

Drug Shortages After the Eastern Japan Earthquake: Experiences in a Tertiary Referral Center

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Abstract

The large earthquake in eastern Japan on March 11, 2011, caused a nationwide drug shortage. The authors investigated the reasons behind the drug shortage and its impacts on clinical practice in a tertiary referral center. From the day the earthquake occurred until September 11, the authors identified shortages of 26 items (2.6% of all drugs in their hospital). The primary shortage causes included the destruction of pharmaceutical plants ($n = 24$) and packaging factories ($n = 1$) and a production shift toward other items ($n = 1$). The nuclear accident at the Fukushima Daiichi nuclear power plant was associated with shortages of 2 items. During the 6-month study period, drug supply of 6 items recovered, alternatives were introduced for 2 items, and prescriptions were restricted for the remaining 3 items. Recoveries were achieved through the repair of damaged factories ($n = 18$), importation from foreign countries ($n = 2$), and production in alternate existing factories ($n = 1$). Physicians avoided long-term prescriptions of all 11 items, and substituted 4 items with similar brand agents, with the informed consent of patients. Although large-scale disasters inevitably cause drug shortages across broad areas even in developed countries, these shortages can be minimized by the coordinated efforts of clinicians and patients.

Keywords

disaster, pharmaceutical supply chain, nuclear accident, levothyroxine, pharmaceutical company

Introduction

Drugs are manufactured in pharmaceutical plants, stored by wholesale firms, and then delivered to medical institutions and pharmacies. Most pharmaceutical companies in Japan have adopted the Toyota production system:¹ drugs are purposefully manufactured in amounts that will satisfy current demand, meaning the supply chain has little excess inventory.

The large earthquake in eastern Japan on March 11, 2011, is likely the first natural disaster that devastated the complex pharmaceutical supply chains of a developed country, causing a nationwide drug shortage. Drug shortages can be detrimental to patients with underlying diseases requiring daily medication; however, little information is available concerning the effect of natural disasters on the drug supply and medical practices in developed countries.² In addition, the earthquake precipitated the nuclear accident at the Fukushima Daiichi nuclear power plant, which affected most of eastern Japan including the Tokyo area. We investigated the magnitude of the shortage's influence on the pharmaceutical supply at our hospital in Tokyo during the 6 months following the disaster.

Methods

To investigate the reasons behind the drug shortage, we reviewed the pharmacy records in our hospital, which is one of the major tertiary referral centers in Tokyo. The hospital has 500 beds, 33 doctors (17 staff and 16 residents), and 21 pharmacists. Approximately 1000 kinds of drugs are prescribed

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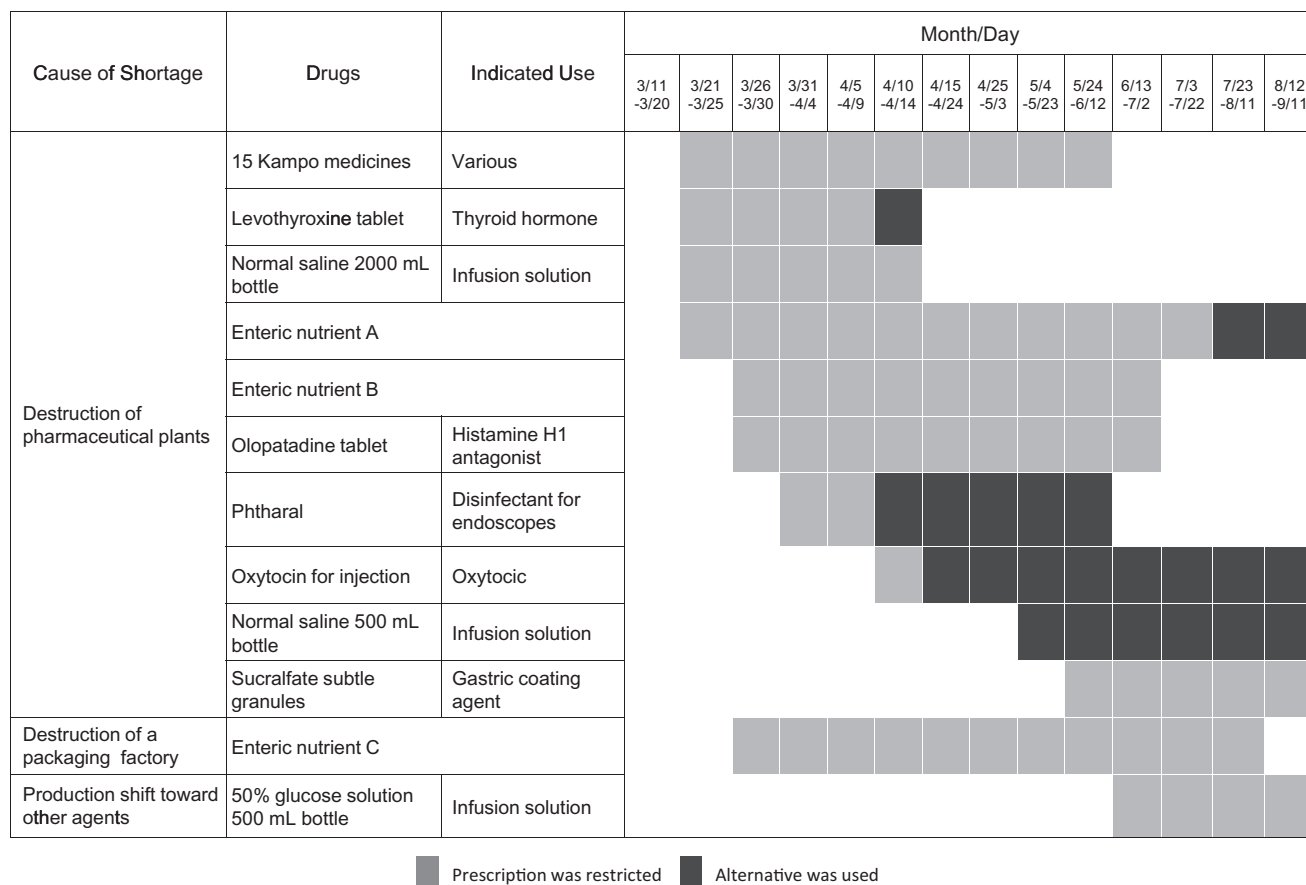


Figure 1. The causes of drug shortage, drug items, indicated use of each drugs, and chronological changes of response to the shortages in our hospital after the large earthquake in eastern Japan, March 11, 2011.

routinely, and the annual expenditure for drugs is approximately US\$10 million. The pharmacists identified a list of drugs at risk of shortage on the basis of the balance between hospital stock and drug supply. When a brand-name drug had multiple dosage forms, they were counted as 1 item. To identify the reasons for the drug shortage, we investigated drug production and distribution in our country using the disclosed information from pharmaceutical or wholesale companies. We directly contacted them if further information was required. We examined how physicians responded to the drug shortage through interviews.

Results

The first drug shortage was detected in our hospital on March 23, 2011. We cataloged the shortages of 26 items (2.6% of the total number of drugs in our hospital) until September 11 (Figure 1). Causes for the shortages comprised the destruction of pharmaceutical plants ($n = 24$) and a packaging factory ($n = 1$) and a production shift toward other agents ($n = 1$). The accident at the Fukushima Daiichi nuclear power plant was

associated with shortages of olopatadine tablets and sucralfate subtle granules, as workers were unable to access the factory, 65 km from the Fukushima Daiichi plant (Figure 2). The disaster caused severe damage to distribution centers in the affected areas, and the Tokyo Electric Power Company instituted blackouts to avoid power shortages. However, this was not a principal cause of the shortages of any of the 26 items.

Physicians substituted 2 items with same-brand agents and 3 with similar-brand agents. Alternatives were not available for the remaining 21 items, and prescriptions were restricted. As of September 11, 2011, supplies of 21 drugs had recovered and alternatives continued to be used for 3, while prescriptions were still restricted for the remaining 2. The recovery of production of the 21 items was achieved through the repair of damaged factories ($n = 18$), importation from foreign countries ($n = 2$), and production in alternate existing factories in Japan ($n = 1$). As the abrupt halt in levothyroxine production was most likely among the 26 items to lead to fatalities, the Sandoz Pharmaceutical Corporation urgently imported the drug from Germany.

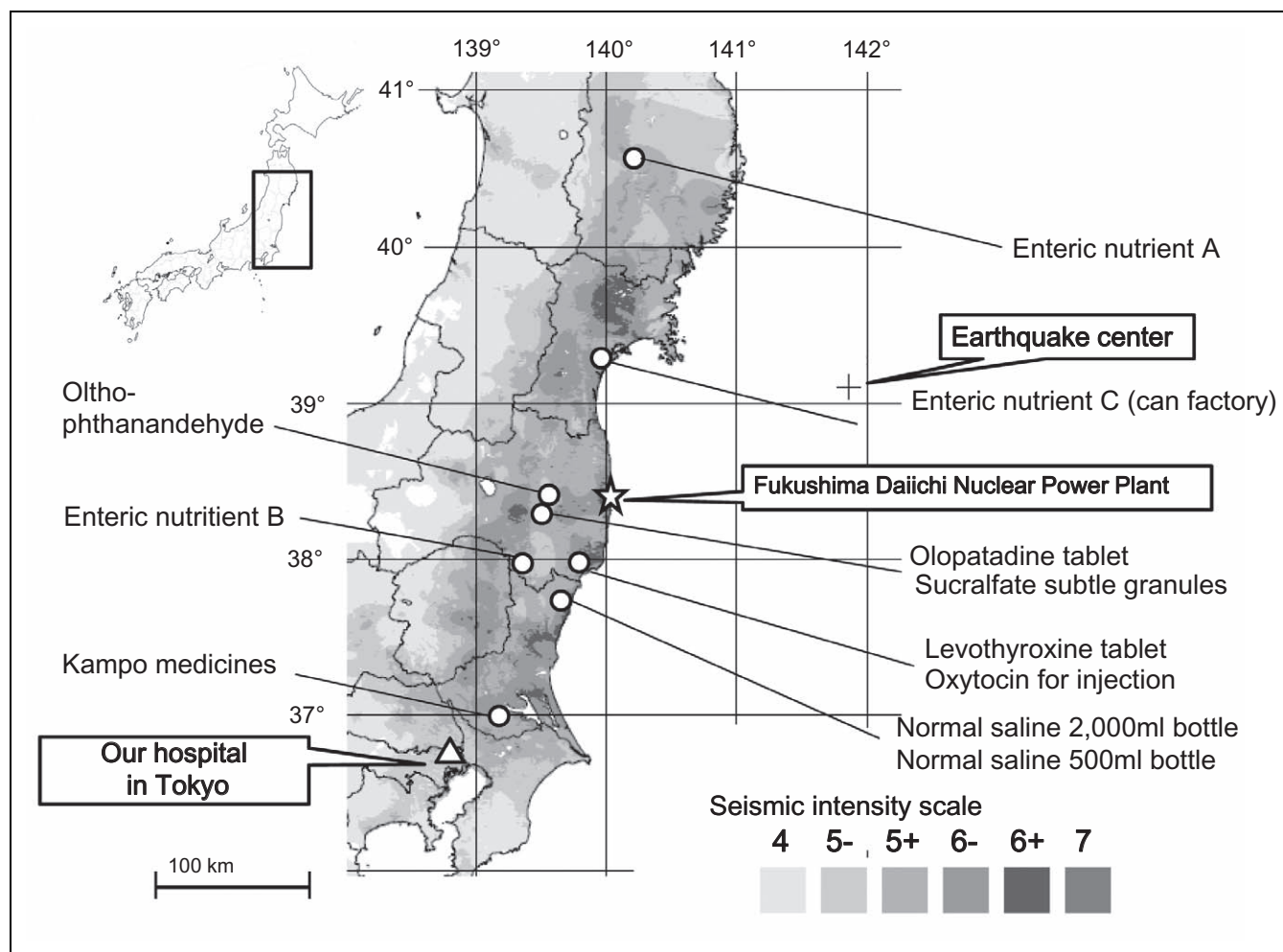


Figure 2. Depicted are the areas of Japan affected by the magnitude 9.0 earthquake, tsunami, and Fukushima nuclear plant accident, in relation to the locations of destroyed pharmaceutical plants and canning factory, which led to the drug shortages in our hospital.

Discussion

This study reveals that drug shortages can be a significant problem following a devastating disaster. Past studies have reported shortages resulting from troubles in manufacturing processes,³ the unavailability of materials,⁴ and increased demand.⁵ Although the drug shortage rate was approximately 0.25% per year during the past 10 years in our hospital, we found that 26 of 1000 drugs (2.6%) suffered shortages following the disaster.

This drug shortage was much more severe than any we had experienced before. The main cause of the supply shortage was the destruction of manufacturing institutions (pharmaceutical plants for 24 items and a packaging factory for 1) (Figure 2). Pharmaceutical companies have consolidated factories and developed approaches using supply chain management to improve productive efficacy and reduce costs. However, the destruction of a can factory led to the suspension of production of an enteric nutrient, which was manufactured in an unaffected

area, leading to 1 of the shortages. This was beyond our expectations. These findings suggest that the complex drug supply system is particularly vulnerable to large-scale disasters. A decentralization of factories and supply chains may be essential, as depicted with the Toyota Motor Company's construction of 3 manufacturing bases in addition to their original factory following the Hanshin-Awaji earthquake in 1995.

Of particular note was the nuclear accident at the Fukushima Daiichi power plant. The earthquake damaged a pharmaceutical factory located near the plant, and some factory employees refused to return to work unless sufficient information regarding the nuclear accident was provided to them. Three days after the earthquake, the damage to the facility was required to be assessed, which delayed the recovery of the facility and led to a shortage of 2 items at our hospital. Thus, the mental stress on factory staff as well as the local inhabitants after the occurrence of a nuclear accident must be considered.

While drug production and delivery were severely impaired by the disaster, it had minimal influence on daily clinical practice. Since the Japanese government had no predefined policy or guidance concerning a nationwide drug shortage after such a disaster, the efforts of clinicians at the hospital level were essential to avoiding running out. Several types of media, including social media, were utilized to provide detailed information on the drug shortage, and this information was then shared among physicians and patients. Physicians avoided long-term prescriptions, and patients accepted these terms after informed consent. Physician–patient cooperation was thus essential to coping with the drug shortage.

Conclusion

As this was a small, single-institution study, we should be careful in interpreting its results. However, we believe that this study provides some important information on the condition of medical systems after earthquakes. Drug supplies may be disrupted across wide areas when large-scale disasters occur in developed countries. Sharing information and physician–patient cooperation are both essential in minimizing the impact of disaster-associated drug shortages on daily clinical practice.

Declaration of Conflicting Interests

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