The use of electronic dosimeter for individual exposure assessment and management after a nuclear accident : the example of the D-Shuttle in the Fukushima Prefecture

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In the days and weeks following the Fukushima Daiichi nuclear power plant (F1NPP) accident resulting from the East Japan earthquake of 11 March, 2011, approximately 85,000 people from 12 municipalities were forced to evacuate from areas within a 20 km radius of F1NPP and heavily contaminated areas outside of this zone. Six years after the nuclear disaster, the radiation levels have greatly decreased due to physical decay, weathering, and decontamination operations in Fukushima. As of April 2017, the evacuation order of nearly 70 percent of the former population areas in the restricted aeas has been lifted. Only a limited number of residents, however, have returned to their original home in areas for which the evacuation order has been lifted, and their reasons for not returning include limited social infrastructures and employment opportunities, and a concern regarding radiological conditions. In order for individuals to return to their original residential areas, it is important to assess current and future realistic individual doses. In the study presented here, we used electronic personal dosimeter (D-shuttle) along with the Global Positioning System (GPS) and Geographic Information System (GIS) to understand realistic individual external doses and to relate individual doses, ambient doses, and activity-patterns of individuals in the affected areas in Fukushima.

The measured individual external doses measured by D-shuttle for approximately 250 study participants showed that doses measured during time spent outside at evacuation areas or undecontaminated areas were higher and widely distributed compared to the doses measured during time spent at home. Exposure ratio (ER) was defined by the ratio of additional individual external dose measured by D-shuttle to the additional ambient dose based on an airborne monitoring survey. The ERs for study participants ranged 0.03 – 0.42 for time spent at home and 0.01 – 0.80 for time spent outdoors. Projected additional annual individual external doses as of April 1st 2017 for an exacuation zone calculated using ERs obtained in our study were well below the individual external doses estimated using the approach taken by the central government.

The government-proposed approach may have been appropriate in the absence of actual measurement data during the initial stages following the accident. However, in the rehabilitation stage, it is important to correctly understand or estimate realistic individual external doses for those who want to make decisions based on their radiological protection or to return to restricted areas. The individual external dose is not the sole determinant for deciding whether or not to return to the evacuation zone after lifting of the evacuation order, but is one of the most important factors. The results of our study provide valuable information for understanding the actual radiological situation in evacation zone, and for those wanting to know their future individual external dose in order to make an informed decision regarding whether or not to live in in areas for which the evacuation order has been lifted.

During the workshop presentation, a pragmatic estimation tool (AIST-EDEST) based partly on our D-shuttle results to assess and manage the individual external doses for

those who want to know their future individual external dose living the affected areas in Fukushima will be introduced.