

Research in Radiation Protection

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Aims of presentation

- To present the importance of research in Radiation Protection.
- To facilitate for literature review for research in Radiation Protection.
- To present examples of research in Radiation Protection in literature.
- To discuss some research findings by IIUM students related to radiation protection.

Overview of Research

- Definition: a systematic and scientific investigation to establish facts.
- Re-search: to search again / to reexamine
- To enhance our understanding of certain body of knowledge.
- To communicate the understanding gained to others.

- Research areas - development, testing, evaluation, re-evaluation, contribute to / or enhance and expand generalizable knowledge.

Overview of Radiation Protection

- All measures taken to reduce risks to ionising radiations to patient, staff and general public.
- Radiation effects (deterministic and stochastic) are health concerns.
Deterministic effects occurs at threshold level while Stochastic effects can happen without any threshold level.

Measures as outlined by European guidelines

- The European Guidelines address the three important inter-related aspects of radiation protection:
 - the diagnostic quality of the radiographic image is obtained at the lowest possible radiation dose to the patient with respect to the choice of radiographic technique.

No unnecessary repeat required.

Importance of research in Radiation Protection

- Professional Obligation to look for ways to reduce radiation risks to patients.
- The right of the patient for a safe practice
- Meeting patient expectation and satisfaction
- Changing technology – Health Technology Assessment
- Professional commitment
- Fulfilling religious obligation

Literature search / review

- Perhaps the most important before starting the research proper.

Search:

- Books
- Official documents
- Journals
- online searches

Books

- Library
 - request assistance from the librarian
 - provide him with ISBN number
 - inter-library loan

Specific books:

<http://www.amazon.com/> - [example](#)

<http://www.barnesandnoble.com/>

Free online resources

<http://www.onlinebooks4free.com/menu/medicine.html>

<http://www.e-book.com.au/freebooks.htm>

Journals

- Hardcopy – subscription : Radiology, BJR etc
- On-line
 1. Pubmed: example : radiation protection in CT scanning – related articles
 2. Radiology - <http://radiology.rsna.org/>
 3. British Journal of Radiology – <http://bjr.birjournals.org/>

Other online journals

- American Journal of Roentgenology - <http://www.ajronline.org/>
- American Journal of Neuroradiology - <http://www.ajnr.org/>
- Springer
- American Association of Physicists in Medicine - <http://www.aapm.org/>
- Health Technology assessment at www.hta.ac.uk

Areas of research in Radiation protection – as derived from Pubmed – as on 18th July 2009

- Keyword :

Radiation protection : 24311

Radiation protection in medical imaging – 3795

Radiation protection in medicine – 3482

- reviews

- experimental

- occupational exposure

- radiographic guidelines

Radiation protection in medicine

- Reviews

- Dental radiographic guidelines: a review. Kim IH, Mupparapu M. Quintessence Int. 2009 May;40(5):389-98.
- A review of factors affecting patient doses for barium enemas and meals. Martin CJ. *Br J Radiol.* 2004 Oct;77(922):864-8.
- Fluoroscopy: patient radiation exposure issues. Mahesh M. *Radiographics.* 2001 Jul-Aug;21(4):1033-45. Review

Reports

1. Report of a consultation on justification of patient exposures in medical imaging. Hendee W, Mettler M Jr, Walsh M, Guleria R, Craven C, Sia S, Durand-Zaleski I, Sheehan M, Czarwinski R, Rehani M, Le Heron J, Boal T, Zaknun J; International Atomic Energy Agency (IAEA). *Radiat Prot Dosimetry*. 2009;135(2):137-44.
2. Ensuring patient safety: a summary of the 2008 Intersociety Conference. Dunnick NR. *J Am Coll Radiol*. 2009 Apr;6(4):230-4

Specific topics

- Pediatric CT radiation dose: how low can you go? Cohen MD. *AJR Am J Roentgenol.* 2009 May;192(5):1292-303
- Measurement of HVL on fluoroscopy units. Finney L *Health Phys.* 2004 May;86(5 suppl):S88-9.
- Doses to patients in routine X-ray examinations in Malaysia. Ng KH, Rassiah P, Wang HB, Hambali AS, Muthuvellu P, Lee HP. *Br J Radiol.* 1998 Jun;71(846):654-60.

- Professional issues

Ethical issues for radiographers: general observations and a pilot qualitative study.

Gruppetta E. *Radiat Prot Dosimetry*. 2009;135(2):88-9. Epub 2009 Jun 13

- Radiation protection in medicine: ethical framework revisited. Malone JF .*Radiat Prot Dosimetry*. 2009;135(2):71-8. Epub 2009 Mar 5.

Strategies for dose reduction

- Strategies for dose-optimized imaging in pediatric cardiac dual source CT. Kuettner A, Gehann B, Spolnik J, Koch A, Achenbach S, Weyand M, Dittrich S, Uder M, Staatz G. *Rofo*. 2009 Apr;181(4):339-48.
- Validation of CT dose-reduction simulation. Massoumzadeh P, Don S, Hildebolt CF, Bae KT, Whiting BR. *Med Phys*. 2009 Jan;36(1):174-89.

Practice

- A study of operator's hand and finger exposure dose reduction during angiographic procedures. Sakamoto H, Ikegawa H, Kobayashi H, Kiuchi T, Sano Y, Fukasawa M, Araki T. *Nippon Hoshasen Gijutsu Gakkai Zasshi*. 2009 Jan 20;65(1):25-34. Japanese
- A practical demonstration of improved technique factors in paediatric fluoroscopy. Fenner JW, Morrison GD, Kerry J, West N. *Br J Radiol*. 2002 Jul;75(895):596-602
- A search for improved technique factors in paediatric fluoroscopy. Tapiovaara MJ, Sandborg M, Dance DR *Phys Med Biol*. 1999 Feb;44(2):537-59

Clinical Trials

- Management of pediatric radiation dose using GE fluoroscopic equipment. Belanger B, Boudry J. *Pediatr Radiol.* 2006 Sep;36 Suppl 2:204-11
- A clinical trial of the Nomad portable X-ray unit. Brooks SL, McMinn WE, Benavides E. *J Mich Dent Assoc.* 2009 Feb;91(2):54-8
- Filter material selection for region of interest radiologic imaging. Massoumzadeh P, Rudin S, Bednarek DR. *Med Phys.* 1998 Feb;25(2):161-71

Dose and Image Quality

- CT radiation dose and image quality. Payne JT. *Radiol Clin North Am.* 2005 Nov;43(6):953-62, vii
- Effect of patient support pads on image quality and dose in fluoroscopy. Geiser WR, Huda W, Gkanatsios NA *Med Phys.* 1997 Mar;24(3):377-82.
- Added copper filtration in digital paediatric double-contrast colon examinations: effects on radiation dose and image quality. Hansson B, Finnbogason T, Schuwert P, Persliden J. *Eur Radiol.* 1997;7(7):1117-22.
- Evaluating radiographic parameters for mobile chest computed radiography: phantoms, image quality and effective dose. Rill LN, Brateman L, Arreola M. *Med Phys.* 2003 Oct;30(10):2727-35.

Dose / Diagnostic reference levels

- Towards establishment of the national reference dose levels from computed tomography examinations in Tanzania. Ngaile JE, Msaki P, Kazema R. 1: *J Radiol Prot.* 2006 Jun;26(2):213-25. Epub 2006 May 26
- Application of European Commission reference dose levels in CT examinations in Crete, Greece Tsapaki V, Kottou S, Papadimitriou D 1: *Br J Radiol.* 2001 Sep;74(885):836-40
- Local diagnostic reference levels in standard X-ray examinations. Compagnone G, Pagan L, Bergamini C. *Radiat Prot Dosimetry.* 2005;113(1):54-63. Epub 2004 Nov 30..

Optimisation in imaging

- Investigation of optimum X-ray beam tube voltage and filtration for chest radiography with a computed radiography system. Moore CS, Beavis AW, Saunderson JR. *Br J Radiol.* 2008 Oct;81(970):771-7. Epub 2008 Jul 28.
- Effect of X-ray tube parameters, iodine concentration, and patient size on image quality in pulmonary computed tomography angiography: a chest-phantom-study. Szucs-Farkas Z, Verdun FR, von Allmen G, Mini RL, Vock P. *Invest Radiol.* 2008 Jun;43(6):374-81.

- Optimization of radiographic technique for chest radiography Warren-Forward HM; Millar JS
British Journal of Radiology
1995, vol. 68, no815, pp. 1221-1229

Four recommendations have been made to lower patient doses ; these are : (1) an increase in applied potential to a minimum of 90 kVp ; (2) a film-screen sensitivity of 400 ; (3) optimization of processor performance and (4) regular radiological audits to reduce repeat rates to a level of 5%. If all of these recommendations are followed, an estimated overall entrance surface dose saving of 53% would result. Changing the applied potential alone will see the variation in the mean entrance surface dose from non-gridded systems reduce from a factor of 4 to a factor of 2.

Publications

- Optimization of the radiological protection of patients undergoing radiography, fluoroscopy and computed tomography
IAEA, VIENNA, 2004

Available online.

General Education

- The AAPM/RSNA physics tutorial for residents: general overview of fluoroscopic imaging. Schueler BA *Radiographics*. 2000 Jul-Aug;20(4):1115-26
- The AAPM/RSNA physics tutorial for residents. Typical patient radiation doses in diagnostic radiology. Parry RA, Glaze SA, Archer BR. *Radiographics*. 1999 Sep-Oct;19(5):1289-302.

Some research by IIUM students:

- Yusraa Kasim : Bismuth shielding in CT Brain- An Image analysis (2008)- study using CATPHAN using 4 ply bismuth shielding. Results: Shielding only one side. If shielding opposing sides, artefacts will be produced.

Implications: Possibilities for dose reduction in CT head examinations using bismuth.

Future work: perform on head phantom and if possible to validate for human subjects.

- Mazlina Haja Mydin: Effect of magnification and minification on carpal bones images in CR systems (2008)
 - using electronic minification and magnification of carpal bones – minified not less than 0.9 times or magnified not more than 1.8 times
 - for certain abnormalities of scaphoid #, bone lesions and bone mineralisation best visualised at 1.2 times magnification.
 - Dislocations and osteoarthritis 1.8 times magnification is suggested.

- Suraya Sulaiman Khan : Adjusting the Table height in CT Scanning: Effects on image quality (2008)
- Using CATPHAN
- Results: High resolution, low contrast detectability and image uniformity is best at table height 145cm.
- Future work: How this finding can be translated to Image quality and dose to the eyes in CT brain as well as specific lesions to the other parts of the human anatomy..

- Zanariah bt. Mohd : Radiation Protection Policy used for women of childbearing age who undergo pelvic region irradiation- A survey across various radiology departments in central region of peninsular Malaysia.
- 10 private hospitals.
- 80% of the departments surveyed has written radiation protection policies.
- 50% did not follow the 10 day rule for high dose examinations.
- Need for coordination / standardisation in radiation protection policy.

Summary

- Importance of research in radiation protection is very much relevant.
- Institutions should create avenues for a research culture at the work place.

How to do research?

- Identify the specific area to be researched.
 - through observation, questioning and critical thinking
 - list out the present state of affairs
 - list out what could be different to present state of affairs (hypothesis)
 - why is it important to research this area
- Try to forge collaboration with other institutions.

- Specify the objectives of the research
 - the general objective (usually only 1 objective)
 - the specific objectives (many)
 - the hypotheses to these objectives
- Conduct a literature search / literature review
 - to find out current state of affairs
 - to find out if the subject had been researched by others
 - to relate the findings of past research to the findings of the intended research

- Formulate the methodology
 - type of research : experimental, longitudinal etc
 - identify the data collection method : questionnaire etc
 - identify the statistical test to support the data generated.

- Presentation of results
 - Tables, figures, appendix as appropriate
- Discussion : based on the results
 - relate to existing knowledge
 - highlight the significance of the result
 - suggest how others should use the findings
- Conclusion : should relate to the objectives.