THE ESTABLISHMENT OF UNSCEAR REPORT IN THAILAND

A.Krisanachinda[1], T.Chaiwatanarat[1], T.Phungrassami[2], P.Treenavarat[1], N.Pongnapang[3], S.Srimanoroth[4], J.Laothamatas[5]

[1]Faculty of Medicine Chulalongkorn University, Bangkok, Thailand. [2]Faculty of Medicine Prince of Songkla University, Songkla, Thailand, [3]Faculty of Medical Technology, Mahidol University, Bangkok, Thailand. [4]Bureau of Radiation Medical Devices, Department of Medical Sciences, Ministry of Public Health, Nontaburi, Thailand [5]Faculty of Health Science Technology, HRH Princess Chulabhorn College of Medical Science, Chulabhorn Royal Academy, Bangkok, Thailand

Abstract- **The radiation medicine was established in Thailand in 1921. The rules and regulations on the use of ionizing radiation had been enacted by the Atomic Energy for Peace of Thailand in 1961. After that the application of radiation in various fields had been grown up rapidly. There was no official report on the increasing use of radiation in any field until 2019. The Office of Atoms for Peace set up the Sub Committee on the use of ionizing radiation in medical field with the main objective is to collect the data according to UNSCEAR requirements on medical exposure and occupational exposure and be able to submit such the data for publication in UNSCEAR Report of the year 2020.**

Keywords- **medical exposure, occupational exposure, healthcare level, frequency, effective dose.**

I. Introduction

Royal Government of Thailand had appointed a board, Atomic Energy Commission for Peace, A.E.C. since 1956. The Cabinet later assigned the committee to implement the plan to establish a nuclear research reactor and laboratory for education, training and research of Thai scientists and engineers pursuing peaceful utilization of atomic energy. On 15 October 1957, Royal Thai Government ratified the statue of the International Atomic Energy Agency, IAEA, as an agency under the United Nations and consequently was the 58th on the list of IAEA Member States. On May 14th 1958, the Cabinet approved the Thai A.E.C. to issue a contract for the construction of a research reactor building and the reactor from Curtiss-Wright Corporation, USA at the location of Bangkhen, Vibhavadi-Rangsit Road on May 20th, 1960. On April 25th 1961, Royal Government of Thailand proclaimed the enactment of the Atomic Energy for Peace Act, B.E. 2504 resulting in the establishment of the Office of Atomic Energy for Peace, OAEP. The Cabinet Resolution on November 21st 2006 on transfer of business, property, authority, liability, and budget involving nuclear research have separated Thailand Nuclear Institute of Technology, TINT (Public Organization), from the Office of Atoms for Peace, OAP, to mainly focus on nuclear research conduction.

At present, the Office of Atoms for Peace is a major organization responsible for formulating of a national nuclear policy and strategy for peaceful purposes and for regulating the use of radiation and nuclear energy in the country for safety of users, people and environment according to international standards and obligations. The responsibility of the OAP is to protect life, health and property from the hazards of nuclear energy and from the harmful effects of ionizing radiation.

II. UNSCEAR

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was established in 1955 at the General Assembly of the United Nations. The committee collected and evaluated information on the levels and effects of ionizing radiation from all nuclear explosions. The first two substantive reports[1,2] submitted to the General Assembly, in 1958 and 1962, presented comprehensive evaluations of the state of knowledge about the levels of ionizing radiation to which human beings were exposed and of the possible effects of such exposures (Figure 1). UNSCEAR became the official international authority on the levels and effects of ionizing radiation, used for peaceful as well as military purposes and derived from natural as well as man-made sources. The first UNSCEAR report of 1958 had been recognized that medical diagnostic and therapeutic exposures were a major component of artificial radiation exposure globally, a fact that remains true today. The Committee has systematically reviewed and evaluated global and regional levels and trends of medical exposure, as well as exposure of the public and workers. These reviews have prompted significant worldwide reductions in unnecessary radiation exposure, and continue to influence the programs of international bodies such as the International Atomic Energy Agency (IAEA), the International Labor Organization (ILO), the World Health Organization (WHO) and the International Commission on Radiological Protection (ICRP).

The Chernobyl accident in 1986 was a tragic event for its victims and there has been major hardship for those most affected. From early on, UNSCEAR was involved in the assessment of radiation exposures and health effects. In 1988 it published a first account of acute radiation effects in emergency workers and of the global exposures[3]. A more detailed assessment of radiation levels and effects from the accident was published in 2000[4]. Furthermore, the Committee held technical discussions on four documents:

- Evaluation of medical exposures to ionizing radiation;
- Evaluation of occupational exposures to ionizing radiation;
- Biological mechanisms relevant for influence of cancer risks from low-dose radiation,
- Levels and effects of radiation exposure due to the accident at the Fukushima Daiichi nuclear power station: implications of information published since the 2013 UNSCEAR report[5].

Fig 1: Nuclear explosion

III. MEDICAL RADIATION EXPOSURE

Medical radiation exposures include the exposure of patients as part of their medical diagnosis or treatment, the exposure of individuals as part of health screening and program, and the exposure of healthy individuals or patients voluntarily participating in medical, biomedical, diagnostic or treatment research program. Medical exposure is more voluntary and mostly as accepted to bring more benefits than risk. Three general categories involve in medical radiation exposure are diagnostic radiology and image-guided interventional procedures, nuclear medicine and radiation therapy.

UNSCEAR Report in 1982[6] was the first to use a survey developed by WHO and UNSCEAR to obtain the available information of diagnostic radiology equipment and annual frequency of diagnostic X-ray examinations in various countries. Data on doses were also collected by survey. For each procedure, the number of procedures per head of population is multiplied by the effective dose per procedure and the relevant population size. Trends in average effective dose in countries of healthcare level I have been decreasing effectively for chest radiography and mammography. On the other hand, the average effective dose per examination from CT examination, which is relatively high dose procedure, has slightly decreased on the last 30 years.

For the analysis of medical exposures, the four-level healthcare model has been introduced in UNSCEAR 1988 Report[3]. In this model, countries had been stratified according to the number of physicians per head of population. **Level I Countries** were defined as those in which one physician in every 1,000 people in the general population. **Level II Countries,** there was one physician for 1,000-2,999 people, **Level III Countries** there was one physician for every 3,000-10,000 people, **Level IV Countries,** there was less than one physician for every 10,000 people. This healthcare model has been used in the analysis of worldwide exposure.

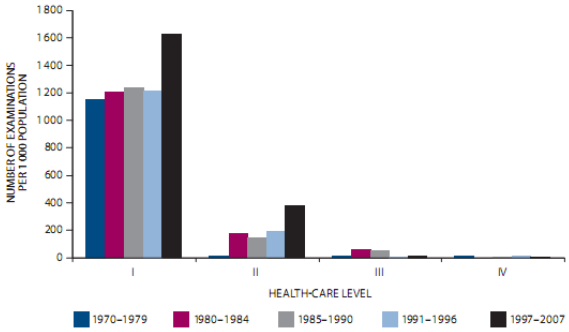

Fig 2. Trends in the annual frequency of diagnostic medical and dental radiological examinations for each health-care level[7]

Only 24% of the population living in the health-care level 1 countries receives approximately two-thirds of these examinations. The annual frequency of only diagnostic medical examination in health-care level I countries is estimated to have increased from 820 per 1000 population to 1334 per 1000 population in 1970 to 1979.

The ionizing radiation has been increasingly applied in medicine in Thailand as an essential tool for diagnosis and treatment since 1921. The benefits to the patients from properly conducted procedures have fostered the widespread practice of medical radiology, with the result that medical radiation exposures have become an important component of the total radiation exposure of populations. Even though the use of radiation medicine in Thailand is increasing, the information on UNSCEAR survey had never been collected.

In February 2019, the Sub-Committee in medical applications of OAP on UNSCEAR had been announced by the Minister of Higher Education, Sciences, Research and Innovation. The duty and responsibility of this Sub Committee are:

1. To design the policy on working and reviewing the role of each stakeholders in radiation medicine to recruit the database on radiological equipment, radiation workers, the diagnostic and treatment procedures and radiation dose according to UNSCEAR manual.
2. To plan for the short and long term with the outcome to cover the data collection and analysis.
3. To follow up, cooperation and support the objective of UNSCEAR
4. To report the progress on output and outcome to the Sub Committee in Medical Applications twice a year.
5. To work on other issues relevant to UNSCEAR survey and questionnaire.

Three meetings of sub – committee had been organized for short- and long-term planning, data collection and analysis according to UNSCEAR survey template in 2018. Two workshops on education about UNSCEAR and detail on surveys had been practiced. Approximately two hundred participants from hospitals and related stakeholders

attended the one - day workshops in July and August 2019. In September 2019, the UNSCEAR data had been gathered and analyzed from major centers represent all parts of the country. The information on the number of populations, physicians, radiologists, dentists, radiation oncologists, nuclear medicine physicians, medical physicists, technologists, nurses, etc. and the number of equipment in diagnostic radiology, radiotherapy and nuclear medicine in 2018 in Thailand had been collected. Furthermore, the number on procedures in radiotherapy and nuclear medicine as well as the patient radiation dose had been estimated to obtain the effective dose as detail in UNSCEAR manual. Unfortunately, the data on diagnostic radiology on estimated number of procedures and radiation dose could not be collected in time. UNSCEAR data on medical exposures in radiation oncology and nuclear medicine and occupational radiation exposure had already been submitted to the UNSCEAR Headquarter via OAP official channel. Information on diagnostic radiology submitted only equipment and personnel. That information, hopefully, should be published in UNSCEAR 2020 Report.

IV. Occupational radiation exposure

The information on occupational exposure relates to the number of all workers working in supervised and controlled areas with the percent uncertainties. The information related to dosimetry consists of external and internal dose monitoring, the value of minimum detectable level (MDL) per measurement interval. Work categories on medical use are diagnostic radiology consisted of conventional diagnostic radiology, interventional procedures - radiology and cardiology, nuclear medicine, radiotherapy, dental practice, veterinary medicine and other medical uses. The workforce consists of the number of workers in dose intervals such as below MDL, MDL-1,>1-5, >5-10, >10-15, >15-20, >20-30, >30-50 and >50 mSv, the average and median effective doses by the dose interval, dose to eye lens and hands, number of female workers.

V. Unscear report of thailand:

5.1 MEDICAL RADIATION EXPOSURE

The UNSCEAR Survey form version 1.6 in 2018 consists of three parts on

A. Diagnostic and interventional radiology (RD)
B. Nuclear Medicine (NM)
C. Radiotherapy (RT)

There are two methods of data collection regarding the annual frequency of procedures. First – a representative sample of hospitals then scaled up to the whole country. Practically, the data is available from the hospital radiology information system (RIS). Second- central statistics held by government department or insurance companies for all radiology practices in the country. In Thailand, the first method is used and the data is mostly collected from the government offices, organizations, professional societies such as Medical Council of Thailand, Royal College of Radiologists of Thailand, Nuclear Medicine Society of Thailand, Thai Association of Radiation Oncology, Radiological Technology Society of Thailand, and Thai Medical Physicist Society, etc.

The government department involving directly in the survey data on occupational exposure is the Bureau of Radiation Medical Devices, Department of Medical Science, Ministry of Public Health. The Bureau of Radiation Medical Devices offers the service on the personnel monitoring. The information related to UNSCEAR survey is well recorded on annual basis.

For the Medical Exposure Report, the data recorded in the questionnaires are classified as:

1. Essential information: the number of population on the survey period in 2018 is 66,413,979
2. Staff and devices:

a. all physicians are 58,025, radiologists 1,834, nuclear medicine physicians 66, radiation oncologists 174

b. all radiographic systems 28,039, nuclear medicine equipment 82, radiotherapy system **123** and radiotherapy imaging system 99

3. Information on the frequency of the radiological examinations, nuclear medicine procedures (diagnostic and therapeutic), external beam radiotherapy and brachytherapy with number of patients is recorded.
4. Dose: the mean effective dose per procedure is recorded in the unit of mSv for radiology and nuclear medicine. In radiotherapy the dose is in the unit of gray.

According to the number of physicians at 58,025 and Thai population of 66,413,979, these result in the ratio of one physician to Thai population at 1:1144 leading to **Healthcare Level II** for Thailand.

5.2 OCCUPATIONAL RADIATION EXPOSURE

The personnel radiation monitoring service is available at the Bureau of Radiation Medical Devices, Department of Medical Sciences, Ministry of Public Health and Thailand Institute of Nuclear Technology (TINT). The minimum detectable level (MDL) per measurement interval is 0.1 mSv. In 2018 the average, median and standard deviation of the effective dose were 0.45, 0.17 mSv and 1.87 respectively. The number of occupational exposed workers in Thailand was 86,922. Total number of medical workers was 50,519. The workers received effective dose higher than MDL was 20,628 and the number of female medical workers was 48,816.The workers in RD, RT and NM were 37364, 3349 and 1085 respectively. Number of female workers in RD, RT and NM were 34,389, 2,215 and 741 respectively.

5.3 THE FUTURE PLAN

The sub-committee will review the obstacles in collecting data especially in diagnostic radiology. The data collection on number of radiation workers, equipment, the frequency of procedures and the patient dose should be

collected annually. The result should be reported to the Sub Committee in medical application for the publication of OAP Newsletter or other relevant publishers.

For diagnostic radiology, the data from simple procedure could be collected from participating centers at 13 healthcare regions of Thailand while the complex procedures could be collected at the university hospitals where the manpower is available. This could be applied for interventional radiology which the simple procedures such as TACE and PTBD could be firstly collected in 2020.

The workshop on UNSCEAR should be set to inform more members in medical field to be more cooperative in data collection and be aware of the safely use on ionizing radiation. The future trend on number of workers and equipment, number of procedures, frequency and dose could be estimated for the development in medical radiation exposure of the country. All data could be archived at the main computer system at OAP.

VI. Conclusions

The data on the exposure of patients and workers on national level are valuable. Therefore the data collection should be improved to provide further relevant data about levels, effects and risk of radiation exposure from various sources. The government should support the NCP (National Contact Persons) and Sub Committee to facilitate coordination of collection and submission on the exposure of patients, workers and public in Thailand. The data should be published annually on website.

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Contacts of the corresponding author:

Author: Anchali Krisanachinda
Institute Faculty of Medicine, Chulalongkorn University
Address: Bangkok, Rama IV Road, Thailand
Email: anchali.kris@gmail.com