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Newsletter

CSIR-Indian Institute of Toxicology Research
Lucknow, India

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In This Issue

Editorial

In medicine, the power of radiation and nuclear techniques has been harnessed for the benefit of mankind. Today, medical imaging helps to detect and diagnose disease in its earliest stages but can be harmful to human life. So it is assumed by the people that all radiation exposure is equally harmful or risky but it is based on the doses of radiation. So medical radiation carries risk as well as provides beneficial effects so it has both positive effects and negative effects. There are some ways that we can limit the exposure from medical radiation.

Editors:

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Environmental Information System (ENVIS)

Centre on Toxic Chemicals at CSIR - Indian Institute

of Toxicology Research,

Lucknow India

ODDS and ENDS

1. Radiation dose verification using real tissue phantom in modern radiotherapy techniques.

[Gurjar OP, Mishra SP, Bhandari V, Pathak P, Patel P, Shrivastav G. J Med Phys. 2014 Jan;39(1):44-9.]

In vitro dosimetric verification prior to patient treatment has a key role in accurate and precision radiotherapy treatment delivery.Most of commercially available dosimetric homogeneous phantoms have almost density throughout their volume, while real interior of patient body has variable and varying densities inside. In this study an attempt has been made to verify the physical dosimetry in actual human body scenario by using goat head as "head phantom" and goat meat as "tissue phantom". The mean percentage variation between planned and measured doses was found to be 2.48 (standard deviation (SD): 0.74), 2.36 (SD: 0.77), 3.62 (SD: 1.05), and 3.31 (SD: 0.78) for three-dimensional conformal radiotherapy (3DCRT) (head phantom), intensity modulated radiotherapy (IMRT; head phantom), 3DCRT (tissue phantom), and IMRT (tissue phantom), respectively. Although percentage variations in case of head phantom were within tolerance limit (< ± 3%), but still it is higher than the results obtained by using commercially available phantoms. And the percentage variations in most of cases of tissue phantom were out of tolerance limit. On the basis of these preliminary results it is logical and rational to develop radiation dosimetry methods based on real human body and also to develop an artificial phantom which should truly represent the interior of human body.

2.Impact of repeat computerized tomography replans in the radiation therapy of head and neck cancers.

[Bhandari V, Patel P, Gurjar OP, Gupta KL. J Med Phys. 2014 Jul;39(3):164-8.]

Anatomical changes can occur during course of head-and-neck (H and N) radiotherapy like tumor shrinkage, decreased edema and/or weight loss. This can lead to discrepancies in planned and delivered dose increasing the dose to organs at risk. A study was conducted to determine the volumetric and dosimetric changes with the help of repeat computed tomography (CT) and replanning for selected H and N cancer patients treated with IMRT plans to see for these effects. In 15 patients with primary H and N cancer, a repeat CT scan after 3(rd) week of radiotherapy was done when it was clinically indicated and then two plans were generated on repeat CT scan, actual plan (AP) planned on repeat CT scan, and hybrid plan (HP), which was generated by applying the first intensity-modulated radiation therapy (IMRT) plan (including monitoring units) to the images of second CT scan. Both plans (AP and HP) on repeat CT scan were compared for volumetric and dosimetric parameter. The mean variation in volumes between CT and repeat CT were 44.32 cc, 82.2 cc, and 149.83 cc for gross tumor volume (GTV), clinical target volumes (CTV), and planning target volume (PTV), respectively. Mean conformity index and homogeneity index was 0.68 and 1.07, respectively for AP and 0.5 and 1.16, respectively for HP. Mean D95 and D99 of PTV was 97.92% (standard deviation, SD 2.32) and 93.4% (SD 3.75), respectively for AP and 92.8% (SD 3.83) and 82.8% (SD 8.0), respectively for HP. Increase in mean doses to right parotid, left parotid, spine, and brainstem were 5.56 Gy (Dmean), 3.28 Gy (Dmean), 1.25 Gy (Dmax), and 3.88 Gy (Dmax), respectively in HP compared to AP. Repeat CT and replanning reduces the chance of discrepancies in delivered dose due to volume changes and also improves coverage to target volume and further reduces dose to organ at risk.

3. Can positron emission tomography be more than a diagnostic tool? A survey on clinical practice among radiation oncologists in India.

[Thomas HM, Balukrishna S, Devakumar D, Muthuswamy P, Samuel EJ. Indian J Cancer. 2014 Apr-Jun;51(2):145-9.]

AIM:

The purpose of the survey was to understand the role of positron emission tomography (PET) in clinical radiotherapy practice among the radiation oncologists'

in India.

SETTINGS AND DESIGN:

An online questionnaire was developed to survey the oncologists on their use of PET, viewing protocols, contouring techniques practiced, the barriers on the use of PET and the need for training in use of PET in radiotherapy. The questionnaire was sent to about 500 oncologists and 76 completed responses were received.

RESULTS:

The survey shows that radiation oncologists use PET largely to assess treatment response and staging but limitedly use it for radiotherapy treatment planning. Only manual contouring and fixed threshold based delineation techniques (e.g. 40% maximum standard uptake value [SUV max] or SUV 2.5) are used. Cost is the major barrier in the wider use of PET, followed by limited availability of FDG radionucide tracer. Limited or no training was available for the use of PET.

CONCLUSIONS:

Our survey revealed the vast difference between literature suggestions and actual clinical practice on the use of PET in radiotherapy. Additional training and standardization of protocols for use of PET in radiotherapy is essential for fully utilizing the capability of PET.

4. Late effects of cancer treatment in breast cancer survivors.

[Agrawal S. South Asian J Cancer. 2014 Apr;3(2):112-5.]

Postoperative radiation therapy (RT) and chemotherapy,both reduces the risk of local recurrence and extends overall survival in patients with breast cancer (BC). Concerns have, however, been raised about the risk of acute and chronic side effects in breast cancer survivors as the number of treated individuals is large and their expected survival is long compared to most patients with other malignant diseases. Cardiac toxicity, reproductive dysfunction, pneumonitis (RP),arm lymph edema, neuropathy, skin changes are examples of the wide range of complications that has been associated with adjuvant treatment.

5. Thymoma: first large Indian experience.

[Rathod S, Munshi A, Paul S, Ganesh B, Prabhash K, Agarwal JP. Indian J Cancer. 2014 Apr-Jun;51(2):109-12.]

BACKGROUND:

Thymoma is the most common tumor of the anterior mediastinum. Surgery is mainstay of treatment, with adjuvant radiation recommended for invasive thymoma. Because of rarity, prospective randomized trials may not be feasible even in multicentric settings hence the best possible evidence can be large series. Till date Thymoma has not been studied in Indian settings.

MATERIALS AND METHODS:

All patients presenting to Thoracic disease management group at our Centre during 2006-2011 were screened. Sixty two patients' with histo-pathological confirmation of thymoma medical records could be retrieved and are presented in this study. Mosaoka staging and WHO classification was used. The clinical, therapeutic factors and follow up parameters were recorded and survival was calculated. Effects of prognostic factors were compared.

RESULTS:

Sixty two patients were identified (36M, 26F; age 22-84, median 51.5 years) and majorities (57%) of thymoma were stage I-II. WHO pathological subtype B was most common 30 (49%). Mean tumor size was smaller in patients with myasthenia (5.3cm) than the entire group (7.6cm). Neoadjuvant therapy was offered to five unresectable stages III or IV a patient's with 40% resectability rates. Median overall survival was 60 months (Inter quartile-range 3-44 months) with overall survival rate (OS) at three year being 90%. Resectable tumors had better outcomes (94%) than non resectable (81%) at three years. Mosaoka Stage was the only significant (P = 0.03) prognostic factor on multivariate analysis.

CONCLUSION:

This is first thymoma series from India with large number of patients where staging is an important prognostic factor and surgery is the mainstay of therapy. In Indian context aggressive multimodality treatment should be offered to advanced stage patients and which yields good survival rates and comparable.

6. Three distinct urethral fistulae 35 years after pelvic radiation.

[Sharma A, Kurtz MP, Eswara JR. Nephrourol Mon. 2014 Feb 22;6(2):e14197.]

INTRODUCTION:

While the development of fistulae is a well-known complication of radiotherapy, such fistulae can often be challenging to manage.

CASE PRESENTATION:

We describe the case of a 37 year old male who developed in succession a urethrocutaneous fistula to the thigh, a rectourethral fistula and a peritoneo-urethral fistula 35 years after radiotherapy for pediatric pelvic rhabdomyosarcoma.These complications were managed successfully after multiple surgical procedures.

DISCUSSION:

We subsequently discuss the different approaches currently employed for the management of radiation induced urinary fistulas and describe the rationale behind our approach towards their surgical management.

7. Role of radiation therapy for renal tumors.

[Parashar B, Patro KC, Smith M, Arora S, Nori D, Wernicke AG. Semin Intervent Radiol. 2014 Mar;31(1):86-90.]

Renal cell carcinoma (RCC) is an aggressive malignancy that carries a poor prognosis, especially in patients presenting with advanced stage. Primary treatment for localized RCC is surgical resection however, a significant number of patients still develop locoregional and distant metastasis after curative resection. In metastatic disease, radiation therapy (RT) has been used for palliation routinely for brain and other extracranial lesions with respectable response rates. However, RT for primary RCC has questionable benefit. In this article, the authors discuss the evidence with regards to the role of RT in primary RCC either as a primary treatment, adjuvant treatment, or preoperatively to improve resection outcomes. In addition, novel RT techniques such as stereotactic body radiation therapy and its use in RCC management are also addressed. Finally, the authors discuss the techniques and doses of RT for primary RCC.

8. Cytogenetic endpoints and Xenobiotic gene polymorphism in lymphocytes of hospital workers chronically exposed to ionizing radiation in Cardiology, Radiology and Orthopedic Laboratories.

[Vellingiri B, Shanmugam S,Subramaniam MD, Balasubramanian B, Meyyazhagan A, Alagamuthu K, Prakash V, Shafiahammedkhan M, Kathannan S, Pappuswamy M, Raviganesh B, Anand S, Shahnaz N D, Cho SG, Keshavarao S. Ecotoxicol Environ Saf. 2014 Feb;100:266-74.]

Ionizing radiation (IR) is known as a classical mutagen capable of inducing various kinds of stable and unstable chromosomal aberrations (CA) including the possibility of increasing the incidence of DNA damage. This study aims to assess occupationally induced CA in workers chronically exposed to low doses of IR in Radiology (RL), Cardiology (CL) and Orthopedic (OL) Laboratories in hospitals of Tamil Nadu. We performed the analysis of CA by trypsin G-banding, micronucleus (MN) assay, Comet assay and Xenobiotic-metabolizing gene polymorphisms (GSTM1, GSTT1 and GSTP1) in 56 exposed and 56 control subjects who were matched for gender and age (± 2 years). Higher degree of CA and MN frequencies were observed in exposed groups, especially in CL subjects compared to other exposed groups and controls ($p<0.05$). Higher frequency of DNA tail length and tail moment was observed in the CL exposed subjects compared to the RL and OL subjects. The frequencies of GSTM1 and GSTT1 null genotypes were 39.3 percent and 14.3 percent, respectively. No significant difference in allele frequencies between exposed subjects and controls were observed ($p=0.0128$). Using multiple linear regression analysis, statistical significance was determined for work duration and age for the CL, RL and OL workers and the examination of the possible impact by confounding factors showed few significant influences on the radiation exposure, as a specific biomarker. However, the findings from the present study suggest that, awareness should be created among the personnel exposed to radiations in hospital laboratories, highlighting the necessity of applying radiation protection principles against medical radiation exposure.

9. Antioxidants in dermatology.

[Pai VV, Shukla P, Kikkeri NN. Indian Dermatol Online J. 2014 Apr;5(2):210-4]

Antioxidants neutralize free radicals produced by various environmental insults such as ultraviolet radiation, cigarette smoke and air pollutants, thereby preventing cellular damage. The role of oxidative stress and antioxidants is known atherosin diseases like obesity, clerosis, and Alzheimer's disease. Herein we discuss the effects of oxidative stress on the skin and role of antioxidants in dermatology.

Facts about Medical Radiation

Image Source:

https://www.dochandal.com/medical-radiation-exposure/

Today the topic of discussion is risk from medical radiation exposure. Likewise with radiation, the harm from medical radiation is largely dependent upon many factors such as the size of the dose, the type of radiation, the part of the body exposed, and the age and health of the exposed individual. Like: *Aspirin* is very effective to treat mild to moderate pain and to reduce fever or inflammation. If you take aspirin medicine in large quantities, can be very harmful. Small doses of radiation may pose a risk of increased cancer which is generally as small when compared to the natural incidence of cancer. Today radiation dose and risk information are inaccurately conveyed and people make perpetuate misperceptions. These misperceptions create a fear of radiation. So It is assumed by the people that all radiation exposure is equally harmful or risky. Today, most of the data, regarding the risk of cancer (or other effects) from radiation is based on very high doses of radiation. So high doses of radiation do lead to increased risks of cancer.

In medicine, the power of radiation and nuclear techniques has been harnessed for the benefit of mankind. Today, medical imaging helps to detect and diagnose disease in its earliest stages. With the help of medical imaging physicians determine the most appropriate and effective care where, previously, exploratory surgery was necessary to discover the cause of symptoms or the nature of a disease. Although radiation carries risk as well as provides beneficial effects so it has more positive effects than negative effects.

Way to Reduce Risk Of Radiation From Medical Devices

Below are some ways to reduce unnecessary radiation exposure from diagnostic tests.

1. X-ray test:

Some tests, which are not necessary for diagnosing and treating a problem but some doctors, recommend X-ray tests. So ask your doctor if the x-ray is necessary otherwise avoid those tests.

2. Keep track of diagnostic X-rays:

You have to keep track of your medical record of all medical tests and also record of radiation which receives from medical tests. So that you and other doctors will know your lifetime radiation dose.

3. Alternatives to high-radiation tests:

Some medical tests do not have any known health risks and having low radiation exposure. So instead of high radiation tests (CT scan, fluoroscopy or PET scan) you should ask your doctor about low radiation tests (MRI, ultrasound or simple x-ray).

4. If recently had another X-ray test:

If you are changing your doctor or taking treatment from multiple doctors and you are undergone to same or similar test then you have to show your x-rays to new doctor.

5.For Pregnant women, children, and young adults:

In case of pregnant women, children, and young adults if x-ray tests are mandatory then low doses should be used if possible.

Medical Radiation Side Effects

Bleeding from the nose, mouth, gums, and rectum

Bloody stool

Bruising

Confusion

Dehydration

Diarrhea

Fainting

Fatigue

Fever

Hair loss

Inflammation of exposed areas (redness, tenderness, swelling, bleeding)

Mouth ulcers

Nausea and vomiting

Open sores on the skin

Skin burns (redness, blistering)

Sloughing of skin

Ulcers in the esophagus, stomach or intestines

Vomiting blood

Weakness

http://www.nlm.nih.gov/medlineplus/ency/article/000026.htm

International systems of radiation protection

While dealing with issues pertaining to radiation protection, the following situations could occur:

1) Some countries require a medical prescription to have radiation exposure for diagnosis, while other countries do not.

2) In some countries, whole body computed tomography screening is allowed, while in others it is not.

3) One country's dose limit for occupational protection is 20mSv/yr, while another country prescribes 50 mSv/yr, etc.

4) In some countries, there is pressure to impose dose limits for patients undergoing medical examinations, while in others there are no dose limits for patients.

5) In some countries, patients who have received therapy with unsealed radiopharmaceuticals are sent home after a few hours, while other countries retain the patients in the hospital.

6) In some countries, those working with radiation enjoy certain privileges, while other countries do not allow privileges to replace radiation protection measures.

Such situations emphasize the need for credible international standards that are based on worldwide consensus.

How can professional bodies participate in the regulatory process?

Proactive involvement of the professional bodies in the process of establishing standards and regulations and in their application produces a number of benefits. Not only does it minimize the need for enforcement actions to ensure compliance, but also more importantly, it ensures a better understanding of radiation protection requirements and improves safety for patients. Professionals should be made aware of their responsibilities on the overall patient protection and safety in the prescription of and during the delivery of medical exposure. Professional bodies can contribute to this end, by:

1) Actively participating upon request in reviewing and giving advice to national authorities in the preparation of regulations.

2) Working with authorities in developing or adopting training and accreditation (or certification) criteria with regard to radiation protection matters and in providing education, training and professional development.

3) Developing or adopting appropriateness criteria for the use of X rays in diagnostic and interventional radiology, i.e., justification of generic procedures in general, and providing advice to its member radiologists on how to justify the exposure of individual patients where needed.

4) Providing guidelines for Ethical Review Committees on biomedical research involving the exposure of humans and providing advice on dose constraints to be applied on a case by case basis in the optimization of protection for persons exposed for medical research purposes if such medical exposure does not produce direct benefit to the exposed individual.

5) Working with manufacturers and medical physicists in establishing radiation protection criteria for radiological equipment, including the recording of data relevant for assessing patient exposure, and ensuring that instructions for use of equipment are given in a language acceptable to the users, as well as providing advice on matters of equipment maintenance and malfunction.

6) Developing or adopting recommendations on criteria for acceptable image quality.

7) Establishing guidance levels on patient exposure, by providing advice to authorities on methods of surveying patient doses and deriving guidance levels and participating in them and in evaluating the results.

8) Developing or adopting typical protocols for quality assurance and quality control and make it available to registrants/licensees and medical practitioners and qualified experts

Sources of information:

https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Standards/SafetyStandards.htm

List of medical ethics cases

CASE	YEAR	COUNTRY	LOCATION	SUMMARY
Death associated with psychotropic drugs	United States	Cheyenne, Wyoming	1998	60-year-old Donald Schell went tosee his doctor complaining of difficulty sleeping. He was diagnosed with an anxiety state and placed on Paxil, an SSRI anti-depressant. Within forty-eight hours of being put on Paxil Schell killed his wife, daughter, infant granddaughter, and himself. Tim Tobin, Schell's son-in-law, took legal action against SmithKline (now GlaxoSmithKline). The Tobin case was heard in Wyoming from May 21 to June 6, 2001. The jury returned a guilty verdict against SmithKline and awarded Tobin $6.4 million. This was the first verdict returned guilty against a pharmaceutical company regarding adverse behavioral effects of a psychotropic drug.
Robert Courtney	United States	Kansas City, Missouri	2002	Courtney is a former pharmacist who owned and operated Research Medical Tower Pharmacy in Missouri. In 2002 he was convicted of pharmaceutical fraud and sentenced to federal prison.
Greenberg v. Miami Children's Hospital Research Institute	United States	Florida	2003	Patients donated tissue samples, which researchers subsequently used in a plan to generate profit.
GlaxoSmithKline human experiments	Various		2004-2012	In 2004 GlaxoSmithKline (GSK) sponsored at least four medical trials using Hispanic and black children at New York Incarnation Children's Centre. Normally trials on children require parental consent but, as the infants are in care, New York's authorities hold that role. Experiments were designed to test the "safety and tolerance" of Aids medications, some of which have potentially dangerous side effects.
				in 2006 GSK and US Army have been criticized for Hepatitis-E vaccine experiments on 2000 soldiers of Royal Nepalese Army conducted in 2003. It was said that using

CASE	YEAR	COUNTRY	LOCATION	SUMMARY
				said that using soldiers as volunteers is unethical because they "could easily be coerced into taking part".
				in January 2012 GSK and two scientists who led the trials have been fined approximately $240,000 in Argentina for "experimenting with human beings" and "falsifying parental authorization" during vaccine trials on 15000 children, under the age of one. Babies were recruited from poor families that attended public hospitals for medical treatment. 14 babies allegedly died as a result of trials.
Death from prescription drugs	United States	Hull, Massa-chusetts	2006	Rebecca Riley, the daughter of Michael and Carolyn Riley and resident of Massachusetts, was found dead at age 4 in her home after prolonged exposure to various medications, her lungs filled with fluid. The medical examiner's office determined the girl died from "intoxication due to the combined effects" of prescription drugs. Police reports state she was taking 750 milligrams a day of Depakote, 200 milligrams a day of Seroquel, and .35 milligrams a day of Clonidine. Rebecca had been taking the drugs since the age of two for bipolar disorder and ADHD, diagnosed by child psychiatrist Kayoko Kifuji of the Tufts-New England Medical Center.

Sorce: http://en.wikipedia.org/wiki/List_of_medical_ethics_cases

Book Stop

Title Medical Radiation Dosimetry: Theory of Charged Particle Collision Energy Loss

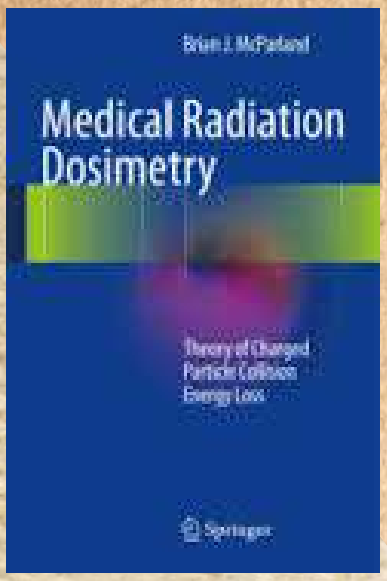
Author Brian J. McParland

Publisher Springer Science & Business Media, 2013

ISBN 1447154037, 9781447154037

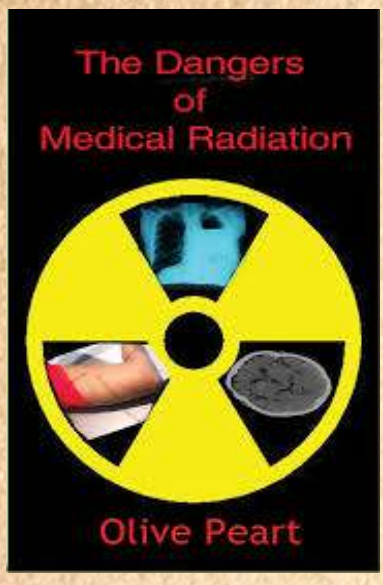
Length 658 pages

Accurate radiation dosimetry is a requirement of radiation oncology, diagnostic radiology and nuclear medicine. It is necessary so as to satisfy the needs of patient safety, therapeutic and diagnostic optimisation, and retrospective epidemiological studies of the biological effects resulting from low absorbed doses of ionising radiation. The radiation absorbed dose received by the patient is the ultimate consequence of the transfer of kinetic energy through collisions between energetic charged particles and atoms of the tissue being traversed. Thus, the ability of the



medical physicist to both measure and calculate accurately patient dosimetry demands a deep understanding of the physics of charged particle interactions with matter. Interestingly, the physics of charged particle energy loss has an almost exclusively theoretical basis, thus necessitating an advanced theoretical understanding of the subject in order to apply it appropriately to the clinical regime.? Each year, about one-third of the world's population is exposed to ionising radiation as a consequence of diagnostic or therapeutic medical practice. The optimisation of the resulting radiation absorbed dose received by the patient and the clinical outcome sought, whether diagnostic or therapeutic, demands accuracy in the evaluation of the radiation absorbed doses resulting from such exposures.

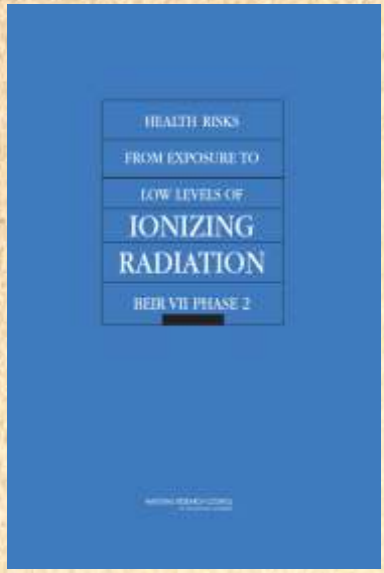
Tital The Dengers of Medical Radiation
Author Olive Peart
Publisher DLite Press, 2010
ISBN 0982977417,9780982977415



Length 106 pages
We worry about radiation dose at airport security systems. We worry about electromagnetic radiation from power lines and cell phones yet we are willing to tolerate the massive doses of radiation given to us by our health care providers. Read how to protect yourself from medical radiation!

Health Risks from Exposure to Low Levels of Ionizing Radiation:: BEIR VII Phase 2

Title Health Risks from Exposure to Low Levels of Ionizing Radiation:: BEIR VII ï¿½ Phase 2 *Volume 7 of BEIR (Series)*
Authors Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, Division on Earth and Life Studies, National Research Council
Edition illustrated
Publisher National Academies Press, 2006
ISBN 030909156X,9780309091565



Length 424 pages
BEIR VII develops the most up-to-date and comprehensive risk estimates for cancer and other health effects from exposure to low-level ionizing radiation. It is among the first reports of its kind to include detailed estimates for cancer incidence in addition to cancer mortality. In general, BEIR VII supports previously reported risk estimates for cancer and leukemia, but the availability of new and more extensive data have strengthened confidence in these estimates. A comprehensive review of available biological and biophysical data supports a "linear-no-threshold" (LNT) risk model-that the risk of cancer proceeds in a linear fashion at lower doses without a threshold and that the smallest dose has the potential to cause a small increase in risk to humans. The report is from the Board on Radiation Research Effects that is now part of the newly formed Nuclear and Radiation Studies Board.

Forthcoming Conferences

ICMPRPR 2015: XIII International Conference on Medical Physics, Radiation Protection and Radiobiology

January 13 - 14, 2015

Zurich, Switzerland

Conference on Medical Physics, Radiation Protection and Radiobiology aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Medical Physics, Radiation Protection and Radiobiology. It also provides the premier interdisciplinary and multidisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns, practical challenges encountered and the solutions adopted in the field of Medical Physics, Radiation Protection and Radiobiology.

https://www.waset.org/conference/2015/01/zurich/ICMPRPR

15th International Congress of Radiation Research (ICRR 2015)

May 25 - 29, 2015

Kyoto, Japan

The theme of ICRR 2015 is "Radiation Science Shaping the Future of the Earth and Mankind". Radiation science is a comprehensive research area that covers many branches such as radiation-related physics, chemistry, biology , and medicine, each of which has progressed remarkably in recent years. Radiation science is nowadays an advanced science that is closely linked to human societies and applicable to life in many aspects. In ICRR 2015, the latest discoveries in each research field as well as interdisciplinary research will be presented. Invitation of renowned scientists and travel support for young investigators are planned.

http://www.congre.co.jp/icrr2015/messages.html

Joint Congress on Medical Imaging and Radiation Sciences in 2015

May 28 – 30, 2015

Montréal, Québec

Joint Congress on Medical Imaging and Radiation Sciences in 2015's theme is Collaborative Care–Imaging and Treatment. It will be infused throughout provocative lectures, informative workshops and poster sessions and will carry on into the exhibit hall, a large showcase for today's–and tomorrow's–innovative products and practices. This bilingual congress offers unparalleled opportunities for collaborative learning and professional networking among radiologists, medical radiation technologists and other members of the medical imaging team.

http://www.camrt.ca/conferences/

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