Topics

Report of Joint Workshop by ICRP-RERF-JHPS “Recent Progress in Radiation Dosimetry for Epidemiology and Radiological Protection”

Md. Mahamudul HASAN^{*1, #} and Xiao MA^{*1, 2}

1. Objectives

Radiation dosimetry plays an important role in radiological protection and epidemiological studies. In this joint ICRP-RERF-JHPS workshop co-organized by Japanese Society of Radiation Safety Management (JRSRM), recent developments on radiation dosimetry were discussed. Additionally, recent studies on atomic bomb survivors as well as the challenges in environmental remediation after medical incidents and the Fukushima nuclear accident were also reported.

2. Key point of each presentation

Introducing a new set of dose estimates as DS02R1, Mr. CULLINGS provided more universal & accurate terrain shielding input data on Japanese atomic bomb exposure dealing with the random errors additionally. He clarified the differences in dose estimates and the corresponding differences in risk assessments based on the recent cancer mortality data set. Moreover he described major improvements in dosimetric input data along with systematic changes in dose estimation. Finally, Mr. CULLINGS recommended new phantoms & calculations based on organ dosimetry mentioning uncertainty of classical as well as Berkson errors.

Later the discussion of Mr. BOLCH reviewed both the development and implication on the phantoms of ICRP estimating organ doses due to medical imaging. Besides appropriate methodologies for quantifying the patient's specific reference phantom and phantom libraries regarding internal organ doses were the key aspects in this lecture. He also suggested phantoms based on pregnancy case, age and gender variations along with six methods of phantom matching for CT organ dosimetry.

Thirdly, Mr. HARRISON elaborately explained the prevalent implications of effective dose as a dosimetric quantity and incorporated few recommendations on using mean absorbed

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Date: December 2, 2017

Scientific Session (13:40–16:50)

Honorable Speakers

First Session	Second Session
Harry CULLINGS (RERF)	Daiki SATOH (ICRP)
DS021R1: New dose estimates in use for latest LSS studies	External doses to the public from contaminated land
Wesley BOLCH (ICRP)	Yusuke Koba (JHPS)
Modern phantoms and their applications	CT dosimetric calculator
John HARRISON (ICRP)	Kentaro MANABE (JHPS)
Dosimetric quantities and risk	Modeling of internal dose from an insoluble cesium

dose in lieu of effective dose for single organ that obtained majority of doses. Radiation protection essentials, phantom model differing with gender, LNT dose response and implication of effective dose coefficient in case of worker's exposure were the crucial discussed topics in his lecture. In addition, he recommended necessary cautions, judgment in relation to background incident rates for predicting possible health effects using collective dose considering it as an appropriate indicator of possible risk from medical examinations with the determination of uncertainties.

Again it is difficult to identify the external doses for the public owing to the contaminated soil of Fukushima disaster directly relying on ICRP publication 116 data. Mr. SATOH represented a database on conversion coefficient as the fourth speaker of the symposium for estimating the external exposure due to the soil and further showed the interrelationships among personal dose equivalent rate, ambient dose equivalent rate and effective dose rate emphasizing the use of dosimeter regarding public exposure control equipment in Fukushima. Later he recommended a calculation system for the estimation of decontamination effect in this regard.

Mr. Koba determined both organ doses and exposure doses due to the X-ray CT scanning applying the WAZA-ARI system of National Institute of Radiological Sciences (NIRS), Japan. Likewise, he explained the database function for storing the calculation result in medical facilities checking the exposure levels for CT examination in Japan with the help of newly updated WAZA-ARIV2 system. Furthermore, he suggested several future improvements in WAZA-ARIV2 system regarding user registrations, consideration of body types and available exposures conditions.

As a final speaker, Mr. MANABE referred the approach modeling the stochastic bio kinetic method in addition to internal dosimetry of micro sized insoluble radioactive Cesium. He also provided the explanations concerning characteristics of insoluble Cesium particles, methods on dose estimations, compartment model of Cesium on human body, probability density function of doses, stochastic biokinetic (SB) verification method and calculation conditions of dose estimation. Additionally, the uncertainties belonging to lung doses with the particles were also deliberated in his lecture differentiating his constructed model with the existing Cesium model.

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3. Outcomes and opinions

The discussions severely helped learning numerous fundamentals of radiation dosimetry especially the ‘Dosimetric quantities and risks’ by honorable speaker John HARRISON caught our attention. We found plentiful explanations and future trends of our interested radiation protection strategy in his lecture like-clarification of effective dose, standardization of public dose assessments based on age variations, special considerations for several radionuclides affecting doses on fetus, the optimization process implicating proper utilization of dose constraints and reference level. **Fig. 1** elucidates the structure of effective dose applying in specific age groups, the arrangement for public dose assessment emphasizing special radionuclides on fetus doses and finally the proper utilization of radiation principle. In addition, the proposals for possible risks from medical examination, implication of optimization for radiation exposures, recommendations against confusion on using equivalent dose and effective dose significantly enriched our knowledge in field of radiation protection. Limiting the usage of equivalent dose as a distinct protection quantity, **Fig. 2** exacts the organ doses and finally eliminates the confusion between equivalent dose and effective dose. Besides **Fig. 3** emphasizes effective dose as an approximate indicator for exacting probable risks in medical examination along with determining uncertainties regarding its adjustments. We considered the contents of all the lectures as helpful and beneficial for us to discriminate some crucial concepts

Clarification

- Effective dose is not a scientific quantity that is “correct” for a particular age group
- In public dose assessments, may use three age groups - 1y, 10y and adults - in representative person calculations (Publication 101, ICRP 2006)
- For a few radionuclides, consideration of doses to the fetus may be important (isotopes of P, Ca and Sr)
- Use of constraints and reference levels that apply to all workers and all members of the public, together with optimisation, provides a pragmatic and workable system of protection

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Fig. 1 Slide of the discussion “Dosimetric quantities and risk” based on clarification of effective dose, dose assessment on age variations and utilization of radiation protection principle.

[John HARRISON (ICRP), Presentation entitled “Dosimetric quantities and risk”, Joint ICRP-RERF-JHPS Workshop on Recent Progress in Radiation Dosimetry for Epidemiology and Radiological Protection, Held in The University of Tokyo, Saturday, December 2, 2017].
Website address: http://www.icrp.org/docs/workshop2017_2/3Presentation.pdf, Accessed on 25th March 2018.

Proposal : Equivalent dose

Discontinue use of Equivalent Dose as a separate protection quantity

Organ / tissue dose = Gy
Effective dose = Sv

- Limits to prevent tissue reactions for the eye lens, skin, hands & feet - better as absorbed dose, Gy
- Avoids confusion between equivalent dose and effective dose. Eg. iodine-131, $E = 40$ mSv, thyroid dose = 1 Sv.
- Avoids confusion between equivalent dose and the operational quantity, dose equivalent, Sv

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Fig. 2 Slide of “Dosimetric quantities and risk” describing proposal on equivalent dose.

[John HARRISON (ICRP), Presentation entitled “Dosimetric quantities and risk”, Joint ICRP-RERF-JHPS Workshop on Recent Progress in Radiation Dosimetry for Epidemiology and Radiological Protection, Held in The University of Tokyo, Saturday, December 2, 2017].
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Proposal

Use E as an approximate indicator of possible risk from medical examinations

- MAY apply simple adjustments for age and sex, according to procedure – factors of a few higher in young children and lower at older ages
- BUT UNCERTAINTIES should be recognised
- AND not a substitute for risk analysis using organ doses in Gy – with consideration of uncertainties

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Fig. 3 Slide of “Dosimetric quantities and risk” proposing an appropriate use of effective dose in medical examination risk.

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explicitly as well as obtaining new thoughts of the specialists on radiation dosimetry. In our point of view, this collaborative association could be a role model as strategy for solving other important problematic issues and also be implemented for young researchers in a regular basis. Further, we do consider strong motivation as an outcome from the symposium and strongly desire for being a lecturer in future session.

Finally, as the early learners of radiation protection and safety management, undoubtedly this symposium was an effective approach for us regarding numerous achievements, success & possibilities of this esteemed field of radiation dosimetry.

Md. Mahamudul HASAN

Md. Mahamudul HASAN a Bangladeshi student, performing his master's study in Graduate School of Frontier Sciences, The University of Tokyo. His focused research area is environmental radon measurements and aerosol exposure assessment. He is a JICA scholar belonging to IIMOTO laboratory.

Xiao MA

Xiao MA Chinese researcher (CNNC BRIUG), a member of IIMOTO laboratory under MEXT Nuclear Researchers Exchange Program FY2017. The main field of his research is radon measurements, as well as radioactive waste disposal management. He also aims at environmental assessment and protection on radiation.