



Emergency Response and Policy Consideration on Measles Epidemics

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Abstract

Since November 2008, the number of imported measles cases has been increasing and leading to several epidemics among susceptible individuals seeking for medical services in different hospitals. Because its frequency and times have rarely been seen in history, these events have surprised and attracted much attention from governments and various sectors of society. To avoid it happening again, issues of clinical diagnosis, infection control, emergency response, and vaccination should be intensified and improved through the efforts of reminding clinical physicians of maintaining vigilance in case finding, enforcement of nosocomial infection control, fleshing out the standard measles control manual, and enforcing the follow-up and management of individuals in vaccination age and strengthening the exception management of vaccination. In addition, to reduce the risk of importing an

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infected case, to intensify the diagnosis and notification of suspect cases, to enhance quality of disease control, and to elevate herd immunity can also reduce the probability of occurring the similar epidemic. In the future, the government will continuously follow the international measles elimination strategy and agenda, to intensify surveillance, prevention, and control, so that the global elimination goals could be achieved earlier.

Keywords: measles, MMR vaccine, IMIg

Introduction

Measles is an acute, highly contagious disease, which the most effective prevention is through vaccination. However, vaccination coverage in a population is unlikely to reach 100%, and even vaccinated individuals can potentially get infected. Based on findings from previous researches, only about 92% of them will develop immunity after one shot of measles-mumps-rubella (MMR) vaccine and reaching about 95% after a second booster dose of vaccine. Therefore, World Health Organization (WHO) and its West Pacific Regional Office (WPRO) can merely set the measles elimination goals but not the eradication goals. This means that in a large geographical area we can only eliminate susceptible population to a very low level in number to sustain high herd immunity so as to effectively and continuously prevent the measles virus from spread [1,2].

Owing to the active implementation of the Poliomyelitis, Neonatal Tetanus, Congenital Rubella Syndrome and Measles Eradication Project and the commitment to it through various disease control measures by different levels of Taiwan governments in more than a decade, sporadic cases or cluster infections of measles have rarely been seen in recent years.



Nevertheless, Taiwan Centers for Disease Control (TCDC), in order to achieve the global goals of eradicating/eliminating the disease of poliomyelitis, neonatal tetanus, congenital rubella syndrome and measles, to protect the health and safety of our citizens, to assure the enforcement of diseases control measures, and to avoid the potential effects of the high turnover of personnel in charge of the control works for the eradication goals, have compiled Control Guideline and relevant Core Education Material, and conducted performance audit to the local governments.

Recently, several epidemics of measles cases highlighted the needs for improving clinician awareness on measles and the deficiency of emergency response capacity among healthcare workers. Although the overall coverage for measles vaccine is high in counties, to reach the measles elimination goals, high alert should be put on the occurrence of infections potentially caused by very small number of children failing to get vaccination. To fulfill our international obligation and to reach the measles, neonatal tetanus, and congenital rubella syndrome elimination goals earlier, we have reviewed our measles control strategies and proposed our suggestions on improving the strategies.

Epidemic Descriptions

Several epidemics of measles have occurred in southern, northern, and central Taiwan separately since November 2008. Source investigation and contact follow-up reveal four imported cases from China and Vietnam are responsible for these cluster infections. Up to March 25, 2009, 31 cases were identified to be related to the four cases, with the longest chain of transmission lasting about seven weeks up to now, being composed of

five waves of secondary epidemic (Table 1).

Table 1. Number of measles cases identified in each wave of secondary epidemic.

Year	Transmission chain	No. of cases	Country of origin of index cases (onset date)	No. of cases in each wave of secondary epidemic* (onset date of the last case in this wave)				
				1 st wave	2 nd wave	3 rd wave	4 th wave	5 th wave
2008	Hospital A in S. Taiwan	8	China (11/4)	2	1	1	1	2
	Hospital B in S. Taiwan			(11/15)	(11/20)	(12/2)	(12/16)	(12/23)
	Hospital C in S. Taiwan			1	1	7	1	1
2009	Hospital D in N. Taiwan	12	China (1/23)	(2/4)	(2/15)	(2/21)	(3/1)	(3/14)
	Hospital E in S. Taiwan	8	Vietnam (2/10)	5 (2/28)	1 (3/4)	1 (3/12)	-	-
	Hospital F in C. Taiwan	3	China (2/6)	2 (2/20)	-	-	-	-

* As compared with the onset date of index cases, cases with the difference of onset date less than six days was defined as the same infection source, within 7 to 14 days as the first wave, within 15-24 days as the second wave, then every ten days as a wave [4].

It is estimated that the four index cases have transmitted at least 21 children and 6 adults, aged between 8 months and 40 years (medium age: 18 months), with approximately 60% being male. Although all cases have appeared typical measles symptoms, some of the cases, including four index cases infected abroad, either have not been diagnosed and reported at the first time or have been diagnosed as other diseases. Hence, these measles cases have not been isolated immediately and subsequently causing the spread of the measles cases through the interactivities at clinic setting, home, and school (Table 2). All cases were in mild symptoms and have recovered and been discharged from hospitals.

On investigation of measles vaccination record, we found that 12 infants were unvaccinated because of not reaching the age recommended



Table 2. Analysis of transmission route among measles cases in the epidemics

	No. of cases	Percentage
Gender		
Female	13	41.9
Male	18	58.1
With known infection sites		
Hospital	22	81.5
Wards	11	50.0
Emergency room	7	31.8
Wards & emergency room	3	13.6
Others	1	4.5
Clinics	1	3.7
Home	1	3.7
Children day-care center	2	7.4
With known transmission route		
Patient to patient	16	72.7
Patient to healthcare worker	2	9.1
Patient to hospital visitor	3	13.6
Healthcare worker to hospital visitor	1	4.5

Table 3. Vaccination status among measles cases in the epidemics

Year	Transmission chain	No. of cases	No. of cases under the recommended age for MMR vaccine (under 15 months of age)	No. of cases failing to receive MMR vaccine (months of vaccination delay)			No. of cases having received measles-containing vaccine		No. of cases of unvaccinated adults
				1 to 6 months	7 to 12 months	Over 12 months	infants	adults	
2008	Hospital A in S. Taiwan	8	3	1	0	3	0	0	1 ^c
	Hospital B in S. Taiwan								
	Hospital C in S. Taiwan								
2009	Hospital D in N. Taiwan	12	5	1	1	3	1 ^a	0	1 ^c
	Hospital E in S. Taiwan								
	Hospital F in C. Taiwan								
	Total	31	12	4	1	7	1	3	3
	Percentage	-	38.7	12.9	3.2	22.6	3.2	9.7	9.7

* Having received one shot for each of measles vaccine (MV) and MMR vaccine

** Having received MV in one of them, and reporting themselves having received one shot of MV or MMR vaccine in two of them

*** With unknown measles-containing vaccination record

for receiving MMR vaccine. An additional 12 (38.7%) infants failed to vaccinate in their age for vaccination. One infant and one adult (a physician) have received measles-related vaccine. Two adults (families of hospitalized patients) reported themselves having received one shot of measles-containing vaccine. Three adults have never received measles vaccine (Table 3).

Emergency Response

Since all the recent epidemics was caused by imported cases, which the frequencies and times occurred was higher than ever before, and the increasing number of secondary cases has become a challenge to the elimination Project. In order to deal with the epidemics and cool down the social panics, TCDC initiated a working group on February 22, 2009. This working group held meeting every day to update epidemic situation and discuss response strategies, which four-dimension strategy for epidemic control were established. Moreover, an Expert Consultation Meeting on Measles Epidemic Control was convened on March 4, 2009, to specify the implementation direction in each of the four dimensions. The summary of the four dimensions and their implementation directions are described as follow:

1. To strengthen the follow-up of contacts:

Health workers should be able to identify contacts at the first time and find out those of the contacts without the MMR vaccination record through the National Immunization Information System (NIIS), and then conduct health education, supplementary vaccination, and dissemination of post-exposure prevention measures for them, to promptly and effectively



decrease the number of susceptible contacts and to interrupt the occurrence and spread of infections. TCDC Branches were required to collect the data about these implementations from local health bureaus in their regions and report them to TCDC headquarter. In addition, TCDC is considering stocking extra measles vaccine for emergency use in epidemics.

2.To stop the transmission chain in hospital:

Every medical-related associations were required to inform their members of the necessity to improve the awareness in diagnoses of measles cases and reports of suspect cases and to validate the standard personal protective procedure during performing the medical practice. Healthcare workers, students receiving training in hospital, no matter the units they were staying, and disease control personnel without antibody were specifically recommended to receive MMR vaccine.

3.To intensify the management of individuals failing to receive vaccine and actively implement supplementary vaccination:

Children between one and preschool years of age and failing to receive MMR vaccine were considered as unusual individuals needed to be followed until they are vaccinated. The Ministry of Health will periodically inform County Governments of the progress of these implementations. Moreover, the proportion of individual unvaccinated and completeness of supplementary vaccination will be included into the indicators of the annual performance evaluation to local health bureau. Counties where epidemics occurred are required to complete the supplementary vaccination immediately. The meeting of Advisory Committee on Immunization Practices (ACIP) convened by Ministry of Health on March 25, 2009

has made the resolution to modify the age recommended for receiving MMR vaccine from 15 to 12 months of age.

4.To intensify the dissemination of prevention measures and the quarantine procedure to passengers arriving from Southeast Asia and China:

A health education sheet will be given to parents of infants and young children arriving from China and Southeast Asia. Moreover, dissemination on measles prevention will be conducted for businessman and their families frequently traveling between Taiwan and China. The data in the Information System of Self Health Management and Home Quarantine in Incoming Passengers and those in the NIIS will be cross-checked to identify the arrival date of the unvaccinated passengers for local health worker to conduct follow-up, health education, supplementary vaccination, and health monitoring. The meeting of ACIP on March 25, 2009 also resolved to vaccinate infant older than 6 months of age with measles vaccine when they are planning to have a trip to Southeast Asia and/or China.

As of March 20, 2009, an accumulated 2,349 of contacts accounted for more than 99% have been followed. Given that no measles cases were identified among contacts older than seven years of age during the period of health monitoring, the individual for follow-up have been narrowed down to infants and young children under preschool age starting from March 11, but putting our full power on health education and supplementary vaccination for this group. However, the routine supplementary vaccination still needs to be actively implemented during this period. Data from NIIS shows number of individual failing to receive MMR vaccine has decreased from



43,520 of February 23 to 33,000 of March 23, and the proportion of individual completing vaccination was enhanced from 96.6% to 97.5%.

Problem Analysis

1. When the measles epidemic in international community increased, the risk of importing cases increased.

The measles epidemics have occurred more frequently in recent years, for example, our neighboring countries such as China and Vietnam, and even some developed countries such as United Kingdom, Switzerland, Australia, and Japan were all having this epidemic. The surveillance data by TCDC show the number of imported cases is closely related to the severity of epidemic in other countries. For example, China is responsible for a relatively large number of imported cases, and then Japan. However, the situation is changed in this year, which three measles cases were imported from Vietnam, and this is more than those (two cases) imported from China (Table 4).

Table 4. Number of measles cases occurred during the period of 2002 and March 2009

Source Country	Number of Cases in the Same Onset Year								Total
	2002	2003	2004	2005	2006	2007	2008	2009/3/25	
Indigenous	18	1	0	6	1	0	9	26	61
Imported	6	5	0	1	3	10	7	5	37
China	5	1	0	0	3	5	5	2	21
Japan	0	1	0	0	0	4	1	0	6
Philippines	1	2	0	0	0	1	0	0	4
Vietnam	0	0	0	0	0	0	0	3	3
Thailand	0	1	0	0	0	0	1	0	2
German	0	0	0	1	0	0	0	0	1
Total	24	6	0	7	4	10	16	31	98

As the interaction with other countries became more frequent, the instance of importing cases from other countries will inevitably occur. Therefore, how to prevent imported cases from spreading in this country has become the focus in infectious disease control.

2.Cases should be detected as early as possible so that disease control can be conducted at the first time.

Three of the four index cases were identified during the epidemiologic investigation by health workers but not diagnosed or reported by physicians they visited for disease onset, identified with an elapse of more than two months after the date of onset in one of the three cases. Although another case of the four index cases was reported by physician, the report was not sent until a positive examination conducted by hospital itself came out, more than two weeks after the date of onset. Investigation revealed that all the four index cases ever appeared symptoms of measles infection during hospitalization. However, because they are not timely isolated, other susceptible patients visiting the same hospital were infected, leading to a spread of infection and nosocomial infection.

Because of the dedication to the eradication and elimination of poliomyelitis, neonatal tetanus, congenital rubella syndrome and measles, and having included measles-containing vaccine into the routine childhood vaccination schedule for a long time, measles cases have been rarely occurred in recent years. The measles cases definition for notification include symptoms of rash, fever, and cough, coryza, or conjunctivitis. However, the prodromal symptoms that appear before rash appears are not specific for measles, adding that rare measles cases occurred recently in Taiwan, the diagnosis of measles cases is substantially more difficult.



If physicians can ask patients for a detailed travel history and contact history and be aware of the occurrence of epidemic, the diagnoses and notification of the measles-related disease would be improved.

3. Nosocomial infection control should be intensified so that the occurrence of epidemics could be eliminated.

Although the measles-containing vaccine coverage is high in Taiwan, because of the re-emerging of measles cases in many countries and the imported cases occurred at one time or another, the risk of occurrence of epidemic in hospital where susceptible individuals are gathering is increased. Except that the unvaccinated infants and young children are high risk groups, unprotective adults can also be infected. For example, six of the measles cases occurred in recent epidemic are adults between 20 to 40 years of age, including two healthcare workers and four patient's families, except infant cases. The epidemic caused by nosocomial infection has been reported in many countries around the world such as Switzerland [5], Dane [6], and Italy [7] in 2008. If the nosocomial infection can not be well controlled, the infection may even spread to local communities.

Previous reports show the proportion of measles cases acquired in hospitals will increase when the vaccine coverage is enhanced. This means that high coverage rate in a community may prevent community from large scale epidemic, while the hospital where individuals with low protection such as children are gathering will become vulnerable to occur epidemic [8]. A national nosocomial infection survey conducted in United States during 1980 and 1984 reported that the proportion of measles cases acquired in hospital increased from 0.5% to 3% of total

measles cases. The largest parts of the hospital-acquired cases are patient in the hospital, especially infants less than the age recommended for receiving vaccine [9]. A small-scale survey conducted in France also found that hospital-acquired measles cases tended to have a higher rate of various complications, as compared with community-acquired cases [10]. A research conducted in South Africa indicated that hospital-acquired cases have a higher death rate among the measles cases admitted to the intensive-care unit [11]. Although these studies did not describe or analyze the factors potentially affecting the prognosis, the importance of these finding should not be overlooked.

Healthcare workers are often exposed in an environment with various highly infectious pathogens during the process of medical care delivery. If personal protective measures or infection control procedures is not appropriately performed, they may not only put themselves at risk of infection but can be a spreader of the pathogens. Studies cited in previous paragraph indicated that healthcare workers with a frequent contact with patients are also a high risk group for infection. Moreover, a large amount of patients' relatives and friends can be incidentally infected when they did not have immunity and visited emergency room, clinic room, or wards without appropriate personal protection. All these instances potentially occurred in hospital highlights the importance of infection control.

4.The standard epidemiology investigation and disease control procedure should be administered actually for closely tracking the epidemic situation.

Taking the epidemic occurred in Southern Taiwan in 2008 as an



example, although the first case (a male children) and the second case (a nurse working for the children) were notified to local health bureau on December 26 and 31, 2008, respectively, but the investigation conducted by local health workers only focus on a very limited number of contacts and health surveillance at that time, they did not identify the epidemiological association between the two cases. It was not until the two cases are laboratorily confirmed on January 8, 2009 that the local health workers, suggested by TCDC, conducted a large scale investigation about the transmissible period, high risk group, and close contacts in each of the site of hospitals, clinics, household, and education or daycare centers. The latter investigation clarified the whole picture of the epidemic and verified that the epidemic was caused by an imported case occurred in early November 2008 through the contact in hospital admission and household activity, finally leading to the occurrence of nosocomial infection in multiple hospitals.

The investigation found that, except that nine of the 24 infant cases infected in the four epidemics are younger than the recommended age for receiving vaccine, 15 of them have delayed the first shot of MMR vaccine in an elapse from one to several dozen months at the date of onset. This revealed that the track and supplementary vaccination for the children failing to vaccinate are not effectively enforced, giving the virus the opportunities to spread. Furthermore, local health bureau should have immediately examined the vaccination completeness of the children in epidemic areas and given unvaccinated children supplementary vaccination. However, taking the first epidemic occurred in hospital of Southern Taiwan as an example, local health bureau did not establish the schedule

and implementation goals for supplementary vaccination until January 16, 2009, revealing that the attention and vigilance of the health workers needed to be enhanced.

5. The contents of the epidemiological investigation form are not well designed, leading to the source investigation and disease control can not be efficiently conducted.

Currently, the epidemiological investigation was conducted based on the questionnaire in the Infectious Disease Investigation Information System (IDIIS). The questions in the questionnaire were designed for simultaneously using in several similar diseases. Some questions are not specific or detailed enough for some certain diseases, for example, they do not mention the length of period needed be tracked and the scope needed to be investigated for cases of specific disease, leading that local health workers have no documental basis in conducting the investigation of infection source and contacts. Some local health workers without sufficient knowledge and experience may not notice the importance of the information and fail to collect them, not to mention that the epidemiological investigation will be helpful to the infection source analysis and the later disease control. Therefore, the questions in the investigation form should be modified to be more specific and detailed, providing health workers with definite and concrete work directions.

In addition, some data input into the IDIIS are incorrect and unlogical, but the existing system is lacking of automatic checking function. These have been adversely affecting the work direction in conducting the later disease control.



6. Vaccine can not provide 100% protection, and the susceptible individuals are accumulatively increasing year by year.

MMR vaccine has been included into the routine childhood vaccination schedule in Taiwan since 1992, which recommends that one shot of MMR vaccine should be provided for children at 12 to 15 months of age and 7 years of age, respectively.

According to NIIS statistics, accumulatively, there are almost 3,600 children between one and preschool years of age having failed to receive MMR vaccine in Taiwan currently. Studies indicated that two shots of MMR vaccine can provide about 95% of protection. We, therefore, estimated that there are around 9,500 vaccinated children without vaccine-induced protection in one year when it is calculated by using the data of the number of births, 200 thousand per year, and the averaged coverage after first shot of MMR vaccine in recent three years, 95 to 96%. In other words, there are around 57,000 vaccinated children without vaccine-induced protection among the population between one year and preschool years of age. Totally, around 93,000 children are susceptible individual (including unvaccinated children and vaccinated children with vaccine failure) in the age group between one year and six years of age. In addition, because the antibody from the mother can be maintained only six to nine months after birth, a window period without protection will occur before the age recommended for receiving vaccine. Once measles virus is introduced into our community, the virus will spread rapidly in short period through the activities, such as seeking medical service, nursery care service, and relatives gathering, among susceptible individuals, leading to the occurrence of epidemic.

Problem-solving Recommendations

1. To enforce the follow-up and management of unvaccinated individual to eliminate risk of virus introduction

For the reasons that recent epidemics are all caused by imported cases and unvaccinated individuals traveling to epidemic countries or areas are high risk group potentially introducing virus into our community, the data in the Information System of Self Health Management and Home Quarantine in Incoming Passengers and those in the NIIS will be cross-checked to identify the arrival date of the unvaccinated passengers for local health worker to conduct follow-up, health education, supplementary vaccination, and health monitoring so as to decrease their risk of being infected and safeguard the safety of citizens from infectious disease. During the period of February 1 to March 18, 2009, 980 unvaccinated incoming children from one to preschool years of age have been identified and transferred to local health bureau for conducting supplementary vaccination. As of March 20, 2009, 312 of them have been completed for follow-up. This follow-up procedure will be added to the routine works of disease control. The meeting of ACIP on March 25, 2009, decided to vaccinate infant older than 6 months of age with measles vaccine when they are planning to have a trip to Southeast Asia and/or China, to decrease the risk of infection when abroad and virus introduction.

Because some incoming foreigners have become carrier of virus and frequently lead to an epidemic, starting from January 1, 2009, foreigners both male and female are required to submit certificate with information of positive antibody titers or vaccination record for measles



and German measles when they are applying for residence or citizen.

2. To alert clinical physicians to be vigilant in diagnosis and notification of suspect cases

In order to enhance the vigilance among physicians on measles infection, TCDC has officially required local governments to inform physicians in their regions of the measles epidemic and diagnosis. Also, TCDC has twice officially asked around ten medical groups and associations such as Taiwan Medical Association, Taiwan Pediatric Association, and Infectious Disease Society of Taiwan, etc., to inform physician members of keeping high vigilance on diagnosis and notification of suspect measles cases through the media of publications, activity notification letter, education and training activities, and seminars. At the same time, TCDC has also provided photos showing measles symptoms on its internet website and dissemination article through journal related to infection control, to give physicians sufficient information and to improve the diagnosis and notification of suspect measles cases so that the local health workers could conduct disease control efficiently.

According to existing measles cases definition for notification, a suspect case is defined as patient with symptoms of rash, fever, and cough, coryza, or conjunctivitis. Owing that some of the symptoms less specific, we are considering establishing additional criteria that patients with symptoms of fever and rash, without measles-containing vaccination history, and with travel history to measles epidemic areas also should be notified. Hopefully, this alternative will increase the sensitivity and specificity of measles surveillance and improve the rate of notification.

In the future, physicians working in TCDC will attend seminars and annual members meeting organized by the relevant Medication Associations to deliver lectures on issues of measles (German measles), to intensify case finding by disseminating the information of measles diagnosis and notification definition.

In addition, we are planning to amend the provisions of the 1st item, 6th Article of the Regulations Governing Awards for the Control of Communicable Diseases by adding measles to one of the diseases that persons who come forward to the competent authorities for testing and are verified as an imported or indigenous case by the competent authorities shall be issued a reporting bonus of NT\$ 2,500 per case.

3.To intensify nosocomial infection control to eliminate the probability of spread

Measles is a highly contagious disease, which is transmitted through airborne, respiratory droplets, and secretions of infected person. If suspect measles cases are not diagnosed before its communicable period and immediately isolated in the respiratory isolation room, the universal nosocomial infection control measures are insufficient in preventing the disease from spread, individuals never getting infection by measles virus or unvaccinated with measles-containing vaccine are potentially infected after exposure. Furthermore, measles virus may spread through susceptible individuals seeking medical service in the same hospital, leading to the occurrence of nosocomial infection.

To prevent measles from spread, except that the routine vaccination and supplementary vaccination of young children and the ability of physicians to appropriately diagnose need to be intensified, the protection



against disease should be ensured for clinical healthcare workers. Therefore, we suggest to add an additional requirements that clinical healthcare workers should receive antibody test (such as measles, German measles, and chickenpox, etc.) or vaccine (such as MMR vaccine and chickenpox vaccine, etc.) for some important diseases, in addition that the existing nosocomial infection control measures such as enforcement of standard infection control procedures, adherence to airborne infection control methods, and obedience of procedure for diagnoses and settlement of suspect cases should be followed. We believe this requirement will have substantial effects on reducing the risk of infection and disease spread. However, this suggestion involved the nosocomial infection control policy and vaccine policy, needed to be discussed and approved in the next Infection Control meeting and ACIP meeting.

4.To establish well-organized standard measles control guideline to elevate the quality of disease control

Because the number of cases of poliomyelitis, neonatal tetanus, congenital rubella syndrome and measles has largely declined in recent years and the turnover rate of personnel in TCDC Branches and local health bureaus is high, the health workers are commonly lack of experience, vigilance, and response capability in the control of these diseases.

In order to flesh out measles-related knowledge, to establish emergency response capability, and to construct concrete working principles for health workers in various level of health authorities, we will review the existing disease control guideline and refer to the experience of this country and foreign countries on disease control, to revise our epidemic response procedures and specify the focus and directions on epidemiologic

investigation as follows:

- (1) Travel history: The travel history to the epidemic areas during the period of probably having become infection (one to three weeks before rash), to speculate the source (country) of infection
- (2) Symptom development and seeking medical treatment activities
 - a. Length of each symptom during the disease course
 - b. History of visiting clinics or hospitals (including emergency room, clinic room, or wards) during transmissible period (four days before and after rash) and the period of probably having become infection, needed to specify the time period, date, clinic room, and medical unit of visiting
- (3) Activities and contacts in the sites other than hospitals such as home, school, daycare center, work place, and other place meeting with relatives during transmissible period and the period of probably having become infection, especially the activities of contacting with persons unvaccinated or having suspect symptoms
- (4) Vaccination history: date (country) of date

In addition, we have commenced our review and revision of the existing Manual of Standard Measles Control Procedures. The principles and processes administered in the recent epidemics and the focus and directions mentioned above will be included into this manual so that disease control actions could be rapidly motivated when epidemic occurred in the future.

In the future, the performance of local health worker in the epidemic control will be examined on the basis of case by case, and an improvement suggestion will be given when any faults in the control process were



found. When it is necessary, we may have somebody conduct an on-site examination to assure the quality of surveillance and control, to enforce the follow-up and management of patients, and to provide the record of working on disease elimination/eradication.

5.To intensify the follow-up of contacts, to enforce post-exposure prophylaxis, to decrease susceptible individuals

In order to stop the spread of measles epidemic, for any measles cases, we should use all possible approaches to identify all possible contacts of each case during his/her transmissible period, and list the name of all contacts for conducting health education and health surveillance. Once suspect measles cases appeared, local health workers should assist them to make arrangement for medical treatment, to decrease the risk of spread through hospitals.

In order to rapidly and effectively diminish the number of susceptible individuals, the Expert Consultation Meeting on Measles Epidemic Control convened on March 4, 2009 decided that contacts of measles cases should be treated in accordance with the principles as follows:

- (1)For contacts under one year of age (no minimum age required), the injection of intramuscular immunoglobulin (IMIG) could be administered within six days of exposure when they are evaluated by physician as being appropriate to do so. For contacts in this age group and receiving IMIG injection, a time interval of six months is required before they can receive MMR and chickenpox vaccine.
- (2)Contacts between one and thirty-two (born after September 1976) years of age and with an unknown history of infection and vaccination

should receive the first priority for MMR vaccine. For contacts under seven years of age and with contraindications to MMR vaccine, the IMIG could be administered only after they are carefully evaluated by physician as being appropriate to do so.

(3) To stock extra MMR vaccine for contacts between six and twelve months of age when it is necessary in response to epidemic.

6. To intensify exception management in vaccination practice to complete supplementary vaccination rapidly

To intensify vaccination practice is the key strategy in achieving the goals of measles elimination in international community. To minimize the number of individuals susceptible to measles rapidly, a large scale catch-up vaccination [12] is usually adopted for the age group with high risk of infection, to stop the spread of virus in a very short time. An example of adopting the strategy was a large scale measles vaccination conducted in Guangdong, China, during March and April 2009 for 23 millions of children between eight months and fourteen years of age in response to the rising number of measles cases and the incoming seasonal epidemic.

As compared with the 86% coverage of measles-containing vaccine (MCV) in China before 2006, the coverage rate after the first shot of MMR vaccine in cohort of children born during 2004-2006 in Taiwan has been maintaining over 96%, far higher than that in China. Since the proportion of susceptible individual in age group with high risk of infection is relatively lower in Taiwan, the probability of occurring large scale measles epidemic is supposed to be lower. In consideration of the limited resources and cost-benefit effects, the catch-up vaccination



strategy is unnecessary but the keep-up [12] strategy intending to maintain a high coverage rate of routine vaccination and mop-up [12] strategy for intensifying supplementary vaccination should be very important at the present time.

According to NIIS statistics, accumulatively, there are almost 35,604 children between one and preschool years of age having not received MMR vaccine in Taiwan currently. Because some of these children are traveling to China and South-east Asia frequently, the potential risk of occurring infection, cluster infection, or even epidemic still exists. In order to enhance the vaccination coverage, to effectively interrupt the transmission of virus, and to achieve the goals of measles elimination project, we have established the following principles of exception management for individuals failing to vaccinate.

(1)The age recommended for receiving routine MMR vaccination was revised from 12-15 months to 12 months of age. In every county, except that the regular supplementary vaccination should keep going as before, children between 15 months and preschool years of age should be considered as the focus population for exception management and should be followed until supplementary vaccination is completed. TCDC will periodically inform County Governments of the progress of these implementations. Moreover, the proportion of individual unvaccinated and the completeness of supplementary vaccination will be included into the indicators of the annual performance evaluation to local health bureau. Hopefully, the local government will put an emphasis more on these jobs.

(2)Once epidemic occurred, unvaccinated individuals between one and

preschool year of age in every county should be identified and be required to receive supplementary vaccination immediately.

- (3) The cooperation mechanism with social administration and police administration should be established to assist health worker to find out high risk individual and to conduct follow-up for intervention.

7. To evaluate existing vaccination policy to effectively elevate herd immunity

According to the resolution of ACIP meeting on June 29, 2005, nine months of age previously recommended for receiving first shot of MMR vaccine was changed to 12-15 months of age starting in January 2006, while the age for second shot of MMR vaccine was maintained at the first grade year of elementary school to conduct mass vaccination. The evidences based for this change were that the number of measles cases has been less than ten cases (including imported cases) for the previous ten years except 24 cases in 2004 because of epidemic, MMR vaccination coverage in young children has been maintained at over 95%, and the vaccination of the second shot of MMR vaccine has totally completed in cohort of children born after October 1990. This resolution also required that, under the new policy, the vaccination coverage of the first shot of MMR vaccine in every township would have to be elevated to over 95%. In addition, measles surveillance should be intensified and a serum epidemiological investigation in each age group should be conducted for exploring the impacts potentially caused by the new policy and for evaluating whether the second shot of MMR vaccine should be administered at an earlier age.

Meanwhile, the resolution also said that, for young children with



special reasons (such as study abroad, immigration, or residence in China), the vaccination of vaccine currently administered at the first grade year of elementary school such as Td, OPV, MMR, and JE, could be given earlier at the age of 4-6 years, to enhance herd immunity. (also reducing the work load of public health nurse and school nurse on the mass vaccination of children at the first grade year of elementary school)

According to the recommendations of WHO in 2001, the objectives of measles elimination plan is to reduce the numbers of susceptible individuals to a low level, to maintain high herd immunity, and to effectively and continuously interrupt the transmission of indigenous measles virus in large geographic areas, through the enforcement of routine vaccination program. The enforcement of routine vaccination program means that the vaccination coverage of first shot of MMR vaccine is over 95% and the second opportunity for measles vaccination is provided for all children. The overall vaccination coverage of MMR vaccine in Taiwan has currently reached 95%. Specifically, we hope that the vaccination coverage of first shot of MMR vaccine in every township could reach the goal of over 90%. Of course, these coverage should be reached under the conditions of a well operated cold chain system for assuring vaccine quality and vaccine efficiency.

An extra MMR vaccine will be stocked for young children over six months of age and planning to travel to measles epidemic areas, China and Southeast Asia, and for contacts between six and twelve months of age in epidemic, when it is necessary.

Conclusion

Measles has become the next target for global eradication after polio. We believe that the epidemic events frequently occurred in domestic and abroad recently have surprised, and attracted much attention from, various sectors of society. Moreover, these events have accelerated government to thoroughly review the existing policy and correct possible deficiency, and further to intensify emergency response mechanism and consolidate disease control system. In the future, the government will continuously follow the international measles elimination strategy and agenda, to intensify surveillance, prevention, and control, so that the global elimination goals could be achieved earlier.

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