]Mannu Bardhan Paul , [1]Prof. Dr. Md. Kabir Uddin Shikder, [1]M Monjur Ahasan

Abstracts

IP-1: Education, Research and Clinical Importance of Medical Physics Profession

Salahuddin Ahmad, Ph.D., DABR, FACMP, FAAPM, FACR

Department of Radiation Oncology &

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A medical physicist is a professional who specializes in the application of the concepts and methods of physics to the diagnosis and treatment of human diseases for example: cancers of different sites of human body. The discipline consists of the field of therapeutic radiologic physics, diagnostic imaging physics, medical nuclear physics and medical health physics. The mission of the therapeutic medical physics is to provide cutting-edge oncologic care within a milieu of commitment to teaching and research. To promote quality education of medical physicist, accreditation of graduate, residency and continuing medical education that meets high standard; and professional certification that an individual has demonstrated a prescribed level of professional competency must be required in order to minimize unexpected radiation accidents. The objective and the requirements of graduate and therapeutic medical physics residency, as well as examples of physics and clinical research currently undertaken in Stephenson Cancer Center of Oklahoma University Health Sciences Center as well as throughout the medical physics discipline will be highlighted.

IP-2: Measurements of Reaction Cross Sections of Various Medical Isotopes

G.N. Kim[1] and H. Naik[1,2]

[1]*Department of Physics, Kyungpook National University, Daegu 41566, Korea*
[2]*Radiochemistry Division, Bhabha Atomic Research Centre, Mumbai-400085, India*

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Isotopes of different elements have various applications in the field of research, geological and archaeological, molecular biology, agricultural, industry and medical. Some of the isotopes used for medical purpose are, ^{11}C, ^{18}F, ^{24}Na, $^{32,33}P$, ^{47}Sc, ^{59}Fe, $^{57,60}Co$, ^{57}Ni, ^{68}Ga, ^{89}Zr, ^{99}Mo-^{99m}Tc, $^{111,114m}In$, $^{124,125,131}I$, $^{196,198}Au$ and ^{203}Hg. The medical uses of these isotopes are based on the emission of γ-ray, positron or β^- particles. In this talk, I am presenting the measurements of production cross sections of the medical isotopes such as ^{59}Fe, ^{57}Co, ^{57}Ni, ^{68}Ga, ^{89}Zr, $^{111,114m}In$ and $^{124,125}I$ using photon (bremsstrahlung), medium energy neutron, proton and alpha particle induced reactions. The preparation of the above-mentioned isotopes were done by using the electron linac at ELBE, Dresden, Germany, at PAL Pohang and the MC-50 cyclotron at KIRAMS, Seoul. The proton beam was used from the MC-50 cyclotron, whereas the medium energy neutrons were produced from the $^{9}Be(p,n)$ reaction. The photon flux in the form of bremsstrahlung was produced in the electron linac at ELBE and PAL. We measured the production reaction cross section as a function of excitation energy i.e. the excitation function of $^{59}Co(n, x)^{56,57,58}Co$, $^{nat}Ni(\gamma, pxn)^{55,56,56,57,58}Co$, $^{nat}Ni(\gamma, xn)^{56,57}Ni$, $^{59}Co(n, p)^{59}Fe$, $^{68}Zn(p, n)^{68}Ga$, $^{90}Zr(\gamma,n)^{89}Zr$, $^{nat}Zr(n, xn)^{89}Zr$, $^{nat}In(\gamma,xn)^{111,114m}In$, $^{127}I(\gamma,xn)^{123,124,126}I$, $^{197}Au(\gamma,n)^{196}Au$ and $^{nat}Pb(n, \alpha xn)^{203}Hg$ reactions. Among these, ^{89}Zr, ^{57}Ni and ^{68}Ga are for PET alternatives to ^{11}C and ^{18}F. The radionuclide ^{59}Fe is used for the diagnosis of blood cancer. ^{57}Co is frequently used as a calibration standard for γ-ray spectrometry and in SPECT. Similarly, ^{111}In is widely used as radiopharmaceutical for diagnosis of cancer and other disease through SPECT, whereas ^{114m}In as therapeutic agents. ^{124}I can also be used as a PET radiotracer due to its longer half-life compared to ^{18}F. The radionuclide ^{203}Hg in place of ^{131}I can be used to detect and locate the brain tumour.

IP-3: Activities of TMSS Health Sector in Brief

Prof. Dr. Hosne-Ara Begum *(Ashoka Fellow & PHF)*

TMSS, Bogura, Bangladesh

TMSS is one of the largest organizations in Bangladesh and the largest women-led and women focused NGO in Bangladesh, working for poverty alleviation, socio-economic development and empowerment of women. TMSS is implementing various projects all over the country for improving the health status of the people of Bangladesh, TMSS established Health Sector in 1990. At present, TMSS Health Sector is the largest sector of this organization.

Under this sector, TMSS Medical College is the largest Non-Government Medical College in the country which is six kilometer north to Bogura town, established in January 2008. It has 1000 beds multi-disciplinary hospital with modern diagnostic equipment and treatment facilities. Recently TMSS Medical College & Rafatullah Community Hospital has extended its services and has established a Modern Cancer Care Center named TMSS Cancer Center. It has 150 beds with all kind of latest teleological equipment for radiation therapy, chemotherapy, surgery, diagnosis and treatment of different kinds of cancer. It is now ready for operation. Along with services to patients, the facilities in TCC and in recently established Biomolecular Lab will be used for research and academic purpose.

IP-4: Medical Physics for Sustainable Healthcare- need of Structured Medical Physics Education

Professor Dr. Arun Chougule

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The theme of International Day of Medical Physics -IDMP2022 is "Medical Physics for sustainable development". Further Medical Physicists [MP] are health professionals recognized by International Labor Organization (ILO) and therefore medical physicists working in clinical environment should have required competency and therefore undergo minimum two years structured residency training program under experienced medical physicist in recognized institution after completing postgraduation in medical physics. IOMP has taken lot of initiatives to standardize the medical physics education across the globe. The IOMP policy statement no. 2 [https://www.iomp.org/wp-content/uploads/2019/02/iomp_policy_statement_no_2_0.pdf] provides the requirement and curriculum to become a clinically qualified medical physicist [CQMP]. Further IOMP has started the accreditation of medical physics education programs and the residency programs [https://www.iomp.org/accreditation/]. The medical physics education [MPE] program information across the globe is compiled and regional organization [RO] wise information is put on IOMP website [https://www.iomp.org/education-training-resources/]. From the information it is clear that there is huge disparity in availability of MPE programs and need of CQMP's in various RO's of IOMP. Out of total of 354 MPE programs, 60 are in USA and Canada (0.16 programs/million population), 105 are in EFOMP (0.14 programs/million population), 107 are in AFOMP (0.024 programs/million population), 32 are in ALFIM (0.048 programs/million population), 36 are in FAMPO (0.026 programs/million population) and 14 in MEFOMP (0.034 programs/million population).

Asia-Oceania Federation of Organizations for Medical Physics (AFOMP) was founded in 2000 and today 21 countries national medical physicist associations (NMPO) with over 11000 medical physicists in Asia-Oceania region are members of AFOMP. If we look at socio-economic & educational status of AFOMP countries, we find huge diversity and therefore task of AFOMP to homogenies the medical Physics education and profession is quite challenging. To be specific with Bangladesh, the population of Bangladesh is about 168 million and the cancer incidence is 160000 new cases per year. Radiotherapy is main modality of cancer treatment and about 60 % of cancer patients need treatment by radiotherapy, i.e., about 100000 cancer patients needs radiotherapy. On a teletherapy machine at the most 500 cancer patients treated per year and therefore needs at least 200 teletherapy units however in whole of Bangladesh only about 35 teletherapy machines are available for treatment. There is a shortfall of 6-fold. To establish a radiotherapy center needs a huge budget, manpower and takes about 2 years to establish the facility. Further to take care of the radiotherapy treatment CQMP required in Bangladesh will be 200 however available are only 70, a huge gap. Similarly, services of CQMP are required in radiology, nuclear medicine, teaching and research. Bangladesh needs to enhance the education and training facilities for making available sufficient number of CQMP.

AFOMP is working to cater to the needs of the medical physicists and their education, AFOMP has created three main committees to work on number of important tasks.

1. Professional Relations Committee (PRC)
2. Education and Training Committee (ETC)
3. Science Committee (SC)

These committees have drafted policy statements to deal with minimum level of education and training of medical physics, continuous professional development, and career progression for clinical medical physicist in AFOMP countries. All the six policy statements of AFOMP are available on AFOMP website [https://afomp.org/policy-statements/]. AFOMP has formed a task group to prepare a medical physics education curriculum in tune with the needs of AFOMP region and after many deliberations the drafts are in final stages, two curriculums, one is standard encompassing requirements of IAEA and IOMP and another is advanced considering the recent development and future requirement of medical physicists' competency.

To enhance standards of education and research in medical physics, AFOMP has started many award programs, the detailed information is available on AFOMP website[https://afomp.org/category/award-programs/]. With continuous efforts in subsequent years the status of medical physics and physicist has increased but still there is long way to go ahead to reach its goals.

"To achieve more, we should imagine together."

KP-1: Past, Present and Future of Radiation therapy in Bangladesh

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The Past of Radiation Therapy

The first radiation treatment of Bangladesh was performed by using some radium needles at Dhaka Medical College Hospital (DMCH) of erstwhile East Pakistan in 1946. Dr. Huq was the first local radiation oncologist of the country.

The first Deep X-ray machine of the country for radiation therapy treatment was installed in 1953 at a private hospital named Kumudini Hospital at Mirzapur.

The first radiotherapy department under government setup was started in 1959 in Dhaka Medical College Hospital.

In 1981, a project of 100 bed Cancer Institute was approved to be built at Mohakhali, Dhaka. In 1985 RCDU building was built by Rotary Club of Dhaka at Mohakhali on government allocated land and it was handed over to government. In 1991, Cancer Institute initiated the services of 50 bed indoor facility. The first Cobalt60 machine was installed in 1995 at NICRH.
The first private cancer centre of the country Delta hospital started its journey in 1994 with a Cobalt60 machine.

Present state of Radiation therapy

Radiation therapy facilities

NICRH is the only tertiary level comprehensive cancer care centre of the government in the country situated at Dhaka. Most of the medical colleges are having oncology department offering cancer care to the patients. But only eight centres have radiotherapy treatment facilities. The average waiting time for radiotherapy is three to four months at NICRH.

Summary of Current Radiation therapy equipment in Bangladesh is as follows:

Sl.	Equipment	No
1	Clinical Accelerator	25
2	Cobalt 60	13
3	CT Simulator	15
4	HDR Brachytherapy	19

Human resources

There are around 150 radiation oncologists in the country. There are four post graduate courses for higher training in radiation therapy in the country. Bangabandhu Sheikh Mujib University is offering MD in Radiation Oncology and MD in Clinical Oncology and BCPS is offering Fellowship in Radiotherapy (FCPS) and Membership in Radiotherapy (MCPS).

There are around 38 medical physicists working at different radiotherapy centres of the country. Gono Bishwabiddalay pioneered the master's program of medical physics in the country. A similar master's program was also initiated in Dhaka University. Total eight institutes are offering diploma degree to the RTT.

The Future of Radiation therapy

There is a serious inequality of distribution of RT facilities around the globe. While 85% of the world's population lives in the developing countries but it possess only 30% of the world's RT facilities. Paradoxically the developed countries having the 15% of the world's population avail 70% of the RT facilities.

The existing RT equipment of Bangladesh provides a RT coverage of only 12.9% which is one of the lowest in SAARC region.

Every year a good number of new radiation oncologist are being conferred post gradation degrees. State of art radiation therapy treatments like IMRT, IGRT, SRS and SBRT are now practiced at limited centres.

Almost all the anti-cancer drugs are now available in the country and majority of the common anti-cancer drugs are manufactured locally.

The Lancet, a renowned British medical journal, termed Bangladesh's success as the "Bangladesh paradox" describing it as one of the great mysteries of global health.

It is believed that the wave of this success will also have a positive impact on the cancer care sector of the country and significant quantitative and qualitative improvement will be achieved by the combined effort of government, private sectors and other local and international supporting agencies.

KP-2: Medical Exposure Control: Perspective on Risk Management and Compliance with Regulatory Requirements

Meherun Nahar

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Medical exposure primarily refers to exposures to individuals as part of their own medical diagnosis or treatment and to exposures (other than occupational) incurred knowingly by individuals healing in the support and comfort of patients undergoing diagnosis or treatment. Exposure of an individual to other sources such as stray radiation from diagnosis or treatment of other persons is not included in medical exposure, nor is any occupational exposure of staff. It however includes exposures incurred by volunteers as part of a programme of biomedical research (ICRP-60).

Uses of complex technologies, utilizing radiation sources in radiotherapy facility has brought in its wake the need for exercising regulatory requirements to justify and optimize medical exposure. This expo sure is deal in a strikingly different manner from occupational and public exposures, because procedures causing the exposures are for the direct benefit of health of a person. Dose limits specified for occupational and public exposures does not apply to medical exposure. Though no dose limits are specified, as the knowledge of effect of ionizing radiation and the associated risk of growing, the bland assumption that the benefits outweigh the risk of the patient is no more considered to be true in all cases of medical exposures. Since radiation exposure in popular term is undesirable, it is necessary to control medical expo sure by risk assessment and analysis of events relative to accidental and unintended medical exposures. The medical physics role within national healthcare, facilities and hospitals has become effective in this context.

Methodology: The principal legal documents which apply to the control of medical exposure in radiotherapy practices, in Bangladesh are :

(1) Bangladesh Atomic Energy Regulatory (BAER) Act (No. 19 of 2012)
(2) Nuclear Safety and Radiation Control Rules (SRO No.205-Law/97)
(3) Regulatory Guide on Radiation Protection in Radiotherapy- NSRC –RT-G-01

Results: The mandatory regulatory requirements which must be fulfilled by Radiation staff: radiation oncologists, medical physicist and radiation therapist to deliver medical exposure without risk and preventing accident in radiotherapy practices are:
(1) Pursuant to the section 18.2 and 21 of BAER Act 2012 any user shall require authorization for procure, own, possess, use, repair-maintain, store, abandon or dispose any device or apparatus producing ionizing radiation and radioactive material for radiotherapy work.

(2) According to Rule 26 of NSRC Rules -1997 to control therapeutic exposure. – the license shall ensure that –

(a) the exposure of normal tissue during radiotherapy be kept as low as reasonably achievable consistent with delivering the required dose to planned target volume, and organ shielding be used where feasible and appropriate;

(b) the radio therapeutic procedures causing exposure of the abdomen or pelvis of a woman, pregnant or likely to be pregnant, be avoided unless there is strong clinical indication;

(c) the administration of radionuclide for therapeutic procedures to a woman, pregnant or likely to be pregnant, or in lactation, be avoided unless there is strong clinical indication;

(d) the therapeutic procedure for a pregnant woman be planned to deliver the minimum dose to the embryo or fetus; and

(e) the patient be informed of the possible risks

(3) Investigation of Accidental Medical Exposure. –the licensee shall ensure the compliance with investigation requirements as per the applicable standards of an accidental medical exposure. (Rule 33)

(4) For therapeutic uses of radiation, the calibration, dosimeter and quality assurance requirements in pursuant to the applicable standards are conducted by or under the supervision of a qualified expert in radiotherapy physics (Rule 23.2).

Beside this the - Chapter-IV (Safety, Technical and Management Requirement), Chapter-VI (Medical Exposure Control) and Chapter –IX (Operating Exposure Control) are important for the regulatory compliance with the radiotherapy practice.

Conclusion: All Radiation staff: radiation oncologists, medical physicist and radiation therapist should aware about national and international safety standards for safe use of ionizing radiation in radiotherapy technology for cancer management in Bangladesh. Sufficient training, effective communication with different professional and proper documentation and clear procedures are essential component for medical exposure control during radiation therapy with minimizing accidental exposure. Intent of this study is to strengthen regulatory compliance assurance regime within the facilities in Bangladesh. The medical physics role within national facilities and hospitals and the cooperation with the regional and international organizations will accelerate the development of medical exposure control regime in this country.

KP-3: Biological individualization of radiotherapy- A translational approach

Dr. Mohammad Kamruzzaman

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NSU Genome Research Institute

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Introduction

Radiotherapy targeting and delivery have improved over the last two decades due to advances in medical physics, planning software and imaging for staging and delineation of tumor extent. Radiotherapy is now targeted with increased accuracy to tumors while minimizing doses to surrounding healthy tissue. To further improve clinical outcome, precision radiotherapy includes the established use of concurrent chemotherapy, molecularly targeted agents or immunotherapy plus chemotherapy. Given the increased toxicity with multi-modality treatment, there is an increasing need to identify patients who are likely to benefit from these more aggressive treatments using relevant biomarkers and spare those who are unlikely to benefit. Improvements with physical optimization are now being realized and further gains in therapeutic ratio should be possible using biological optimization. There are many approaches for biomarker development that include investigation of functional assays, high-throughput technologies to derive DNA, RNA or protein profiles, and functional or molecular imaging. So, it is time demanding to focus on predictive assay research and the development of approaches for the biological individualization of radiotherapy.

Materials and methods for predictive assays

The materials and methods are many and can be tumor site specific. The most widely studied tumor tissue is formalin fixed and paraffin embedded (FFPE). Fresh frozen tissue is also used as some assays require enzymatic activity or post-translational protein modifications which can be lost during formalin fixation. Assays have also been developed using circulating tumor cells or DNA in blood. Macromolecules taken for study can be DNA, RNA or protein. Sequencing of the human genome and the development of high-throughput technologies are increasingly being used to derive both prognostic and predictive gene signatures. Methods for genome-wide analysis are widely used, e.g. there are arrays to analyze single nucleotide polymorphisms (SNPs), DNA methylation, large genome alterations via comparative genomic hybridization (CGH) and activity via mRNA and non-coding RNAs (e.g. microRNAs). It is now possible to study a large number of proteins using proteomics. The development of tissue microarrays has facilitated the study of protein expression in large numbers of archival tissue samples. Application of these methods shows promise for developing biomarkers for tumor diagnosis, prognosis and prediction. Biomarkers for cancer treatment individualization are now being used clinically; but none that specifically target outcome in radiotherapy patients.

Discussion

When reliable predictive assays are developed, their successful use must depend on the availability of alternative treatments. For example, patients with very hypoxic tumors could be assigned to treatments which include hypoxia-modifying or hypoxia-exploiting agents. Tumors with fast repopulation potential would be candidates for accelerated fractionation (including hypofractionation), or radiotherapy combined with drugs designed to combat proliferation (e.g. EGFR inhibitors).There is now good evidence that patients that have hypoxic tumors benefit most from combining hypoxia-modifying treatment with radiotherapy, high EGFR–expressing tumors benefit from accelerated rather than conventional radiotherapy, MGMT methylation in brain tumors benefits from the addition of temozolomide to radiotherapy, and HPV-associated head and neck tumors have a good prognosis following radiotherapy. If reliable information were available for predicting the risk of severe normal tissue effects, possible strategies would be to offer surgery rather than radiotherapy for some cancers (e.g. mastectomy rather than breast-conserving radiotherapy; surgery rather than radiotherapy for some bladder and head and neck tumors); to reduce the radiation dose for radiosensitive individuals; to offer a radioprotective agent (assuming the agent does not also protect tumors); or to use a post-radiotherapy strategy designed to reduce vascular and parenchymal consequences of irradiation, such as anti-TGF-β and anti-inflammatory approaches.

Conclusion

Once improvements with physical optimization of radiotherapy are realized further gains in therapeutic ratio require radiobiological optimization. Intrinsic tumor cell radiosensitivity is a significant and independent prognostic factor for radiotherapy outcome, but functional assays have limited clinical utility as predictive assays. Derivation of gene signatures associated with tumor radiosensitivity is a promising approach. Continuing progress is being made in developing techniques for monitoring tumor genetics and this, coupled with the development of molecular-targeted drugs, should mean that more tumor specific therapies with less toxicity should emerge in the near future.

KP-4: In search of noble material for medical and industrial radiation dosimetry

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The radiobiological or clinical outcomes in radiotherapy are inherently dependent on accurate radiation dosimetry. A radiation dosimeter does not provide protection but detects and measures the radiation that is exposed to an individual. Over the last few decades, a range of dosimeters such as ionization chambers, thermoluminescence dosimeters, film dosimeters, semiconductor dosimeters, etc. has been commonly used in radiotherapy or other applications. However, the shortcomings of each type of dosimeter limit their applications for in vivo radiation measurements for the provision of real-time dosimetric information. On the other hand, this decade has seen intensive research on carbon-based materials for a wide variety of applications. Since carbon-based materials have an effective atomic number similar to that of adipose tissue, they may be suitable for soft tissue dosimetry, and thus we find a particular interest in the thermo-luminescent properties of Hi-polymer carbon and their sensitivity towards ionizing radiations. The objective of this work is to explore a new generation of radiation dosimeters by using state-of-the-art technologies to realize real-time monitoring of dose delivery in radiotherapy.

The considerable versatility of carbon materials arises in great part from the strong dependence of their physical properties on the ratio of sp2 (graphite-like) to sp3 (diamond-like) bonds. Present work is distinct from the many defect alteration studies in graphite and graphene conducted using neutron, gamma-mediated and electron/ion irradiation dose values from 10s to several hundred kGy. The intention is to demonstrate that x-ray irradiations create structural alterations in carbon-rich materials at much lower doses than previously determined, also pointing to a convenient means by which analyses of structural changes in carboniferous media can be made.

Structural alterations of the irradiated polymer pencil lead graphite (PPLG) have been observed via Raman and Photoluminescence (PL) spectroscopy, also via X-ray diffraction (XRD), providing information on physical parameters relating to the defects participating in the luminescence process. The results indicate 0.3 mm PPLG to offer promising potential as a new generation of radiation dosimeter, including for medical radiation applications.

KP-5: Scopes of FDG PET-CT Imaging in Patient Management: Six Years' Experience at NINMAS

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FDG PET-CT (fluorodeoxyglucose Positron Emission Tomography-Computer Tomography) is a newer and more advanced technique. The discovery of the Warburg effect, followed by the creation of the fluorinated glucose analogue 18F-fluorodeoxyglucose (18F-FDG) and the invention of positron emission tomography, lay the foundation for the PET-CT scan. This is a non-invasive molecular imaging approach that combines PET and CT images using a single imaging device. Because it provides metabolic as well as morphologic information, PET-CT has offered cancer patients a new lease on life. It helps with cardiology, neurology, and a variety of viral and inflammatory diseases. The first government set up PET-CT machine was established in 2015 at National Institute of Nuclear Medicine and Allied Sciences (NINMAS), Dhaka. Prior to this, patients had to go to abroad for this complex test, which took a long time and cost a lot of money. Patients may now get this opportunity at NINMAS for last six years. In this investigation, the NINMAS PET-CT scan database was queried for all patient FDG PET-CT scans completed between January 2016 and December 2021. A total of 2402 scans were performed and in this lecture the experience for various clinical purposes of PET-CT will be sheared.

KP-6: Design and Development of Covid related Medical devices during Pandemic by groups at Dhaka University and BIBEAT Limited

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The recent Covid pandemic revealed a great weakness of the system of development and manufacture of Medical Devices prevailing in the world. At present only the advanced countries develop and manufacture such devices but 80% of global population living in low and medium income countries (LMIC) remain devoid of the benefits of these devices based on modern technology. Unless such devices are designed and developed in each country, the majority of the global population is going to suffer, which will also bring down the advanced countries with them eventually.

With this view, the author has been consistently leading groups at the University of Dhaka, first at the Department of Physics and later, at the Department of Biomedical Physics & Technology, to develop Medical Devices and techniques appropriate for LMICs. However, through this process the groups also contributed through innovations that are unique in the world and can be of use globally. Side by side, the author also founded BIBEAT Limited, a social enterprise, to fabricate and distribute (commercially if viable), some of these developed items. In this talk the author will only describe the devices for which requirements were felt during the recent Covid pandemic and which this two groups under his leadership developed and fabricated. These devices are:

i. Negative Pressure Isolation Canopy-on bed (NPIC), a unique design.
ii. Pressurised Air Purifying Respirator (PAPR).
iii. Positive Pressure Isolation Canopy – on bed (PPIC), a first in the world.
iv. UV-C Room Steriliser, with a unique feature to irradiate 360 degree directly.

The first two are to protect healthcare workers from infective patients (such as Covid patients) during caregiving, the third is to prevent infection of a patient in a hospital from others, to prevent Hospital Acquired Infection (HAI), a severe global problem. This is also very useful for burn patients. The fourth item is to augment disinfection of hospitals including operation theatre, ICU, outpatient departments, etc., and also to disinfect offices, shops, educational and religious institutions, etc., where many people gather together. All the above products are ready and may be fabricated on demand by BIBEAT Ltd.

KP-7: Present Day Radiation Oncology Towards Intensity-Modulated Radiation Therapy (IMRT) – Bangladesh Perspective

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Radiotherapy is the most successfully and most frequently used treatment modalities for cancer patients after Surgery; it is applied about 60% of all cancer patients as definitive, adjuvant or palliative to surgery or chemotherapy.

Radiotherapy aims to deliver a radiation dose to a tumor, which is high enough to kill all tumor cells. That is from the physical & technical point of view a difficult task, because malignant tumors often are located close to radiosensitive organs such as the eyes, optic nerves and brainstem, spinal cord, bowels or lung tissues.

These so-called organs at risk (OAR) must not be damaged during radiotherapy. The situations even more complicated when the tumor itself is radio resistant and very high are needed to reach a therapeutic effect.

This is the point where new technologies in radiation oncology, especially Three Dimensional Conformal Radiotherapy (3DCRT), come into play. Any 3DCRT plan conforms the spatial distribution to the prescribed dose to the target, concomitantly excluding critical normal tissue from the volume receiving high radiation doses.

The reduction of dose to normal tissue permits tumor dose escalation, compared to conventional methods. Advances in computer technologies have significantly changed the practice of radiotherapy towards Intensity Modulated Radiation Therapy (IMRT). IMRT is considered an extension of an advanced form of 3DCRT.

Instead of using uniform fields as in 3DCRT, IMRT uses intensity modulated fields to generate dose distributions that are more conformal to the target. IMRT requires a higher level of precision compared to 3DCRT.

This is because the generation of modulated fields by the inverse treatment planning algorithm is directly based on the Computerized Tomography (CT).

In radiotherapy practice over the years of experience and research have confirmed that escalation of radiation dose to tumors results in better tumor control, with the routine radiotherapy technique it would not be possible to increase the tumor dose due to the associated increase in dose to normal structures around the tumor. Higher doses to normal structure have exhibited unacceptable complications. Thus a balance was sought between tumor control (cure) and morbidity (complications), with improved imaging modalities better delineation of target volume is possible alone with critical structures around.

Development of computerized treatment planning systems and facility to transfer computerized tomography (CT) images to planning systems improved escalation of dose to various structures and the uniformity of dose to entire target volume.
Development of various dose calculation algorithms could define dose precisely and point to point in the entire patient body. This enables volumetric studies and critical analysis of dose to various structures by Dose Volume Histograms (DVH) for target and other critical structures.

All facilities are available in Bangladesh.

KP-8: Measurement of accurate production and decay data of the non-standard positron emitter ^{86}Y for theranostic application in medicine

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The β^+- emitting radionuclide ^{86}Y ($T_{1/2}$= 14.7 h) forms a "matched-pair" with the β^--emitting therapeutic radionuclide ^{90}Y ($T_{1/2}$= 2.7 d) for theranostic application in medicine. This concept was first applied in1993 at the Forschungszentrum Jülich, Germany, and the radionuclide ^{86}Y was administered to a tumor-bearing patient prior to medication with the beta-emitting therapeutic radionuclide ^{90}Y. Based on the distribution kinetics of ^{86}Y, determined via Positron Emission Tomography (PET), quantitative radiation dosimetry data could be obtained while using ^{90}Y. This approach proved to be very successful. This pair has been used for labelling of antibodies and peptides in many investigations. In this work we concentrated on the accurate determination of production data and decay data of ^{86}Y which were still rather uncertain.

The $^{86}Sr(p,n)^{86}Y$ reaction on a highly enriched target over E_p = 14 → 7 MeV is the most suitable route for the production of high-purity ^{86}Y on a clinical scale. This experimental study provides an accurate set of data for this important radionuclide.

Thin samples of 96.4 % enriched $^{86}SrCO_3$ were prepared by sedimentation and, after irradiation with protons in a stacked-form, the induced radioactivity was measured by high-resolution ©-ray spectrometry. Through an accurate measurement of the excitation function of the $^{86}Sr(p,n)^{86m+g}Y$ reaction, the discrepancies in the existing data have been removed and the database has been strengthened. An accurate estimation of the isotopic impurities $^{87m,g}Y$ and ^{88}Y showed that > 98 % pure ^{86}Y is produced using the 96.4 % enriched ^{86}Sr target. The level of the impurity would be considerably reduced if ~ 99 % enriched target could be made available.

This theranostic approach with the $^{86}Y/^{90}Y$ matched pair demands a precise knowledge of the positron emission probability of the PET nuclide ^{86}Y. In this work an ^{86}Y source of high radionuclidic purity was prepared and a direct measurement of the positron emission intensity was performed using high-resolution HPGe detector γ-ray spectroscopy; whereby the 511 keV annihilation radiation was characterized. The electron capture intensity was also determined as an additional check by measuring the *K*〈 and *K*® *X*-rays of energies 14.1 and 15.8 keV, respectively, using a special HPGe detector. From those measurements, values of 27.2±2.0% for β^+ emission and 72.8±2.0% for *EC* were obtained. Our measured positron intensity is 14-20% lower than the evaluated value available in the Nuclear Data Sheets. The detailed results will be presented during the conference.

CP-1:Dosimetric comparison of 2D, 3DCRT, IMRT and RapidArc in the treatment of Carcinoma of Brain Tumor

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Aim: To compare the dosimetric advantage of 2D, 3DCRT, IMRT and RapidArc in Carcinoma of Brain Tumor.

Materials and Methods: We retrospectively selected ten previously treated brain tumor patients with 2D, 3DCRT, IMRT and RapidArc technique. All the ten patients under went CT simulation. The target is CTV and PTV and critical structures are brain steam, optic chiasma, pituitary gland, lens, optic nerve, eye etc., were delineated according to the RTOG guideline. 2D plans were created using bilateral fields, 3DCRT plans were created using 5 fields, IMRT plans were created using 5 fields equilibrium gantry angle rotations and RapidArc plans were created using 2 full arcs. 6 MV photon bream using for all types of plans with a dose rate of 600 MU/min were used. Same dose constraints for the targets and the critical structures for a particular patient were used during the optimization in IMRT and RapidArc datasets. 2D and 3DCRT normalizations at field 1 isocenter. IMRT and RapidArc plan normalizations is at 100% target mean. We intend to deliver 60 Gy in 30 fractions for all the patients. Doses to the critical structures and targets were recorded from the dose volume histogram for evaluation.

Results: Target homogeneity for all the 2D, 3DCRT, IMRT and RapidArc plans are evaluated where the RapidArc plan is more homogeneous than that of 2D and 3DCRT as well as IMRT. Conformity index shows that the 2D plans over treat by 117% more of PTV volume, 3DCRT by 38%, IMRT by 15% and RapidArc plans by 13% i.e., the RapidArc plans were treated minimum overtreated volume.

Conclusion : Significant dose reduction in both lenses, both optic nerve, pituitary gland and optic chiasma IMRT plans compare to 2D, 3DCRT and RapidArc plans. It is found that the low dose volume is reduced for 2D plans compared to 3DCRT, IMRT and RapidArc plans.

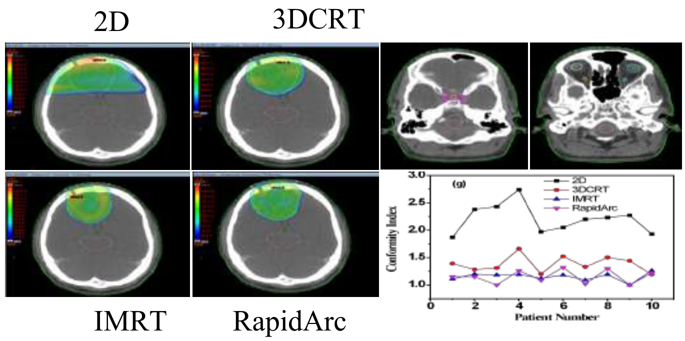

Fig.: (a-d) Dose distribution in 2D, 3DCRT, IMRT and RapidArc planning, respectively. (e,f) OAR and target delineation in axial slices. (g) Conformity Index of 2D, 3DCRT, IMRT and RapidArc plan for different patients.

CP-2: Estimation of Jaw Transmission Factor of Medical LINAC Installed at Institute of Nuclear Medical Physics, BAEC

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Introduction

Medical Linear Accelerator delivers ionizing radiation. For increasing target coverage and spare healthy tissue radiation treatment techniques using photon beam such as Intensity Modulated Radiotherapy Treatment (IMRT) and Three-Dimensional Conformal Radiation Therapy (3D-CRT) need accurate dose calculation. In the Institute of Nuclear Medical Physics the Eclipse 13.6 Treatment Planning System (TPS) is used where a model-based photon dose algorithm (AAA) is used to determine the Jaw Transmission Factor (JTF) on the basis of commissioning data. On the dose distribution, there may have a dosimetric effect for model parameters (obtained by the phantom study process in TPS) because the values can be different for direct measurement.

Methods

The Jaw Transmission Factor has been measured with FC65-P ionization chamber using 1 D phantom at reference condition for Clinac iX for photon beam of energy 6 MV and 15 MV installed at Institute of Nuclear Medical Physics, AERE, Savar. JTF is the ratio of the output at the reference depth under the closed jaw collimator to that at the same depth with the field size 10×10 cm^2 in the water phantom. In this work we used the TPS for estimating the JTF obtained by the phantom study process.

Result

For direct measurement, JTF **were** 0.003307 for 6 MV and 0.00354 for 15 MV. For phantom study process in TPS the JTF was 0.0035007 for 6 MV and 0.003543 for 15 MV.

Conclusion

By the direct measurement, the JTF slightly differ from those by phantom study process in TPS with the consideration of the photon beam of energy 6 MV and 15 MV. In the low-dose region, the dose is affected by these different parameters. During the beam commissioning, to get rid of the dosimetric error for the estimation of JTF, comparison of direct measurement and phantom study process in TPS of JTF is a must.

Keywords: LINAC, Dose, Jaw Transmission Factor, TPS, Photon Beam, Water Phantom.

CP-3: Quality Control Results of a Medical Linear Accelerator by Analyzing PDD at Institute of Nuclear Medical Physics

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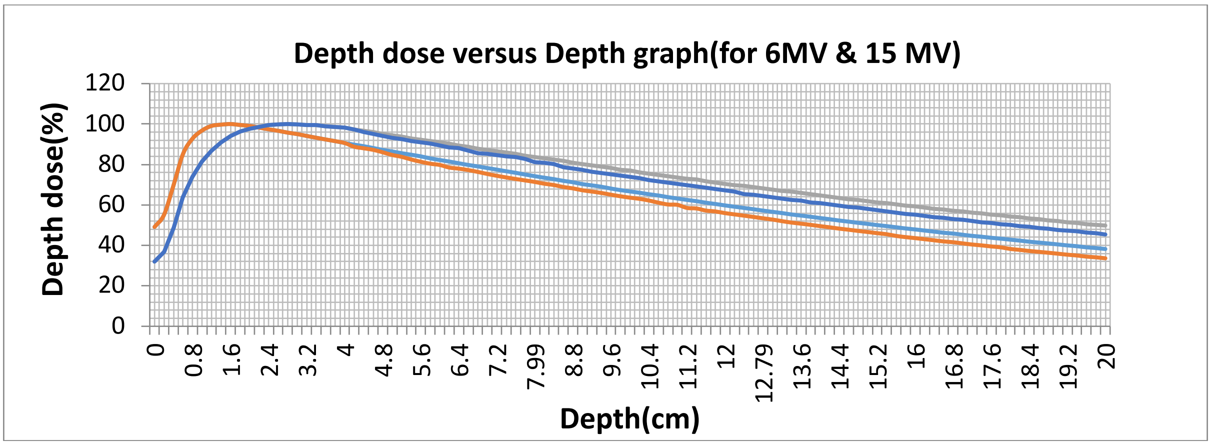
Introduction: In Bangladesh, nuclear medicine and nuclear technologies are being used in the diagnosis and the treatment of cancer. Radiotherapy is mainly used for the treatment of the cancerous tumors. With a high dose, the exposed cells (both healthy and cancerous cells) can be damaged. For the quality check of the Medical Linear Accelerator (LINAC), we have measured Percentage Depth Dose (PDD) in water phantom. This was done by using ionization chambers for different energies of photon. We have compared the measured results with commissioning data used for Treatment Planning System (TPS).

Methods: We used a water phantom (IBA Blue Phantom^2) for measuring the PDD for photon beam energies of 6 MV and 15 MV of a Medical LINAC (Varian Clinac iX) installed at Institute of Nuclear Medical Physics. In this work, three dimensional water phantom (IBA Blue Phantom^2) was used with the setup, SSD: 100 cm, Field Size: 10 cm×10 cm, Dose Rate: 400 MU/Min. Two ionization chambers - one is called as reference chamber (Type:CC13 ; Serial no.:15051) and other is called field chamber (Type:CC13 ; Serial no.:15050) was connected to a computer via Common Control Unit (CCU). The PDD was measured at the centre axis. The "myQA Accept" software was used to get the dosimetric data.



Results: The PDD varies with the changes in depth, SSD and field size. The measured results are undergone through the comparison with the results found using TPS.

Conclusion: The PDDs characteristics of medical LINAC are very important for the perfection in radiotherapy treatment planning. From this work we can conclude that, dose decrease is a function of energy and higher energy beam have greater ability to penetrate.

CP-4: A Study about Wedge Factors: Physical and Enhance Dynamic Wedge for Clinac iX

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Introduction

The aim of modern radiotherapy techniques is to deliver maximum dose to the tumour cell and minimum dose to the normal cell. To ensure this purpose, different types of accessories are used in modern radiotherapy system, wedge is one of them. Wedge is commonly used to improve dose uniformity in the target volume. At Institute of Nuclear Medical Physics, linear accelerator (CLINAC iX) has two types of wedges, one is physical wedge and another is enhance dynamic wedge. To use these wedges in treatment planning system (TPS), it was commissioned earlier. These commissioned data may have change with time.

Methods and Material

For experimental data, iba 1D phantom with FC 65P chamber was connected with the electrometer (iba Dose 1). Source to surface distance (SSD) was set at 100 cm. chamber was kept at 10 cm depth from the surface and field size was 10cm·10cm. The dose was delivered according to the plan which was previously done at TPS with energy 6 MV and 15^0 wedge angle for both physical and dynamic wedges. The corresponding charge and absorbed dose were noted. For same setup and monitor unit, data were taken without any wedge. Wedge factor was calculated as a ratio of dose in water at a point on the central axis with and without the wedge for same monitor units.

Results

Physical wedge factor from experimental data was found 1.673 and from TPS data was found 1.638. Enhanced dynamic wedge factor from experimental data was found 1.732 and from TPS data was found 1.763.

Conclusion

Both Physical wedge factor and Enhanced dynamic wedge factor values are slightly varied for TPS value and experimental data. These data will be preserved for further study for different field sizes, wedge angles and energies.

CP-5: Study on Breast Cancer Contouring for 3D-CRT at INMP

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Objectives: There is always risk of recurrence of breast cancer. Cancer-cells may escape surgery and-chemotherapy. The aim is this study is to evaluate the contouring of breast cancer patients to reduce the risk metastasis and recurrence. This would support radiotherapy to reduce the risk of recurrence in breast cancer patients.

Introduction: 3D-CRT is the most common in external-beam radiation therapy to kill cancers cells. 3D-CRT allows radiation exposure of the tumor that is too close to vital organs and structures. This is achieved in balance with minimizing dose to normal tissues and developing dose in the treatment volume. The axiliary lymph node is always a risk factor in metastasis of breast cancer. During a mastectomy, the surgeon tries to reduce the risk by removing these nodes along with the breast mass. After surgery, chemotherapy is an excellent option to reduce the risk. However, in lypoma, these nodes are left behind if the histological reports are lymph node negative. But due to high-risk factor radiation oncologist consider these underarm lymph nodes during contouring. Available contouring guidelines for breast cancer are beneficial for routine practice and essential for clinical trial quality assurance. A good number of international consensus guidelines with detail clinical target volumes (CTVs) are available, but which one is most appropriate for a given clinical situation is confusing.

Material and Method : In this study, ten radiotherapy plans of breast cancer patient who were treated from January, 2018 to November, 2018 at Institute of Nuclear Medical Physics (INMP), were evaluated. All of the patients had gone through total mastectomy and chemotherapy. The CT of 128 slices was used to get the 3D image of the patients. According to the protocol for breast cancer patient lungs, heart and spinal cord are the organs at risk. These organs were drawn first. Then PTV (Plan Treatment Volume) was drawn directly, as all these patients were mastectomy patients. Additionally, the head of the humorous was drawn on the therapy side. TPS was done by Eclipse 13.7 software, in all cases, 3D-CRT is the technique for RT and the dose was set for 50Gy in 2Gy per fraction. Among these patients, 7 patients with under arm swelling are suspected of possible lymph node involvement. Most of the lymph node were at axilla level-I, followed by supraclavicular region and axilla level-Il. So we considered the supraclavicular area for RT in the axiliary lymph node.

Result : The average volume of PTV was $479.34 \pm 3 cm^3$, where in the 7 recurrence cases the average PTV volume was $535.13+24 cm^3$. Due to cover the axilla region the PTV have to increase for 3D-CRT. Here results are discussed in the context of the contouring guidelines.

Conclusion: This study will facilitate further discussion about guideline selection and modification, particularly for future clinical application of 3D-CRT at INMP although the research results are encouraging radiation therapy in breast cancer management. The population size would be increased for better interpretation statistical analysis. The possible side effects should be monitored at chest region by physical exam and other diagnostic procedures.

CP-6: Occupational Radiation Exposure among the Workers in Major Medical Practices of Bangladesh

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Introduction: Ionizing radiation plays an important role in medical practices throughout the world and consequently workers in the medical establishments are being exposed to ionizing radiation advertently or inadvertently. Measurement of the radiation doses to the occupational personnel is mandatory according to the rules and guidelines of IAEA, ICRP and ICRU.

Objective: To understand the complete scenario of the effectiveness of radiation protection practices in the workplaces of Bangladesh, especially in the medical fields where ionizing radiation is being used for the purpose of diagnosis and therapy. Therefore, efforts have been given in the assessment of collective effective dose, average effective dose, and contribution of different gender workers in the collective effective dose.

Methods: The occupational radiation exposures for 799 workers were investigated in the fields of radiotherapy (RT), cardiology (CD) and nuclear medicine (NM) throughout Bangladesh in 2019 by using thermoluminescent dosimeter (TLD). A Harshaw TLD reader (Model-4500) was used to measure the effective dose in a quarterly basis throughout the year. Database was prepared and recorded on the basis of the value of personal dose equivalent ($H_p(10)$).

Results: The collective effective dose was 25.80, 39.72 and 11.11 man.mSv among 187, 263 and 349 radiation workers in RT, CD and NM, respectively.

Table 1. General database of workers in various fields

Department	Physician				Other			
	Male	Collective Dose (man.mSv)	Female	Collective Dose (man.mSv)	Male	Collective Dose (man.mSv)	Female	Collective Dose (man.mSv)
Radiotherapy	37	BDL*	19	BDL	99	21.75	32	4.05
Cardiology	97	17.61	11	1.38	80	10.91	75	9.81
Nuclear Medicine	62	BDL	21	BDL	218	9.86	48	1.25

**BDL means below detection limit which is 0.05 mSv*

Discussions: The maximum effective dose received by radiation workers in a year was 8.72, 8.63 and 5.86 mSv in RT, CD and NM, respectively, that remained within the predetermined dose limits imposed by Nuclear Safety and Radiation Control (NSRC) Rules-1997, Bangladesh and International Commission on Radiological Protection (ICRP-103).

Conclusion: This kind of monitoring would help to construct a national database that will be used by the end users to improve their implementation of optimization in occupational radiation protection in the medical fields of Bangladesh.

CP-7: Calculation and structural design parameters of radiotherapy bunker shielding at TMSS Cancer Center according to Bangladesh Atomic Energy Regulatory Authority guidelines.

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It is well known that during radiation therapy not all the radiation coming out of its source is absorbed by the tumor. It pierces the patient's body and run towards the bunker walls, ceiling and floor. We have to shield the radiation adequately to stop its passing through the walls or ceiling so that it cannot inflict the peoples working outside the bunkers.

Radiation shielding ensures the radiation dose received by people outside the bunkers lower than the permissible level. Shielding against neutrons should also be considered for LINAC operating above 10 MV, because of the production of photoneutrons (ɣ, n) in the accelerator head. As we know, photoneutrons are produced when the primary photons have energies above the neutron binding energy of roughly 8 MeV for most radionuclides.

We calculated concrete density of 2350 kg/m^3 used for shielding in constructing bunkers to comply with Bangladesh Atomic Energy Regulatory Authority (BAERA) regulations. Concrete has high hydrogen content and is thus effective in shielding against photons and fast neutrons. We designed bunker shielding to keep radiation exposure limit 0.25mSv/year and occupational dose limit 1 mSv/year. This is below the exposure level advised by the Bangladesh Atomic Energy Regulatory Authority (BAERA) and the "NSRCD Act 1997". As per NCRP Report No: 151 neutron production for 15 MV LINAC at isocenter is 0.1% Sv/Gy and for 10 MV LINAC at isocenter is 0.004% Sv/Gy.

We have used boron painted PVC (Polyvinyl chloride) board along with thick concrete wall of bunkers for neutron protection and interior design as well. This is a plastic having chemical formula CH2=CHCl. The advantages of PVC are low cost, durability, high thermal and chemical stability. Significant quantities of hydrogen chloride formed due to the oxidation of PVC resins can thermalize fast neutrons. We have used high density polyethylene sheet for neutron shielding at the entrance door. We considered LINAC machine head leakage and dispersed radiation for photon and neutron radiation protection.

The maze wall is thicker at its beginning (door location) and thins gradually towards the end in LINAC bunker design. Maze wall has nearly one-foot slanting on the outside so that radiation leakage from machine head can be kept as low as possible. Another advantage is that door is lighter than usual. The maze wall length should not be less than 5 meters in such case.

We have tried to maintain concrete density roughly 2350 kg/m^3 in our calculation. To preserve the density of concrete, we aim to mix the basic materials in a 1:2:4 ratios (1kg cement: 2kg sand: 4kg stone chips). To achieve our desired density, we kept the water to cement ratio between 0.5 and 0.55. However, due to poor mixing ratios and water-to-cement ratios, we were unable to manufacture concrete with a density of 2300-2400 Kg/m^3. In that case we have added 10-12% more concrete to increased thickness of wall and ceiling to prevent radiation leakage because of density below 2300 kg/m^3.

CP-8: Real-time Radiation Monitoring around Square Hospital Campus, Dhaka and Estimation of Radiological Risk on Public

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Ionizing radiation plays an important role for diagnosis & treatment of patient in the hospital. More than 90% public radiation exposure comes from the medical procedures from the man-made radiation sources. Public who are living beside a large hospital campus is usually getting higher radiation doses comparing to others. The aim of the study is to monitor the real-time radiation around the Square Hospital campus, Dhaka and estimation of excess life-time cancer risk (ELCR) on public based on annual effective dose. The real-time radiation monitoring was performed from February to April 2021 using digital portable radiation monitoring devices and GARMIN eTrex HC Series Personal Navigator for location identification. The digital portable radiation monitoring device was placed at 1 meter above the ground on tripod and data collection time for each monitoring point (MP) was 1 hour. 32 MPs were selected for taking real-time radiation data around the Square Hospital campus. The measured dose rates due to natural and man-made radionuclides were found to be ranged from 0.099-0.266 μSv/hr with an average of 0.153 ± 0.019 μSv/hr. The annual effective dose to the public due to hospital's radiation was found to be varied from 0.026- 3.066 mSv with an average of 0.287 ± 0.216 mSv. ELCR on public around the Square hospital campus based on annual effective dose was calculated and was found to be varied from 0.107×10^{-3} to 12.686×10^{-3} with an average value of 1.190×10^{-3}. It is observed from the study that in every thousand people, one of them is at the risk of developing cancer caused by the scattered radiation exposure from the Square hospital during his/her life time.

Key words: Square Hospital; Ionizing Radiation; In-Situ; Public; Cancer.

CP-9: The Mass Attenuation Coefficient and Half Value Layer of Some Locally Developed Madhupur Clay Based Composites Reinforced with Beach Sand and Minerals for X-ray in the Energy Range of 80kV to 200kV

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In order to protect living beings from hazardous ionizing radiation such as X-rays, some locally developed composite materials were fabricated using Madupur clay as base matrix which was reinforced with the filler of beach sand (BS), inland sand (IS) and beach minerals such as magnetite, Ilmenite (M-I) for shielding behavior analysis. The shielding factors of various fabricated composites and ordinary concretes (OC) were measured using broad beam transmission geometry, GM detector, and stated in terms of mass attenuation coefficient (μ_m) and Half Value Layers (HVL) in the energy range of 80kV to 200kV of X-ray. The attenuation efficacy was explained with the help of entire structural morphology of the composites by neutron imaging method. The results showed that the addition of BS and M-I with Madhupur clay enhance the μ_m and decrease of HVL factor. The μ_m of BS composites (2:1), M-I composites (1:1:1), IS composites (1:1:1) and ordinary concrete (OC) decreases from 0.5321cm^2g^{-1} to 0.1537cm^2g^{-1}, 0.5925cm^2g^{-1} to 0.1610cm^2g^{-1}, 0.2594cm^2g^{-1} to 0.1334cm^2g^{-1} and 0.3025cm^2g^{-1} to 0.1414cm^2g^{-1} for 80kV to 200kV of X-rays, respectively. The M-I composites have exhibited attenuation behavior while the IS composites were in the lowest. The HVL increasing sequences of the composites are: IS>OC>BS>M-I for the mono-energetic X-ray photons. The entire structural morphological investigation reveals that the fine and homogeneous structured Madhupur clay based M-I and BS composites have lower gray values than that of ordinary concretes which indicates their significant attenuation behavior. The experimental observations would be useful for designing potential radiation shielding materials for X-ray facilities based on the locally developed cost effective raw materials.

CP-10: Evaluation of Radiological Risk on Public around BSMMU & DMCH Hospital Campuses in Dhaka, Bangladesh

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Radiation is all-around human beings. It has many beneficial applications as well as health hazards. Bangabandhu Sheikh Mujib Medical University (BSMMU) and Dhaka Medical College Hospital (DMCH) are routinely used a variety of radioactive materials and different types of radiation generating equipment for service, treatment, and diagnosis purposes. Though ionizing radiation is very beneficial to patients in hospitals, low doses of radiation can increase the risk of cancer in the future for radiation workers and the public. Real-time radiation monitoring is conducted around BSMMU and DMCH in Dhaka to assess the radiation risk associated with medical usage of ionizing radiation. The objective of the study is to monitor the real-time radiation and estimate radiological risk on public based on annual effective dose around two large hospital's campuses in Dhaka city. This study used a real-time digital portable radiation monitoring device with the Garmin eTrex Global Positioning System (GPS) were mounted on a twin-headed tripod one meter above the ground for radiation monitoring and positioning around those hospitals. A total of 64 locations were selected for monitoring radiation dose rate and data collection time for each monitoring point (MP) was one hour. The real-time radiation dose rates around the BSMMU & DMCH Hospital's campuses were ranged from 0.049-0.288 $\mu Sv.h^{-1}$ (mean: 0.145 $\mu Sv.h^{-1}$) & from 0.012-0.355 $\mu Sv.h^{-1}$ (mean: 0.135 $\mu Sv.h^{-1}$), respectively. The excess life-time cancer risk (ELCR) on the public who are residing nearby the hospitals were ranged from 0.355×10^{-3}-2.09×10^{-3}(mean: 1.05×10^{-3}) and from 0.087×10^{-3}-2.57×10^{-3} (mean: 0.983×10^{-3}), respectively. The annual effective doses and ELCR on the public in a few locations around the two large hospital's campuses in Dhaka are higher than those of the prescribed limit of the International Commission on Radiological Protection (ICRP). It is observed from the study that in every thousand people, one of them is at the risk of cancer caused by the scattered radiation exposure from the hospital without any knowledge of being exposed to ionizing radiation. Healthcare workers must handle the radiation generating equipment & radioactive material as per national regulations and IAEA guidelines to minimize the public's radiation risk and keep hospital environments as radiation-free as possible.

Key Words: Hospital; Radiation; In-Situ; ELCR; Public.

CP-11: Estimation of Radiological Risk on Public around Ever Care Hospital Campus in Dhaka, Bangladesh

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Medical uses of ionizing radiation have great benefit to patient. Healthcare workers and public are getting radiation from hospitals during diagnosis & treatment of patients. Although recent radiation generating equipment have considerably improved patient care, inappropriate or unsafe handling of the radiation generating equipment as well as radioactive material may also cause possible health risks for patients, workers and also public. Thus, real-time radiation monitoring around the Ever Care hospital campus in Dhaka is carried out to identify the radiation hazard arising from medical uses of ionizing radiation. The objective of the study is to monitor the real-time radiation around a large hospital campus in Dhaka city and estimation of radiological risk on public based on annual effective dose. The real-time radiation monitoring around the Ever Care hospital campus was carried out using digital portable radiation monitoring devices and those devices were placed at 1 meter above the ground on tripod. 32 locations around the Ever Care hospital campus were selected for monitoring the real-time radiation and data collection time for each monitoring point (MP) was 1.0 hour. The MPs were marked-out using the Global Positioning System (GPS) device. The real-time radiation dose rates around the Ever Care hospital campus were found to be ranged from 0.014 – 1.132 $\mu Sv.h^{-1}$ with an average of 0.138 ± 0.039 $\mu Sv.h^{-1}$. The excess life-time cancer risk (ELCR) on public who are residing nearby the hospital were found to be ranged from 0.101×10^{-3} - 8.206×10^{-3} with an average of 1.003×10^{-3}. The annual effective doses and ELCR on public around the Ever Care Hospital campus were found to be higher than those of the prescribed limits of the International Commission on Radiological Protection (ICRP). It is observed from the study that in every thousand people, one of them is at the risk of cancer caused by the scattered radiation exposure from the hospital without any knowledge of being exposed to ionizing radiation.

Key Words: Hospital; Radiation; In-Situ; ELCR; Public.

CP-12: Establishment of X-ray reference radiation for calibration of radiation protection devices and Monte Carlo calculation of Backscattering Factor (BSF) for personal dosimetry

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Introduction

The aim of this work was to establish and analyze the beam quality of the X-ray irradiator (Model: X80-225 KV, Hopewell Designs, Inc) installed at SSDL, Bangladesh Atomic Energy Commission in accordance with the ISO 4037-1 standard narrow-spectrum series: N-40 to N-200. In personal dose monitoring, the backscattering factor (BSF) contributes a considerable amount to the total absorbed dose. In this study, an evaluation of backscattering factors based on different phantom materials was also conducted by MCNPX Monte Carlo Code (version 2.6.0).

Materials and Methods

The X-ray beam irradiator X80-225KV with variable tube potentials 15-225 kV, a reference class electrometer (IBA Dose-1), and an ionization chamber (NE2575) were used for the determination of air kerma, 1st, and 2nd half-value layer (HVL), the effective energy and homogeneity coefficient. A set of conversion coefficients for ambient dose equivalent, *H*(10)*, directional dose equivalent, *H′(0.07, Ω),* and personal dose equivalent, *Hp(10)* & *Hp(0.07)* were derived from an empirical mathematical relationship applicable for monoenergetic photons with energies between 10 keV to 10 MeV. These conversion coefficients were eventually used to measure ambient dose equivalent, directional dose equivalent, and personal dose equivalent. These values were compared with the recommended values of ISO 4037-1**.** Finally, Backscattering Factors (BSF) for three different circular field sizes (5 cm diameter, 10 cm diameter, 15 cm diameter) were evaluated by MCNPX Code for IAEA water phantom and ICRU Slab phantom.

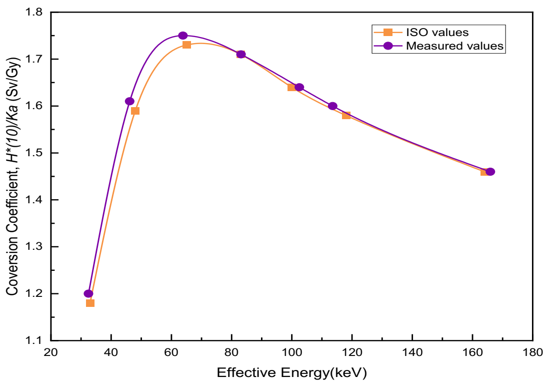

Figure 1: Conversion coefficients vs Effective energies for ISO and Measured Values

Result

Experimentally measured HVL and ISO standard HVL were compared for both 1st and 2nd HVLs. Among all the beam qualities N60, N80 and N200 showed the closest approximation to ISO values for both HVLs. The maximum deviation of -12.50%

from the standard value of 1st HVL was found for N40. The beam homogeneity coefficient (HC) lied between 0.84 to 1.104. The N40 was the most homogeneous beam having an HC of exactly 1.0. The derived values of conversion coefficients also showed a good agreement with ISO values (Figure 1). The maximum deviation of -1.69% from the standard value of HC was found or N40 and for N100, N120, and N200 were found exactly the same as ISO values. Monte Carlo calculated BSF for N80 to N200 showed a pattern of almost linear decrease with increased kVp and increase with increased field sizes for both the phantoms.

Conclusion

An effort was given to ensure the reproducibility of beam quality of calibration X-ray irradiator at SSDL, BAEC in accordance with ISO 4037-1. The outcome was in good agreement with using the beam qualities in personal radiation protection. The backscattering factors differ with phantom materials and composition which is an important part of the uncertainty involved in calibrations of personal dosimetry systems. In a further study, an experimental approach to determine BSF can also be taken to validate the theoretical calculations.

Keywords: X-ray beam quality, Conversion coefficients, Backscattering Factor (BSF), Monte Carlo N-Particle (MCNP), ISO-4037

CP-13: Investigation of some regular x-ray imaging parameters in indicative radiography of four hospitals in Bangladesh

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Introduction

Analytic radiography is an extremely normal image testing technique which has been utilized for quite a long time. It is recommended by specialist so they can see any problem in patients' body without cut. Thinking about its wide use, the principle objective of this investigation is to give top notch picture by keeping the radiation portion as low as conceivable through identifying any variety in quality control (QC) boundaries.

Methodology

In this work, some standard quality control boundaries, for example, voltage exactness test, time precision test, tube yield linearity, half value layer (HVL) of x-beam machines were reviewed. These quality control (QC) boundaries were estimated by a dosimeter keeping a distance of 100 cm from source.

Result and Discussion

The voltage precision went from 0.31% to 4.67% and the time exactness test went from 0% to 2.29%. The consequences of this investigation show that all the QC boundaries are inside the acknowledgment level which guarantees the advancement of low portion conveyed to the patients.

Conclusion

This investigation reflects the present circumstance of utilizing radiography framework of diagnostic in Bangladesh.

Keywords: Diagnostic Radiography, Quality control, X-ray, HVL, Dosimeter.

CP-14: Detection of Brain Hemorrhagic Stroke using Image Processing

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Now-a-days brain hemorrhagic stroke is one of the primary reasons for death. The risk of death from a bleeding injury in traumatic brain is higher once the injury happens within the brain. In recent times, computer-aided diagnosis systems become the focus of numerous research endeavors which are based on the concept of processing and examining images of different portions of the human anatomy for a fast and conventional diagnosis. In this paper, we proposed an approach that takes Computed Tomography (CT) scans of the brain and that is able to detect whether there exists a brain hemorrhage or not. Moreover, the nature of the hemorrhage could also be identified. The proposed method consists of several steps which include image preprocessing and segmentation, feature extraction, and classification. The obtained results of the conducted experiments are very promising. The features extracted from Hemorrhagic Stroke are 0.274472 for contrast, 0.109469 for correlation, 3.10849 for entropy, 0.00536637 for mean and 0.0896542 for standard deviation. Similarly, the features extracted for the normal brain are 0.26307, 0.0948142, 3.22372, 0.00279804, and 0.0897711 for contrast, correlation, entropy, mean and standard deviation respectively.

Keywords: Brain Hemorrhagic Stroke, Laplacian Filtering, Otsu's Segmentation, Discrete Wavelet Transform (DWT), Support Vector Machine (SVM)

CP-15: Determination of dosimetric accuracy of newly installed Cobalt-60 teletherapy machine at SSDL, Bangladesh

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Introduction: External beam radiotherapy or teletherapy is considered as one of the most effective modalities for cancer treatment. All emerging technologies in radiotherapy can only be fully utilized if there is high accuracy in dose determination and delivery. To maintain this accuracy, the IAEA protocol TRS-398 has recommended the calibration of ionization chambers at Secondary Standard Dosimetry Laboratory (SSDL) at regular intervals. In this study, the focus is on dosimetric accuracy of a newly installed Cobalt-60 teletherapy unit at SSDL of Bangladesh Atomic Energy Commission in purpose of rendering Quality Assurance and Quality Control services as well as research for all radiotherapy machines in Bangladesh.

Materials and Methods: A series of measurements are taken that are essential for commissioning and acceptance of the newly installed Co-60 machine (Equinox 100) both in mechanical and dosimetric levels viz. accuracy of various indicators and field sizes, absolute and relative dosimetry, inter chamber comparison and comparison of absorbed doses measured with two protocols TRS-277 and TRS-398. IBA FC65-G Farmer chamber, IBA Dose 1 Electrometer and two different reference water phantoms are used for this study. The IAEA water phantom is used for dosimetry measurements in several fields and a 2D water phantom is used for the Percentage Depth Dose (PDD) calculation, beam profile measurements and other calculations.

Results and Discussion: The measured absorbed dose for several fields maintains a good accuracy as the output factors have a good consistency. The PDD curves for several fields have an accuracy in the accepting range which indicates a good accuracy in the whole dosimetry. The beam profile for three different normal fields are found to be in a good level of accuracy since the linearity, penumbra and other parameters are in accepting level. The value of uncertainty in the dosimetric level is nearly 1.1 to 1.4% which is a good indication of accuracy. In case of inter chamber comparison the maximum deviation among values of absorbed dose to water for four Farmer chambers are 0.27% for $D_w(Z_{ref})$ and 0.26% for $D_w(Z_{max})$, which indicates a good sign of accuracy in the measurements.

Conclusion: This whole study is mainly focused on the calibration purposes to ensure the almost accurate dosimetry plan for treating a cancer patient. The resultant output of this study can also contribute in developing the treatment planning system in the realm of cancer treatment.

Keywords: Dosimetric Accuracy, Quality Assurance, Absolute Dosimetry, Inter Chamber Comparison, Percentage Depth Dose (PDD)

CP-16: Measurement of Radiation Dose for Small Radiation Field with Various Radiation Detectors in ^{60}Co Beam

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Background: In modern radiotherapy techniques like IMRT, SRS, VMAT and SBRT, the uses of small fields have become very important. The practice of using ion chamber for small field sizes can cause uncertainty in dosimetry due to the lack of charge particle equilibrium, volume averaging effect and subsequently should not be used as a reference dosimeter, therefore special dosimeters are desiderated for small field dosimetry. The motive of this study is to compare dosimetric measurements e.g. absorbed dose, output factor (***OF***), polarity correction factor (k_{pol}), ion recombination correction factor (k_s), $D_w(Z_{max})$, $D_w(Z_{ref})$ and Percentage Depth Dose (PDD) among three ionization chambers-Farmer (FC65-G), Semiflex (31010) and IBA Razor Nano.

Methods: The measurements are all performed in a ^{60}Co teletherapy unit (Theratron Equinox100, S.N. 2149) in a 2D water phantom changing the field sizes from 1×1 cm^2 to 4×4 cm^2. In this study, two dosimetric protocols (TRS-398, TRS-483) have been used. According to TRS-398, the absorbed dose to water for field sizes from 1 × 1 cm^2 to 4 × 4 cm^2 and reference field size 10 × 10 cm^2 have been measured. Also the PDD for field sizes (1×1 cm^2 to 4×4 cm^2) have been measured for three types of ionization chambers (Razor Nano, Farmer, Semiflex).

Results: The variations of absorbed dose to water under reference condition (10×10 cm^2 field, 100 cm SSD at 5 cm depth) arefound about 5.85% in between Razor Nano and Farmer chamber and 4.64% in between Razor Nano and Semiflex. The k_{pol} and k_s are almost same for Semiflex & Farmer chamber, whereas for Razor Nano chamber k_{pol} and k_s values fluctuate with different field sizes. The deviation of output factor (***OF***) in respect to Razor Nano chamber had been observed much higher for Farmer chamber than the deviation of Semiflex. In case of PDD calculation, for different fields the average dose at reference depth (5 cm) for Razor Nano and Farmer are 68.23% and 65.74% respectively, but for Semiflex it is found 77.85%. The maximum dose (100%) is found between 0.5 cm and 0.6 cm for three ionization chambers for all radiation field sizes.

Conclusion: There is no ideal detector with all of the features required for small field dosimetry. This study recommends combining different types of detectors rather than only one to collect the essential data, because each form of detector has its own limitations. The details of this measurement data are analyzed and summarized which will help to define small field dosimetry.

Keywords: Small Field Dosimetry, Razor Nano Chamber, Radiation Detectors, TRS-483, Output Factor *(OF)*

CP-17: Outfield Dose Distribution and Risk Assessment of Measured Dose Using High-Energy Photon Beam (Co^{60}) – An Investigation by Alderson Rando Phantom

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Background: Radiotherapy is a treatment modality by which a large amount of radiation dose is delivered to the cancerous cell and minimum to the healthy tissue. Although the received scattered radiation by out of field healthy organs is small but have the risk of inducing radiogenic late effect such as second cancer. This study aims to evaluate the dose distribution outside the target organs and gives an importance to the estimation of the excess lifetime risk of second cancer.

Methods: The study was performed with a male Alderson Rando Phantom using a ^{60}Co teletherapy beam unit (Theratron Equinox100, S/N: 2149, Canada). The dose of outfield organs was measured using the thermoluminescence dosimeter (MTS-100). TLDs were inserted in different geometrical depths of the target organs such as the left lung, right lung, and stomach of the phantom for measuring the absorbed dose and placed on the skin of peripheral organs for measuring the dose of corresponding organs. Target organs were irradiated at 100 cGy and 200 cGy by ^{60}Co teletherapy unit, and TLDs were readout by a RE-2000 TLD reader (Mirion technology, S/N: 390018, Germany). A radiation risk assessment tool RadRAT, Version 4.2.1. designed by the Division of Cancer Epidemiology and Genetics, National Cancer Institute, US was used to estimate the lifetime risk of radiation-related cancer with uncertainty intervals following a user-specified exposure history.

Results: The out-of-field dose of peripheral organ for three corresponding target organs was measured by calibrated TLDs. The calibration factor of TLDs showed about 1, and dose-response showed very good linearity with an uncertainty of 1.54%. For lung treatment, the closest organs of lung: liver, colon stomach received higher doses and have the higher lifetime risk of developing second cancer. In case of stomach treatment; lung, liver, kidney, colon received significant doses compared to the other distant organs and showed higher lifetime risk of inducing second cancer. The study revealed that the excess future risk (chances in 100,000 Population) of second cancer due to scattered out of field dose is dependent on age of patients and prescribed dose. The study carried out for 30 years, 50 years and 70 years patients and demonstrated that the future lifetime risk of second cancer decreases with increasing patient age. The younger patients are more likely to have lifetime risk and the lifetime risk of developing second cancer in out of filed organs for 200 cGy dose is almost double of 100 cGy.

Conclusions: The total future lifetime risk of inducing second cancer in every case demonstrated that low dose radiation could cause cancer. To avoid scattered low dose radiation during the treatment, a

shielding technique should be applied to the outfield organs. Our results can be of interest for the dose estimations delivered in healthy tissues outside the treatment field for the radiotherapy patient, as well as in studies exploring radiotherapy's long-term effects.

Keywords: Out-of-field Dosimetry, Alderson Rando Phantom, Risk Analysis, Radiogenic Late Effect, RadRAT-Version 4.2.1

CP-18: Effective Point of Measurement (EPOM) of Some Ionization Chambers for High Energy Photon Beam Dosimetry used in Radiotherapy for the Treatment of Cancer Patient

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The volumetric effect occupied by the air cavity for the dosimetry of high energy photon beam is impossible to ignore using standard ionization chambers. Hence, the dose measurement should be corrected with a displacement perturbation correction factor (P_{dis}) or using an Effective Point of Measurement (EPOM). The aim of this study was to calculate the EPOM of some ionization chambers and evaluation of the shift of EPOM that was recommended by various international protocols under both reference and non-reference condition. The work was performed with Percentage Depth Dose (PDD) curves by placing chambers (PTW 30013, FC 65G and Semiflex 31010) at the geometrical centers for field sizes of 5cm × 5cm to 30cm × 30cm at 100cm Source to Surface Distance (SSD) for photon energy 6, 10 and 15 MV respectively. The shift of the cylindrical chambers also estimated from PDD values in comparison with reference PDD values by Parallel Plate Chamber (PPC 40 and Murkus 23343) of 100%, 80% and 50% depth in the water. The present study shows that the effective shift not only varies with chamber materials but also with photon energy. On the other hand, the periodical calibration factor of some ionization chambers at standard procedures were compared with manufacturer values also varies with time which is an important issues for the precisional dosimetry in radiotherapy. The details of the EPOM and chamber calibration factor is discussed.

Abbreviations: EPOM: Effective Point of Measurement; TRS: Technical Report Series; PDD: Percentage Depth Dose; TG: Task Group; SSD: Source to Surface Distance.

CP-19: Small Field Dosimetry of High Energy Electron Beam Delivered from Medical LINAC

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Introduction

In this work, we focus on the study of high energy electron beam in small fields and hence to measure the quality correction factors for accelerated electron delivered from medical linear accelerator (LINAC).

Methodology

In this recent work, a comparative study between the protocols (TRS 398, DIN 6800-2 and TG 51) for electron beams in reference field (**10 cm × 10 cm**) was performed. By taking the TRS 398 protocol the standard one Varian Clinac IX SN6298 was used for both 6 and 12 MeV electron beams in 1 to 5 squard cm small field sizes. Eventually, Percentage of depth dose (PDD), beam profile was determined in water phantom. From the PDD curves range of fifty percent dose (R50) and Zref was measured experimentally. Using R50 in different field size(s) beam quality correction factors for electron beam was measured.

Results

For the measurement of the maximum absorbed dose depth to water using three protocols, the maximum deviations were observed between TRS 398 and TG-51 as well as TG51 and DIN 6800-2. In case of medical accelerator, for both 6 and 12 MeV electron beam R50 was increased with the increase of field size (s) in case of small field using CC13 chamber. On the other hand, beam quality correction factors were found to be decreased when the field sizes and beam energies were increased. Beam profiles showed dose scattered more in the small field rather than intermediate sizes. Combined uncertainty of this current work was kept under 1.44%.

Conclusions

In case of electron beams, PDD and profile measurement in small field, field size up to (**2 cm × 2 cm**) experimental values and theoretical values were matched closely. At same time when field sizes narrower than **(2 cm × 2 cm)** both Razor nano chambers and CC13 chambers were showing discrepancies.

Keywords: Electron Beam, Small Fields, Quality Correction Factors, TRS 398 Protocol.

CP-20: Optimization of F-18 radioisotope production with "Cyclone 18/9 MeV IBA Cyclotron" installed at NINMAS

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A cyclotron is a particle accelerator, which employs electromagnetic fields to accelerate charged particles to extremely high speeds and energy. It is used to create radioisotopes for radiopharmaceuticals, which are used to diagnose and treat cancer. Because cyclotron-produced radiopharmaceuticals are exceptionally effective in identifying various cancers, cyclotrons are fast evolving and will play an increasingly important role in the health care industry, particularly in advanced medical imaging techniques like as positron emission tomography (PET) and single photon emission computed tomography (SPECT). An 18/9 MeV Cyclotron (18 MeV for proton and 9 MeV for deuteron, Model: Cyclone 18/9, IBA) was installed at National Institute of Nuclear Medicine and Allied Science (NINMAS), Bangladesh Atomic Energy Commission (BAEC). Radioisotopes such as ^{18}F, ^{11}C, ^{13}N and ^{15}O can be produced with this cyclotron. Solid target option is also available here which can be used for producing ^{67}Ga, ^{68}Ga, ^{124}I, ^{123}I, ^{111}In, ^{99m}Tc, ^{64}Cu, ^{89}Zr radioisotopes. ^{18}F is the radioisotope of choice for many radiopharmaceuticals due to its glucose analogous and half-life of 110 min. We are producing FDG at a regular basis. For a 60-minute bombardment time, a 40 to 50 micro amp beam current is employed to produce 18F with a mass of 2500 to 3500 mCi. Because of the variable production parameters used, the production of 18F varies. Parameters used in the production of 18F radioisotope are limited to physical factors such as target material, target volume, collimator, stripper foil, and ion source. As a result, we consider 18F yield to be the most important aspect in providing sufficient activity since we want to find the best operating point that minimizes both production time and cost. In order to produce optimal 18F, all parameters such as dee voltage, vacuum level, beam current, irradiation time, amount of enriched O-18 water, target pressure, and others are taken into account.

Keywords: Cyclotron, Radioisotopes, FDG, PET, SPECT, Half-life.

CP-21: First Case of Successful Radioactive Iodine Ablation in DTC Patient with End Stage Renal Disease and Experience of Exposure Dose Rate

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Background: Radioactive iodine (^{131}I) ablation (RAIA) following total thyroidectomy is considered a key element of successful treatment of differentiated thyroid carcinoma (DTC) patients. As kidneys play an essential role in iodine clearance, so the patients on hemodialysis (HD) due to End-Stage Renal Disease (ESRD) must be handled cautiously, considering the renal clearance of this radionuclide. ^{131}I is dialyzable and exposure can be monitored with a standard survey meter during dialysis. The safety of the procedure and subsequent long-term outcome is still not well defined. The aim of our study is to present our experience on exposure dose from ^{131}I treated DTC patients with ESRD indirectly providing the information of renal clearance of ^{131}I in immediate post-ablative days.

Case Report: A 68 years old male patient came to NINMAS on January 2022 for treatment of papillary thyroid carcinoma at 20 days after total thyroidectomy. Patient has been suffering from ESRD since 2019. He is on hemodialysis thrice in a week. His post-operative investigation revealed TSH was 150 mIU/ml, thyroid radioiodine uptake was 7%, thyroid scan showed multiple focal radiotracer concentration in thyroid bed, initial thyroglobulin (Tg) level was 23 ng/ml, antiTgAb-1.3 IU/ml, creatinine level was-7.0 mg/dl. The patient was administered 30 mCi of ^{131}I while hospitalized in a special shielded $\mathbf{^{131}I}$ cabin for 5 days. Patient was under supervision of a nuclear medicine physician, physicist, technologist and nephrologist. He was encouraged to drink liquids one liter per day as allowed by nephrologist. He underwent his usual outpatient dialysis treatment the day before of RAIA. Radiation exposure rate by survey meter at one meter apart from patient was measured at 10 minutes and two hours after therapy. Exposure rate were 50.72 μSv/ hr and 45.82 μSv/hr respectively. After approximately 48 hours from dose of $\mathbf{^{131}I}$, the patient underwent HD again. After 48 hours before dialysis exposure rate was 40.71μSv/hr, after dialysis was 18.93 μSv/hr. At 5th day before dialysis, radiation was 11.52 μSv/hr, after dialysis it was 4.20 μSv/hr. In preparation for the procedure, single room for dialysis was arranged with nurse station behind a thick wall. The nephrologist, technologist and nurse were properly trained to handle the patients treated with ^{131}I.

Conclusion: It may be concluded that DTC patients with ESRD can be given ^{131}I safely with HD and proper planning. The exposure rate from this patient was 4.20 μSv/hr at 5th day of post-ablation, which was far less than recommended dose (25 μSv/hr) for discharge from isolation of patient.

Keywords: End stage renal disease, Radioactive iodine (^{131}I) ablation, Survey meter

CP-22: ^{18}F FDG PET-CT in Recurrent Ascites- A Case Report

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Background
Oncological management of metastasis of unknown origin relies on detection of the apparently unknown primary. ^{18}F FDG-PET-CT, due to its ability of detecting metabolically active disease can aid in detection of occult primary.

Case summary
This report is of a patient who, with complaint of abdominal distension, underwent computed tomography imaging to reveal huge ascites with normal abdominal study. Cytology of ascitic fluid showed negative for malignant cell but patient had rising tumor marker CA-125. Subsequently, an FDG PET-CT scan revealed a soft tissue density hypermetabolic area adjacent to head of the pancreas, ascending colon, descending colon and multiple intra-abdominal lymph nodes including supra-pancreatic, right para-iliac, para-colic and retroperitoneal lymph nodes. This patient underwent undergone laparoscopy and afterwards the biopsy from pancreatic head revealed pseudopapillary tumor of pancreas.

Conclusions
FDG PET-CT is a single shot tool for detecting biopsy site. It facilitates initiation of appropriate oncological management.

Keywords: Metastasis of unknown origin, recurrent ascites, FDG, PET-CT

CP-23: Focus on ^{11}C labeled Choline Radiopharmaceuticals by Cyclotron Technology at Institute of Nuclear Medical Physics

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Introduction
A Cyclotron is a type of compact Particle accelerator which produces short lived radionuclides that can be used for radio pharmaceuticals imaging procedure for Cancer treatments. Among hundreds of

radionuclide's, ^{11}C-Choline is being enormously used throughout the world. ^{11}C-Choline positron emission tomography (PET)/ Computed Tomography (CT) is an increasingly used technology in the diagnostic of patients with biochemically suspected recurrent prostate cancer. ^{11}C-Choline is a radiolabeled analog of choline, a precursor molecule necessary for the biosynthesis of cell membrane phospholipids. Choline is involved in synthesis of the structural components of cell membranes, as well as trans-membrane signaling. Increased phospholipid synthesis has been associated with proliferation and the transformation process that occurs in tumor cells. [^{11}C]-choline tracers were revealed to be especially useful in early-state prostate cancer diagnostic imaging. The main problems of ^{11}C-Choline PET imaging is a high-cost procedure due to the short physical half-life of approximately 20 minutes and the requirement of its on-site production but choline PET/CT can detect both bone and soft-tissue metastases with a single examination and due to on-site Cyclotron insertion at Institute of Nuclear Medical Physics, BAEC the overall procedure will make it cheaper.

Material and Methods

The starting point of the production of ^{11}C labeled radiopharmaceuticals is the ^{14}N (p, α) ^{11}C irradiation nuclear reaction using on-site cyclotron with protons of more than 18 MeV energy. The [^{11}C]-CO_2 produced in a cyclotron was trapped on the molecular sieve of the synthesis module. The release of [^{11}C]-CO_2 gas into the reaction vial was reduced to methanol with $LiAlH_4$ in a THF environment. After the evaporation of THF, a solution of hydriodic acid was added the reaction vial therefore will be formed [^{11}C]-CH_3I. Then distilled [^{11}C]- CH_3I was transported into the vial by a constant flow of nitrogen (10 ml/min). The vial, which is a part of the reagent kit is contained the precursor DMAE dissolved in DMF. The reaction of [^{11}C]-CH_3I with DMAE takes place almost instantaneously. Thereafter, 1 ml of ethanol is added to the reaction vial then whole mixture was extracted to solid phase on a cation exchange resin. Then [^{11}C]-choline will capture by the SPE column. The final product was released from the SPE column using 0.9% saline solution and collected in a sterile, pyrogen-free vial.

Purpose of the Study

In PET imaging, [^{18}F]-FDG is most popular one due to its high sensitivity to neoplastic processes but its value is limited in diagnosing cancers characterized by low glucose metabolism. Therefore, the outcome of diagnosis with [^{18}F]-FDG for prostate cancer which is the most commonly diagnosed cancer among men and women is not up to mark. Whereas, carbon atoms are present in the construction of almost all biologically active compounds. Therefore, the use of [^{11}C]-Choline radiopharmaceuticals allows the construction of an extremely rich group of PET tracers.

Conclusion

If [^{11}C]-Choline PET imaging modalities come in true in our country, then the poor people will get easy and affordable treatment facilities for early-state prostate cancer diagnostic imaging.

Keywords: [^{11}C]-Choline, Prostate cancer, (fluorodeoxyglucose) [^{18}F]-FDG, dimethylaminoethanol (DMAE), dimethylformamide (DMF).

CP-24: Evaluation of Beam Profiles between Physical and Enhanced Dynamic Wedges.

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Introduction: The purpose of the work is to find out the beam profiles using physical and enhanced wedge of different angles, different field sizes and different energies and to compare among those.

Materials and Methods: The study was conducted using the Varian Clinac iX LINAC with different photon energies - 6MV and 15MV. The slab phantom arranged at a fixed depth (10cm depth) above the iba MatriXX device which consists of a 1020 vented ion chamber 2D array detectors, arranged in a 32 × 32 grid.. The physical and enhanced dynamic wedges different angles (15°, 30°, 45° and 60°) were examined for the field sizes, $5x5cm^2$, $10x10cm^2$ and $15x15cm^2$ by delivering 50 monitoring unit (MU).

Result: In comparison of beam profiles (without rescaling) of PW and DW obtained from 2D array measurement were compared, it was found that there were difference, but gradient of curves are almost same except some points in toe, heel and penumbral region, which is negligible. From the beam profiles, it was understood that

a. the difference between PW and DW increased with increasing of wedge angle while filed size and energy were fixed.

b. The difference between PW and DW increased with increasing of field sizes while energy and wedge angle were fixed.

c. The difference between PW and DW increased with increasing of energy while field size and wedge angle were fixed.

Conclusion: Based on the results of our study, it can be concluded that the Universal detector 2D array (Matrix) can be used effectively to obtain the dosimetric characteristics of both EDW and Physical wedge.

Keyword: Physical Wedge (PW), Enhanced Dynamic Wedge (EDW), MatriXX, Beam Profile

CP-25: Indigenous development of powered air-purifying respirators (PAPR) to provide safety to health care workers from airborne pathogens spread by patients

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Health care workers (HCWs) are constantly at high risk of exposure to various infectious pathogens such as bacteria and viruses while providing patientcare. This is particularly of concern during aerosol-generating procedures (AGPs) on patients with respiratory diseases such as the recent Covid19 caused by SARS-CoV-2 virus; many frontline HCWs contracted the disease resulting in widespread tragedies. Surgical masks are unable to provide a barrier against bio-aerosols with a size of less than a micrometer and face fitting N95 filtering facepiece respirators (FFR) are uncomfortable as they require additional breathing effort. A good solution is to use powered air-purifying respirator (PAPR) which provides purified air at a positive pressure into a hood (as shown in the figure) worn over the whole of the head. It has additional benefits such as reduced breathing effort and a cooling effect on the face due to a continuous flow of air. PAPR for HCW are available in advanced countries but are very expensive due to which these find very little use in low and medium income countries (LMIC) like Bangladesh. Therefore, we embarked upon the design and development of a portable light-weight PAPR incorporating a type H-14 HEPA filter which blocks 99.995% of bacteria and viruses but does not impair breathing, vision, speech, or hearing.

The PAPR we developed is comprised of four main sections: PAPR Hood, Air Purifier & Blower Unit (APBU), Battery & Control Unit (BCU) and Air Breathing Tube (ABT). An external battery charger unit is used to charge the battery when needed. The hood was made of parachute fabric and was mounted on a plastic helmet to which a clear transparent visor was attached. The visor was fabricated locally, heating and bending a plane acrylic sheet appropriately. The hood has a rope lace at the neck position which can be tightened slightly in a loop to a comfortable fitting while allowing exhaled air to go out of the hood. The APBU and the BCU are mounted on a waist belt, worn by the user. The output of the BCU is connected to the hood using a medical grade flexible ABT with 19mm internal diameter.

Figure: Powered Air-Purifying Respirators (PAPR) Prototype

The APBU has an H-14 type corrugated HEPA filter (size: 5”x5”x2”) through which ambient air is drawn in using a suction pump, which is essentially a centrifugal fan (brushless 12V dc motor rated at 6A, but driven to a lower current). This then blows the purified sucked air into the hood through the ABT. Utmost care is taken so that no leaked air from outside reaches the hood, plugging all possible gaps using O rings and high-temperature RTV Silicone Gasket Sealant. A suspension system within the hood creates a space between the wearer's head and the PAPR hood, allowing filtered air from the breather tube to flow freely throughout the hood. The front transparent visor has a viewing area of 8.4” x 6.4”, allowing the wearer to see and converse with patients and others with ease. The BCU houses two Lithium-polymer battery connected in parallel, each of capacity 10,000 mAH at nominal 4.2V, giving a total capacity of 84 Watt-Hour. An 8-bit microcontroller is used to keep the motor fan from over-draining the battery power and to notify re-charging information. The prototype provides at least 2.5 hours uninterrupted running time creating an average of 180 LPM (7.6~8.3m/s) air flow inside the hood.

The fabricated prototype units have been tested on healthy volunteers and nobody reported any discomfort in wearing the hood or in breathing. These units are now ready for carrying out a pilot study in healthcare facilities.

CP-26: Development of a pulsed electromagnetic field (PEMF) based bioreactor for fabricating bone like substitutes

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Pulsed electromagnetic field (PEMF) stimulation is widely used in clinical practice to promote endogenous fracture repair. However, PEMF is applied empirically in clinics without standardized guidelines, since many biological mechanisms and signaling pathways modulated by PEMF stimulation are unknown [1]. The goal of this effort was to develop a flexible PEMF based bioreactor which can produce a reliable in vitro inquiry approach to examine the precise combination of physical parameters necessary to generate a specific biological impact.

Our electromagnetic bioreactor consisted of a custom-made support structure made using Acrylic (polymethyl methacrylate) sheet within which a beaker containing the reactive material can be placed. The Acrylic structure supported two circular electric coils connected in Helmholtz configuration. All parameters of the two coils were the same: wire gauge 25, diameter 16 cm, number of turns 200, resistance 10 ohms. The coils are powered using a pulsed electromagnetic field (PEMF) generator designed to give a pulse train with a width of approximately 1.3ms at a frequency of about 75 Hz giving a duty cycle of 9.75%. The peak output power was 36.5W. We calculated the magnetic field using Biot-Savart law and measured the induced emf between two coils using a search coil and a digital oscilloscope to evaluate the uniformity of the field.

The calculated magnetic field between two coils was 2.3 mT. The measured pulse width and frequency were very close to that designed and the field was uniform between the coils. Previously, Fassina et al (2006) developed an electromagnetic bioreactor using which they successfully produced bone like substitutes where they used the following parameters: intensity of the magnetic field 2±0.2 mT, frequency of the bioreactor 75±2 Hz, and pulse width 1.3 ms [2]. So, having almost the same parameters, our PEMF-bioreactor is expected to be successful in fabricating bone like substitutes.

The proposed PEMF-bioreactor will be effective in creating environment for fabricating bone like substitutes which will have potential application in regenerative medicine.

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CP-27: Assessment of the Condition of Pneumothorax Lungs using Anterior-Posterior Electrical Impedance Technique

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Introduction: Pneumothorax is a life threatening condition of Chronic Obstructive Pulmonary Disease (COPD) when inhaled air get in the cavity between the lungs and the chest wall and gets partially or fully collapsed. Healthy lungs have higher electrical impedance than that of lungs with COPD and pneumothorax. The Electrical impedance method is a noninvasive method for continuous assessment of these conditions. Due to inhalation of insulating air the lung impedance is higher in inspiration phase than at expiration. We have developed the Anterior-Posterior Electrical Impedance (APEI) Technique for the assessment of the lung conditions and found more sensitive than other existing planar electrical impedance measurement techniques. The Relative Change in Electric Potential (RCEP) for eight (8) voltage sensing electrodes was 5.97% higher for healthy lungs than lungs with pneumothorax at inspiration.

Material and Methods: Our developed the Anterior-Posterior Electrical Impedance (APEI) Technique uses two (2) driving electrodes for injection of 1 mA, 50 kHz alternating current at the center of the anterior and posterior side of the chest at the right lung, and the other eight (8) voltage sensing electrodes are placed at the posterior side of the chest around the right lung following the ellipsoid shape as that of lungs. The COMSOL Multiphysics simulation software of AC/DC Module is used for 3D studies. Computer generated geometric model of the human chest phantom was eccentric cone shaped and the dimensions were: a- semi axis=10 cm, b-semi axis=20 cm, height=42 cm, ratio=1, electrical conductivity= 0.352 S/m, relative permittivity =10094. Right lung and left lung both were ellipsoid shaped and their measurements of semi principal axes were 4.5 cm, 6 cm, 16 cm and 4 cm, 4.5 cm, 17 cm respectively. Lung(s) connector were cylindrical shaped of radius= 3 cm and height= 6 cm. The electrical conductivity and relative permittivity values of inspiration, expiration and COPD & pneumothorax were taken 0.103 (S/m) and 4272.50, 0.262 (S/m) and 8531.40, 0.60 (S/m) and 1000 respectively. The dimension of sphere shaped silver surface electrodes were radius=1cm, electrical conductivity = 6.16×10^7 S/m, and relative permittivity=3.4. The dimension of the lungs with pneumothorax and their connector were same but their electrical conductivity and relative permittivity were taken 0.60 S/m and 1000.

Results and Discussion: The average Relative Changes in Electric Potential (RCEP) for eight (8) voltage sensing electrodes were calculated. The RCEP was 5.97% higher for healthy lungs at inspiration than that of pneumothorax lungs at inspiration. Similarly, it was 2.82% higher in case of expiration phase. It indicates that the inspiration phase is more sensitive for assessment of condition of pneumothorax lungs.

Conclusion: Our developed APEI technique is a simple but noninvasive method for continuous assessment of condition of Lungs with pneumothorax, and inspiration phase is more sensitive, therefore will be more accurate.

Key words: Anterior-Posterior Electrical Impedance (APEI) Technique, COMSOL Multiphysics, Chronic Obstructive Pulmonary Disease (COPD), Pneumothorax, Relative Change in Electric Potential (RCEP).

CP-28: Comparison of Machine Learning Algorithms on Breast Cancer Detection

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Breast cancer is one of the prominent cancers among women worldwide including middle-income countries like Bangladesh. An early diagnosis and prompt treatment can improve the possibility of cure. Many state of the art studies are conducted worldwide by researchers to find ways for early and accurate diagnosis of breast cancer although low and middle-income countries are far behind in receiving the full benefits from the latest developments compared to other developed nations. So, doctors must have a dependable and accurate method to make an early diagnosis to treat the patients and eventually cure them. Machine learning is a branch of artificial intelligence (AI) that uses algorithms for the improvement of the performance of prediction and analysis of different real-life problems. Researchers have tried to apply machine learning techniques to ensure early diagnosis of different diseases. In this study, four popular supervised machine learning algorithms namely Logistic Regression, Random Forest (RF), XGBoost and Support Vector Machine (SVM) were applied on the breast cancer Wisconsin dataset from the UCI repository and compared for performances in breast cancer detection whether it is benign or malignant. The multivariate dataset comprised of information from 569 patients and 33 features. After preprocessing and applying four machine learning algorithms, analysis revealed that the XGBoost algorithm showed promising performance with an accuracy of 98%, precision of 97%, recall of 100%, F1 score of 99% compared to the other three algorithms. Also, the lowest false negative of 3 was achieved from the XGBoost algorithm. Considering all these performance measures, XGBoost was the best fit model compared to Logistic Regressing, RF and SVM algorithms in detecting breast cancer.

Keywords: Breast Cancer Detection, Biomedical Engineering, Machine Learning, XGBoost, Support Vector Machine (SVM), Wisconsin Breast Cancer Dataset.

CP-29: Development a dose escalation of IMRT protocol of HN cancer patient based on SBRT treatment procedure

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The number of metastatic cancer patients is increasing day by day in the developing countries where modern radiotherapy treatment facilities are very limited. Appropriate treatment protocol with less fraction is, therefore, urgently needed to provide an effective and economic treatment to this huge number of metastatic cancer patients with limited treatment setup. The objective of the present study is to design such hypofractionated scheme capable to provide an efficient and economic palliative treatment. This is a theoretical based dosimetric calculation in which the number of fractions and corresponding optimal fractional doses have been thoroughly evaluated for different tumor doses typically prescribed in conventional IMRT technique. This study has been carried out using Linear Quadratic (LQ) model at the Ahsania Mission Cancer and General Hospitals, Dhaka.

In the study, we have designed two hypofractionated schemes, namely Modified Fraction with Low Dose (MFLD) and Less Fraction with High Dose (LFHD), for the palliation of the metastatic patients. In our proposed protocols number of fraction has been reduced by about 30% to 70% as compared to the conventional IMRT technique keeping same the biologically equivalent dose (BED) and acute effects for the tumor tissue. Assuming α/β=10 Gy, our proposed hypofractionated protocols will allow one to deliver the equivalent of 20 - 70 Gy with acute effects equivalent to 18.4 - 63.7 Gy and 15.7 - 55.7 Gy, respectively, by MFLD and LFHD. Because of the least number of treatment fraction, these protocols will reduce the treatment cost by several fold that was the primary objective of the present study.

As the biological effects on late responding normal tissues are usually not come during the patient's survival time the late effects in the present study have been ignored. However, both of the proposed schemes produce comparable late effects slightly higher in LFHD compared to MFLD. In this context, the present study suggests MFLD for patients having a probability of larger survival period and the LFHD for the patients having a probability of very poor survival period. This is a first-time study to develop hypofractionated treatment course and, therefore, our proposed MFLD and LFHD schemes may lead in designing standards hypofractionated treatment protocols to provide effective and economic treatment facilities for the metastatic cancer patients.

CP-30: Commissioning of Radiotherapy Treatment Planning System using CIRS Thorax Phantom

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Background
The purpose of this study is to commissioning of Radiotherapy Treatment Planning System (RTPS) using the IMRT Thorax Phantom (CIRS - 002LFC) and to investigate the deviation between the calculated and measured dose distribution in the phantom.

Materials and Methods
The study was carried out using by the IMRT Thorax Phantom (CIRS - 002LFC) and Eclipse TPS (version 13.7). At first the phantom was scanned by GE-Light Speed CT-simulator, the gated raw data was fed into Eclipse TPS (version 13.7) which performed the calculated value. The phantom was set up on the couch of Varian D-2300CD-6X LINAC and IBA Farmer Type Ionization Chamber (FC65-P) was set up in the phantom according to protocol. DOSE 1 Reference Class Electrometer (IBA) was used for the dose calculation. After completing the treatment plan and dosimetry, the calculated data and measured data was found to verify the deviation.

Results
The deviation between the measured and calculated does for all test cases have been made with advanced algorithms and the agreements of criteria was mentioned in the first bracket individually. Percentage of deviation between calculated and measured dose for case-1 in hole-1, hole-3, hole-5, hole-9, hole-10, are 1.6%(2%), 0.14%(2%), 0.59%(2%), 14.59%(4%), 0.08%(3%), case-2 in hole-1, 1.14%(3%), case-3 in hole-3, 0.09%(3%), case-4 in hole-5 from different angle 0.24%(2%), 1.47%(3%), 0.69%(3%), 1.97%(3%), hole-6 from different angle 42.74%(4%), 5%(3%), 30.28%(3%), 2.5%(4%), hole-10 from different angle 1.25%(3%), 3.37%(4%), 2.66%(4%), 3.37%(3%), case-5 in hole-2, hole-7, are 0.74%(2%), 0.59%(4%), case-6 in hole-3, hole-7, hole-10, are 1.5%(3%), 3.5%(4%), 4.7%(5%), case-7 in hole-5 from different angle 0.65%(2%), 1.51%(4%), 1.26%(4%) respectively. Thus this study is satisfied with the agreement criteria through the dosimerty based on protocol.

Conclusion
The work have helped the users to better understand the operational features and limitations of their TPSs and resulted in increased confidence in dose calculation accuracy using TPSs. The CIRS Thorax phantom is satisfactionally performed in the commissioning of TPS based on Protocol.

Key Words: TPS, dosimetry, algorithm, phantom.

CP-31: A new approach for determination of correction factor to make plane parallel and thimble chamber substitutable in dosimetry of photon and electron beam

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Introduction: In dosimetry protocols, thimble ionization chambers are recommended to use for photon beams whereas plane parallel ionization chambers are recommended to use for electron beams, specifically when the electron beam quality, $R_{50} < 4$ g cm^{-2}. In case of using one type in place of another type for dosimetry one requires beam quality correction factor, $k_{Q,Q_\circ}$. This study focused to evaluate $k_{Q,Q_\circ}$ factors for various ionization chambers in high energy photon and electron beams.

Methods: The measurements were performed for 10×10 cm^2 field size at an SSD of 100 cm in high energy photon and electron beams of Varian iX LINAC using a plane parallel type (IBA PPC40), two cylindrical type (PTW-31010 Semiflex & PTW- 30013 Farmer) ionization chambers and IBA Blue phantom. Absorbed dose to water calibration factor of plane parallel and semiflex chamber was determined with respect to the farmer chamber in ^{60}Co teletherapy unit (Theratron Equinox100 # 2149) to validate the obtained data.

Results: The beam quality correction factors for IBA PPC40 chamber with respect to Semiflex PTW-31010 chamber were found 0.997 & 0.987 and with respect to PTW-30013 Farmer chamber were found 0.982 & 0.974 for 6 MV & 15 MV photon beams respectively. Again, the beam quality correction factors for PTW-31010 Semiflex and PTW-30013 Farmer chambers with respect to IBA PPC40 chamber were found 0.916 & 0.926 respectively for 9 MeV electron beam ($R_{50} < 4$ g cm^{-2}). For validation of obtained correction factors, all three chambers were also used to determine the absorbed dose to water in ^{60}Co gamma beam and were found very close to each other. The dose deviation of plane parallel and semiflex with respect to the Farmer chamber at reference depth were found 1.08% & 0.48% and at a depth of dose maximum are found 1.07% & 0.82% respectively.

Conclusion: As all the resulting beam quality correction factors showed very small deviation from each other, a feasibility of using cylindrical chamber for comparatively low-energy electron beam and plane parallel chamber for high energy photon beams could be established, if necessary.

Keywords: Plane parallel chamber, Thimble chamber, Beam quality correction factor, Reference depth, Electron beam quality, R_{50}

CP-32: Analysis of percentage depth dose for 6 and 15 MV photon energies of medical linear accelerator with CC13 ionization chamber

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Now-a-days, success of external beam radiotherapy is mainly depended how to commissioning and safety precaution is maintained before beam is heated to infected cells. CC13, an intermediate size ionization chamber is frequently used for the commissioning process of dose calculation for both standard and non-standard sizes field. The measurements of PDDs (Percentage of Depth Dose) were performed using TG-51 at the North East Cancer Hospital, Bangladesh using Varian Clinac IX-5982 with 6 MV & 15 MV photon beam energies for a set of 9 field sizes (4 × 4, 6 × 6, 8 × 8, 10 × 10, 15 × 15, 20 × 20, 25 × 25, 30 × 30 and 40 × 40 cm^2), keeping the same conditions such as pressure, temperature, incremental step, direction, geometry, chamber voltage, and polarity. The PDD for 6 & 15 MV photon beams were obtained with the above-mentioned field sizes and at SSD 100 cm. The obtained PDD results showed that maximum dose depth (d_{max}) for above all mentioned field sizes were varied within 11.8 to 15.8 mm and 21.9 to 29.9 mm respectively for 6 and 15 MV photon energies. In modern clinical radiotherapy PDD is the most essential parameters for the commissioning of medical linear accelerator. Our measured values for depth dose (d_{max}) and PDD applying TG-51 protocol at 10 cm depth (d_{10}) for both 6 MV and 15 MV photon energies are found within the international refereed limits.

Key-words: FS (Field Size), PDD (Percentage of Depth Dose), TG (Task Group).

CP-33: Radiation Monitoring of ^{60}Co Teletherapy Unit, SSDL, BAEC

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Background: Assurance of radiation safety at the radiotherapy facility by periodical survey is very important during the operation of a radioactive source or facility. In this study, a radiation survey was conducted at the Secondary Standard Dosimetry Laboratory of Bangladesh Atomic Energy Commission to ensure environmental and occupational radiation safety of a 445TBq ^{60}Co Teletherapy unit (Equinox100).

Method: According to national guidelines (Nuclear Safety & Radiation Control Rules 1997, Chapter-V, Para 20:1-20:3 & Chapter-VII, Para 37), the occupational exposure of a worker shall not exceed an effective dose of 20mSv per year averaged over five consecutive years and the public exposure limit shall not exceed 1mSv per year. We used a calibrated gamma dose rate meter, Radiation Alert^{TM} Ranger (SN: R310223), to measure the radiation dose at chest height and the bottom. Normally, the 445TBq ^{60}Co source is encapsulated in stainless steel capsule and housed in a self-shielded gantry-head, equipped with a collimator to control beam divergence. At SSDL, it was installed in a bunker with 1.3716m thick primary wall & rooftop and 0.9144m thick secondary wall. ^{60}Co emits 0.31MeV β^- and two photons with energies 1173.228keV and 1332.492keV to reach ground state. We measured the leakage radiation of high energy gamma photons at six different strategic locations (the east & west primary wall, the south secondary wall, rooftop, entrance of the source room and control room) outside of the source room. The survey was carried out for a maximum field size 43x43cm^2 at four different gantry angles (0^0, 90^0, 180^0 and 270^0).

Result: We recorded the highest dose outside the primary wall (west) for **90^0 position** at chest height 0.697μSvhr^{-1} (SD: ±0.017) and at bottom 0.763μSvhr^{-1} (SD: ±0.056). Comparatively, a higher dose, 0.497μSvhr^{-1} (SD: ±0.029) was found on the rooftop for only **180^0** than other gantry angles. At **270^0** angle the dose was almost like a secondary wall as the east primary wall had maize in the way of the beam. For this angle at the entrance, the dose was 0.24μSvhr^{-1} (SD: ±0.022) at chest height and 0.75μSvhr^{-1} (SD: ±0.064) at the bottom. However, the console is our main concern for the safety of workers and here the dose was found very low (0.113μSvhr^{-1} to 0.153μSvhr^{-1}). For the **0^0** gantry position at the entrance, the dose was 0.153μSvhr^{-1} (SD: ±0.017) at chest height but 0.437μSvhr^{-1} (SD: ±0.074) at the bottom. Overall, for this vertical gantry position at the two primary walls (east & west), the secondary wall and entrance, the dose at the bottom was a little bit higher than chest height.

Conclusion: In this study, the leakage radiation level was acceptable as at all the six target locations for different gantry positions the dose was below 10μSvhr^{-1}. So the yearly cumulative dose will not exceed the dose limit.

Keywords: Radiation safety, Dose limit, ^{60}Co Teletherapy unit.

CP-34: Noise Scenario in Rural Areas of Khulna City and Its Impact on Human Health

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Noise is one of the most pervasive environmental problems. Noise pollution makes impact not only in urban areas but also rural areas. This study has been conducted during both day and night time to collect the whole 24 hours data at some villages in Khulna City. Digital sound level meter and GPS have been used. The Highest ANL (Average Noise Level) has been found 98.80 dB on working day from 6 AM-12 PM at Anondanagar Nesaria Madrasa and lowest ANL has been found 62.60 dB at Terokhada Ikhri Gorur Hat. The Highest ANL on working day time from 12 PM- 6 PM at bus stand road Terokhada has been found 92.3 dB and lowest (60.3 dB) at Nondonpur Govt. Primary School. The maximum ANL in active day's night time from PM -12 AM at Terokhada Bazar has been found 87.8 dB and minimum (60.2 dB) at Jame Mosque. The maximum ANL for active day's night from 2AM - 6 AM has been found 76.3 dB and it's at Moshundia Govt. Primary School, minimum (52.4 dB) from 12AM - 6 AM at Harikhali Bus Stand. Maximum ANL from 6AM-12PM on holiday has been found 98.4 dB at Shrifaltala Bazar and lowest (58.4 dB) at Govt. Ikhri Katenga Fazlul Haque Model Secondary School. The Highest ANL has been found 98.6 dB at Shekhpura Bazar from 2PM-6PM on Holiday's Day time and lowest (53.10 dB) for Nandanpur Govt. Primary School. The highest ANL on Holiday's night time from 6PM-12PM at Nalamara Govt. Primary School and it has been found 72.4 dB and lowest (50.3 dB) at Khan Rice Mil. At almost all the palaces, noise levels are above the maximum permissible limit. Questionnaire survey has also been done during the study to observe the health impacts. From the survey it has been observed that the respondents (112) have been suffering more heartbeat, heart pain, headache, sleeplessness, bad temperament, hearing problems etc. Finally, increase public awareness, argued for ban of hydraulic horns, expired vehicles, planting trees and administrative measures should be taken to decrease the intensity of noise pollution.

Key word: Sound, noise pollution, heart problems, headache, questionnaire survey, sleeplessness, awareness, planting trees.

CP-35: Present status and future prospectus of PET-radiopharmaceuticals production facility at NINMAS of BAEC

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PET-CT (Positron Emission Tomography and Computed Tomography) is a gold-standard cancer imaging tool for diagnosis, management, and treatment-based prognosis. The positron-emitting radioisotope ^{18}F (Fluorine) is synthesized by accelerating particles to high enough energy within the cyclotron to trigger the nuclear reaction $^{18}O(p,n)^{18}F$. Nucleophilic reaction converts mannose triflate to 2-[18F] Fluoro-2-deoxyglucose ([18F] FDG). A medium energy (18/9 MeV, IBA) Cyclotron was established at the National Institute of Nuclear Medicine and Allied Sciences (NINMAS) under the aegis of the Bangladesh Atomic Energy Commission. The unit was constructed in Oncology Building (Block F) of Bangabandhu Sheikh Mujib Medical University (BSMMU). To maintain the product's quality, tests such as identification, radionuclide purity (Gamma spectrum detection and half-life measurement), radiochemical purity, chemical purity, residual solvent measurement, pH measurement, sterility, and bacterial endotoxins (LAL test) are performed. The Cyclotron is currently being used to synthesize ^{18}F-FDG for PET-CT at seven (07) government and private PET-CT centers in Dhaka. The Cyclotron facility has been operational since October 2020, with more than 100 batch of ^{18}F[FDG] production completed. This cyclotron will also be used to synthesize radioisotopes ^{11}C, ^{13}N, and ^{15}O, in addition to ^{18}F. ^{68}Ga, ^{124}I, ^{99m}Tc, ^{64}Cu, ^{86}Y and ^{89}Zr radioisotopes will be manufactured by using the solid target in the future.

Keywords: Positron Emission Tomography and Computed Tomography, 2-[18F] Fluoro-2-deoxyglucose, Cyclotron.

CP-36: Rising Trend of Gastrointestinal Carcinoma and Role of PET-CT & Cyclotron: A Single Institute Experience

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PET-CT (Positron Emission Tomography-Computer Tomography) is a non-invasive molecular imaging technique that integrates PET and CT images in a single imaging device. PET-CT became commercially available after the development of fluorinated glucose analogue 18F-fluorodeoxyglucose (18F-FDG). It is a blessing for cancer patients as it provides metabolic and morphologic details. Gastro-intestinal tract carcinoma is one of the most common and leading causes of cancer death worldwide, with increasing risk and prevalence. Predisposing factors are diet containing smoked, pickled, salty food and lack of fresh fruit and vegetables, smoking, Helicobacter pylori infection, genetic factors, etcetera. For better patient survival and proper management, early diagnosis is mandatory. 18F-FDG PET-CT scan became available in the National Institute of Nuclear Medicine & Allied Sciences (NINMAS) in 2015.

From the beginning to 2021, 2257 scans were performed for oncological purposes. In 2016, total patients were 228 and 377, 240, 307, 367, 736 in 2017, 2018, 2019, 2020 and 2021 respectively. Total 309 scans were performed for gastrointestinal carcinoma which includes carcinoma of stomach, rectum and colon, other part of GIT (oral cavity, esophagus, small intestine). Physicians referred 31, 38, 25, 37, 55, 123 patients for 18F-FDG PET-CT scan for GIT carcinoma in the year of 2016, 2017, 2018, 2019, 2020 and 2021 respectively; here a rising trend is evident.18F-FDG PET-CT scan can accurately describe the functional status as well as anatomical localization minimizing the anatomical limitation of PET and functional limitation of CT scan. It is useful in detecting nodal and extranodal metastases and local recurrence. It can evaluate the effectiveness of therapy. Decreased tumor FDG uptake is an indicator of therapy response which can be detected as early as after the first cycle of chemotherapy. It is an accurate predictor of prognosis. From the patient trend, it is clear; that there is a drastic change in number of patients in 2021. Cyclotron became functioning in NINMAS from November 2020; one of the reasons behind this increased number of patients. 18-F FDG PET-CT scan becomes more available in NINMAS after installation of the cyclotron. Other causes of increased yearly patients of GIT cancer at NINMAS are- actually increased incidence, early detection by modern technology, awareness of both patients and doctors, and increased interdisciplinary rapport. Creating more awareness among the general population to reduce the incidence of GIT cancer is required.

Keywords: Gastrointestinal tract cancer, PET-CT, Cyclotron.

CP-37: Determination of Radioactive Exposure at the PET-CT Facility of Institute of Nuclear Medical Physics.

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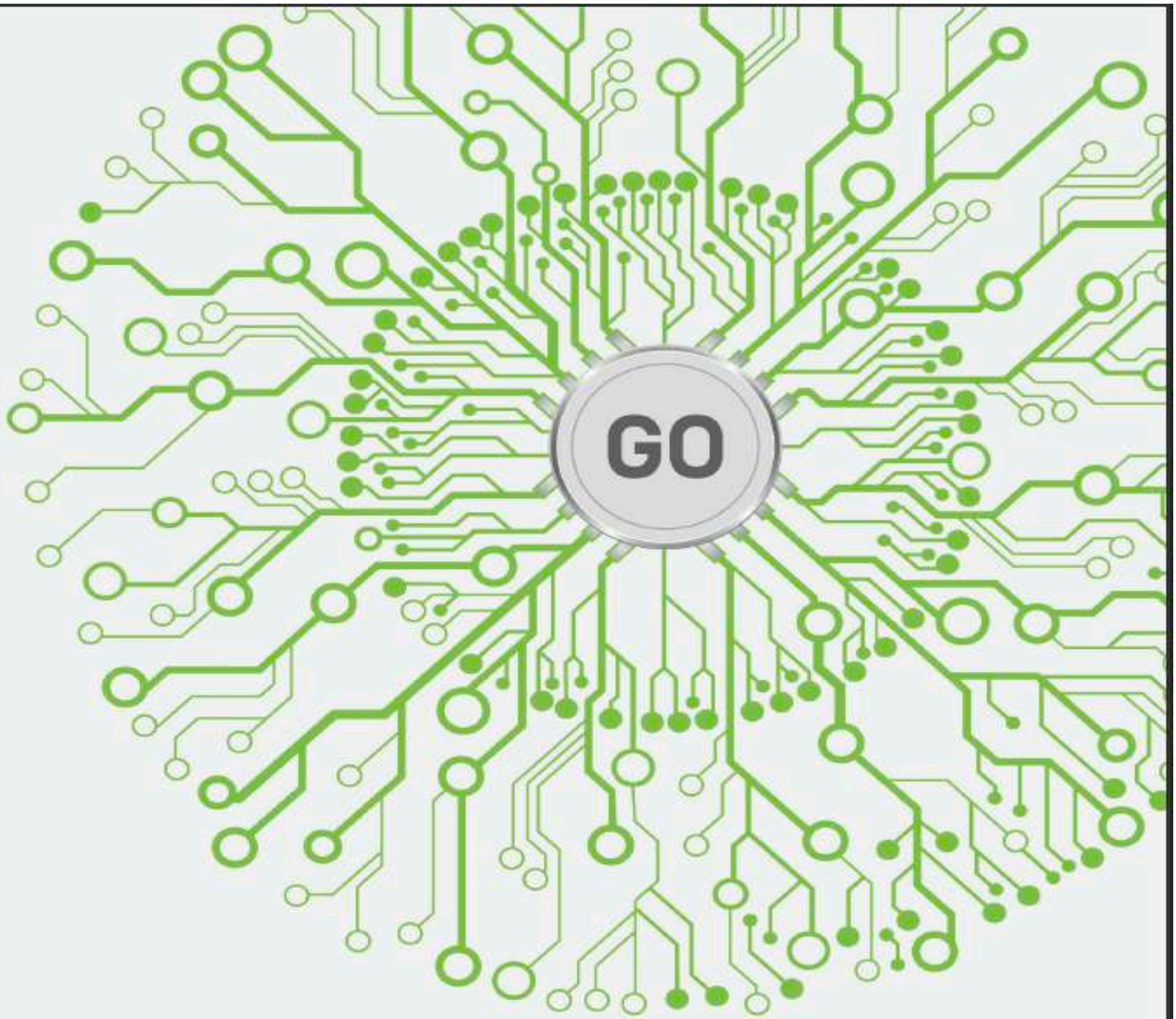
PET-CT (Positron Emission Tomography & Computed Tomography) scan is used to detect malignancy in different organs of human body. For PET-CT scan, a radioactive tracer (drug) named FDG (Fluorodeoxyglucose), is injected into patient intravenously which is a compound of Fluorine radioisotope 18F. The half-life of 18F is 110 minutes. So, FDG injected patient radiated a high amount of radiations for a certain time. Moreover, there is $_{22}$Na radioactive nuclei (half-life 2.6 years) which is used to calibrate the PET-CT machine. People who work at the PET-CT facility face many such radioactive patients & continuously being exposed to high radiations. For this reason, PET-CT scan lab needs proper safety shields and radioactive zone marking. For calibration purpose, rod and coin type Na-22 sources have been used here. We found that, at 1 feet distance radially from the source, the average dose rate is 2.218 uSv/h which goes down to 0.2214 uSv/h after 7.6 feet.



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বিজ্ঞান ও প্রযুক্তি মন্ত্রণালয়
জন্মগত হাইপোথাইরয়েডিজম
শিশুর মানসিক ও শারীরিক প্রতিবন্ধিতার একটি অন্যতম কারণ
নবজাতকের জন্মগত রোগ সনাক্তকরণ-এর মাধ্যমে শিশুকে জন্মগত হাইপোথাইরয়েডিজম জনিত স্থায়ী শারীরিক ও মানসিক প্রতিবন্ধিতার হাত থেকে রক্ষা করা সম্ভব।
জন্মের সাথে সাথে শিশুর নাড়ী (Cord Blood) অথবা জন্মের ৪৮ ঘন্টা পরে শিশুর পায়ের গোড়ালি থেকে (Heel prick) কয়েক ফোঁটা রক্ত দিন এবং বিনা মূল্যে জেনে নিন আপনার শিশুর থাইরয়েড হরমোনের অভাবজনিত কোন সমস্যা আছে কি না ?
জন্মের ৪ সপ্তাহের মধ্যে শিশুর এই রোগ নির্ণয় ও চিকিৎসা শুরু করা গেলে তাকে প্রতিবন্ধিতা থেকে রক্ষা করা যেতে পারে।
নবজাতকের জন্মগত হাইপোথাইরয়েডিজম সনাক্তকরণ পরীক্ষাকে জাতীয় কর্মসূচী হিসেবে প্রতিষ্ঠা করতে এগিয়ে আসুন।
এক ফোঁটা রক্ত দিন-শিশুর জীবন বাঁচান
বাংলাদেশ পরমাণু শক্তি কমিশন, বঙ্গবন্ধু শেখ মুজিব মেডিকেল বিশ্ববিদ্যালয়ে অবস্থিত ন্যাশনাল ইনস্টিটিউট অব নিউক্লিয়ার মেডিসিন এন্ড অ্যালায়েড সায়েন্সেস (নিনমাস) এবং দেশের বিভিন্ন প্রান্তে অবস্থিত ১৪টি ইনস্টিটিউট অব নিউক্লিয়ার মেডিসিন এন্ড অ্যালায়েড সায়েন্সেস (ইনমাস)-এর মাধ্যমে নবজাতকের জন্মগত হাইপোথাইরয়েড রোগ সানাক্তকরণের সুবিধাদি চালু করেছে।
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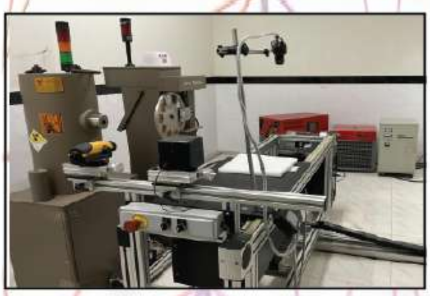

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ESTABLSIHMENT OF CALIBRATION AND QUALITY CONTROL FACILITIES FOR RADIOTHERAPY, DIAGNOSTIC RADIOLOGY AND NEUTRON PROJECT

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TMSS is the **third largest organization in Bangladesh** and the **largest women organization in Asia,** working for poverty alleviation, socio-economic development and empowerment of women. TMSS is implementing various projects all over the country. For improving the health status of the people of Bangladesh, TMSS established Health Sector in 1990. Now, **TMSS Health Sector** is **the largest sector of this organization.**

Under this sector, **TMSS Medical College** is the largest Non-Government Medical College in the country which is six kilometer north to Bogura town, established in January 2008. **It has 1000 beds multi-disciplinary hospital** with modern diagnostic equipment and treatment facilities. Recently **TMSS Medical College & Rafatullah Community Hospital** has extended its services and has established a Modern Cancer Care Center named **TMSS Cancer Center.** It has 150 beds with **all kind of facilities of diagnosis and treatment of different kinds of Cancer.** It is now ready for operation.

SERVICES IN TCC

Cancer Prevention

Cancer Screening

Cancer Related Investigation

- Biomolecular Lab
- Histopathology
- Immunohistochemistry
- Others

Treatment

- Surgery
- Radiotherapy
- Chemotherapy
- Palliative Service

Rehabilitation

- Physiotherapy
- Artificial Limb Replacement
- Training for patients

Dormitory Facilities for patients and their attendants

Radiotherapy Service

External Beam Radiotherapy

- 3D Conformal Radiotherapy (3D-CRT)
- Image Guided Radiotherapy
- Intensity Modulated Radiotherapy (IMRT)
- Volumetric Modulated Arc Radiotherapy (VMAT/RapidArc)
- Electron Therapy

Internal Radiotherapy (Brachytherapy)

- Interstitial
- Intraluminal
- Intracavitary

Chemotherapy Unit Services

- Chemotherapy
- Hormone Therapy
- Immunotherapy
- Targeted Therapy

TMSS Cancer Center

TMSS Cancer Center

TMSS Medical College & Rafatullah Community Hospital

Rangpur Road, Thengamara, Bogura-5800, 01704-124127, 01704-124130
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