Development of a function for estimating intakes of radionuclides using the models and data based on ICRP 2007 Recommendations

Kentaro MANABE, Kaoru SATO, Fumiaki TAKAHASHI

Radiation Risk Analysis Research Group, Nuclear Safety Research Center, Japan Atomic Energy Agency

Background

- We are developing an internal dosimetry code in accordance with the ICRP 2007 Recommendations to revise the RP system in Japan.
  - ✓ Main function: calculating dose coefficients, $e(\tau)$
- After the Recommendations are incorporated into the RP system, intakes and exposure doses should be estimated by using the revised models and data in accordance with the 2007 Recommendations.
  - ✓ Function for estimating intakes: an application of the function for calculating $e(\tau)$

Features of the internal dosimetry code

- Function for calculating $e(\tau)$* *K. Manabe, et al., Bio Conf. **14** 03011 (2019).
  - ✓ Based on the ICRP's dosimetric models and data: nuclear decay data, biokinetic models, specific absorbed fractions…
  - ✓ Enable to edit the models and data: Japanese specific data…
- Function for estimating intakes from monitoring results
  - ✓ Maximum likelihood method with singular value decomposition (SVD) is employed.
  - ✓ Single/multiple acute intakes, and chronic intakes are supported.
- Graphical User Interface (GUI) for integrating the two functions

Development schedule

Fiscal year	2017	2018	2019	2020
Function for calculating $e(\tau)$	Development of main module	Development of module for editing models and data	Finished !	
Function for estimating intakes	Need survey & conceptual design		Development of main module	Finished !
Construction of GUI and manuals			Development of GUI	Betaware provision & improvement Manual preparation

Code will be released
- ✓ Free of charge
- ✓ Domestic use only (Open-sourcing in the future)

Verification of the function for estimating intakes

- Exercise cases were selected from
  - ✓ IDEAS Guideline (EURADOS Report 2013-01)
  - ✓ IAEA Safety Report Series No. 37
  - ✓ IMBA manual (IMBA Pro ver. 5.0.0)

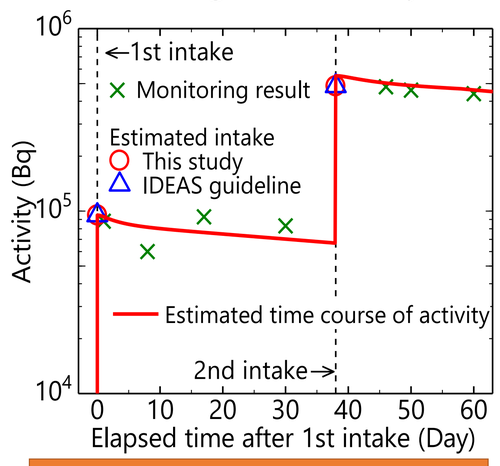
Intakes are estimated by using the former biokinetic models: 1990 Recommendations

- The former models were implemented to the code
  - ✓ Original respiratory tract clearance models (ICRP Publ. 66)
  - ✓ Gastrointestinal tract model (ICRP publ. 30)
  - ✓ Systemic models for I, Cs, U, Pu (ICRP Publ. 56, 67, 69)

Estimated intakes by the function ⟷ Comparison ⟷ Literature values

Case 1: Simple case

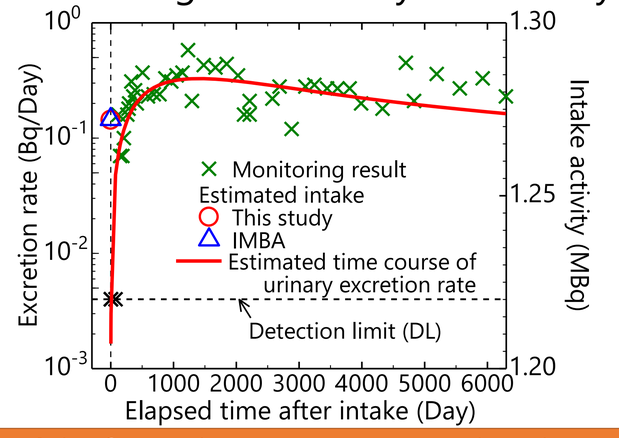
- Ingestion of ^{137}Cs (IDEAS)
  - ✓ Intake: 2 times
  - ✓ Monitoring: 7 times by WBC



Good agreement

Case 2: Results lower than DL

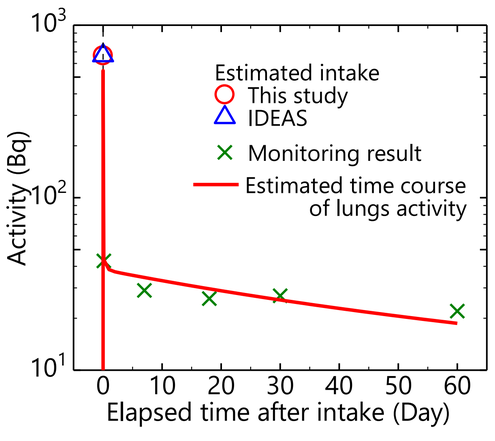
- Inhalation of ^{238}Pu special type (IMBA)
  - ✓ Intake: 1 time
  - ✓ Monitoring: 48 times by urine assay

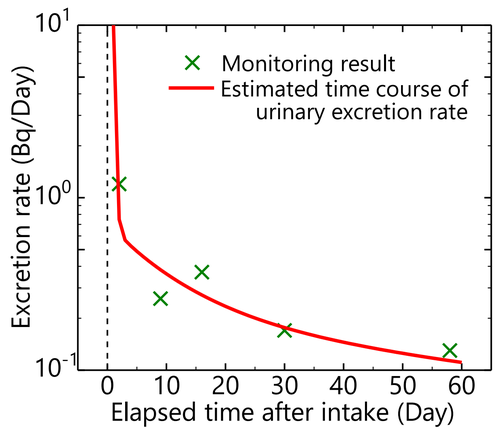


This function treats monitoring results lower than DL as half of DL.

Case 3: Multiple measuring methods

- Inhalation of ^{235}U type M (IDEAS)
  - ✓ Intake: 1 time
  - ✓ Monitoring: 5 times by WBC and 5 times by bioassay (urine)



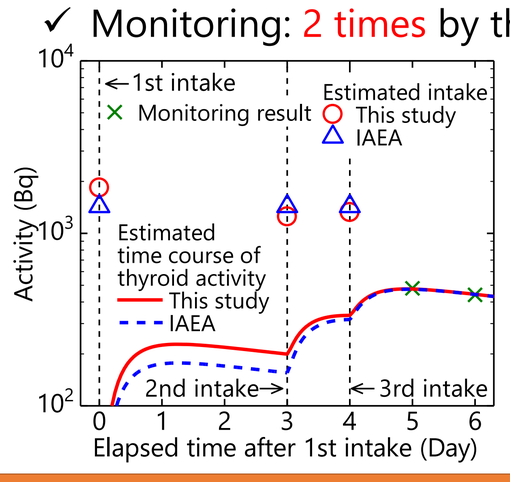


This function can consider monitoring results by multiple measuring methods simultaneously.

Case 4: Shortage of the number of measurements

- Inhalation of ^{131}I type F (IAEA)
  - ✓ Intake: 3 times
  - ✓ Monitoring: 2 times by thyroid monitor

Measurement times, n_M < Intake times, n_I



IAEA:
It is assumed the intakes on each day are equal.

This study:
Assumption about each intake is NOT necessary for estimating intakes because of SVD.

This function can estimate intakes without assumptions even if n_M < n_I.

Note that assumption is effective in some cases.
Eg., information on working time, concentration of activity in work place is available.

Summary & future plans

- We confirmed the function for estimating intakes of the internal dosimetry code works correctly.
- This FY: We will construct the betaware of the internal dosimetry code in accordance with the ICRP 2007 Recommendations.
- The next FY: We will complete the code based on comments and suggestions from betaware users and prepare manuals.

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