# Current issues in diagnostic imaging and radiation therapy

*At the annual Engineering and Physical Sciences in Medicine Conference held recently in Newcastle, Australia, several items of general interest for users of radiation in medicine were discussed.*

- The use of CT scanners in the developed world is now responsible for approximately half of the radiation dose arising from the use of radiation in diagnosis. This is an increase from an estimated 20% in the early nineties.
- Multi-slice CT scanners are beginning to appear in hospitals and practices in New Zealand and Australia. While the multi-slice platform results in reductions in overall examination time and x-ray tube loading, initial measurements suggest that the radiation dose for multi-slice CT scanning is significantly higher than the equivalent single-beam CT scanning, with factors in excess of 2 being reported. The increase in the dose appears to be due to dose profiles that are considerably larger than the nominal slice widths.
- Non-film based imaging systems for radiography continue to make inroads in x-ray practices. Whether the systems are computed radiography or digital radiography, there are potential implications for patient dose. Whereas in film-screen systems the density on film acts as a limiter on the film dose (and therefore also on patient dose), there is no equivalent limiter on computed radiography and digital radiography. The level of dose is effectively determined by the amount of noise that is considered acceptable in the image. Because less noisy images look more acceptable, there is potential for exposures to "creep" over time to higher levels than are necessary to produce the required diagnostic information. Regular surveillance of exposures is required as part of the quality assurance programme in radiation protection.
- As clinical usage of CT fluoroscopy increases it is becoming evident from dose studies that doses to the hands of the clinician are determined largely by their practice, and in particular by proximity to the beam. The use of leaded surgical gloves, as well as providing less tactility, can lead to a false sense of security and ensuing poor practice. The importance of keeping the hands out of the beam cannot be stressed enough.
- The use of interventional procedures under x-ray guidance continues to increase. Long complicated procedures can lead to regions of skin in the incident primary beam receiving doses that exceed the thresholds for various skin effects. Many practices have established protocols to identify patients who may be at risk of deterministic effects. These protocols include a system for follow-up of the patient over a period of many months, as the nature of the radiation injuries means that there is considerable delay before their appearance.
- Intensity-Modulated Radiation Therapy (IMRT), is a development of "conformal" therapy where the radiation dose from a linear accelerator delivered to the patient is designed to conform as closely as possible to the shape of the volume of tissue to be treated. It uses multiple beams with each beam being modulated by moving the collimator across it so as to vary the intensity of dose delivery in a predetermined pattern. The plan of each treatment is generated by computer using optimisation techniques. There are considerable technical difficulties in setting up and using an IMRT system, including verification that the computer plan is correct, that the linear accelerator delivers the intended plan, and that the patient does not move during treatment. However there appear to be considerable advantages for the patient, in that a greater dose can be given to a tumour with reduced damage to surrounding tissue.
- A session was devoted to discussion of the possibility of installing a (very expensive) proton therapy centre in Australia that would provide a service to all of Australia and also to New Zealand. Protons are generated by a large cyclotron or synchrotron and can deliver a very high dose of radiation with pinpoint accuracy because of the way protons interact with matter. It is the treatment of choice for some tumours that either cannot be treated with or do not respond to conventional radiation therapy. In spite of the high start-up cost, the cost per patient is estimated to be no more than twice the cost of a course of treatment on a linear accelerator. A working party is to be formed to take this proposal forward.

The above developments and issues, where not already adequately covered, will be addressed in future revisions of the relevant *Codes of safe practice*. NRL compliance monitoring audits will also be used to monitor how facilities continue to ensure safe practice as new developments and issues arise.

Congratulations to John Le Heron from NRL who won the Conference award for best presentation in the field of diagnostic physics. His presentation was entitled: *Estimating effective doses to children for CT examinations.*

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# The Source

Issue 4
December 2000

## Australia and New Zealand agree to work towards uniform radiation safety practices

Mutual recognition legislation between Australian States, and also between Australia and New Zealand has been in place for some time. Issues associated with mutual recognition have been considered in detail by the Australian Radiation Health Committee (RHC), on which NRL has observer status. At a recent RHC meeting in Melbourne it was agreed that a Uniformity Panel should be established, and that NRL should be a member of the Panel. The principal initial task will be the development of a *Directory for Radiation Protection*. While this directory will be non-binding upon jurisdictions, it will provide a framework for an eventual movement to uniformity of practices within Australasia.

## Future changes to the licensing of non-medical users of radiation

During the last 18 months, a specialist committee established by the Radiation Protection Advisory Council (RPAC) has been considering the robustness of current licensing practices associated with the non-medical uses of ionising radiation. This committee, consisting of industry and research representatives, and members of NRL, was chaired by Dr Peter Englert, Dean of Science at Victoria University. Its findings and recommendations have been accepted by the RPAC and now require policy development and implementation by NRL. As a first stage in implementation, NRL will be communicating with Industry, Universities and Crown Research Institutes during the early part of next year. The most significant recommendations relate to users needing to demonstrate specific competency and training in radiation safety and the development of establishment-based safety plans.

## NRL Codes of safe practice – amendments & erratum

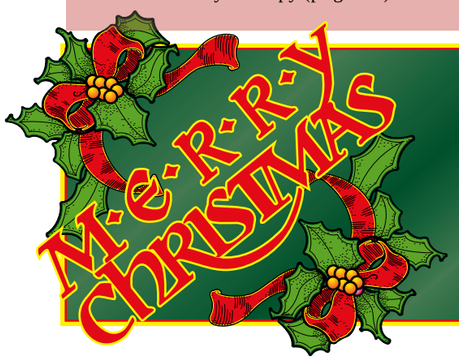
An Amendment to *NRL C12 Code of safe practice for the use of irradiating apparatus in medical therapy* has recently been published.

The amendment alters the protocol for reference calibration of medium and low energy x-ray beams and replaces Sections 5.2.2 and 5.2.3 of the current (1992) edition of the Code.

A previous Amendment, published in August 1998, modified the calibration requirements for the *Local reference dosemeter - Section 5.1.1.*

A copy of the Code including these Amendments has been sent to each licensee. However there may be others who have purchased the Code and wish to obtain a copy of either or both of the Amendments. If so please contact Ursula Ryan (Ursula_Ryan@nrl.moh.govt.nz)

*NRL C1 Code of safe practice for the use of unsealed radioactive materials* (1996 edition) contains an error.
In Appendix 1 the ALI for the radionuclide I-125 should read 1.3 MBq (not 13 MBq).
Please amend your copy (page 36).




We wish all of our readers a happy and safe Christmas and New Year and hope you are looking forward to a busy and productive 2001.

Producing The Source has been a new and exciting project for those involved and we are glad of the positive feedback that we have received. We are still keen to hear of ideas for further improvement or topics that you would like to see covered.

# Radioactive phosphate - the facts

*An article concerning radioactive phosphate ore which recently appeared in the magazine* Healthy Options *has subsequently attracted considerable media interest. Amongst other things, the article implied that New Zealand fertiliser companies were importing phosphate from the Christmas Island associated with nuclear weapons testing during the 1950s and early 1960s, and that this phosphate was radioactive due to fallout from nuclear explosions. The article also implied that the use of such phosphate as fertiliser posed radiation health risks to workers handling the material, to farmers and to the public through uptake into the food chain.*

### *An interesting story maybe, but quite incorrect.*

Most significantly, phosphate ore is imported into New Zealand from *Christmas Island*, an island located in the Indian Ocean. This is not the formerly-named *Christmas Island* associated with nuclear weapons testing, which is now part of the nation of Kiribati, and is known as *Kiritimati*. This Pacific Ocean coral atoll is lacking in any form of natural phosphate ore.

Radioactivity is naturally present in the environment; all soils and ground waters have a certain radioactivity content, typically due to uranium and other transuranic elements. Naturally occurring ores, including phosphate, commonly contain higher amounts of radioactive substances than typical soil. These elevated levels are still extremely low however, and are well within the health-based guidelines established by the International Commission on Radiological Protection.

NRL has tested phosphate rock samples over the last several years. Generally phosphates imported into New Zealand have been shown to have uranium concentrations within the expected range.

Exposure of the population to radiation due specifically to the use of phosphate fertilisers is a very small addition to natural exposures, including those associated with cosmic rays and natural radioactivity within our bodies and in the environment, and much smaller than the natural variation in exposures from terrestrial radioactivity from place to place.

NRL has requested that the magazine print a correction in its next issue.

# Cellphones - exposure information & limiting devices

In common with other countries, there are plans to have exposure details for cellphones made available in New Zealand. It is likely that this will take the form of a confirmation in the phone manual that exposures comply with the New Zealand radiofrequency field exposure Standard *(NZS 2772.1:1999)*, along with details of the actual exposures when the phone is operating at maximum output. This process is being co-ordinated by the Ministry of Consumer Affairs, with technical advice being provided by NRL. Full implementation can only occur once a Standard defining test methods has been finalised, and that is not expected before April 2001. This Standard will follow closely the procedures that have been used to date for testing phones.

### *Simple ways to minimise exposure*

Although exposures from phones currently available do comply with the New Zealand exposure Standard, some people would nevertheless prefer to take steps to minimise their exposures. Two simple methods to achieve this are to use a car kit with external antenna, or to use a hand-held phone only in areas of good signal strength (if the signal strength is good, the phone reduces its output power up to one-hundredfold).

### *Are exposure limiting devices effective?*

Devices are now being promoted which claim to provide dramatic reductions in exposure. NRL advises to treat such claims with caution. Many of the devices being promoted have not been tested in any way which resembles actual use on a phone. Radiofrequency fields are produced along the whole body of a cellphone, so discs which attach to the earpiece, for example, will only block a small percentage of the total exposure. The best option at present appears to be a hands-free kit. (Although the UK *Which?* magazine suggests that such kits may actually increase exposures, more realistic tests carried out have invariably found large exposure reductions.)

For more information please contact Martin Gledhill (Martin_Gledhill@nrl.moh.govt.nz)

# ReSources

- The Health Council of the Netherlands established an expert group to report to government on GSM (Global System for Mobiles) cellsites, and whether they might cause adverse health effects in people living or working near them. The group concluded that "The chance of health problems occurring among people living and working below base stations as a result of exposure to electromagnetic fields originating from the antennas is, in the Committee's opinion, negligible." However, they also considered that such people should be involved in the planning phase of the development. The report is available at www.gr.nl/engels/welcome/frameset.htm (Follow the links from the URL to: Publications→Reports→GSM Base Stations.)
- UNSCEAR 2000 has recently been published. This is the 14th report of the United Nations Scientific Committee on the Effects of Atomic Radiation. The large 2-volume report has a particular emphasis on evaluation of exposures and health consequences of the Chernobyl accident. It also includes annexes on exposures from natural sources, artificial sources, including medical and occupational exposure data. UNSCEAR publications form the scientific basis on which international and national agencies develop radiation protection standards for workers, patients and the general public.
- Drinking-Water Standards for New Zealand 2000 (DWSNZ 2000) replace the 1995 Standards, with effect from 1 January 2001. In line with previous editions, Chapter 5 details radiological compliance for drinking-water including maximum acceptable values.

# Dental drill: the pregnant dentist or assistant

Following discussion in the third *Dental drill* article of the implications for the dental patient and her embryo or foetus, this time consideration is given to the dentist or assistant who is pregnant.

### *Where you stand is important*

The situation for the pregnant dentist or assistant differs from that of the patient in that the dentist is going to be exposed to scatter from all the patients they x-ray. The factors that will influence the magnitude of the radiation dose to the embryo or foetus are: how many x-ray examinations are being performed, and how far and in what direction is the dentist standing from the patient when the x-rays are taken. The recommendation in Issue no. 1 of *The Source* was for a minimum distance of 2 metres in a position behind the patient's head. A pregnant dentist following this recommendation taking 50 intra-oral films per week for the duration of the pregnancy would receive a uterine dose equivalent to a few days' natural background radiation. Standing further away would lower the dose (by approximately the inverse square of the distances) and taking a different number of films would scale the dose (up or down) in proportion to the number taken.

### *Use of a leaded apron*

Hence for most situations the embryo or foetus of a dentist or dental assistant is afforded protection by the appropriate use of distance and position. For high workload situations a leaded apron may be needed. If the dentist wishes to wear a leaded apron then, unlike the patient situation discussed in Issue no. 3, it will reduce the low levels of radiation exposure even further.

For further information please contact John Le Heron (John_Le_Heron@nrl.moh.govt.nz)

# Intercomparison planned for personal monitoring systems

Readers of *The Source* who are also customers of the NRL Personal Dosimetry Service may be interested to read about an intercomparison exercise being planned for the personal dosimeters provided by dosimetry services in the South East Asia region. The NRL Personal Dosimetry Service is planning to participate in this intercomparison with its blue and yellow holders.

The intercomparison is an initiative of the International Atomic Energy Agency (IAEA), to encourage the harmonisation of radiation protection practices world-wide. The results of the personal dosimeter intercomparison will be used to assess whether the participants are reporting in quantities appropriate for the radiation types used, and to assess the accuracy for each dosimetry system to a range of radiation types and fields. For developing countries who may have limited calibration facilities, the intercomparison also provides a means of obtaining calibration information to improve their systems.

The planning for this exercise took place at a recent meeting in Japan attended by John Laban from NRL. The intercomparison will occur in two parts in 2001 and 2002, with participants submitting a number of their dosimeters for a set of blind irradiations. The irradiations are to be provided by five laboratories: two in Japan and one each in New Zealand (at NRL), Australia and Korea. Once irradiated, the dosimetry services will then have their film badges returned to them for reading (they will not know the details of the irradiations), and the results are to be reported to the IAEA, who will collect all results both from the irradiating laboratories and the dosimetry services.

The IAEA will then convene a final meeting to review the results, and, where appropriate, determine what courses of action may be necessary for participants to improve the accuracy of their systems.

For more information on the intercomparison exercise, contact John Laban (John_Laban@nrl.moh.govt.nz). Further information on NRL's Personal Dosimetry Service can be obtained from either Abby Davis or Miriam Bugler (pds@nrl.moh.govt.nz)

# Protection from the sun

Recent reports of the Antarctic ozone hole reaching a record size this year highlight the need for sun protection over the summer months. Although many people use sunscreen as their first line of protection against sunburn, research has shown that people who use high SPF (sun protection factor) sunscreen are more likely to report being sunburned than those who rarely or never use it.

### *Sunscreens and SPFs*

There may be several reasons for this. One is that sunscreens are never applied on the skin as thickly as when the product is tested in a laboratory – indeed, it is almost impossible to achieve the "standard" thickness used in testing sunscreens, as the sunscreen just runs off. Compounding this is the observation that sunscreen is never applied uniformly, with some areas of skin receiving less than others. The net result is that the effective SPF is only 20-50% of the rated value. Consequently people may be sunburned because not enough sunscreen was applied, some areas of the body were missed or they were overexposed to the sun because they believed they were protected.

### *Clothing and shade*

The best protection from sunburn is offered by clothing and shade. Most clothing offers a real SPF of at least 10, and wide-brimmed hats protect the face and neck. Sunscreen should only be regarded as a secondary means of protection.

Further information can be obtained from the Cancer Society website: www.cancernz.org.nz