POSSIBLE IMPACT OF ICRP 60 RECOMMENDATIONS ON MEDICAL PRACTICE

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Introduction

Three changes recommended by the I.C.R.P. are likely to have a significant impact on medical procedures, the revised occupational dose limits, which include a new five year cumulative effective dose limit of 100 mSv and also a lower limit for exposure of the skin, the lower annual dose limit of 1 mSv recommended for members of the public and the recommendation that the dose to the foetus during pregnancy should be limited to 1 mSv. The proposed new 100 mSv in 5 years occupational dose limit has been generally presented as the most important proposal which was made by I.C.R.P. Many hospital administrators have reviewed the implications of such a dose limit for their own organization, found from past dose records that very few staff appear to be at risk of exceeding the proposed five year limit, and filed the report, or passed it on to the hospital Radiation Safety Officer, assuming that they can safely ignore it. In practice however the other major changes summarised above may have more impact on the operation of hospitals than the proposed new occupational dose limit. Some changes in working practices which hospitals may need to make to meet ICRP recommendations are reviewed below.

The Proposed New Occupational Dose Limits

Most occupationally exposed radiation workers in a hospital would regard it as very exceptional if they received a radiation dose greater than 20 mSv per year. Such exceptions may occur after there has been a major change in the workload which has not been reflected in corresponding improvements in staffing and facilities, procedures for reducing doses to normal levels are then self evident. However a few categories of workers receive consistently higher doses on an ongoing basis in some large hospitals. In diagnostic radiology these categories include staff extensively involved in cardiac catheterisation procedures and nurses in paediatric hospitals who frequently hold children during X-ray procedures. In nuclear medicine radiopharmacists producing large quantities of labelled drugs will need to handle very large activities and will receive significant whole body doses if the radiopharmacy has not been adequately designed to minimise their exposures. Nuclear medicine technicians in busy departments also sometimes accumulate relatively large doses when dispensing is carried out in house and a properly equipped dispensary is not available. Both these groups are also liable to receive significant finger doses, and meeting the proposed new limit for skin dose averaged over 1 cm^2 (ICRP 60 paragraph 173) is likely to require some changes in working procedures. In radiotherapy departments staff involved in brachytherapy also frequently receive both effective doses, and finger doses, which are not inconsiderable.

Hospital procedures with respect to the classification of staff as radiation workers vary widely; but in my experience nurses and orderlies have not generally been classified as radiation workers and they are therefore, with a few exceptions, subject to the same dose limits as members of the public. Nevertheless nurses caring for iodine therapy patients may receive significant whole body doses, and attention may also need to be paid to the dose received by orderlies responsible for transporting patients who have just received radioactive injections. In some children's hospitals which are not equipped with adequate child restrainers, or where clinicians oppose the use of restraining devices, nurses are frequently called upon to hold children during radiological examinations and this may lead to significant radiation doses being incurred. Doses to nurses are also possible when working in wards where there is a considerable use of mobile X-ray equipment, or where patients with implanted radioactive sources have been placed. In all these cases the new I.C.R.P. recommendations may necessitate such members of staff being formally designated as radiation workers subject to the new occupational dose limits rather than the existing limit for members of the public, or at least being provided with monitoring devices to demonstrate that this is not necessary.

Radiation Exposure of Members of the Public

Radiation facilities in hospitals have generally been designed so that the maximum dose which might be received in an area accessible to the public does not exceed the present public dose limit of 5 mSv/y. In principle, if this limit is reduced by a factor of five the relevant areas in every hospital should be provided with additional shielding. Equally there are likely to be other areas of the hospital occupied by general staff members where there is a possibility of exposing the workers concerned to annual doses in the range 1-5 mSv/y and these will therefore also need additional shielding. Such areas can include canteens, physicians rest rooms, teaching rooms and office space. Paragraph 168 of ICRP 60 indicates clearly that the Commission expects such modifications to be completed as early as possible. Shielding requirements for diagnostic radiology suites are calculated using a formula which includes relevant data on all the x-ray sources present, the work loads for each, the occupancy factors for adjacent areas and the existing structural shielding. Although many rooms with low work loads have been more than adequately shielded to allow for increasing future work loads, this has not been a universal practice and, when the recognised formula has been rigidly applied, existing shielding may be quite inadequate to meet the recommended new limits. This is not a technical problem as additional thin sheets of lead can quickly cure any deficiencies, but the economic impact of introducing such requirements for a significant proportion of the existing radiology departments would be enormous. Some calculations made by Health Canada suggest that this problem may be most severe for dental operatories currently shielded only by gypsum plasterboard, but that standard radiographic facilities with workloads of around 200 mA-min/week may require more than an additional 0.5 mm of lead shielding.

Similar concerns apply to most existing nuclear medicine and radiotherapy departments, but with two important differences. The number of departments affected is very much smaller, but the problem of adding additional shielding within the constraints of the existing building may be very much greater because of the higher energy of the radiation of concern. For example there are relatively few 20 MeV linacs, but retrofitting the shielding of the bunkers in which these are installed to increase the beam attenuation by a factor of five would often be almost impossible. Radiotherapy departments may also be faced with a need for the installation of additional shielding where their brachytherapy sources are stored, and around the beds of patients with implanted sources.

Additional problems will affect nuclear medicine departments. These have all developed rules for allowing the discharge of patients after the administration of significant quantities of radioactivity. Such rules are generally based on limiting the dose which could be received by any member of the public outside the hospital to less than 5 mSv. These rules will have to be rewritten to reflect the new I.C.R.P. limit once this has been introduced. The Commission has introduced one concession which may help in this regard, the greatest problems will arise in the patient's home where it is likely that the patient will spend the longest periods of time in the vicinity of other people. In paragraph 139 of ICRP 60, it is stated that any exposure knowingly and willingly received in the course of supporting and comforting patients, may be classified as a medical exposure that is not subject to the normal dose limits. Other rules that limit the activities that can be discharged from busy departments, or from the homes of outpatients may also have to be modified. An indirect effect of the new public dose limit in ICRP 60 is likely to be a reduction in the permissible concentration of radionuclides in effluent, and this would have very important consequences for the operation of nuclear medicine departments. Calculations made by one Canadian hospital suggest that such changes would necessitate delaying the discharge of all iodine therapy patients, at a cost to the hospital of several million dollars per year.

Radiation Doses Received by Pregnant Workers in Hospitals

The I.C.R.P. recommendations have raised considerable concerns among female nuclear medicine technologists in hospitals who fear that it may not be possible for them to continue normal work during a pregnancy if these new recommendations are implemented. They believe that should this prove to be the case it would lead to the preferential employment and promotion of male staff, and would therefore have a very adverse effect on their career prospects. Similar concerns are felt by some X-ray technologists who are routinely involved with high dose procedures such as cardiac catheterisation. Other pregnant workers, such as nurses, orderlies or even cleaning staff, have become aware that a large reduction in the permitted dose during pregnancy is being

recommended, and this has led to concerns that the doses which they are currently experiencing may be too high and may be harmful to their expected child. Explaining to all these workers that such fears are generally unwarranted has placed a considerable additional burden on many hospital Radiation Safety Officers.

Optimisation in Hospitals

One of the most important points stressed in this I.C.R.P. report is the need to improve optimisation procedures in hospitals (ICRP 60 paragraph 180). Any attempt by a hospital to comply with the various recommendations necessitates a complete review of its ALARA program, with particular attention being paid to the available dose data and to ways in which existing dose levels for both staff and members of the public could be reduced. This could not be restricted to consideration of occupational exposures only as the I.C.R.P. report places great emphasis on the need to reduce the dose delivered to the patient during commonly used diagnostic procedures. Some of the principal areas in which it appears possible to improve the optimisation of the uses of ionizing radiations in hospitals as recommended in this ICRP report, are reviewed below:

(a) Radiotherapy

External beam treatment bunkers have all been designed to ensure that the dose which could be received by members of the public (including ancillary hospital staff) does not exceed 5 mSv/y. A requirement to reduce this by a factor of five would involve additional shielding of the bunkers that may be felt to be impracticable. An alternative in some circumstances may be to address specific concerns individually, for example where rooms immediately adjacent to a treatment bunker are continually occupied by ancillary hospital staff, problems could be alleviated by relocating accommodation so that these rooms are restricted to uses involving low occupancy factors such as storage. Although no major problems should be encountered in controlling the doses received by occupationally exposed staff associated with external beam treatment procedures, this does not apply to brachytherapy where there is often a long history of relatively high radiation doses to the staff involved. Optimisation may require more hospitals to adopt remote afterloading techniques to reduce these doses.
The doses received by other staff; such as porters, orderlies, nurses and nursing auxillaries who are not classified as radiation workers but who may be exposed to radiation from brachytherapy sources; will also have to be reviewed very carefully. In most instances additional shielding would probably help to meet optimisation requirements, but it may also be important to review whether some of these workers should be reclassified as occupationally exposed radiation workers. If this becomes necessary additional problems arise as soon as one of the staff concerned became pregnant and has to comply with the ten times lower dose limit to the foetus which the I.C.R.P. are now recommending. Serious problems would result if these considerations lead hospital administrators to preferentially appoint male staff to some of these positions.

(b) Diagnostic Radiology

The most important aspect of optimisation in diagnostic radiology is the reduction of patient doses associated with different procedures by improved quality assurance procedures. This is too large a subject to discuss further here, but there is increasing recognition that patients have the right to be given dose measurement data relating to any procedures that they undergo, and in many instances this should also include comparative data generated in other centres. In the case of staff, optimisation generally involves a careful review of the maintenance procedures for equipment and of the use of personal shielding such as aprons, gloves and lead spectacles.

(c) Nuclear Medicine

As with diagnostic radiology, optimisation will involve attention both to doses delivered to patients and those received by staff. An effective quality assurance program for imaging equipment is clearly essential. It is also necessary to assess whether the availability of imaging equipment is adequate. In an expanding department it may become necessary to reduce scanning times by increasing the activity administered. It is easy for such temporary expedients to become permanent practice. Attention also need to be paid to the optimisation of doses outside the hospital which result from the discharge of treated patients; at the minimum such patients must be given adequate instructions on elementary radiation hygiene and on the precautions that they should follow to protect family members. In the case of doses to staff members the most promising (and expensive!) approach to optimisation is usually a careful review of both equipment and working practices in the radiopharmacy and the dispensing area.