Original Article

Enhancing Preparedness against Rubella at the Workplace: Proactive Prevention Efforts by the Tokyo Metropolitan Government

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SUMMARY: In the 2012–2013 rubella epidemic in Japan, most transmissions in Tokyo occurred at workplaces, especially among men aged 20–49 years. This tendency was likely related to previous rubella immunization policies that prioritized female adolescents. Since 2015, the Tokyo Metropolitan Government has been promoting a project to prevent rubella and other infectious diseases in workplaces. Companies participate by choosing one or more of three options: (i) acquire fundamental understanding of infectious diseases, (ii) develop a Business Continuity Plan (BCP) for infectious diseases in the workplace, and (iii) increase rubella antibody prevalence in employees.

Criteria for accomplishment are (i) at least 80% of employees complete the infectious disease training modules or (ii) produce a BCP and (iii) at least 90% of employees demonstrate the presence of antibodies at levels sufficient for preventing rubella. As of July 2018, 39.8% ($n = 90$) of the 226 companies that began participating in 2015–2017 had met at least one accomplishment criteria (Option I, 42.7% of 192 companies; Option II, 19.3% of 140; and Option III, 17.0% of 53). The main project challenges were recruiting companies and following participating companies. Although early in its implementation, this project has made considerable contributions toward rubella elimination in Japan.

INTRODUCTION

Rubella is an acute infectious disease caused by the rubella virus and characterized by fever, rash, and lymph node swelling. However, asymptomatic infection frequently develops, and only half of patients with rubella present these characteristic symptoms (1). The prognosis is typically benign but rarely includes complications, e.g., arthritis, thrombocytopenic purpura, and acute encephalitis. Infants who are born to susceptible pregnant women infected with rubella virus early in their pregnancy can develop congenital rubella syndrome (CRS), which is characterized by cardiac diseases, auditory disturbance, and eye abnormalities (1).

Vaccination is the best method for preventing rubella and CRS. The effectiveness of the rubella vaccine has been well documented (2). In Japan, nationwide epidemics tended to occur from spring through early summer, mainly among children, every 5–6 years (3). Epidemics ceased to occur after regular immunization of infants began in 1995, with only small outbreaks continuing to occur. The national incidence of rubella declined throughout the 2000s.

In 2012 and 2013, Japan again experienced a nationwide epidemic of rubella (4). A total of 4,116 rubella

cases were reported in Tokyo in 2012–2013, resulting in 16 cases of CRS (5). Infections in the workplace were frequent, mainly among men aged 20–49 years (5). The epidemic has been attributed in part to populations not having acquired immunity through rubella immunization, especially those populations for whom there was no recommendation to vaccinate (6).

After the 2012–2013 epidemic in Japan, the perception that rubella was a disease of children changed, and intervening in the working population was prioritized (as has occurred elsewhere). In the World Health Organization's Western Pacific Region (WPR), which includes Japan, rubella elimination has been set as a target goal (7). To progress toward rubella elimination in the WPR, the prevention of rubella transmission in workplaces has been proposed (8). In the United States, epidemics of rubella in workplaces (9) showed that the vaccination strategy targeting only infants was insufficient; thus, vaccination in the working environment for high-risk adults was also adopted (10). Presently, the United States has eliminated rubella.

To contribute to national and regional progress toward rubella elimination and reduce future CRS incidence, in 2015, the Tokyo Metropolitan Government launched a project to support countermeasures against rubella and other infectious diseases in the workplace. Here, we report on the progress of this project.

MATERIALS AND METHODS

Implementation: The project “Enhancement of infectious disease response in the working environment” was started in October 2015 as a collaborative effort of the Tokyo Metropolitan Government, Tokyo Chamber of Commerce and Industry, and Tokyo Metropolitan

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Fig. 1. Collaboration model for implementation of the project “Enhancement of infectious disease response in the working environment”.

Medical Association. The project aimed to support and introduce (or enhance) measures against infectious diseases in companies (Fig. 1). The Tokyo Metropolitan Government assumed responsibility for establishing options for participation, preparing educational materials, and publicizing participating companies and their accomplishments. The Tokyo Chamber of Commerce and Industry assumed responsibility for supporting companies and publicizing the merits of the project to increase participation. The Tokyo Metropolitan Medical Association assumed responsibility for ensuring mechanisms of vaccination for those desiring to receive them and liaising with companies’ occupational health units. The Secretariat for this project was the Tokyo Chamber of Commerce and Industry, which was additionally responsible for convening briefing sessions, registering company participation, and confirming the accomplishment criteria. A group of public health nurses used phone calls and visits to advise and support participating companies who had lagged progress.

Subjects: The intended targets of this project were medium- and small-sized companies in Tokyo. In 2014, there were 655,886 business establishments with < 300 employees in Tokyo, accounting for 99.0% of all business establishments (11). Companies, individual offices, and departmental units were eligible to apply throughout the year. Participation was free of charge,

and no additional expenses were expected to be borne by participating companies. To increase participation, recruitment guidance was provided on the website of the Tokyo Metropolitan Government; the project was announced to Tokyo companies belonging to the Tokyo Chamber of Commerce and Industry (approximately 45,000) by fax; briefing sessions were conducted five times per year (October to December) for personnel officers and labor and health management staff of Tokyo companies; and information was communicated directly to occupational health physicians in the companies and regional occupational health centers.

Establishment of options: To participate in the project, companies choose from three options (Table 1). Selecting multiple options simultaneously was possible. For each option, the Tokyo Metropolitan Government supported companies by providing the appropriate tools and materials.

Option I: acquire fundamental understanding of infectious diseases

Option I aimed to improve employees’ abilities to prevent the spread of infectious diseases by improving their knowledge of these diseases. Educational materials that focused on such knowledge—symptoms, prevention methods, and management of disease while symptomatic—were provided with a series of multiple-choice questions. After the employee selected an answer, a detailed

Table 1. Company participation options for the project “Enhancement of infectious disease response in the working environment”

Options	Description	Attainment Criteria
I. Acquire fundamental understanding of infectious diseases	To provide information on basic knowledge of infectious diseases to improve knowledge for prevention (materials available by paper and e-learning)	more than 80% of employees complete mandatory sections
II. Develop a Business Continuity Plan (BCP) against infectious diseases	To develop BCP against infectious diseases, including countermeasures, to continue operations when infectious diseases occur among workers in the workplace	companies produce a tailor made BCP against infectious diseases
III. Increase rubella antibody prevalence in employees	To encourage rubella antibody measurement and vaccination for employees without history of vaccination, history of disease, or sufficient antibody titer	more than 90% of employees demonstrate the presence of antibodies at levels sufficient for preventing rubella

Table 2. Contents of educational materials provided to companies participating in Option I: Acquire fundamental understanding of infectious diseases

Sections	Contents	No. of questions
Mandatory	Basic knowledge of infectious diseases	5
	Rubella	5
	Influenza	5
	Norovirus	5
Optional	Tuberculosis	5
	Avian influenza/Pandemic influenza	5
	Dengue fever/Zika virus infection (Mosquito-borne infection)	5
	Overseas travels	5
	Sexually transmitted infections	5
	Ebola virus disease/Middle East respiratory syndrome (MERS)	5
	Total	50

commentary was provided. Mandatory sections included 20 questions with commentaries on basic knowledge of infectious diseases and specific information on rubella, influenza, and norovirus (Table 2). Optional sections included 30 questions with commentary that focused on additional diseases, e.g., tuberculosis, avian influenza/pandemic influenza, and dengue fever/Zika virus infection (mosquito-borne infections). Inclusion of optional sections depended on the characteristics of the workplace and the employee's interest. Printed materials were provided, but in December 2016, an e-learning platform was also available, which employees could access through the Internet with an ID and password. Accomplishment for Option I was defined as > 80% of employees completing the four mandatory sections.

Option II: develop a Business Continuity Plan (BCP) against infectious diseases

Option II aimed to ensure business activities would continue when infectious diseases affect the workers. The method was to develop a BCP that clarified the plan for preventing infection before and during epidemics and outbreaks. For Option II, the Tokyo Metropolitan Government developed BCP templates and a preparation

guide that targeted common infectious diseases. The templates were created in Microsoft Word and filled with standardized content. Companies could then refer to the preparation guide in modifying the BCP by adding necessary, appropriate, tailored content. Accomplishment for Option II was defined as company completion of the BCP.

Option III: increase rubella antibody prevalence in employees

Option III focused on ensuring that employees had sufficient rubella antibody to prevent disease and its spread within the workplace. For this option, employees were interviewed and classified as having antibody if the employee had (i) history of rubella vaccination, (ii) history of rubella disease, or (iii) evidence of sufficient antibody titer. Vaccination was recommended in those persons with insufficient antibody (Fig. 2). Those persons whose antibody was unknown were encouraged to have their antibody titer measured or be directly vaccinated against rubella.

The Secretariat (Tokyo Chamber of Commerce and Industry) introduced companies participating in this option to cooperating medical institutions that could support them by allowing their employees to obtain antibody titer measurements or vaccinations at the medical institutions. (As a countermeasure against CRS, all municipalities in Tokyo [as of July 2018] are providing free antibody titer measurement for women aged >19 years who are planning or expecting to become pregnant. If the results indicated insufficient immunity against rubella, these women could receive vaccination at a cost subsidized by the municipality.). After the Tokyo Metropolitan Government provided relevant information to participating companies during briefing sessions, some companies decided to offer on-site titer measurement and vaccination. In some companies, rubella antibody titer measurement was incorporated into blood tests that were performed during annual company health examinations, and other companies, vaccinations were provided at workplaces. A rubella antibody prevalence of at least 83–85% has been suggested as sufficient for suppressing spread within a group (12). Therefore, accomplishment for Option III was defined as > 90% of employees having antibody

Fig. 2. Classification of employees' rubella antibody status for Option III, "Increase rubella antibody prevalence in employees".

against rubella.

Public announcement: The companies that applied to participate in the project were posted on the Tokyo Metropolitan Government website as “cooperating companies,” and those that met the accomplishment criteria were posted as “companies with accomplishment.” The posting period for cooperating companies was six months. For companies with accomplishment, their success was posted at the time accomplishment was recognized. For Option III, the names of companies were posted with their corresponding employee antibody prevalence, e.g., 70%, regardless of whether or not they achieved 90% accomplishment.

Measurement of accomplishment: To assess the success of the overall project, the number of participating companies that accomplished any of the three options was divided by the total number of participating companies.

Moreover, the proportion of participating companies that accomplished each option was calculated.

RESULTS

The number of participating companies is shown in Table 3 according to their preferred option(s). There were 62 (27.4%) participating companies with <10 employees, 113 (50.0%) with 10–99 employees, 41 (18.1%) with 100–999 employees, and 10 (4.4%) with at least 1,000 employees.

As of July 10, 2018, there were 90 (39.8%) companies with accomplishment in at least one option. Companies selecting only Option I had the highest accomplishment number and percentage ($n = 43$; 52.4%; Table 4). The proportion of companies that accomplished each option was 42.7% of 192 companies for Option I, 19.3% of

Table 3. The number and percentage of participating companies, 2015–2017, according to the option(s) they chose

		2015 ¹⁾	2016	2017	Total (%)
Classification of participating companies	a) Option I only	19	22	41	82 (36.3%)
	b) Option II only	5	8	19	32 (14.2%)
	c) Option III only	0	1	1	2 (0.9%)
	d) Option I and II	18	18	23	59 (26.1%)
	e) Option I and III	1	1	0	2 (0.9%)
	f) Option II and III	0	0	0	0 (0.0%)
	g) Option I, II, and III	21	8	20	49 (21.7%)
No. of participating companies	Total (a + b + c + d + e + f + g)	64	58	104	226 (100%)
No. of companies participating in each option	Option I (a + d + e + g)	59	49	84	192
	Option II (b + d + f + g)	44	34	62	140
	Option III (c + e + f + g)	22	10	21	53

¹⁾: Application period for year 2015 was 3 mo only (October to December).

Table 4. Number and proportion of companies with accomplishment, as of July 10, 2018

		Classification of participating companies							Total
		Option I only	Option II only	Option III only	Option I and II	Option I and III	Option II and III	Option I, II, and III	
Detail of accomplishment by option chosen	One option	Option I	43		9	1		6	59
		Option II		6	2		0	0	8
		Option III			0		0	0	0
	Two options	Option I and II			10			4	14
		Option I and III				0		4	4
		Option II and III					0	0	0
	Three options	Option I, II, and III						5	5
Companies with accomplishment	a) Total	43	6	0	21	1	0	19	90
b) No.of participating companies		82	32	2	59	2	0	49	226
Proportion of companies with accomplishment ([a/b]*100)		52.4%	18.8%	0.0%	35.6%	50.0%		38.8%	39.8%
No.of companies that accomplished each option	Option I	43			19	1		19	82
	Option II		6		12		0	9	27
	Option III			0		0	0	9	9

Table 5. Outcome of multiple-choice test by e-learning, Option I, December 2016 to August 2018

Sections of test	Average test scores (scoring 100)	No. of participants (person)
Basic knowledge of infectious diseases	85.7	5,429
Rubella	80.6	5,375
Influenza	93.7	5,354
Norovirus	90.1	5,344

Table 6. Characteristics of companies participating in Option III

		Proportion	
Participating companies that chose Option III (<i>n</i> = 53)	Companies that accomplished Option III (<i>n</i> = 9)	Companies with fewer than 10 employees (<i>n</i> = 8)	88.9%
		Accomplishment of option I (<i>n</i> = 9)	100.0%
		Accomplishment of option II (<i>n</i> = 5)	55.6%
	Companies that did not accomplish Option III (<i>n</i> = 44)	Companies with fewer than 10 employees (<i>n</i> = 17)	38.6%
		Accomplishment of option I (<i>n</i> = 11)	25.0%
		Accomplishment of option II (<i>n</i> = 4)	9.1%

140 for Option II, and 17.0% of 53 for Option III. The average scores for Option I multiple-choice tests for the four mandatory sections are shown in Table 5; that of Rubella was the lowest.

The characteristics of companies that preferred Option III are shown in Table 6. All companies that accomplished Option III had already accomplished Option I, and approximately half had accomplished Option II. Almost all companies (88.9%) that accomplished Option III had <10 employees. Companies that selected Option III but did not reach accomplishment typically had >10 employees.

Among the companies who registered to participate in 2015 and 2016, nine (7.4%) were supported by public health nurses' follow-ups through phone calls or visits. These follow-up activities involved encouraging companies to resume suspended efforts and report accomplishment to the Secretariat.

DISCUSSION

The Tokyo Metropolitan Government launched the project "Enhancement of infectious disease response in the working environment" in October 2015. It aimed to minimize the impact of rubella and other infectious diseases in the workplace by improving understanding of the fundamentals of infectious diseases, preparing a BCP for infectious diseases, or increasing antibody against rubella. Participation in this project was voluntary. After 27 months, 226 companies had participated in the project with the majority of them selecting Option I (acquire fundamental understanding of infectious diseases) either alone or in combination with other options. Among the three options, Option I had the highest proportion of participating companies that meet the accomplishment criteria, even when restricted to companies that only participated in one option (Table 4). Overall, approximately 40% of participating companies met the accomplishment criteria for at least one option.

We believe that Option I was the most favorable based on two reasons: First, the accomplishment criteria were based on the percentage of employees completing the modules (as opposed to the percentage of employees who correctly answered the test questions). Second, the method of participating in Option I (paper-based or e-learning module questionnaires) made it easily accessible, especially compared to the multistep process involved in Option III.

Option III likely presented companies with substantial challenges, perhaps explaining its low participation and accomplishment. As mentioned, Option III consisted of a multistep process for participation: confirmation of disease or vaccination among individual employees,

measurement of antibody titer, recommendation of vaccination, etc. Accomplishment for Option III relied heavily on employee cooperation, especially for those companies that do not provide on-site services. The burden for the employee and company might have been extremely high. Perhaps, the accomplishment criteria (90% of employees with antibody) were too high, especially for large companies. Most companies that accomplished Option III had <10 employees. Compared to those that did not accomplish Option III, those that accomplished Option III were also more likely to accomplish Options I and II.

For Option II, developing BCPs against infectious diseases required internal agreement and collaboration among multiple departments within the company, which might explain the limited progress of BCP development.

At this point, we have yet to implement a robust evaluation to document improvements in knowledge or prevention activities related to this project. However, it is reasonable to assume that most of these 226 companies were not engaged in active prevention of rubella prior to participating in this project. We also could not assess changes in these companies compared to non-participating companies and recognize that participating companies are likely different from non-participating companies in important ways (evidenced by their interest in participating in infectious disease prevention activities). Greater efforts need to focus on increasing participation in this project and evaluating its impact. We hope to evaluate the project by collecting information on employee knowledge of rubella prevention before and after participation and reporting vaccination coverage for target groups.

To our knowledge, no reports of similar initiatives of local governments supporting private companies to prevent rubella and other infectious diseases in the workplace have been published in Japan. However, occupational health and safety training at workplaces is generally considered effective for employees (13).

Through this project, we learned that the understanding of rubella among the participating working population was lower than that of influenza or norovirus. Although accomplishment of Option I cannot be interpreted as increased knowledge because the nature of the design of Option I did not allow conducting post-test assessment of knowledge, exposure to the information likely had beneficial effects on understanding. We must further improve understanding of rubella in order to increase vaccination uptake. Increased vaccination coverage is necessary to eliminate rubella, which is the best way to prevent rubella's most serious public health concern-CRS (14). Efforts to improve knowledge through continued effort to increase awareness must be strengthened through

initiatives like this one.

Moving forward, we believe this project could be improved in several ways: (i) increase participation by promoting this project through sharing of companies' experiences with accomplishment and engaging key stakeholders, such as health management advisors of the Tokyo Chamber of Commerce and Industry; (ii) encourage companies considering participation to begin with Option I, as it appears to be the easiest to accomplish and thus a beneficial first step; (iii) provide greater support to participating companies through public health nurse phone calls and visits, as we observed that some companies reached accomplishment with advice and support from public health nurses; and (iv) encourage companies participating in multiple options but struggling to accomplish any of them to instead focus on Option I and achieve more practical success.

With respect to the three options, we believe certain considerations are important for the continuation of the project. For Option I, the e-learning system introduced in 2016 automated the process and reduced paperwork, which seemed beneficial for both employees and management; thus, continued or increased availability of e-learning systems could further increase the number of companies accomplishing Option I. For Option II, briefing sessions concerning BCP development and site visits with support and technical assistance for BCPs should strengthen progress. For Option III, a quick and easy mechanism for companies to check employee history of vaccination and disease would facilitate accomplishment.

Under the national plan for the control and prevention of rubella (April 2014), Japan aims to eliminate rubella and achieve zero CRS cases by March 2020 (15,16). Since immunization policies for rubella have changed over time, antibody titer varies between male, female, and birth cohort populations (3,17,18), but many working-age men remain susceptible (19). Prior to the 2012–2013 epidemic, outbreaks of rubella had occurred in worksites in Hokkaido and Niigata in 2011 (20). This experience did not result in countermeasures targeting susceptible adult men during the epidemic. In 2015, the incidence of rubella decreased to pre-epidemic levels (19). We should not hesitate to take advantage of these non-epidemic conditions to improve countermeasures for susceptible people, especially working-age individuals, before the next epidemic.

In addition to the beneficial effects it may have had on the health of employees and companies, this project has improved our understanding of the interest in and awareness of rubella in the working environment and tested initial steps for preventing rubella in the workplace. Such knowledge and experience are essential for planning the next steps to suppress transmission in the workplace; prevent outbreaks, epidemics, and CRS; and propel Japan toward rubella elimination.

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