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A reliable and robust method for monitoring large populations to assess thyroid internal exposure in a nuclear accident: A proposal based on experiences from Fukushima

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1 Introduction

The system for nuclear emergency response in Japan has dramatically changed since the Fukushima Daiichi Nuclear Power Plant (FDNPP) accident in 2011. In September 2012, the Nuclear Regulation Authority (NRA) of Japan was established as an independent authority that integrated functions previously covered by different bodies [1]. Stipulations concerning nuclear emergency preparedness as well as response were revised based on experiences from the accident. One of the most important missions in response to any nuclear accident is to assess radiation exposure doses of the affected population. However, this is a very challenging task in Japan where hundreds of thousands of people may live within the Urgent Protective action planning Zone (UPZ). Thyroid exposure due to intake of radioiodine is particularly difficult to assess due to its short-lived nature. On the other hand, the International Atomic Energy Agency (IAEA) has recently provided generic criteria (GC) for protection actions, one of which is related to thyroid exposure (i.e., 50 mSv in the first 7 days) [2]. In compliance with the GC, the Basic Plan for Emergency Preparedness of Japan has stated that assessment of internal exposure by inhalation of radioiodine should be performed within one week. This paper presents a proposal to implement reliable and robust monitoring of large populations to assess their thyroid internal doses not only for medical triage purposes, but also for future epidemiological studies concerning health effects of low-dose radiation.

2 The proposed method

The proposed method consists of three surveys: a screening survey, a detailed survey and an additional survey (Figure 1). The screening survey is to be performed within the first week after a nuclear accident with the main purpose of identifying persons who received significant exposure and performing medical triage. The screening survey will be performed by first responders using a simple hand-held device (e.g., a NaI(Tl) survey meter). This type of measurement was conducted in the FDNPP accident; however, it was delayed by more than two weeks due to the chaotic circumstances [3]. Within the following

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three weeks, a more detailed survey using a sophisticated device (e.g., a spectrometer) is to be performed. This survey will be performed by radiation measurement experts at shelters with low background levels after evacuation of residents living near the site of the accident is completed. The screening survey and the detailed survey are direct thyroid measurements in which a probe is placed on (or near) the front surface of the bottom of the neck along with appropriate background subtraction. A final, additional survey is to be performed using whole-body counters (WBCs) after iodine-131 (^{131}I), the largest contributor to the thyroid dose, cannot be detected anymore. In the FDNPP accident, the period within which ^{131}I could be sufficiently detected was only about one month. The target radionuclides of the additional survey are radiocesium, mainly ^{134}Cs and ^{137}Cs. Several mobile WBC units will be available for this survey because many units have been introduced following the FDNPP accident. Both the screening survey and the additional survey will overlap with the detailed survey, which has the highest accuracy, in order to ensure the measurement accuracy and accurately estimate the intake ratio of ^{131}I to ^{134}Cs/^{137}Cs in individuals, respectively. The target numbers of subjects for the detailed and additional surveys are currently set at 10,000 and 30,000, respectively.

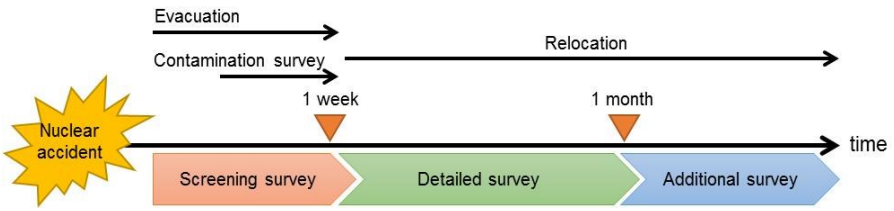

Fig. 1. The proposed method for monitoring populations to assess thyroid internal exposure in a nuclear accident.

3 Discussion

The proposed method intends to effectively use all human data obtained for assessing thyroid internal doses of the affected population. This method is considered robust because it utilizes different techniques suited for each phase. However, the most important objective is to coordinate monitoring of large populations during their evacuation by administrative bodies. Regarding the technical aspects of the three-phase system, the authors have performed various activities, such as training personnel, developing a new device for use in the detailed survey, and considering arrangements for the surveys at a shelter. These activities will be presented in the upcoming workshop.

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