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Radiation Epidemiology and National Dose Registers

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IONISING RADIATION is a well-established risk factor for human cancer [1]. Studies of the atomic bomb survivors in Japan [2], of populations of patients treated with ionising radiation, of uranium and other miners [3] have revealed excess cancer risks of several sites, particularly leukaemia, lung and solid-tissue tumours [4]. All the data, which may be used for human risk estimates, are reviewed and summarised regularly by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) [5–7], United States National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation [1], and other national and international organisations.

Data obtained from observations on humans are strongly supported by data from biological studies. The biological effect of ionising radiation results in the modification and destruction of cellular components [7]. Cells from different tissues vary markedly in radiosensitivity. It is generally accepted that incorrect or unrepaired modification of DNA are the main causes of radiation-induced damage in cells and hence organs and tissues. The radiation-induced malignancies are the most important long-term effects of exposure to ionising radiation in human populations.

Because ionising radiation has been shown to cause cancer in humans, occupational exposures are carefully monitored and controlled. The International Commission on Radiological Protection (ICRP) has developed recommendations for limits on occupational exposure to radiation [8].

In many countries radiation doses experienced by people working in environments where they may be exposed to ionising radiation through their occupation are carefully monitored. This may be done using personal dosimeters, bioassay or area monitoring. These measurements provide the basis for assessing compliance to established dose limits.

Although it is known that ionising radiation is a human carcinogen [5–7], there are still a number of important research questions unanswered. These primarily relate to the effects on different tissues of the body and the effects of exposure to radiation at low doses. This latter issue remains of great importance since the majority of human exposure to ionising radiation (such as from iatrogenic sources) falls into this category. Unfortunately, any such risk is difficult to identify and quantify principally due to the fact that no single national cohort is large enough to investigate the putative effect in a statistically meaningful manner. Thus, there appears to be the need for international co-operation in this area with the sharing and pooling of datasets. This will have several advantages. Aside from increasing the expected number of cases (and hence increasing the statistical power of the study and reducing the observation period) the pooling of data from different cohorts could also serve to extend the range of exposures over those found in any one of the existing cohorts. A necessary prerequisite for this pooling of the datasets would be to determine that there were enough similarities in the individual datasets available to ensure that they could be pooled.

A recent application of the dose registry data has been reported by Kendall and associates [9] who used the National Register of Radiation Workers in the United Kingdom to conduct a large-scale epidemiological study of the mortality experience of workers in the registry in relation to occupational exposure to radiation. The International Agency for research on Cancer is currently co-ordinating an international study of cancer risk among nuclear industry workers that involves carrying out studies with common protocol in 11 countries and eventually combining the data [10].

In order that centralised radiation dose registers be of maximum value for both exposure monitoring and epidemiological investigation, the information to be included in the registry requires careful consideration. Thus, it was decided to hold a workshop intended primarily for persons involved in the development and operation of national registers of occupational radiation dose records and their use in epidemiological studies of occupational radiation carcinogenesis. This workshop was convened principally to review the use of centralised dose registers for epidemiological

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investigations and exposure monitoring, and had the following specific objectives:

- to review on-going epidemiological studies in Canada, Japan, Sweden and the United Kingdom using centralised registers;
- to review existing and planned centralised dose registers in different countries;
- to make recommendations on the optimal design of centralised dose registers for epidemiological purposes; and
- to determine the comparability of existing data records in the various cohorts to evaluate the possibilities for their pooling.

Further background on occupational radiation cancer risks, an overview of the formal presentations made at the workshop, and the specific recommendations concerning the development of centralised dose registers formulated by the participants at the workshop are presented in this supplement of the *European Journal of Cancer* (see article by J.M. Zielinski *et al.*, pages S3–S6). It is clear that possibilities exist at the level of international co-operation, which could help improve our understanding of the carcinogenic effects of ionising radiation.

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