

## Imported Measles Case Induced Hospital Outbreak in Taichung A Hospital, 2009

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### Abstract

On February 20, 2009, Hospital A in Taichung City reported an imported measles case. After following the cases of the 279 persons in contact, 2 cases of infection was discovered. After the Center for Research and Diagnostics confirmation, all three cases were diagnosed as confirmed cases of measles, with the same virus strain as H1 type. According to the investigation, the index case traveled with his parents to Hunan Province, China during the possible transmission period and was hospitalized twice there. Therefore, it is suspected that the origin of this incident came from China. The 2 contact cases that were infected were hospitalized at the time in Hospital A due to gastroenteritis and urinary tract infection. One of the contact cases was in the same room as the index case for thirty minutes

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whereas the other one were at the same emergency room and took the same vehicle when changing rooms. Therefore, this is an outbreak induced by an imported measles case. In order to prevent the spread of the disease and lower the number of vulnerable persons in Taiwan, the Centers for Disease Control has changed the MMR vaccine policy on April 1, 2009 to allow infants that are 12 months old to receive the first MMR vaccine shot in addition to elevating the average vaccine administration rate.

**Keywords: Measles, MMR vaccine, imported case, nosocomial infection, outbreak**

## Introduction

Measles is a highly contagious pathogen which is mostly spread through airborne transmission, droplet transmission, or through direct contact with infected persons' nasal or throat secretions. The incubation period is 7-18 days with the main symptoms being coughing, rhinitis, conjunctivitis, high fever, Koplik spots, and rash that start from the head and neck which eventually spreads to the torso and limbs. In severe cases, the patient may also become infected with otitis media, pneumonia, or encephalitis [1]. The most economic and effective way of preventing the disease is through vaccine.

As of 1991, Taiwan has aggressively promoted the "Polio, Measles, Congenital Rubella Syndrome, and Neonatal Tetanus Eradication Programs" first to fourth stage [2]. As of 1990, apart from the years 1994, 2002, and 2008, measles cases were controlled to 10 or less confirmed cases per year. According to data analysis, 49.4% (38/77) of the confirmed cases of measles from 2000 to 2008 were determined to be foreign intrusion coming from neighboring countries which have high measles incidence rates. Most

of these were from China, followed by those from Japan [3]. Therefore, eradicating imported measles infections is Taiwan's main step in moving towards WHO goal of eradicating measles permanently before 2010.

On February 20, 2009, Hospital A in Taichung City reported a suspected imported measles case. During the investigation (February 24~26) health officials discovered there were two young children who also showed measles symptoms during their stay at the same hospital; thus a suspected measles outbreak. The Third Branch of Centers for Disease Control (CDC) and the local health administration sent health officials to investigate the outbreak and prevent it from spreading further. The purpose of the investigation is to determine the source of infection, estimate the scale of the outbreak, and to assess the relative preventive measures for future reference in similar incidents.

## **Materials and methods**

**Investigated subjects:** The investigated subjects in this investigation include the reported measles cases and persons who contact with the infected person within the incubation period. Those persons that were possibly in contact with the infected case are the family members, passengers on the same flight, or persons in the same hospital. Among these, the focused groups are the passengers aboard the same flight as the index case who were sitting two rows in front of and behind the infected person. Those who came in contact with the index case within the hospital were investigated according to whether they were in the same ward 30 minutes prior to the arrival of the index case or two hours after, along with the index case's family members, doctors, and medical staff personnel. In addition,



if the index case and other confirmed cases were hospitalized during the transmission period, the other patients of the same ward, family members, and medical staff personnel (including doctors, nurses, X-ray technicians, and medical technicians) are considered as investigation subjects.

The CDC has also filtered those investigated subjects according to the NIIS data system of those with MMR vaccine records. However, none were found and thus further follow-up of intramuscular immune globulin (IMIG), mumps, measles, and measles-mumps-rubella (MMR) vaccines were administered.

**Principle of those in contact receiving vaccine:** the principles of those who did not receive the MMR vaccine are as following. Those under one year of age, if exposed for 6 days or less are to be evaluated as to whether they need to receive IMIG or not. Those 1-6 years of age need to receive the MMR again, whereas those 7-32 years of age with no or incomplete data in the NIIS database, after inquiry as to whether or not there were in contact with infected persons in the past, are required to receive the MMR vaccine. Those 33 years old or older, and according to serum epidemiology investigation, have a 90% of already having the current generation of antibodies [4] and only need health education and self management.

**Investigation trace period:** the possible infection time period is calculated. The calculation principle of the trace time period is 7-21 days before rash appears. Possible transmission time is 4 days after the appearance of rash. The ending trace time for those in contact is 4 days after the index case has shown rash plus 18 days (latent period). The outbreak termination date is the latent period x 2 days (28 days).

**Sample collecting and laboratory testing:** for those cases and in contact that showed suspected measles symptoms, throat swabs, whole blood (including Sodium citrate), serum, and urine samples were taken and sent to the CDC for measles virus cultivation, separations, and serum atom analysis.

The culture used the B95a cell strain. The serum tests used the Enzygnost Anti-Masern-Virus / IgM & Enzygnost Anti-Masern-Virus/IgG, Dade Behring, Marburg, Germany to test for the IgM and IgG antibodies within the patient's blood. The bio-atom tests were to separate the virus strain or the other samples which were confirmed but not separated (throat swabs and urine). After extracting RNA, MV64 and MV59 as catalysts, RT-PCR was increased with nest-PCR increased with MV60 and MV63. 580pbs matter was produced and analyzed with ABI377.

A total of 4 throat swabs, 3 whole blood samples, 3 urine samples, and 3 serum samples were collected in this investigation.

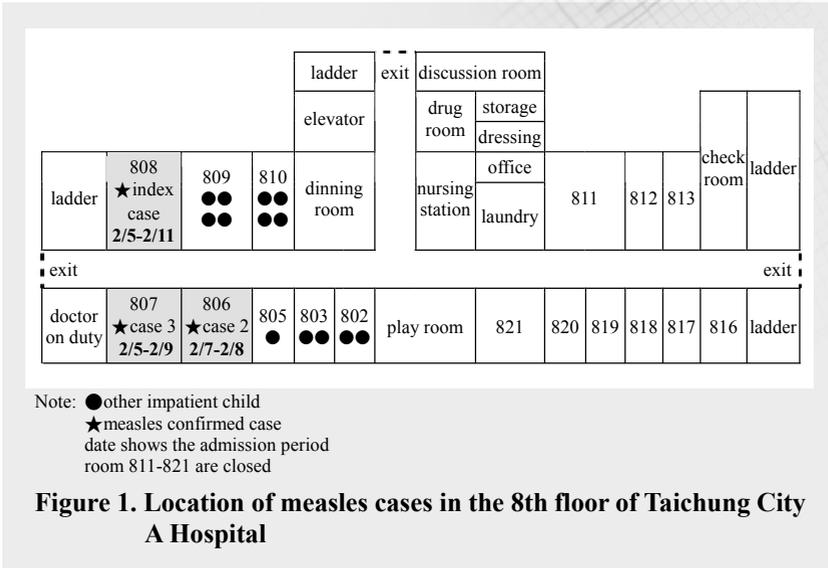
## **Results**

**Historical data of the emergency room and pediatric ward of A Hospital:** the pediatric emergency room includes the assessment area and the therapy area, with a total of 12 beds and 8 staff personnel (with 96 persons taking shifts). In this incident, 3 of the confirmed cases were staying in the pediatric ward (Second hospital building, 8th floor) at the time. The ward includes single bed rooms, double bed rooms, and four bed rooms, with a total of 17 rooms. During February of 2009, only eight rooms were in use (rooms 802 through 810, excluding 804). The play room is provided for the family members and the patients to rest and



socialize. There are 6 staff personnel.

**Case investigation: index case:** On February 5, 2009, a patient (a male child) that was transferred from China was reported as a confirmed measles case (IgM positive, IgC positive) by the CDC Center for Research and Diagnostics and is the index case in this investigation. The boy is 15 months old, lives in the North Section of Taichung City, has no MMR vaccine history, and is taken care of by his Chinese-nationality mother. The mother had never contracted measles and has no clear history of ever receiving the MMR vaccine. According to investigation, the index case and his parents went to visit relatives in Hunan Province on December 18, 2008 and were hospitalized at one Hospital in Hunan Province during January 16 to 21, 2009 due to acute gastroenteritis. Five days after leaving the hospital, the case started to show symptoms of fever, coughing, and vomiting and was hospitalized again during January 27 to February 4. The diagnosis was acute bronchitis and pneumonia. As of February 5, the case did not show improvement and the father decided to bring the case back to Taiwan for further treatment. On that day, at 8 p.m. they took the Cathay Airlines' CX348 flight back to Taiwan. On the morning of February 6, the case was showing symptoms of fever and coughing and was taken to Taichung City A Hospital Emergency Room by his relatives. After examinations, the case was hospitalized in the Second Hospital Building on the eighth floor (pediatric ward), in room 808 (Figure 1). On February 7, the case started to show rash. On February 11, the case showed improvement and was released. On February 20, the case was tested positive for IgM and was reported as a suspected measles case.



After he was reported, CDC started to conduct the list of possible contacts between the transmission period (February 3rd to 11th) with health officials contacting and tracing the contacts. A total of 140 persons were found with 2 index case’s family members, 21 passengers on the same flight who were sitting in the front and back 2 rows of the case (14 Taiwanese passengers and 7 foreign passengers), 54 A Hospital staff personnel, and 63 A Hospital patients. After screening using the NIIS information system, 88 of these persons had no MMR vaccine history, and were listed as traced subjects. The age and following preventive vaccines administration of these 88 persons can be seen in Figure 2, with a traced completion rate of 97.7% (86/88) (Table 1).

**Case 2:** The Taichung County Public Health Bureau found after investigation on February 24 that a case in contact started to show suspected measles symptoms on February 22. In order to prevent further



transmission, health officials contacted A Hospital's infection control personnel immediately and arrange the hospital's treatment assembly in order for the case to receive medical attention immediately and be arranged in a quarantined hospital room. On February 26, the tests results from the CDC Research and Diagnostic Center showed positive for measles (positive IgM, negative IgC) and case 2 was confirmed.

After investigation, case 2 is confirmed to be a 16 month old female child who lives in Tanzih Township, Taichung County and has not received the MMR vaccine yet. Her main caregivers were her grandparents during the day and parents during the night. The case was sent to A Hospital for treatment by family members after starting to show symptoms of diarrhea and dehydration on the 7th of February. The case was first admitted into room 808 of the pediatric ward on the eighth floor of the Second Hospital Building and was transferred to room 806 30 minutes after, allowing the case to be in the same room as the index case for 30 minutes. The case was released on February 8 after showing signs of improvement. Nine days after release, the case started to show symptoms of coughing. After the case started to fever on the 20th of February, the family members took the case to A Clinic where she was diagnosed with the common cold. On the 22nd, the case started showing high fever and rash and was taken to B Clinic for treatment. On the morning of February 23, the case was taken to C Clinic when showing no signs of improvement. On the same night, the case was sent to A Hospital Pediatric Emergency Care Unit where she was diagnosed with the common cold and thrush infection. Only until the tracing of the measles case by the health officials did the case become a highly-suspected case of measles and then immediately quarantined.

The contacts within the transmission period of Case 2 (February 18~26) include 8 family members, the 87 patients and staff members of clinic A, B, and C, and the 121 patients and staff members of A Hospital, totaling up to 216 people. After NIIS screening for those MMR vaccine reception, 100 had already received the vaccine, whereas 116 had no record and are listed as trace subjects. The age span and follow-up can be seen on Figure 2 with a trace completion rate of 100% (116/116) (Table 1).

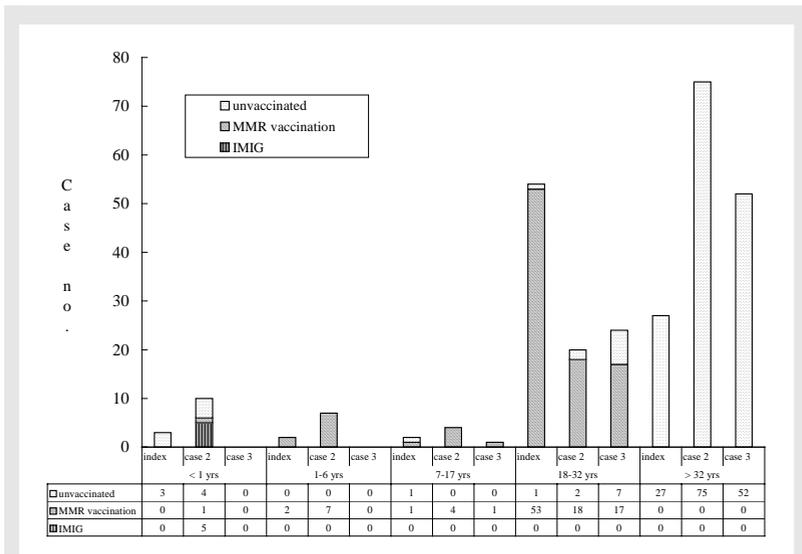
**Case 3:** The Taichung City Public Health Bureau investigation discovered on February 26 that another contact case started to show rash on February 17. After control officials required that the family members take the case to A Hospital for assessment. The diagnosis was that the transmission period had already passes (February 13~21) and therefore did not quarantine the case and sent the case home for rest. On the 27th of February, the CDC Research and Testing Center test results of this case turned out to be positive for measles (IgM positive, IgG positive) and is listed as Case 3.

After investigation, Case 3 is a nine-month old male child who lives in Situn District, Taichung City, is not of MMR vaccine age, and lives with his grandfather and father. At approximately 10 p.m. on February 5, the case was taken to A Hospital Emergency Room due to a urinary tract infection and was treated in the same room as the index case. At approximately 2 a.m. of February 6, the two cases were transported to the pediatric ward in the same transportation vehicle. Case 3 was arranged for room 807 and was released on February 9 with improving symptoms. Seven days after release, Case 3 started to show symptoms of fever and runny nose and was taken to D Clinic for treatment. On the 17th, the case



started to show rash and reddened eyes. The symptoms did not improve during the period between February 18 and 25 and the case was taken to clinics D, E, and F six times until the health officials contacted the case on February 26 when tracing suspected contact cases. Only until then were samples taken and sent for testing.

The contacts within the transmission period of Case 3 include 4 family members, 93 patients and staff members of clinics D, E, and F, totaling to 97 persons. After NIIS screening for MMR vaccine history, 20 were found to have received the vaccine whereas 77 were to be traced. The ages of the traced subjects and follow-up vaccine administration can be seen on Figure 2, with a trace completion of 100% (77/77) (Table 1).



**Figure 2. MMR vaccination, IMIG, and unvaccination status for contacts of measles cases in 2009 measles outbreak in Taichung City A Hospital (8th Floor)**

**Table 1. Tracing of contacts in 2009 measles outbreak in Taichung City A Hospital**

Case	Total				Contract Tracing by Age Group									
	Investigation No.	Must Contact No.	Completion No.	Completion Rate (%)	< 1 yrs		1-6 yrs		7-17 yrs		18-32 yrs		> 32 yrs	
					Must Contact No.	Completion Rate (%)	Must Contact No.	Completion Rate (%)	Must Contact No.	Completion Rate (%)	Must Contact No.	Completion Rate (%)	Must Contact No.	Completion Rate (%)
Index Case	140	88	86	97.7	3	100.0	2	100.0	2	100.0	54	100.0	27	100.0
Case 2	216	116	116	100.0	10	100.0	7	100.0	4	100.0	20	100.0	75	100.0
Case 3	97	77	77	100.0	0	0.0	0	0.0	1	100.0	24	100.0	52	100.0
Total	453	281	279	99.3	13	100	9	100.0	7	100.0	98	100.0	154	98.7

**Laboratory test results:** The test results of this investigation from the throat swabs and urine samples showed negative after culture. Of the whole blood and serum samples, one had positive IgM and IgC negative; the second had positive IgM and IgC; the third had IgM negative and IgC positive. Due to the fact that the three serum samples were collected from the 3 confirmed measles cases. No strains of the pathogen were found after throat swab and urine sample cultures, thus the RT-PCR tests and gene order tests were conducted. The analysis results show that all three cases of measles had the same gene strain-H1, which is the strain that is commonly found in China [5].

**Infection source speculation:** According to the disease latent period calculation, the index case may have contracted the disease between January 20 and 30. During this time, the index case was visiting relatives in Hunan Province, China with his parents and was hospitalized because of acute gastroenteritis, acute bronchitis, and pneumonia. Therefore, this



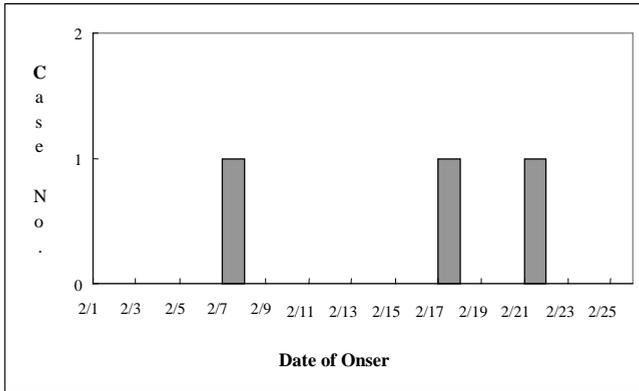
outbreak origin may very possibly be in China. In addition, we can also come to the same conclusion based on the fact that all three case test results showed that same strain of pathogen as of those commonly found in China.

**Epidemiologic analysis:** After a measles case was reported on February 20, through investigation of 453 contacts, and tracing of 279 contacts, 2 cases were found to have contracted the disease, with a total of 3 confirmed cases. The ages of the confirmed cases are nine months old to 16 months old, with 2 males and 1 female, all of which have not received MMR vaccine. This can be seen on the curve chart Figure 3. According to the contact history and the appearance of the disease (Figure 4), the three confirmed cases are epidemiologically related. In addition, all three sample tests show that the pathogen strain were type H1. Whether it is the epidemiologic investigation results or the laboratory statistics, they both prove that this incident is an outbreak. In addition, due to the fact that the index case transmission source was from China, and that the contacts were in the same hospital emergency room and ward, we can conclude that this is a foreign invasive measles outbreak.

In this incident, the trace completion rate was 99.3% with the reception of vaccine rate as high as 85% in each age span. Among these, 5 contacts under the age of 1 were evaluated and administered with IMIG within 6 days of contact. The remaining 102 subjects between the ages of 1-32 were arranged to receive the MMR vaccine. All of the 37 staff members of A Hospital in Taichung City received the MMR before February 28.

The last case that occurred in this incident appeared on February 20.

After no new cases appeared within the following 28 days, the outbreak was terminated on March 20.



**Figure 3. Distribution of onset dates of measles cases in Taichung City A Hospital, 2009**

Case	Age (month)	Period	January							February															
			16	18	20	22	24	26	28	30	1	3	5	7	9	11	13	15	17	19	21	23	25	27	
index case	15	possible transmission	Hunan, China							Taiwan															
		transmission																							
		hospitalization																							
case 2	16	possible transmission																							
		transmission																							
		hospitalization																							
case 3	9	possible transmission																							
		transmission																							
		hospitalization																							

Note: A-F indicates outpatient clinics

**Figure 4. Corresponding transmission periods and dates for 2009 Taichung City A Hospital measles outbreak**



## Discussion

According to references, many measles outbreaks that have happened in hospitals usually lead to members of the medical staff being contracted with the disease. For example, a measles outbreak in A Hospital emergency room in Holand 2008 resulted in 3 medical personnel being transmitted with the disease [6]. In 2003, an outbreak of measles from Nepal occurred in A Hospital in Sydney, Australia. At the time, 2 of the 9 confirmed cases were emergency medical personnel [7]. This shows that emergency medical personnel are under high-risk of contracting measles. In this incident, none of the medical personnel in Taichung City A Hospital contracted the disease when dealing with a measles patient. This may be due to the fact that the 37 staff personnel in contact with the disease had done a good job of preventing contamination and cooperating with the preventive measures in receiving the MMR vaccine before February 28. In addition the hospital held a hospital infection meeting on the 24<sup>th</sup> after receiving the confirmation of a confirmed measles case on the 23<sup>rd</sup> of February in taking the needed precautionary measures such as providing the contacts list of the persons in the hospital for further tracing, providing more door security, emergency room and hospitalization security images, inquiring the travel history, vaccine reception, suspected measles symptoms, and screening suspicious cases of patients under the age of six, and making cough etiquette posters to control the outbreak within the hospital and protecting the medical staff.

In the last two decades, the number of measles case has lowered; thus resulting in an increased number of young doctors who had no experience in diagnosing the disease. In addition, there has been no measles pandemic in Taiwan recently so that the doctors unable to suspect measles earlier. In

this incident, the doctors of the 3 confirmed cases did not suspect measles as the cause. In this case of foreign invasion where the case sought medical help in different places, increases the risk of a hospital outbreak. The habit of the people in walking around the hospital also increases the risk of community outbreak. Therefore, in order to prevent a similar measles outbreak in the future, the first thing is to notify the doctors of the current situation of foreign measles invasion in elevating their diagnosis awareness and educating the people of correct medical seeking procedures.

In addition, medical facilities and health facilities cooperation is the best method in preventing measles infection and controlling outbreaks. In this investigation, the medical facilities provided contacts list and the health officials conducted follow-up tracing. Once a suspected case is found, health officials contact the medical facilities in sending control officers to arrange for the treatment of the case and allowing the patient to enter the quarantine area as soon as possible in lowering the risk of allowing the case to come in contact with other patients. This collaboration between medical facilities and health facilities allows for the measles outbreak to be controlled quickly and to reduce the amount of medical and health resources used.

Due to the fact the confirmed measles cases add up to only a handful each year (according to the Health Department Vaccine Administration Consultant Committee), and that the MMR vaccine administration rate of children is maintained at over 95%, as of 2006, the Taiwan MMR vaccine administration policy has been revised from allowing children nine months of age to receive the first dosage to receiving it when 12-15 months of age. The second dosage is administered during the first year of elementary



school. However, due to the increased frequency of international contact in the past few years, foreign invasion cases of measles have increased. In respect to this situation, in order to lower the possible risk numbers and increase the vaccine rate, the policy has been revised as of April 1, 2009. The newest policy states that the age of the first dosage should be pushed forward to 12 months of age in order to prevent community contamination and reach the goal of eradicating measles.

Measles is a highly contagious pathogen and extremely contagious even before showing symptoms; thus it is difficult to stop contamination with only quarantining the index case. Currently, the MMR vaccine administration rate in Taiwan is 95% which makes the disease difficult to escalate to a pandemic. However, small outbreaks are still possible. Therefore, in facing WHO's goal to eradicate measles, the biggest task is in preventing foreign cases from entering. In order to protect the health of the people, the health facilities must persist in administering vaccine before people leave the country to travel or visit other countries and also in screening foreign workers and spouses before entering the country. The earlier the health facilities step in, the better the chances of preventing the disease. The execution of these preventive measures not only can be used in eradicating measles, but also in preventing respiratory viruses such as H5N1.

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