Sensitivity Analysis of Influence Parameter on Radiological Risk for LINAC Facility

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Introduction

Background
- IAEA and ICRP have recommended to concern about potential risk of facilities using radiation.
- Various types of linear accelerators manufactured have been installed nationwide in Korea.
- The probability of occurring an accident of radiation exposure to radiological workers and the public is considerably low.

Consequence
- However, when the unexpected accidents occur workers and patients may receive high doses because of high energy photon beam from LINAC.
- In the cases of that radiological workers did not wear dosimeters or that exposure accidents were occurred for public members, it is difficult to estimate their radiological risk.

Objectives
- To calculate spatial dose rate distribution in a LINAC treatment room and dose to workers and public.
- To estimate probability of occurring an accident or an incident with various scenarios during patient treatment in LINAC facility.
- To calculate spatial dose rate distribution in a LINAC treatment room and dose to workers and public.
- To assess radiological risk of LINAC treatment and perform sensitivity analysis of influence parameters for radiological risk.

Methods

Risk assessment
- Risk : products of the frequency and consequence associated with possible states of a system
  \[ Risk = \sum_i (Frequency_i \times Consequence_i) \]
  where, \( i \) is the number of possible states
- Frequency : frequency of the initial event times the probability of the state
  \[ Frequency = frequency(initial\ event) \times probability(state) \]
- Consequence : calculated by using MCNP and dose conversion factor

Frequency
- Event tree analysis : composed with success or failure probability of 6 safety factors

Delphi survey : Method that estimate values based on the empirical judgments of experts then through feedback of the results and derive an agreed result finally

Results

Spatial dose rate distribution
- 3-dimensional internal space of the treatment room was equally divided into 10 \( \times \) 10 \( \times \) 30 cm\(^3\) small cubic forms by using energy deposition mesh tally.
- The best way to reduce the radiological risk is to check the risks and to comply with the safety procedures.

Radiological risk
- The probability of occurring an accident of radiation exposure to radiological workers and the public is considerably low.
- However, when the unexpected accidents occur workers and patients may receive high doses because of high energy photon beam from LINAC.

Sensitivity analysis
- Assessment of radiological risk for operating task at LINAC treatment was performed with experts’ judgment and MCNP simulation in order to obtain the frequency of accident and dose to workers and public due to an accident.
- According to the result of sensitivity analysis, SF2 (searching remainders in the treatment room) have influenced the highest effect on the radiological risk.

Conclusion

Assessment of radiological risk for operating task at LINAC treatment was performed with experts’ judgment and MCNP simulation in order to obtain the frequency of accident and dose to workers and public due to an accident.

According to the result of sensitivity analysis, SF2 (searching remainders in the treatment room) have influenced the highest effect on the radiological risk.

The best way to reduce the radiological risk is to check the risks and to comply with the safety procedures.

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<td>Tree</td>
<td>Researcher-panel</td>
<td>Researcher-panel</td>
<td>3 times</td>
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Figure

- Event tree for operating task

- Delphi survey : Method that estimate values based on the empirical judgments of experts then through feedback of the results and derive an agreed result finally