The Role of Community Hospital Pediatric Departments in Counter Measures for Measles Epidemics at Olympic Game Sites

**Running title:** Measles Epidemics at Olympic Game Sites

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Abstract

Background: In preparation for the 2020 Tokyo Olympic/Paralympic Games, the Japanese government assessed the risks of infectious disease outbreaks and determined necessary preparations. This present study reviews efforts made during a previous measles epidemic and describes the roles of hospitals.

Methods: This descriptive study investigated the records of 198 children with measles. Each child was treated at a general hospital January 1997 and February 1998. The study also examined the actions of pediatricians during and after the measles outbreak in the community.

Results: Of the 198 children, 145 (73%) were hospitalized. The measles vaccination rate in the previous year was approximately 75%. Of the patients examined, 53% were below two years of age. The mean age was two years and nine months. Pneumonia and gastroenteritis accounted for 46% and 30% of the complications, respectively. Issues requiring attention included the number of hospital beds located in a negative pressure room or a private room with a window, obtaining gamma globulin preparation with a high measles antibody titer, increased vaccination opportunities, and extended working hours for doctors.
Conclusions: Measles outbreaks are possible in Japan as a result of visitors from abroad. Items to mitigate an outbreak were identified as maintenance of high vaccination rates, readily available information regarding the location of negative pressure hospital rooms, the status of measles development, and finally medical staffing issues. There is a continued risk of measles outbreaks occurring in infants and individuals who do not have a measles antibody titer.

Key words: measles, epidemics, role, hospital, disease outbreaks
Introduction

During the 2020 Tokyo Olympics/Paralympics, there is concern about the introduction of infectious diseases including measles from abroad due to mass gathering. We faced the measles epidemic in the 1990s. Pediatricians are busy dealing with measles patients daily. The epidemic ended after three years. The low measles vaccination rate was one of the causes of the epidemic. During and after the epidemic, we worked to improve the coverage of the measles vaccine. Since the introduction of the two-dose schedule for the measles vaccine in 2006, measles outbreaks have decreased. There is a soccer stadium with a capacity of 41,800 in the area, which is home to a professional soccer team. The soccer stadium will be used at the 2020 Tokyo Olympics and Paralympics. Global visitors are expected.

The federal government appropriately assessed the risk of infectious diseases, while considering the circumstances of local governments. Based on the results, a number of necessary preparations have been identified, including the development of surveillance systems. However, no concrete measures were taken after the outbreak of measles. Responses to outbreaks of measles or other infectious diseases in hospitals where the outbreak often initiates, has historically been the responsibility of local governments.

Most pediatricians who were trained after 2006 have limited experience in treating
measles. Reports of the measles epidemic have been scattered until the 1990s. From the actual experience of the measles epidemic, we considered measures against the problems during the epidemic. By studying past measles countermeasures, they will gain the knowledge to prepare for the future. This paper is a descriptive epidemiological study. Measures against measles were listed from two perspectives: hospital pediatrician and administration.

**Materials and Methods**

The study subjects were 198 children with measles who were treated at Hakujuji General Hospital during a measles epidemic lasting from January 1997 to February 1998. Complications, resulting in the hospitalization of 145 children, included pneumonia, laryngitis, gastroenteritis, and otitis media. This research was a descriptive epidemiology study.

We examined the actions of pediatricians during and after the end of the measles outbreak in the community to formulate suggestions for coping with future outbreaks.

Hakujuji General Hospital, located in the area separated from the Chiba Prefecture by the Pacific Ocean and the Tone River, was one of the principle hospitals in Ibaraki Prefecture in 1997. The hospital had two full-time pediatricians, a 16-bed pediatrics ward, and an obstetrics department. A significant number of infants received medical checkups.
The hospital also had three rooms each containing four beds and four private rooms for inpatients. When there were more than 16 inpatients, beds on rooms on other floors were used temporarily. Each room had windows that could be opened and had installed air conditioning units. Heat was provided through a radiator in each room connected to a central heating system. Children with infectious diseases, such as pneumonia or acute gastroenteritis, were admitted in rooms separated from those with chronic illnesses, such as bronchial asthma or nephrotic syndrome. The closest hospital capable of child admissions was 30–40 km away.

The medical area served by the hospital included eight cities. In 1997, measles vaccinations were mostly done in groups, and the average vaccination rate in the district was about 70–80%. This study utilized anonymously processed information that had been prepared 20 years earlier; consequently, the study was not subject to the Ethical Guidelines for Medical and Health Research Involving Human Subjects.

**Results**

**Measles Epidemics**

Measles outbreaks were not uncommon in Japan during the 1990s. In the district studied here, outbreaks occurred in several nursery schools within the medical service
area. A number of hospitals designated by the prefecture, including the hospital reviewed in the present study, made regular reports to the prefecture regarding the number of patents examined for each type of infectious disease. The public health office probably monitored trends in measles outbreaks, but the hospital pediatricians did not receive any regular contact, as measles outbreaks were relatively common. The pediatrics department of each hospital provided medical care independent of each other during the measles outbreaks. The district containing the hospital examined in this study is separated from the neighboring prefecture by a large river. The measles epidemic information in the adjacent area that occurred six months ago did not reach us at the time\(^1\).

**Actual Patient Numbers**

The total numbers of patients examined between January 1997 and February 1998 are shown in Table 1. (Table 1) Overall, 73% of the examined patients were hospitalized. The measles vaccination rate was 75% the previous year. This vaccination rate was too low to prevent the epidemic. Most communities had group vaccinations, with individual vaccinations occurring in two locations. Vaccination coverage for infants approximately a year old was 0%. Despite obtaining a measles vaccination, a 12-year-old, a 13-year-old, and a 4-year-old child contracted the measles. Of the patients examined, 53% were under
two years of age (Table 2). The mean age was two years and nine months.

**Measles Complications**

Pneumonia and gastroenteritis accounted for 46% and 30% of the complications, respectively (Table 3). Oxygen was administered to four patients with pneumonia. One of the patients was below one year of age while three pneumonia patients and one laryngitis patients were one year old. Mechanical ventilation was performed for a patient who was one year old.

**Treatment during the Outbreak**

Measles spreads as an airborne infection, and consequently, rooms with windows and ventilation are necessary. Measles patients were treated in isolation. The outpatient examination room featured windows and was regularly ventilated with air exterior of the hospital. Hospitalized patients with measles are generally admitted to private rooms. However, at the height of the outbreak, there were insufficient private rooms; consequently, three rooms with four beds each were used. During the outbreak, general patients with diseases other than measles were admitted to private rooms and kept separate from patients with measles. The inpatient room windows were used for regular ventilation.

In many cases, intravenous gamma globulin was administered for serious infections.
Pharmacists ordered gamma globulin from production lots featuring high measles virus antibody titers. Pharmaceutical wholesalers searched for these high-titer gamma globulin in warehouses around the country and sent them to the study hospital. Each day in the outpatient clinic, one to three children received intramuscular gamma globulin. These children were siblings of children with measles. This was an effort to prevent the measles from spreading. Children who had not been vaccinated for measles were vaccinated in the outpatient clinic.

The vaccination of the city gradually transitioned from group vaccination to individual vaccination.

Handling after the Outbreak

In 2006, a two-dose schedule of the measles-rubella (MR) vaccine initiated in Japan. For five years starting in 2008, vaccination was performed during the teen years. In our district, at the suggestion of school nurses, doctors visited high schools and provided group vaccinations with the MR vaccine to students.

Doctors’ Daily Lives

The doctor’s working hours were extended during the outbreak. Two full-time pediatricians who lived on the hospital grounds worked every day. Previously, they received one weekday off per week. On weekends, the doctors worked in shifts. Many
children were brought to the hospital at night, and normal emergency care was provided daily, during the measles outbreak. When individuals are affected with measles, their antibody titers are maintained for a significant period. The attending physicians were afterward confirmed to have shown measles IgG (enzyme immunoassay) values of ≥100.

Discussion

International mass gatherings entail health risks which include infectious diseases. The definition of a mass gathering is “Events attended by a sufficient number of people to strain the planning and response resources of a community, state or nation.” The World Health Organization (WHO) has defined a mass gathering as a meeting of more than 2500 people. Measles outbreaks have been indicated by international travel. Measles outbreaks occurred at the Winter Olympics in 2010 and 2014. The Olympic participants risk importing disease to the host country. Risk assessment has been undertaken as a control measure for infectious diseases during the international mass gatherings.

At the 2020 Olympics, soccer matches are planned to be held in the region, where the significant measles outbreak described in this work occurred. Approximately, 40,000 people, many being international, are expected to visit the soccer venue. To minimize the probability of outbreaks of measles at mass gatherings such as the Olympics/Paralympics,
we propose actions described in the following sections.

Measles can be prevented with vaccination. Currently, the Japanese population receives the Measles Rubella (MR) vaccine twice after a child’s first birthday. The measles vaccination rate has risen from about 70–80%, the rate at which outbreaks have been observed, to about 90–100%, the rate at which outbreaks are unlikely. Measles is highly contagious, and infection leads to onset in almost all individuals who do not have an immunity. Today, there is still a risk of measles outbreaks in children less than a year old who have not received the MR vaccination. It is expected that future outbreaks will be different from those of the past because of the high vaccination rates among children. Residents or travelers returning from measles epidemics are often the epicenter of new measles epidemics. The measles vaccine provides lifelong immunity. Adults develop measles when the attenuation of measles antibodies occurs. This may cause a familial infection, especially in infants under one year old or children under the age of six who received a single dose of the measles vaccine. During outbreaks, the measles vaccine can be used in children as young as six months; however, after the first birthday, the measles vaccine is administered twice.

Two important issues: hospital acceptance, including human factors pertaining to the pediatrician's possible fatigue, and administrative issues, including the establishment of a
medical community network were discussed.

We examined the following: preparations previous to the outbreak, the initiation of
the epidemic, response post epidemic, doctors fatigue during the epidemic, and other
issues.

1. Hospital acceptance

Previously reported measles outbreaks and this study

Information on the measles epidemic was obtained from previous reports. The reports
on Table 4 are data obtained from the medical record retrospectively. The blanks signify
missing data. Table 4 indicates the measles symptoms manifested by patients. Statistical
analysis could not be performed due to the high percentage of missing data.

Until 2006, measles vaccination was administered during a child’s second year of life.
In areas of group vaccinations that were only given once a year, some children did not
complete measles vaccinations after their second birthday. Therefore, most measles
patients were infants approximately one year of age. The majority of these children were
not vaccinated and are susceptible during outbreaks (Table 4). Hospitalization is required
for patients who are children in the first year of life or suffer from pneumonia.

Education for patients and their families

Individuals need to review their vaccination history and confirm if they have been
vaccinated at least twice or had the measles. Even if measles can be eradicated in Japan, it would still be present in other countries, and thus, individuals need to protect themselves against measles with a two-dose vaccination schedule\(^2\). Individuals who do not have measles antibodies should be vaccinated before the Olympic games. Prevention of the outbreak and spread of measles is possible only when active vaccination is available. Measles vaccine shortages are anticipated during outbreaks; consequently, the population must be vaccinated before outbreaks.

Hospital facilities with depressurized rooms are limited, and home care rather than hospitalization is expected for measles cases without complications. With the increase in the prevalence of the nuclear family, assistance from grandparents is becoming difficult. Parents therefore must develop the habit of providing care when their child develops a fever in regular, daily life. Core hospitals have many patients, such as infants and pregnant women, who are at high risk of complications from the measles. Hospital visitors infected with the measles dramatically increase the risk of hospital infection.

**Education for healthcare professionals**

Doctors and medical staff who have no experience with the measles need to be informed in advance of measles complications and skin findings. Measles typically follows a course involving the prodromal, eruptive, and recovery phases. Early
differentiation is difficult, and when fever is observed in foreign patients or Japanese residents returning from abroad, they should be treated in a manner appropriate for a measles infected patient. This precaution should start at the hospital reception.

Providing information to doctors

During a measles outbreak, doctors are focused on medical treatment, and may not have sufficient time to gather information.

Measures post outbreak

Medical institutions established opportunities for vaccination on weekends, but as many students participate in sports club practice and games, and only a small number visited hospitals.

Doctors’ daily lives

In areas with a shortage of pediatricians, hospitals that accept inpatients were consolidated and pediatricians were reallocated. The number of pediatricians per hospital was increased and the occurrence on call decreased. Pediatricians’ overtime work decreased, and the quality of their lives were improved. Doctors were not typically obligated to work excessively during outbreaks of infectious disease.

Problems faced by hospitals

When many patients visit hospitals during measles outbreaks, hospitals become
locations where measles is transmitted to other children and infants.

In treating measles, rooms with windows that take in outside, ambient air are needed. Recently renovated hospitals have central air conditioning, but in many cases, do not have windows that can be opened for ventilation. To help prevent airborne infection at hospitals with central air conditioning, measles patients are treated only in negative pressure rooms. However, the number of negative pressure rooms is limited, and the number of facilities that can admit measles patients is less than before. The number of hospitals that can admit measles patients has also decreased with the reallocation of pediatricians.

Medical cooperation

There is a shortage of hospital beds where measles patients can be accepted in the community during measles outbreaks. Children with measles who have no complications are expected to rest at home. The roles fulfilled by pediatricians in private practice, such as providing explanations to families and making home visits, are important. The Olympics should be taken as a good opportunity to familiarize people with measles and measles vaccinations.

2. Administrative issues

Educate family at third birthday medical examination

Measles is a disease that can be prevented with vaccination. During medical checks
involving children aged three years in Japan, there generally is a confirmation regarding if the necessary vaccinations have been received. Strong encouragement for unvaccinated children to get vaccinated should be provided before they enter elementary school. However, vaccination is not compulsory. The act of refusing vaccination by a small number of parents is allowed, but there is always the risk of measles occurring if the refusal rate is above a threshold.

**Create a list of hospitals with negative pressure rooms**

To prevent the spread of the epidemic, containment is imperative. If there is a lack of facilities that can admit patients in an area where an outbreak occurs, then the distance from patients’ homes to hospitals increases. With this increase there is a concern that the outbreak area will become larger. With the cooperation of medical associations, prefectures need to prepare lists of hospitals within the prefecture where measles patients can be admitted.

**Providing information to doctors**

If public health offices start to receive epidemiological information, that information should be communicated in turn to hospital pediatricians.

**The measles epidemic initiation**

When measles outbreaks are seen in nursery schools, there is concern of onset in
children younger than one year. If the occurrence of measles is confirmed, the age of vaccination must be reduced. The initiation of vaccination with the measles vaccine is changed to six months after birth. Vaccination of unvaccinated adults is recommended.

**After the outbreak of measles**

After the two-dose schedule for the MR vaccine has started with individual inoculations, school nurses negotiated with the municipal government and created opportunities for group vaccinations at high schools within the city. As a result, the vaccination rate among high school students increased.

**Doctor’s daily lives**

With restrictions regarding working hours for doctors, the number of doctors who work irregular shifts will decrease. If doctors cannot assist temporarily at other hospitals, those hospitals will not be able to respond rapidly during measles outbreaks. Thus, there should be tolerance for the flexibility of physician labor.

Finally, the issues and their countermeasures are summarized in Table 5.

**Conclusions**

There is a possibility of a measles outbreak in Japan resulting from visitors arriving from other countries. Since a two-dose schedule was introduced for vaccination in Japan, measles outbreaks have decreased. There continues to be a risk of measles outbreaks...
occurring in infants less than a year old and in children and adults who do not have a measles antibody titer. Therefore, hospitals that treat measles patients should prepare specific action lists in advance based on known facts.

Conflicts of Interest: The authors declare that they have no conflicts of interest.

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Table 1: Area distribution of measles patients (from January 1997 to February 1998) and vaccination rate (1996)

| City | A  | B  | C  | D  | E  | F  | G  | H  | I  | J  | K  | Total | Average |
|------|----|----|----|----|----|----|----|----|----|----|----|-------|---------|
| Total No. of inpatients | 8  | 54 | 41 | 2  | 32 | 3  | 5  | 0  | 0  | 0  | 0  | 145   | -       |
| Total No. of patients examined | 10 | 82 | 55 | 2  | 40 | 4  | 5  | 0  | 0  | 0  | 0  | 198   | -       |
| Vaccination rate in 1996 (%) | 72 | 86 | 90 | 49 | 78 | 60 | 79 | 49 | 87 | 100 | 79 | -     | 75      |

| City | A  | B  | C  | D  | E  | F  | G  | H  | I  | J  | K  | Total | Average |
|------|----|----|----|----|----|----|----|----|----|----|----|-------|---------|
| Distance from our hospital to city hall (km) | 25.3 | 4.6 | 8.8 | 29.4 | 9.8 | 14.1 | 18.9 | 27.9 | 34.1 | 35.9 | 41.9 | -     | -       |
| Travel time (minutes) | 51 | 10 | 18 | 59 | 20 | 29 | 38 | 56 | 69 | 72 | 84 | -     | -       |
| The number of people at 1996 | 38,764 | 45,334 | 60,910 | 11,007 | 25,900 | 6,154 | 17,067 | 10,914 | 14,168 | 28,744 | 11,506 | 270,468 |
| 0-year-old population in 1996 | 435 | 572 | 670 | 77 | 262 | 42 | 103 | 97 | 126 | 275 | 113 | 2,770 |
| 1-year-old population in 1996 | 439 | 572 | 617 | 79 | 247 | 37 | 136 | 88 | 130 | 265 | 117 | 2,727 |
| 2-year-old population in 1996 | 473 | 543 | 645 | 94 | 283 | 45 | 117 | 75 | 140 | 258 | 98 | 2,771 |

a) Ibaraki Prefectural Government. https://www.pref.ibaraki.jp/kikaku/tokei/fukyu/tokei/betsu/jinko/jinko.html#jinko04
Table 2 Age distribution of examined patients (in years)

|     | <1  | 1   | 2   | 3   | 4   | ≥5  | ≥15 |
|-----|-----|-----|-----|-----|-----|-----|-----|
| %   | 16.5| 36.5| 11.5| 11.5| 3.5 | 19.5| 1.0 |
### Table 3: Age and complications (people)

| Age (years) | <1 | 1 | 2 | 3 | 4 | 5 | ≥6 | ≥12 | Total No. of people | Mean age (y, m) |
|-------------|----|---|---|---|---|---|----|-----|---------------------|-----------------|
| Pneumonia   | 20 | 35| 17| 11| 1 | 3 | 2  | 2   | 91                  | 2y1m ± 2y3m     |
| Laryngitis  | 3  | 12| 4 | 0 | 0 | 0 | 1  | 0   | 20                  | 1y4m ± 1y3m     |
| Gastroenteritis | 14 | 31| 6 | 2 | 1 | 0 | 3  | 3   | 60                  | 2y1m ± 2y8m     |
| Otitis media | 0  | 4 | 0 | 0 | 0 | 0 | 0  | 0   | 4                   | 1y0m            |
| Area          | Kashima/Namegata | Katori | Okinawa | Kawasaki | Kawasaki | Sukagawa | Kitaibaraki | Fukushima | Sano | Tomishiro | Tama |
|---------------|------------------|--------|---------|----------|----------|----------|-------------|-----------|------|-----------|------|
| Year of epidemic | 1997–1998       | 1996–1997 | 1998–1999 | 1998     | 2002–2003 | 2002     | 1984        | 1988      | 1990 |           |      |
| Epidemic duration | 2 year      | 5 months | 1 year | 3 months | 16 months | 8 months | 7 months   |           |      |           |      |
| Observation duration | 14 months  |          |         |          |          |          |             |           |      |           |      |
| No. of cases   | 198             | 220     | 2034    |          |          |          |             |           |      |           |      |
| No. of inpatients | 145          | 78      | 33      | 382      |          | 60       | 76          | 46        | 158  |           |      |
| No. of outpatients | 53          | 109     | 69      | 94       | 84       |          |             |           |      |           |      |
| No. <1 year of age | 32           | 47      | 21 (30.4%) | 21 | 104 (27.2%) | 4 | 14 (23%) | 28 | 25 (16%) | 43   |
| No. of vaccinations | 3           | 20/220 (5.5%) |          |          |          |          |             |           |      |           |      |
| No. of vaccinations <1 year of age | 0         |          |          |          |          |          |             |           |      |           |      |
| Deaths        | 1               | 8       | 1        | 2        | 0        | 4        |             |           |      | 34 (8.9%) | 224  |
| Family infections |            |          |          |          |          |          |             |           |      | 30 (86%)  |      |
| Complications Pneumonia | 91/198 | 36/78 | 19 |          | 39 | 65% | 70 (44.3%) |           |      |      |
| Croup         | 1/78            |        |         |          | 8        |          |             |           |      | 8         |      |
| Encephalitis  |                 |        |         |          |          | 3        |             |           |      | 3         |      |
| DIC           |                 |        |         |          |          |          |             |           |      | 3         |      |
| Otitis media  | 4/198           | 2/78   | 3       |          | 3        | 7%       |             |           |      | 2         |      |
| Urinary tract infection |          |          |          |          | 2        |          |             |           |      |           |      |
| Tonsillitis   |                 |        |         |          |          |          |             |           |      | 2         |      |
| Stomatitis    |                 |        |         |          |          |          |             |           |      | 2         |      |
| Febrile seizure | 6/78          |        |         |          | 7        |          |             |           |      |           |      |
| Laryngitis    | 20/198          |        |         |          |          |          |             |           |      |           |      |
| Gastroenteritis | 60/198       |        |         |          |          |          |             |           |      |           |      |
| City vaccination rate | 75% (mean) | 79% |          |          | 13.3–63.8% | 46–61% |             |           |      |           |      |
| Cited references | This study | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Cited references: This study 1 3 4 5 6 7 8 9 10 11
### Table 5: Problems and countermeasures for measles outbreak

#### 1. Before the outbreak

| Category       | Countermeasure                                                                 |
|----------------|--------------------------------------------------------------------------------|
| children       | Confirmation of the maternal and child health handbook at three years old child medical examination. Confirm the first MR vaccination and inoculation is recommended for non-vaccinated persons. Children who have not been vaccinated against measles at the time of elementary school. Vaccination is recommended for persons who are not affected by measles and who have not been vaccinated against measles twice as often as required. |
| Adults         | Persons who do not receive the MR vaccine due to religion or chronic illness. The risk of having someone nearby who may develop measles increase. Vaccination against the measles vaccine is a positive encouragement but not an obligation. Continue efforts to reduce measles unvaccinated. |
| School staffs  | Vaccination with measles vaccine or MR vaccine for adults who are not considered to have measles antibodies. Persons who do not receive the MR vaccine due to religion or chronic illness. The risk of having someone nearby who may develop measles increase. Vaccination against the measles vaccine is a positive encouragement but not an obligation. Continue efforts to reduce measles unvaccinated. |
| Hospital staffs| The history of measles is certain, or blood test shows positive measles antibody titer. |

#### 2. The measles epidemic initiation

| Category       | Countermeasure                                                                 |
|----------------|--------------------------------------------------------------------------------|
| Administrative works | Providing measles epidemic information to doctors working in hospitals. The need to contact doctors directly via email from the public health center. Identify areas where measles is endemic. Map the school districts where measles is prevalent. Preventing epidemics under the age of one. Temporarily change the start time of the measles vaccine from 6 months of age. |
| Hospital staffs | Visiting patients suspected of developing measles. Make sure that patients with suspected measles have a different place and time when they come to see them so that they do not come in contact with other patients. Confirm vaccination history for inpatients. Check maternal and child health handbook and interview survey with family. Prevention of nosocomial infection. Make sure that hospital staff have measles antibodies upon entry. Notification to the public health center and collection of samples. Cooperation with active epidemiological surveys at the public health center. Contact with a measles patient who has no or insufficient measles antibodies. Administration of measles vaccine within 72 hours or intramuscular immunoglobulin within 6 days. Increased intake opportunities for students and adults without measles antibodies. The evening or the weekend is available. Check for complications. Hospitalize patients with complications such as pneumonia, convulsions and encephalitis. |
| Pharmacists     | Securing MR vaccine. Securing gammaglobulin preparation for intramuscular injection. |

#### 3. The number of hospitalized patients exceeds the number of negative pressure room

| Category       | Countermeasure                                                                 |
|----------------|--------------------------------------------------------------------------------|
| Administrative works | There are several hospitals in the area. The designated hospital for infectious diseases will change to medical treatment centered on measles. Cooperation with active epidemiological surveys at the public health center. Staff other than doctors, such as medical secretaries, also participate because the doctors concentrate on medical care. Home recuperation for patients with mild symptoms. A practitioner visits the patient's home. Medical treatment of measles patients and medical treatment other than measles are performed in parallel. Change the location of the outpatient clinic. Eliminate contact between measles patients and measles susceptible. Admission to another hospital with negative pressure rooms. Moving to other areas may lead to the spread of infectious diseases. Hospitalized in a private room with ventilation. Lack of MR vaccine and intramuscular gammaglobulin preparations. At the request of the pharmacist, wholesalers gather from all over the country and deliver them to the hospital. |
| Hospital staffs | There are several hospitals in the area. The designated hospital for infectious diseases will change to medical treatment centered on measles. Cooperation with active epidemiological surveys at the public health center. Staff other than doctors, such as medical secretaries, also participate because the doctors concentrate on medical care. Home recuperation for patients with mild symptoms. A practitioner visits the patient's home. Medical treatment of measles patients and medical treatment other than measles are performed in parallel. Change the location of the outpatient clinic. Eliminate contact between measles patients and measles susceptible. Admission to another hospital with negative pressure rooms. Moving to other areas may lead to the spread of infectious diseases. Hospitalized in a private room with ventilation. |
| Pharmacists     | There are several hospitals in the area. The designated hospital for infectious diseases will change to medical treatment centered on measles. Cooperation with active epidemiological surveys at the public health center. Staff other than doctors, such as medical secretaries, also participate because the doctors concentrate on medical care. Home recuperation for patients with mild symptoms. A practitioner visits the patient's home. Medical treatment of measles patients and medical treatment other than measles are performed in parallel. Change the location of the outpatient clinic. Eliminate contact between measles patients and measles susceptible. Admission to another hospital with negative pressure rooms. Moving to other areas may lead to the spread of infectious diseases. Hospitalized in a private room with ventilation. |

#### 4. The number of inpatients exceeds the number of private rooms

| Category       | Countermeasure                                                                 |
|----------------|--------------------------------------------------------------------------------|
| Hospital staffs | Hospitalize measles patients in a large room. The room should have windows and be ventilated. Prevent nosocomial infections. Private rooms are used for patients other than measles. Bankruptcy of a doctor's life. Ask the relevant university to secure alternative doctors. The government allows doctors to work flexibly. |

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