

Evaluating the Large-Scale Distribution of Thyroid Protective Medications in Comprehensive Nuclear Disaster Prevention Exercise

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1. Introduction

The Nuclear Safety and Security Commission (NSSC), in accordance with Article 35-2 of the 「ACT ON PHYSICAL PROTECTION AND RADIOLOGICAL EMERGENCY」, mandates that local governments, including mayors and governors of Si, Gun, and Gu districts, stockpile and manage iodine thyroid blocking (ITB) agents to prepare for domestic or foreign radioactive disasters, etc. [1]. Annually, the Korea Institute of Radiological and Medical Sciences, entrusted by the NSSC, calculates the required number of ITB agents based on population figures as of the end of June. These agents are then distributed to local governments according to a predetermined minimum stockpile standard.

The distribution plan for ITB agents is integrated into regional radiological emergency plans, with implementation strategies tailored to local characteristics and population density. For example, Busan Metropolitan City, which has the largest population residing near nuclear power plants in the Republic of Korea, manages 6,641,500 ITB tablets categorized into high-dose (130 mg) and low-dose (32.5 mg). These agents are strategically distributed and stored across 124 administrative community service centers, 94 schools, 4 medical facilities, 26 facilities serving vulnerable populations, and 3 disaster stockpile facilities. In the event of a radiological emergency, the distribution of ITB agents is carried out by the heads of villages, school health teachers, nurses, and radioactivity prevention personnel [2]. This distribution system is detailed in Busan's on-site action manual for nuclear safety and is regularly refined through Nuclear Disaster Prevention Exercise. This study aims to evaluate the current distribution system for ITB agents in Busan by analyzing results from large-scale empirical training exercise. The insights will contribute to the development and improvement of expeditious and feasible distribution systems tailored to the characteristics of Korea.

2. Methods and Results

2.1 Outline of Comprehensive Nuclear Disaster Prevention Exercise

In May 2024, Busan Metropolitan City conducted a comprehensive nuclear disaster prevention exercise,

involving approximately 4,000 participants from 60 organizations. These participants included public officials from Busan's 16 local governments, nuclear operators, citizens, and students within the Emergency Planning Zone (EPZ). The exercise encompassed several critical tasks such as the dissemination of radiological emergency alerts, indoor sheltering, evacuation of residents, operation of relief shelters, and distribution of ITB agents. The distribution exercise for ITB agents was conducted simultaneously at community service centers across the nine local government areas within the EPZ, excluding Gijang-gun. A notable feature of this year's exercise was the introduction of training scenarios, particularly the distribution of protective medication to residents in large apartment complexes and individuals in indoor shelters. Each local government prepared for the distribution of ITB agents by conducting exercise that simulated both blue and red radiation emergency scenarios, tailored to the potential spread of radioactive materials from nuclear power plants. Following these exercises, each local government compiled a detailed training report. This study aims to synthesize insights from these reports, critically evaluate the current distribution system, and recommend improvements for the storage and distribution of ITB agents.

During a blue emergency alert at a nuclear power plant, the officer responsible for emergency supplies at the community service center notifies the autonomous disaster prevention corps, which consists of village heads, of the nuclear emergency status and instructs them to assemble. The officer then unlocks the ITB agents cabinet and prepares the supplies, including the agents carrier bags, the resident distribution list, and the confirmation certificates of receipt. In an actual emergency situation, decisions regarding urgent measures for the distribution of ITB agents and instructions for their administration are made by the directors of the Off-site Emergency Management Center. Exceptionally, during this year's exercise, the distribution of thyroid protection pills was handled by local governments immediately following the red emergency alert declared by Busan City Hall. The assembly of the autonomous disaster prevention corps members at the community service centers and medication distribution sites during the exercise is depicted in Fig. 1.



Fig. 1. Distribution of thyroid protection pills during the exercise

2.2 Evaluation of the Exercise

The exercise results indicated that most officers in community service centers successfully assembled their autonomous disaster prevention corps, who effectively carried out their assigned tasks. Disaster prevention personnel, equipped with protective gear, successfully distributed ITB agents to designated indoor shelters based on the established on-site operational manual. This success can be attributed to the proficiency developed over years of experience in distributing thyroid protection pills and the pre-training conducted by city and district officials who coordinated the exercise. However, the exercise revealed a significant difficulty in the community service centers. There is a noticeable imbalance between the number of employees trained in essential radiation prevention and those who distribute medications to residents. This disparity places an excessive burden on medication managers, who are tasked with directly training each disaster prevention team member and corps volunteer on medication usage and precautions, necessitating specialized knowledge. Despite receiving annual job training and radiological emergency training, the nature of the organization, whose responsibilities are frequently changed, causes significant difficulties for drug managers in performing their duties. Moreover, while there were no issues with the organization of the autonomous disaster prevention corps in this exercise due to the pre-training meetings, exercise coordinators suggested several potential issues. These included communication breakdowns with corps members, their possible absences, and delays in reaching designated assembly points in an actual emergency.

2.3 Improvements for the Management of ITB Agents

Due to the pharmacological characteristics of ITB agents, it is necessary to take the medication 24 hours before exposure to radioactive iodine and within 15 minutes after exposure to prevent 95% of absorption. Under the current system, the general population relies entirely on a limited number of administrative officials and autonomous disaster prevention corps members to receive the medication, making it urgent to devise an alternative distribution method. In fact, at the Hwamyong 1-dong community service center, which manages the largest stockpile of ITB agents in Busan, just 26 members of the corps are tasked with distributing

medications to 50,600 residents. This makes rapid distribution challenging and complicates the process of verifying whether each individual has received their medication.

To effectively address these issues, during the distribution exercise conducted in Nam-gu this year, an innovative approach was implemented. Distributors used the Zoom video conferencing app on their mobile phones to communicate in real-time with the operation headquarters, allowing for immediate resolution of any issues that arose during the distribution process. In a broader effort to refine the ITB agents distribution system for Busan City, a survey was conducted targeting 859 citizens who participated in the radiation prevention exercise and 829 public officials who completed radiation prevention training. With a sampling error of 2.4% at a 95% confidence level, the survey revealed that 41% of respondents preferred to receive medications through pharmacies when needed, regardless of nuclear plant emergencies, as shown in Fig. 2. Furthermore, only 22% supported maintaining the current distribution system, highlighting a strong consensus for the need for improvements among both distributors and recipients.

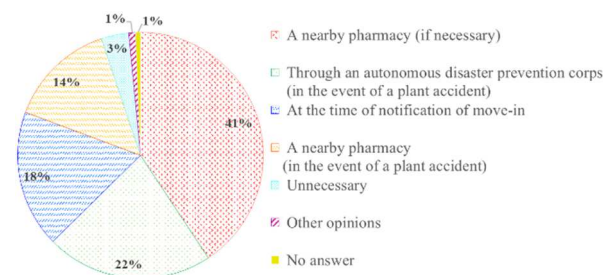


Fig. 2. Survey results on how to receive thyroid protective medication

Additionally, an analysis of distribution systems in the United States and Japan was conducted to improve the distribution system of thyroid protection medication during radiation emergencies. In the United States, thyroid protection medication is not classified as a specialty drug, allowing individuals to purchase it directly from commercial pharmacies and independently prepare for radiation emergencies. In Japan, the medication is provided only to residents in nuclear power plant areas who request it in advance, along with a precaution sheet. It is classified as a specialized drug and managed by the government [3]. In Korea, considering the pharmacological action of thyroid protection medication, there is a need to improve the distribution system to ensure prompt distribution and timely administration. Particularly, the implementation of the Drug Utilization Review (DUR) system, which was utilized for the equitable distribution of government-supported masks during the COVID-19 pandemic, could help prevent duplicate receipt of medication and assess the appropriateness of its use. Therefore, efforts are needed at both the central government and metropolitan city levels to establish a collaborative system that enables residents to receive the medication through pharmacies, which is the most preferred method of distribution.

3. Conclusions

As part of its protective measures against radiation emergencies, Busan City has established a thyroid protection medication distribution system through community service centers and school health offices. This initiative is supported by regular training exercises to improve the action manual for medication distribution. Through this year's radiation emergency preparedness joint exercise, it was identified that the centralized system for distributing medications to the general public leads to an excessive workload for community service center staff, underscoring the urgent need for a solution. Currently, Busan is experiencing a decline in population, resulting in a situation where the initial quantity of medications provided by the NSSC exceeds the minimum reserve stock. Consequently, the nuclear safety division of Busan has utilized the surplus to distribute medications to facilities vulnerable to nuclear emergencies, such as schools and elderly care institutions [4]. However, the quantity of medications provided by the NSSC is based on resident population figures from June two years ago, leading to a continuous decrease in the amount of available medications after collecting expired stock. This results in insufficient quantities for distribution to vulnerable facilities after ensuring minimum reserve stocks at community service centers. Additionally, while the nuclear safety division has incorporated support from the Public Health and Sanitation Department into its emergency manuals, the lack of a legal framework for medication management complicates the establishment of effective collaborative systems. Therefore, the NSSC needs to provide a larger quantity of medications, taking into account both the number of facility occupants and the resident population, and administrative efforts are required to establish pre-arranged agreements with medical institutions.

Distribution of Potassium Iodide. Korean Association for Crisis and Emergency Management, 2016, 8.1: 17-39.

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