THE STANDARD FOR JUSTIFICATION OF RADIATION PRACTICE

Susumu Osaki

Radioisotope Center,Kyushu University 16, Hakozaki, Higashi-ku, Fukuoka, 812-81 Japan

INTRODUCTION

Justification is the first principle for the system of radiological protection proposed by ICRP. Other principles, the optimization of protection and individual dose limits, have been well studied quantitatively. The justification of a practice, however, has been scarcely discussed. The reason is obviously that the justification is related to the evaluation on both the risk and the benefit of a practice. There are social scientific problems in the discussion on the benefit and especially on the comparison between the benefit and the risk. Without the basis of the justification, the purposes of the optimization of protection and individual dose limits become ambiguous.

JUSTIFICATION OF ACTUAL RADIATION PRACTICES

Any existing practices must be justified consciously or unconsciously by some ways. The actual radiation practices, the mass screening tests for tuberculosis and stomach cancer, the use of a smoke detector with ^{241}Am, the use of an artificial tooth containing uranium and a lens of eyeglass containing thorium, and occupational radiation work are observed how they have been justified, mainly in Japan.

MASS SCREENING FOR TUBERCULOSIS: Tuberculosis had been a national disease in Japan more than 40 years ago. Many young people were infected and died, and the mass screening was wanted nationally. The buses for the X-ray inspection went around offices, schools and communities. Gradually the infection rate has fallen and tuberculosis became a geriatric disease. Then the justification of the mass screening has been controverted. In 1975, WHO recommended the stop of the X-ray mass screening for tuberculosis. The benefit has been decreasing with years, and that for the people younger than 20 years old becomes below the risk(1). Even for adult people the cost for one life saving becomes very high. The X-ray mass screening for pupils and students has been decreased in stages.

MASS SCREENING FOR STOMACH CANCER: The mass screening for stomach cancer systematically began at 1960 in Japan. The benefit of the mass screening has been compared with the risk of the X-ray exposure, and further compared with the endoscopic mass screening and with no mass screening(2). Methods for medical decision making have been applied(3), and the economical balance of the mass screening has been discussed in the scales of the mutual society of a company or a local government. The benefit of the mass screening on health and economics increases with the incidence rate which increases with ages. Furthermore in order to neglect practically the genetic effect of the exposure, the X-ray mass screening for stomach cancer is recommended for people above 40 years old.

SMOKE DETECTOR WITH ^{241}Am: The benefit of a smoke detector is the saving of life, house, and others from a fire. The exposure from the ^{241}Am source and the pubic exposure for its waste has estimated and justified from the comparison of the dead from a fire(4). The developments of electron techniques made an electron smoke detectors which is comparable in the efficiencies on fire prevention for that with ^{241}Am. The ^{241}Am smoke detectors in use have drastically decreased.

AN ARTIFICIAL TOOTH CONTAINING URANIUM AND A LENS OF EYEGLASS CONTAINING THORIUM: The justification of these goods is very difficult, because their

benefit is adornment and cannot be compared directly with the risk of the exposure. In practice, the uranium or thorium content is restricted by the government or the guild of manufacturing companies and their goods are on the market. A leaflet from UNEP(5) wrote that the use of these goods was not justified because the benefit is only adornment which is obviously worse than the health risk from the exposure. In such cases that the benefit of a practice is not concerned with health, the comparison of the benefit with the risk is difficult and needs for the social scientific considerations.

OCCUPATIONAL RADIATION WORK: Many people work under radiation environments and are exposed some amounts of dose. The benefit of the practice is the wages of working, the pay of the practice, the joy of working, and/or others. The occupational exposure is accepted naturally under the individual dose limits without the discussion on justification. The benefit changes depending on each individual, but the limit of the risk is same for all workers. If the individual dose limits were the maximum permissible doses, the occupational radiation work would be justified in respect of radiological protection.

THE DEFINITION OF THE JUSTIFICATION

The justification of a radiation practice is not only the comparison of the benefit with the risk, but also the comparison of the justification with the justification of other practices having the same purpose, as shown in above discussion. The benefit and the risk are concerned with health, economics, and others. In some cases, health and economics are trade-off. On the basis of the above observation, the justification of a radiation practice is defined as " The practice is the best in the options which are designed for the same purpose (including the option which does not execute the practice)".The capability approach developed by Amartya Sen(6) is adopted as the standard for what is the best . The capability approach can be discussed on many categories relating to a practice as the capabilities of a person to function.

THE CAPABILITY APPROACH

Sen proposed that the capabilities of functionings can be used for the standard of living(7), instead of opulence or utility. The relationship among capability, function, opulence and utility are schematically shown in Fig. 1. Opulence(goods) has been used for the standard for the evaluation of benefit and risk. Obtaining the goods gives the person command over the corresponding characteristics of the goods and the monetary cost for risk decreases the ability to buy the goods. Opulence, however, is not always proposed to the well-being of a person, because opulence can be used depending on physical and social environment. Utility is widely used in social sciences, especially in economics, and utilitialism is the most available ethical principle. The utility for a person, however, is affected for the person's subjective point of view and surrounding environment.

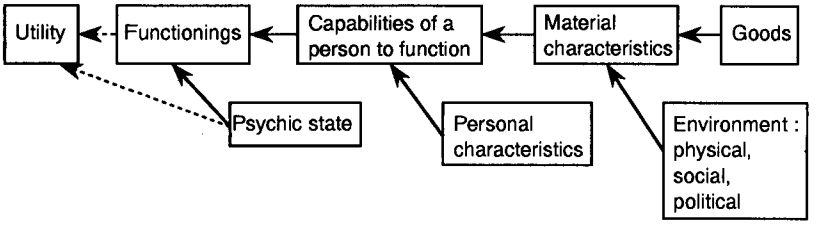

Fig.1. Utility, functionings, capabilities and other sources(7)

FUNCTIONING

The functionings of a person are included in many categories, for example, health, safety, community life etc. on the quality of life. In order to arrange many functionings, "the social indicator" or "the list of social concerns" can be used. For example the social indicators edited by Committee of Quality of Life, Council of Living Life in Japan are divided into ten main areas, 1.health, 2.education, study, culture, 3.quality of employment and working life, 4.leisure, 5.income, consumption, 6.physical environment, 7.crime and execution of the law, 8.family, 9.quality of community life, 10.social strata and movement. Under the main areas, they are further divided into 27, 79, and 160 concerns. With the reference of these indicators, the functionings relating to a radiation practice can be listed.

RANKING OF OPTIONS

If the capabilities of functionings concerned with the options can be ranked, the best option can be evaluated. But overall ranking is obviously impossible, because the comparison between functionings in different areas is very difficult. In practice, the partial ranking can contribute the evaluation of the options.

For the justification of X-ray mass screening for stomach cancer, three options, 1.no mass screening, 2. X-ray mass screening, 3. endoscopic mass screening are ranked in reference to the possibilities on mortality, economical effects, facilities of the screenings and the request from inspected people. The ranking on health has been mainly discussed and the second option is justified for the people above 40 years old.

For the justification of an artificial tooth containing uranium and a lens of eyeglass containing thorium, two options, 1. use of the goods containing uranium or thorium, 2.use of the goods not containing uranium and thorium, are ranked. The related functionings are personal adornment and health risk with radioactive materials(the public exposure with the waste is possible to be neglected). The ranking is not obvious. In this case, the author thinks that the use of an artificial goods containing uranium or thorium is justified, because low risk practices of the user only must be acceptable in society in considering with the importance of passive freedom.

From the viewpoint of the justification, the limits of occupational exposure dose should be changed with a type of occupation and should be made an agreement of the limits with the employee and the employer. The risk(an increase in the possibility of carcinogenesis) itself must be indemnified and furthermore the suffering of a cancer must be also indemnified. A new system for occupational radiation work is necessary, although difficult problems on the evaluation of the risk of low level exposures and the natural occurrence of cancer are existed.

CONCLUSION

The justification of a radiation practice are normatively defined as "The practice is the best in the options which are designed for the same purpose (including the option which does not execute the practice)". The options are ranked by the capabilities of a person to function.

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