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Original Article

Prevention and Control of Enterovirus Infection in Taiwan, 2011-2012

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Abstract

Enterovirus (EV) infection is a seasonal infectious disease in Taiwan. Among the enteroviruses, EV 71 is the major type of virus causing severe complications in EV cases. The EV71 epidemic cycle usually occurred during two to four years. The latest EV71 epidemic occurred in 2008 with a total of 373 severe cases and 14 deaths. Due to the accumulation of susceptible hosts, the activities of EV71 increased obviously in late autumn of 2011, leading to 59 cases with severe complications, including 4 deaths. The EV71 outbreak in 2011 persisted and reached its peak in mid-June 2012 and then descending, with a total of 153 severe cases, including 2 deaths. The fatality rate of severe cases in 2012 was 1.3%, the lowest in the epidemic history of EV71.

Learning from the experience in control of EV71 epidemic in 2008, we have initiated control activities in advance in three major dimensions, including public health, healthcare, and organizational mobilization systems, since the second half of 2011 when we were given the epidemic early warning. These activities include to use various surveillance systems to closely monitor the epidemic trend of EV infections, to early initiate and actively enforce effective control measures, to use the Self-inspection Checklist to fully implement control practices in schools or childcare centers, to strengthen cooperation with education and social welfare authorities, to extend relevant control activities to the sites where young children visit frequently, to develop various dissemination materials for multiple media channels to elevate accessibility of information on control of EV infection, to strengthen health education for caregivers of young children about caring for sick child, to establish platform for communication and cooperation between responsible hospitals for providing services of patients infected with EV so as to promote exchange of specialized medical knowledge and clinical technology and to enhance the efficiency patient transfer system, to strengthen cooperation of cross-ministries and with specialists and healthcare system, and to elevate the

administrative level of command systems. Through these activities, we have reached the goals of effectively controlling EV infection and reducing impacts of the disease to the society.

Keywords: enterovirus, enterovirus 71, hand-foot-and-mouth disease, epidemic disease, control of enterovirus infections

Introduction

An outbreak caused by enterovirus 71 (EV71) occurred on a scale never seen before in Taiwan in 1998, which killed 87 people [1] and had led to a considerable extent of panic and anxiety among public. From then on, the prevention and control of EV epidemic becomes one of the most important works routinely implemented in each year. After many years of collaboration and hard work between central and local governments, well-designed surveillance systems have been established to update the information on trend of EV infections in timely manner, and a well-organized community-based disease control network has been constructed to elevate the capacity for prevention and control of EV infections among general public, educational agencies, kindergartens, and childcare centers [2-3]. In addition, the progress in medical technology and the development of treatment guideline [4] have largely reduced the fatality of EV infection with severe complications in recent years.

Among the enteroviruses, EV 71 is the major type causing severe complications or even death in EV cases [5]. The EV71 outbreak occurs every two to four years. Since the last outbreak in 2008, the risk of causing another large-scale epidemic has gradually increased because of accumulation of susceptible hosts. Therefore, the Taiwan Centers for Disease Control (Taiwan CDC) has been taking it very seriously and has closely monitored the epidemic trend of EV71 infections through surveillance systems since the beginning of 2011, and also has completed the planning and launched various response measures before the epidemic season. As predicted, the EV71 has gradually increased its activity level since the 35th week of 2011 and has become the dominant strain through the 40th week of 2012. During this period, warning alert was released weekly, continuing strengthen health education for caregivers of children under five years of age through multi-dimensional channels and cross-ministry cooperation mechanisms, improved the supervision on health practice and the implementation of health educations in the educational institutions, kindergartens, childcare centers, public areas where young children visit frequently, and medical facilities. Moreover, the responsible hospitals of the medical networks for treatment of severe cases were fully equipped to assure quality of medical care for EV-associated infections and minimize the chance of developing into severe complications or death. A total of 153 cases with severe complications were confirmed in 2012, including two fatal cases, with a fatality rate of 1.3%, which is apparently lower than those in previous years when EV71 epidemics have occurred.

Overview on occurrence of EV infections

A. Emergency room consultation rate of EV cases (surveillance of mild EV cases) [6]

To monitor the occurrence of mild EV cases, the number of EV cases per thousand patients visiting emergency room was calculated (Figure 1). The analysis shows that the rate first passed over the epidemic alert threshold (3.19%) in the 23rd week (early June) in 2011, which happened later in calendar time than those in previous years, and reached its peak in the 31st week (end of July) and then went down in the following weeks. Until the 46th week (middle of November), the rate went upward and formed another peak, and then declined again. Although the rates were going down after the second peak, they appeared to be at the level over the epidemic alert threshold even at the winter season. Until the 5th week (end of January) of 2012, the rates fell down to the value below the epidemic alert threshold. At the 12nd week (late March), the rates once again moved above the epidemic alert threshold (3.04%) and reached its peak at the 26th week (end of June) and then presented a downward trend. At the 35th week (end of August), the rates went below the epidemic alert threshold again and maintained a low level all the way to the end of 2012.

B. Surveillance on strains of EV circulating in the community [7]

The surveillance of virus circulation in 2011 showed that EV became active in the 16th week and coxsackievirus A9 (CA9) strain was the dominant strain while CA10 was the dominant strain after the 26th week (Figure 2). The number of EV71 began to increase in the

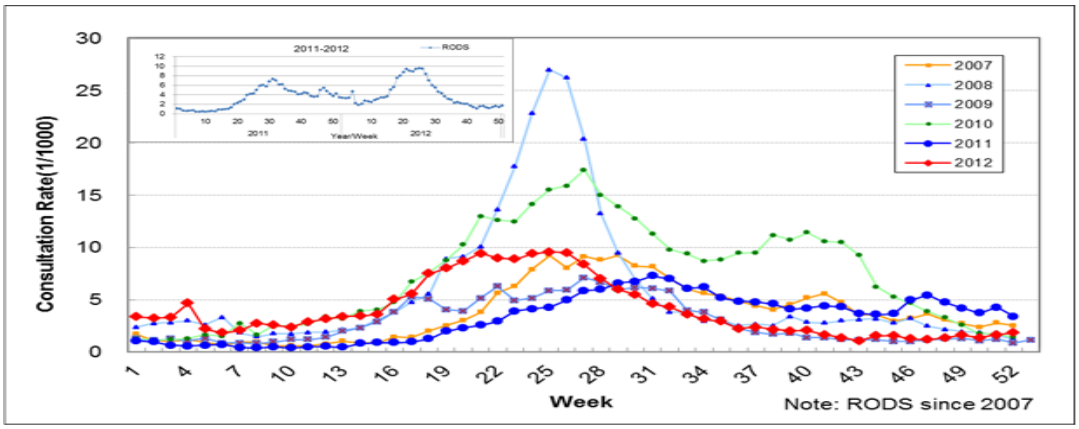

Figure 1. Trend in emergency room visit rate of EV cases in Taiwan during 2007-2012

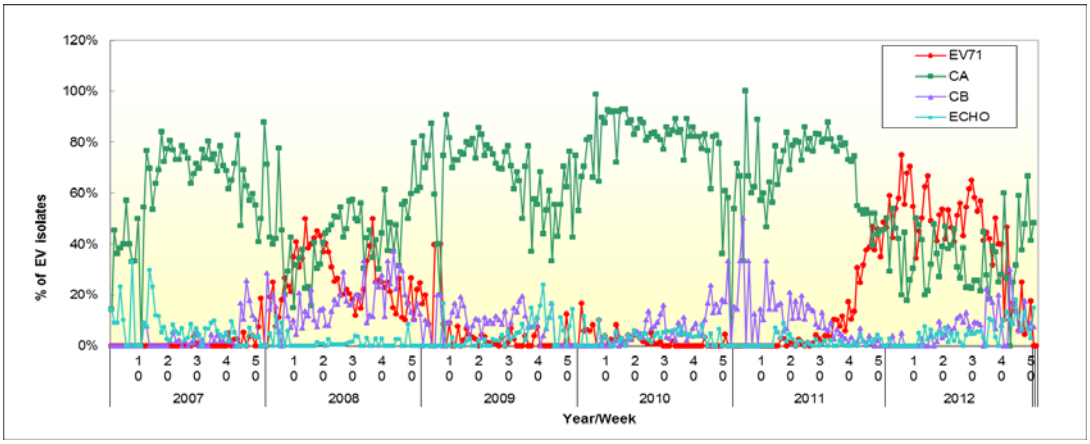

Figure 2. Trends of EV71, CVA, CVB, and ECHO during 2007-2012

35th week of 2011 and became the dominant strain through the 40th week of 2012. The second dominant strain in 2012 was CA2. Although the activity level of EV71 has gradually decreased currently, the strain of coxsackievirus B3 (CB3) that tends to cause severe symptoms in newborn babies has been constantly isolated in small number of cases since the 19th week of 2012, and has caused two severe complications (including one case simultaneously infected with EV71 strain).

C. Surveillance on severe cases of EV infection [8]

The disease of "EV infection with severe complications" is one of the Category C Notifiable Communicable Diseases in Taiwan. The surveillance shows that the first case of EV infection with severe complications occurred in the 27th week in 2011, and the peak number (10 cases) of severe EV infections appeared in the 48th week and then decreased thereafter. However, the occurrence of severe cases extended to 2012 but gradually decreased after reaching peak (17 cases) in the 24th week, which occurred only occasionally after the 35th week and none was found after the 40th week. The pattern of EV epidemic trend in 2012 was slightly different from those in previous years (Figure 3), which the peak of infections did not occur apparently as those in other years and the distribution of severe cases presented more dispersedly in time. The severe cases mainly occurred in the age group between 1-5 years old, and were mostly found in southern and central Taiwan in 2011, accounting for 73%, but in 2012, 70% occurred in Taipei region, southern and northern Taiwan (Table 1).

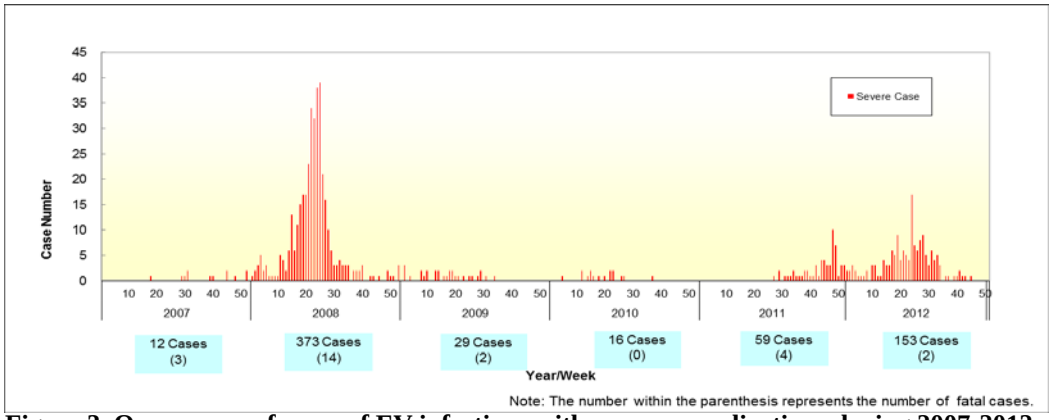

Figure 3. Occurrence of cases of EV infections with severe complications during 2007-2012

Table 1. Analysis on severely complicated EV cases occurred during 2011-2012

	2011		2012	
No. of confirmed cases	59		153	
No. of death	4		2	
Fatality rate	6.8%		1.3%	
Sex ratio(male/female)	1.71		1.78	
Age	No. of cases	Percentage (%)	No. of cases	Percentage (%)
Under 1 year	7	11.9%	41	27.5%
1-5 years	47	79.7%	89	58.2%
6-14 years	5	8.5%	22	14.4%
Regions (R)				
Taipei R.	5	8.5%	41	26.8%
Northern R.	6	10.2%	32	20.9%
Middle R.	15	25.4%	26	17.0%
Southern R.	28	47.5%	37	24.2%
Kao-Pin R.	3	5.1%	16	10.5%
Eastern R.	2	3.4%	1	0.7%
Serotype of EV confirmed				
EV71*	58	98.3%	149	97.4%
CA2			2	1.3%
CA10	1	1.7%		
CB3			1	0.7%
Echo6			1	0.7%

*including cases simultaneously infected with other serotype of EV

Prevention and Control of EV infections

Since the last epidemic caused by EV71 in 2008, the community has accumulated a considerable number of susceptible populations who are at risk of triggering another outbreak. Therefore, the public health authorities have already completed the planning of response measures and undertaken relevant prevention and control actions even before the coming of the epidemic season of 2011, to deal with the problems that the EV71 epidemic might become increased. Since mid-July 2011, the health authorities have combined all possible power from three dimensions such as organizational mobilization, disease prevention, and health care, to fully prepare equipment and materials that are necessary for disease prevention and control, to elevate the administrative level of command in disease control activities, and to strengthen the implementation of relevant control measures until mid-September 2012 when the EV epidemic will slow down. Detailed descriptions of the activities performed in the three dimensions are given in the following sections.

A. Organizational mobilization

a. Preparation stage

In response to the possibility that EVs will be in an elevated level of activities after the Fall semester opening in early September of 2011, the Meeting of Discussion on Strategic Plan for Fight against EV Epidemic was held on 17 August, the 2011 EV Epidemic Working Group was established on 18 August, and the Coordination Meeting on Prevention and Control of EV Infections was convened on 26 August in which the Ministry of Education and the Child Welfare Bureau of the Ministry of the Interior were invited to participate and discuss relevant measure and practices for EV prevention and control.

b. Rising stage of the epidemic

The Meeting for Discussion on Response Strategies for EV Epidemic in 2012 was held on 24 November, 2011. A Special Task Force for Control of EV Epidemic was constituted on 22 December, 2011, and a meeting of the Task Force was held on weekly basis to plan and implement various control measures and to plan and integrate control strategy.

c. Peak stage of the epidemic

The Meeting for Discussion on Response Strategies for EV Epidemic in 2012 was held on 7 March, 2012, in which medical specialists for enterovirus, regional commanders of the Medical Networks for Infectious Disease Prevention and Control (hereafter referred to as Medical Networks), and regional coordinators of the Advisory Committee for Enterovirus were invited to participate and discuss response strategies for EV epidemic. In addition, the Ministry of Education, the Ministry of the Interior, local governments, and regional commander of the Medical Networks for Infectious Disease Prevention and Control were invited to attend the Meeting of Swearing and Mobilization for Control of EV Epidemic held on 28 March, 2012. Since it was the time that the EV outbreak would

be approaching to the peak, a Coordination Meeting on Management of EV Epidemic-Related Issues has been initiated since 14 May based on Article 16 of the Communicable Disease Control Act to integrate resources in relevant ministries and local governments and to communicate with each other about the control strategies so that we could effectively deal with issues on scheduling of medical resources, access restriction to public sites, and public and mass media communication that might occur during peak of epidemic. Because the surveillance showed that the extent of the EV epidemic did not reach the observational indicators or conditions during the later period, a higher level of command system, the Central Enterovirus Command Center, was not initiated.

B. Public health and disease prevention

a. To use various surveillance systems to update information on epidemic trend

To update information on trend of EV infections, multiple surveillance systems were applied. For example, the Real-time Outbreak and Disease Surveillance System (RODS) was used to monitor the occurrence of mild cases of EV infections so that whether the epidemic will be in ascending or descending can be predicted, and deliver early alerts about the epidemic to public and take appropriate infection control measures. To understand the strain and activity of the enteroviruses, a Contract Laboratory System has been established to monitor and analyze the strain of viruses currently circulating in the community. Moreover, the National Notifiable Communicable Disease Surveillance System has been constructed to monitor the occurrence of cases of EV infection with severe complications, from which we could update the number of newly diagnosed cases and number of cured cases on a daily basis, and understand the clinical progress of the severe EV cases, severity of the epidemic, and possible risk factors of the infections so that we could appropriately schedule the resources for critical care of the severe cases. In addition, the operation of the System for Monitoring of EV Epidemic-related School Closure will allow us to understand the picture of the schools, kindergartens, and daycare centers that were closed for EV epidemic, and to evaluate the cost to society due to EV epidemic.

b. To use multi-channel to strengthen dissemination of information on early warning symptoms of severe EV infection and on common sense for prevention of EV infection to target population

1. To enrich knowledge of EV prevention for parents with children under 5 years of age

（1） To create multi-dimensional dissemination channel and materials

A variety of dissemination materials, such as flier, post, and audio and video public service announcements (PSA) in different languages (including Chinese, English, Vietnamese, Indonesian, and Thai), were created to strengthen dissemination of health information through different channels, such as the Mother and Baby Magazine, nonprofit advertisement platform operated by the Government Information Office, the Internet, and the Ronald McDonald House Charities in

Taiwan. Moreover, a toll free hotline 1922 (or 0800-024582) operated 24 hours a day, 7 days a week is provided for general public to notify suspected cases of EV infection and consult with EV-related questions, and is used for collecting feedback and opinions from general public. In addition, we have conducted public opinion survey to parents of children younger than 5 years of age about the EV topics in May 2011 and May 2012, respectively, to track publics' opinions on current policy and to understand whether the gaps between our contents for public communications and the knowledge, attitudes, and practices of the public exist so that we could appropriately modified the contents or ways for public communication.

（2）To strengthen dissemination of health information to newly registered citizens having young children

During the period of EV epidemic, EV-related information was printed in the 4-Way Voice (a newspaper-like monthly magazine) and the Voice of Indonesia which specifically published for newly registered citizens. Besides, we have actively provided health education messages to private sector groups concerning about the newly registered citizens like the Pearl S. Buck Foundation for wide dissemination. In addition, the health education messages were widely disseminated through the assistant of the service stations for newly registered citizens administered by the National Immigration Agency of the Ministry of the Interior at counties, and the classes for newly registered citizens at the community colleges operated by the Ministry of Education.

（3）To strengthen dissemination of information related to prevention of EV infections to grandparents caring for the children

A 30 seconds PSA video recording (master disc, in Chinese, Taiwanese, and Vietnamese language) was co-signed by the Taiwan CDC and health bureau of the local governments so that local governments were in a position to ask local TV stations to offer non-profit dissemination.

2. To make communication with healthcare provider about the prevention and control of EV infections

（1）To publish general notice letters for healthcare providers

Based on the stages of the EV epidemic, information about the outbreak update, control policy, and clinical treatment guideline was provided to healthcare providers in a timely fashion through the channels of the EV Epidemic Weekly Report [9], (the report was simultaneously posted on the Website of the Taiwan CDC and mailed to regional commanders of the Medical Networks, coordinators of the Advisory Committee for Enterovirus, and the contact points of the 71 hospitals specifically assigned for treatment of EV patients), the general notice letters randomly published for healthcare providers, the Electronic Newsletter of the Taiwan National Health Insurance, and medical associations.

（2）To provide EV-related health education materials to medical facilities

A paper note with messages of “healthcare of patients with EV infection—the rules of reassurance” was created and offered to pediatricians for use in health education of visiting patients. In addition, a colorful banner with messages for health education and a video recording titled “Protect the health of your baby—to beat the enterovirus, please do as what I am doing” were provided to medical facilities for health dissemination.

c. To collaborate with counties/cities governments to strengthen community capacity for control of EV infections

The Taiwan CDC asked that health bureau of local governments continually conduct the Strengthen EV Infection Prevention and Control Program, train local seed personnel for performing health educations, and instruct educational agencies, kindergartens, and child care centers to play the major role in practicing EV infection prevention and control activities in the community so that the community capacity of EV infection control could be elevated. A total of 20,735 and 20,618 persons have been trained as seed personnel in counties/cities; 5,971 and 9,937 times of activities of health education, professional training, and workshop with 420,073 and 558,840 participants have been completed; and 21,193 and 26,258 educational or daycare facilities and 8,694 and 9,589 medical facilities have been instructed to sufficiently improve awareness of teachers, healthcare providers, and caregivers in EV infection prevention and control, respectively, in 2011 and 2012.

d. To strengthen supervision on conduction of good health practices in places where children visit frequently to reduce infection

To minimize EV infections of young children, the prevention and control activities have been initiated in the end of March before annual EV epidemic stage by collaborating with the Ministry of Education and the Ministry of the Interior to require and supervise the local governments to complete the inspection of hand wash equipments in educational or daycare facilities, and to instruct teachers in educational or childcare facilities to strengthen health management of the children. To improve prevention and control of EV infections, the Taiwan CDC has worked together with local governments to intensify the supervision and inspection on performance of health-related issues in public areas, such as entertainment areas, shopping malls, and restaurants, and to ask them to correct items deemed inappropriate within a limited period of time to eliminate EV infection of children in public areas since 22 July, 2011.

e. To develop EV71 rapid test kits to promote efficiency in patient treatments

The Research and Diagnostic Center of the Taiwan CDC has undertaken the research and development of the EV71 immunochromatographic test (ICT) kits and transferred the technologies to the Formosa Biomedical Technology Corp. since 2010. On 12 December, 2011, the test kit was approved to be suitably used for serum

specimen by the Food and Drug Administration (FDA), Department of Health of the Republic of China based on procedures of the Inspection and Registration of Diagnostic Medical Equipment and Materials for External Use. To improve the convenience in use, the test kits were modified to be suitably used for whole blood specimen. In April 2012, ten thousand test kits were produced and have obtained agreement from the Taiwan FDA of being used in virology laboratory of the Research and Diagnostic Center of the Taiwan CDC and within laboratories affiliated with the eight contract hospitals during May-July, the peak stage of the EV epidemic, to assist clinical physicians to elevate efficiency in patient treatment. The test kit was formally approved by the FDA based on the procedures of the Inspection and Registration of Diagnostic Medical Equipment and Materials for External Use on 3 October, 2012.

f. To close school at appropriate time in response to the outbreak to prevent spread of EV infections

The decision-making mechanism associated with school closure and reopening due to EV epidemic was constituted by local governments in accordance with the Recommended Criteria for School Closure due to EV Epidemic established by the Taiwan CDC. In principle, when two or more students from the same class were diagnosed with EV infection within a week-long period, the class should be closed. A policy on mandatory and temporary closure of school was implemented in 2008. Since then the rules on notification of EV infection, school closure, and violation punishment have been clearly constituted by local governments based on the Communicable Disease Control Act. Moreover, the local governments and young children's parents have gradually reached consensus on the policy after communication between them in recent years. Since the students who stay home due to taking sick days or school closure may either have already had the ability to infect others, or have been exposed to virus but have not yet become ill, the parents of the students should be given health education and be advised to either take good care of their children by their own or to ask somebody to care for them. The parents should not indulge their children to go out of the home or send them to after-school child care center or cram school, to avoid spread of EV infections. The number of classes closed due to EV infection was 3,114 and 6,007, respectively, in 2011 and 2012.

C. Healthcare enhancement

a. To fully equip hospitals of the medical networks for treatment of severe cases to assure efficient patient transfer and quality of medical care

1. To establish good medical networks for treatment of severe EV infections, the Taiwan CDC will complete medical resource investigation in March every year and administer the assignment of hospitals responsible for treatment of cases infected with EV based on the outcome of the investigation. In addition, the list of the responsible hospitals is supposed to be changed when the situation of the medical resources has changed.

2. The capacity of the pediatric intensive care unit in each hospital will be closely monitored, and patient transfer between hospitals will be conducted by commanders of the Medical Networks when necessary.
3. We have established a smooth channel for the communications among the responsible hospitals to assure the quality of medical care, facilitate horizontal communication, speed the transfer of severe cases, and maximize the efficient use of hospital beds.

b. To enhance physicians' ability in clinical treatment of patient to assure quality of medical care

1. Since December 2011, three times of trainings in clinical treatment of cases caused by EV have been provided to physicians of the responsible hospitals and regional level or higher teaching hospitals located at central and southern Taiwan where the occurrence of severe EV infections were more serious. Subsequently, the identical training programs were also offered in Taipei, Kao-pin, northern, and eastern regions by the end of February 2012.
2. A discussion on treatment of severe cases caused by EV was offered in the Seminar on Security and Quality of Healthcare hosted by the Taiwan Medical Association in March 2012 to enhance professional ability of physicians who may take care of patients infected with EV in a pediatric or emergency department.
3. The Principle for Clinical Treatment of EV71-Infected Cases with Severe Complications was revised in May 2012 based on the Guide to Clinical Management and Public Health Response for Hand, Foot, and Mouth Disease [10] published by the World Health Organization Office for the Western Pacific (WPRO) in October 2011. Moreover, the relevant contents and questions for assessment tests of the Digital Course for Learning Infectious Disease on Website was simultaneously updated to provide clinical physicians with guidance in practicing healthcare.
4. A medical specialist is appointed as the coordinator of the Regional Advisory Committee for Enterovirus, who is responsible for providing medical advice and conducting communication/coordination on treatment of severe EV cases, as well as to chair the Meeting of Discussion on EV-infected Cases with Severe Complications at appropriate time so as to understand the treatment progression on severe cases and give advice when necessary.

Special Control Measures for EV Epidemic in 2011-2012

A. To intensify health supervision and inspection of sites with high risk of infection

The health supervision and inspection of the school or child care center were focused on hand washing facilities and health education activities before. In response to the increased occurrence of EV71 infections, we have expanded our inspection areas to the places (schools or child care centers, public areas, and hospitals or other healthcare facilities) with high risk of infection since November 2011. Moreover, we have created a Checklist for Strengthening the

Control of EV Infection which has listed key items to be inspected so that the Taiwan CDC staff has a substantial basis in examining the completeness of implementation of EV control activities conducted by local governments. In addition, a School/Child Care Center Self-inspection Checklist for Control of EV Infection (Self-inspection Checklist) was developed and provided to the Education Departments and Social Welfare Departments of local governments via the Ministry of Education and the Ministry of the Interior for supervising the enforcement of the EV control activities and self-inspection mechanism in schools, kindergartens, and child care centers. The enforcement of the Self-inspection Checklist has become one of the key topics in the routine inspection of school and child care center. Furthermore, the frequency of inspection has been adjusted from once a month to once a week, and additional instruction and re-inspection will be conducted for those facilities or places where the Self-inspection Checklist is not fully implemented.

B. To expand scope of cross-ministry cooperation

Since children are the major population tending to be infected with EV, the control activities for EV infection will need to be implemented by working together with the Ministry of Education and the Ministry of the Interior. Therefore, Ministry of Education and the Ministry of the Interior have been invited several times to attend the coordination meeting hosted by the Taiwan CDC. In the meeting, a report about the situation of EV epidemic and the works that need to be implemented for EV control by education and social welfare authorities of local governments was made by the Taiwan CDC. Hopefully, the works could be effectively enforced by local governments under the supervision of the Ministry of Education and the Ministry of the Interior through administrative-command system. In addition, the Ministry of Education also actively organized the 2012 Coordination Meeting on Control of EV Epidemic, which pediatric specialists were invited to offer consultation and a discussion on Division of Labor among Education and Health Authorities, Schools, and Kindergarten was made. Besides, the Ministry of Education has exercised supervision over local education authorities in exactly implementing relevant control activities of EV infection following the meeting.

The Taiwan CDC has developed dissemination materials, such as the Guideline for Control of Infectious Disease in School and A Letter to Parents of Students, to be distributed widely through educational and social welfare systems. Moreover, the Taiwan CDC has officially required local health authorities to intensively instruct school and child care center to conduct health education and control activities. Especially, local health authorities should provide the kindergarten (including child care center) did not have nursing staff with appropriate assistance in conducting health education and control activities.

To assist parents to take care of children who stay at home due to school closure, the Child Welfare Bureau of the Ministry of the Interior has established Nationwide Babysitter Information Networks by cooperating with the Organization of Community Babysitter System to provide parents to find a suitable babysitter. Parents also can call the Social Welfare Department of local governments to ask for assistance in finding a babysitter. In this respect,

the Taichung City Government has developed a creative pilot program which the six branches of the Community Babysitter System of the City will provide temporarily caring for child who stays home due to school closure by having child sitter go to his/her home on a service charge. The experience in the implementation of the program was presented by the Taichung City Government in the Coordination Meeting on EV Epidemic Control in Counties/Cities held on 22 December, 2011, to share with other counties/cities and encourage them to do so when necessary. As the child welfare policies are gaining increasing attention, the child care service in the future will become better and better.

C. To extend health education activities to the parents of ill children

The health educations related to prevention and control of EV infection are focused on the caregivers of child under 5 year of age. Since the 2012 EV outbreak was dominated by EV71, the risk of severe complication is potentially increased; we have focused our health education on the parents of ill child. Therefore, the video recording “Protect the health of your baby—to beat the enterovirus, please do as what I am doing” was repeatedly played in clinic waiting room. Moreover, a paper note with messages of “healthcare of patients with EV infection—the rules of reassurance” created by the Taiwan CDC, as well as a sticker note made by local health bureau with information about early indicators of severe complications in EV infected patients and a name list of responsible hospitals for being in charge of treatment of EV infected patients were either directly distributed to the parents of ill children visiting the clinic or pasted on the prescription bag to remind parents to keep noticing on the child and to transfer the child to a larger hospital as soon as possible in case the early indicators are presenting so that the gold treatment could be administered. An investigation on EV-related knowledge of parents of child younger than 5 years of age conducted by the Taiwan CDC in June 2012 shows that, in question about prevention of EV infection, 94.68% of the parents answered “frequent hand washing,” 98.05% “timing for correct hand washing,” and higher than 90% “all other items”; and, in question about early indicators of severe complications of EV infections, 87.64% of the parents answered “drowsiness (disturbed consciousness, inactivity or weakness of the limbs)”, 74.01% “continuous vomiting,” 73.65% “shortness of breath or accelerated heart rate (tachycardia, and tachypnea)” and 75.45% “myoclonic jerks” All these items have a higher percentage than those obtained before.

D. To well manage mass media and risk communication

Risk communication has been a key issue that could not be neglected in dealing with communicable disease outbreaks. The real epidemic situations are very likely to be exaggerated or become society’s focus because of the public broadcasting. To carefully manage issues on media communication could avoid the occurrence of misunderstanding in the epidemic and prevent from happening of unnecessary level of social panics. Therefore, the Taiwan CDC has assigned the Deputy Director-General as the spokesman who hosts press conference on a weekly basis, to actively provide press correspondents with summarized statistics, tables, figures, or pictures about the epidemic so that they could rapidly obtain

updated information on the epidemic and make correct reporting about the epidemic. Moreover, a medical specialist might be invited to give comments on the conference when necessary. Once severe case caused by EV infection occurred, a press statement on the case will be released on a weekly basis to alert general public on the disease, and the families or attending physicians of the case will be invited to share their experience at appropriate time. In case information on expired EV infection case that has not yet been scientifically proven is reported in mass media, local health bureaus will be required to conduct further investigation on the case and actively clarify the reports to avoid misleading and social panic.

E. To actively deliver medical intervention on EV infections

Since no vaccine is available for prevention of EV infection, timely diagnosis and appropriate treatment has been the key points in prevention and control of EV infection except administering health education. Because a small part of physicians on the front lines of clinical treatment (such as physicians in pediatrics, family practice, and ear, nose, throat, as well as physicians in emergency room) may ignore the severity of the disease due to being unfamiliar with the disease course of severe EV infection, the patients are not transferred to another hospital at the appropriate time or the parents of ill child do not be given necessary health education. Eventually, to delay further treatment may threaten the lives of suspected severe cases. Therefore, training of healthcare providers has been the focus in prevention and control of EV infection in each year. For years, the Taiwan CDC organized training activities through the assistance of pediatric or other medical associations in which the physicians in hospitals assigned for treatment of EV patients or in regional level of teaching hospitals were invited to participate. Since the epidemic dominated by EV71 strain may lead to more cases with severe complications, the large-class pattern of training activities is changed to effectively enhance physicians' diagnosis and clinical treatment ability. When the epidemic is presented in an increasing trend, specialists are invited to share experience in treatment of severe cases in the Seminar on Treatment of Severe Cases of EV Infections held for physicians in responsible hospitals for treatment of EV patients or in regional level of teaching hospitals. During the serious epidemic stage, members (or coordinator) of the Advisory Committee for Enterovirus are invited to the hospitals that have fatal or unusual cases of EV infections to convene a meeting for healthcare providers working in the emergency room, inpatient department, or intensive care unit of the hospital to carefully review the clinical course and the treatment of the cases. Physicians working in the hospitals neighboring the hospital with fatal cases are also invited to join the meeting to increase their impression and alerts in treatment of severe cases.

Since the Advanced Pediatric Life Support (APLS or PALS) courses delivered in the routine training program organized by the Taiwan Pediatric Association include the treatments of severe cases of EV infection, specialists recommend that the courses be incorporated into the training program relevant to clinical treatment of EV infection. Therefore, the courses were contained in EV-related training activities under the agreements of the Taiwan Pediatric Association. The training courses will enhance the ability of the healthcare providers in

treatment of severe cases of EV infection and will be continually contained in the training activities for medical specialist in the future.

F. Air referral mechanism has reached the function of timely transfer of patients

To allow the suspected severe EV infection case to obtain appropriate clinical treatments in a timely manner, except strengthening the communication and cooperation with the responsible hospitals within the same administrative region, the medical centers in some regions have played an important role in providing professional instruction to the teaching hospitals at local and regional level by conducting professional exchange and establishing cooperation mechanism for patient transfer. In addition, for offshore islands and areas with scare medical resources, we have used the established air referral mechanism and long-distance medical care equipments to strengthen the cooperation and communication between hospitals in these areas and large hospitals in Taiwan, coordinated with the Bureau of Nursing and Healthcare, Department of Health, to tell the Air Referral Application Review Center to strengthen the review process of application for transfer of suspected severe cases infected with enterovirus, and asked pediatrics to promote efficiency of patient transfer so that the patient could receive treatments within the golden hour. No suspected severe cases of EV infection were delayed to evacuate from offshore islands in 2012.

Efforts to be Made for Control of EV Infection in Future

A. To review and revise the criteria for school closures, to evaluate auxiliary tools for decision-making

School closure is one of the measures to prevent the spread of infections. Several hundred classes were closed due to EV epidemic annually before 2008. During the peak period of EV71 epidemic of 2008, when the Taiwan Central Command Center promulgated a mandatory school closure policy for duration of about one and a half months, 1,274 classes have been mandatorily closed only in June. Afterwards, the criteria for school closures were set up by local governments themselves, which leaned toward a looser policy. The number of classes closed during the period of CA outbreak in 2010 reached 5,857. In 2011 and 2012 when the EV71 virus presented a higher activity, the number of classes closed was 3,114 and 6,007, respectively. The purposes for school closure are to prevent occurrence of the cluster of severe cases caused by EV infection. However, the majority of cases infected with EV present only with mild symptoms. Therefore, to be efficient, the school closure policy should be implemented at the time when the risk of EV71 infections is most likely to cause severe complications. Otherwise, the school closure policy might be overly implemented and excessively expend social cost. Thus, the criteria for school closure in the future will be decided based on the occurrence of severe cases and the results of monitoring of enterovirus circulating in community. Only when EV71 strain become dominated and possibly causes epidemic, the school closure measures will be considered and implemented. The concepts, “when you are getting sick, not go to school,” would be constantly disseminated and fulfilled

in ordinary situation for control of EV infections so that the impact of school closure policy on society will be minimized.

To assist first-line physicians to be able to make diagnosis of EV71 infection at early stage of the disease so that we can make alert and take action early and further prevent the occurrence of sequelae and death, the Research and Diagnostic Center of the Taiwan CDC has initiated the research and development of the immunochromatographic test (ICT) kit for detection of EV71 IgM antibody since 2008. The technology of the ICT kit was transferred to biotechnology companies in private sector. Moreover, the ICT kit was modified and approved for being suitably used in whole blood specimens based on the procedures of the Inspection and Registration of Diagnostic Medical Equipment and Materials for External Use. Hospitals of being involved in the EV test could easily use this technology for routine test. An evaluation on the timing in making the decision on school closure found that to make decisions based on the test results obtained by using ICT kit will be a little bit later in the time, as compared with those made based on the physicians' clinical diagnoses as what it did before, since the ICT kits are most appropriate to be used for specimens collected 2 to 3 days after the patients have a fever. Moreover, the ICT kit may produce false negative results. In case a decision not to close school has been made based on the false negative result, but cluster of severe cases caused by EV infection occurred, some disputes may happen. In addition, in consideration of the cost of stockpiling the ICT kit and the availability of hospitals providing the testing, a further evaluation needs to be conducted before the test results can be used as a basis for decision-making of school closure.

B. To establish mechanism of long-term follow-up of the sequelae of the severe cases caused by EV infection

The governments have cooperated with specialists in medical sectors to dedicate in reducing the occurrence of sequelae and death since the first EV71 epidemic occurred in 1998. The fatality rate of severe cases infected with EV71 has reduced from 20% in 1998 to 3.8% in 2008. Based on the surveillance data and previous experience in disease control, the activities related to prevention and control of EV infections were early prepared and initiated in 2012. The fatality rate was reduced to 1.3% in 2011, the lowest rate of EV71 epidemic in history.

However, some survivors from severe complications have not completely recovered and are still suffering from sequelae. Currently, the statistical data on the survivors are obtained from independent and small-scale research conducted by clinical physicians. In 2012, in order to understand the overall burden of the EV infection with severe complications, the Taiwan CDC has undertaken a retro prospective research about the recovery of severe cases occurred in 2011 and a follow-up study about the sequelae occurred six months after onset of the cases in 2012. Through the researches, a relevant data base will be established to provide as reference for evaluating EV71 vaccine efficacy, to enrich relevant epidemiological data, and to elevate the effectiveness of prevention and control of EV infection.

C. To engage specialists to revise guideline for clinical treatment of cases with severe complications and to share the guideline with international partners

Enterovirus 71 is the major strain causing severe complications in patients infected with enteroviruses. The Guideline for Clinical Treatment of Cases with Severe Complications Caused by EV Infection was created immediately after the epidemic occurred in 1998. Since we have a well-established national health insurance system that includes an integrated and widely covered payment system for medical services, physicians are less worried about the patients' ability of paying for the clinical treatment. Therefore, the Guideline has contained complete, specific, and detailed contents regarding clinical treatment of cases with EV infections. The Guide to Clinical Management and Public Health Response for Hand, Foot, and Mouth Disease released by the WPRO in 2011 has cited many references about the clinical treatment in international journals written by medical specialists in this country.

With the progress and advances in medical technology, the Guideline will need to be revised periodically. Since clinical treatment involved highly specialized technology, the Taiwan CDC has always invited specialists in pediatric, infection control, neurology, cardiology, and intensive care to participate in the revision of the Guideline every year. As we have done before, we also invited specialists to revise the Guideline for Clinical Treatment of Cases with Severe Complications Caused by EV71 Infection in March 2012 and published in May. The effectiveness of clinical treatment of cases with severe complication has a significant impact on the treatment and outcome of patients. Therefore, we could commission relevant medical associations to effectively integrate opinions and experience from medical specialists and to revise the guideline periodically in the future. Moreover, we can share the guideline with international partners via professional channels to show the effectiveness of disease control in this country.

D. To adjust duration for conducting surveillance, prevention, and control of EV infection

The epidemic curve for monitoring of mild EV infections was more moderate but has a prolonged epidemic duration during 2011-2012 than those found in 2008 and 2010 when an apparent peak was presented. We speculate that a couple of factors may have contributed to the difference between these epidemics. First, the accumulated number of hosts susceptible to EV71 infection since 2008 epidemic has reached a critical point, so the epidemic in 2011 did not occur until winter season, and presented in a mild curve due to suppression of temperature to virus activities. Next, the Taiwan CDC has been looking into the epidemic very seriously and has been actively taking early and effective actions to control the epidemic since the beginning of 2011. These actions were implemented continually until the epidemic season of 2012. Therefore, the scale of the epidemic in 2012 was not as large as those in previous years. However, a considerable number of susceptible hosts have been accumulated during a seven-year period since the epidemic of severe cases caused by CB3 infection among neonates occurred in 2005. Therefore, an increasing trend was found in the 19th week 2012. During the following period, we would have to closely and continually monitor for changes in viral

activities and issue alert to general public and medical providers at the appropriate time.

However, as the knowledge of the EV infections and their prevention has been elevated in general public, various control measures were fully implemented in local and central governments, and the climate have changed, the epidemic cycle caused by EV71 or other strains will be different from those of previous years and delay in age affected by the virus may occur [5, 11]. In addition, genetic recombination may result in the production of new strain that might lead to a more serious symptom. All these issues need to be further explored and analyzed by using information collected from multi-dimensional surveillance systems, serial analysis of gene expression, and medical records so that we can conduct appropriate prevention and control measures.

Conclusions

After suffering from devastating epidemic caused by enterovirus for several times, we have established well-equipped surveillance, prevention and control, and health care systems through the cooperative efforts of professionals from multiple disciplines, leading to an annual decrease in fatality rate of cases of severe EV infections. To learn from its own previous experience, the Taiwan CDC has completed its preparation for control of EV infections early before the coming of 2011 epidemic. Except enforcing systematic control measures, we also have strengthened the supervision on conduction of good health practices in places where children visit frequently, the dissemination of prodromal signs of severe complications to parents of ill child, and exchange of physicians' experience in clinical treatment of severe cases. The fatality rate of severe cases caused by EV71 in 2012 has dropped to its lowest level in the history. This indicates that the control measures implemented have worked effectively. The intensified control measures for 2012 epidemic will be constantly and routinely implemented [2-3]. In addition, we will strengthen the monitoring of other virus strains potentially causing severe complications through multi-dimensional surveillance system so that we could conduct prevention and control measures at the very early stage of the infections to protect health of young children.

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References

1. Ho M, Chen ER, Hsu KH, et al. An epidemic of enterovirus 71 infection in Taiwan. Taiwan Enterovirus Epidemic Working Group. N Engl J Med 1999;341:929-35.
2. Taiwan CDC. Guideline for the Prevention and Control of Enterovirus Infection. 2012.

3. Taiwan CDC. Manual on the Prevention and Control of Enterovirus Infection for Staffs (Caregivers) in Kindergarten, Child Care Center, and Elementary School. 2012.
4. Taiwan CDC. Guideline for Clinical Treatment of Cases with Severe Complications Caused by EV71 Infection.
5. Solomon T, Lewthwaite P, Perera D, et al. Virology, epidemiology, pathogenesis, and control of enterovirus 71. Lancet Infect Dis 2010;10:778-90.
6. Taiwan CDC. Real-time Outbreak and Disease Surveillance System. Available at :http://www.cdc.gov.tw/english/list.aspx?treeid=00ed75d6c887bb27&nowtreeid=f0131176aa46d5db2011-2012.
7. Taiwan CDC. Laboratory Surveillance. Available at : http://www.cdc.gov.tw/english/list.aspx?treeid=00ed75d6c887bb27&nowtreeid=f0131176aa46d5db2011-2012.
8. Taiwan CDC. National Notifiable Disease Surveillance System. Available at : http://www.cdc.gov.tw/english/surveillance.aspx?treeid=00ed75d6c887bb27&nowtreeid=f0131176aa46d5db2011-2012.
9. Taiwan CDC. Weekly Report of Enterovirus Infection. Available at : http://www.cdc.gov.tw/english/submenu.aspx?treeid=00ed75d6c887bb27&nowtreeid=fc82bf602877f0502011-2012.
10. WPRO. A Guide to Clinical Management and Public Health Response for Hand, Foot and Mouth Disease (HFMD). Available at: http://www.wpro.who.int/emerging_diseases/documents/HFMDGuidance/en/index.html2011.
11. Ang LW, Koh BK, Chan KP, et al. Epidemiology and control of hand, foot and mouth disease in Singapore, 2001-2007. Ann Acad Med Singapore 2009;38:106-12.

Outbreak Investigation Express

Influenza Outbreak at a Correctional, Taitung,2012

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Abstract

On July 19, 2012, a correctional facility in Taitung reported 25 inmates having influenza-like illness with symptoms of fever, cough, myalgia, and rhinorrhea. The incident was reported as an upper respiratory infection outbreak to the Symptoms Surveillance System of the Centers for Disease Control. Influenza AH3 were isolated from 10 specimens taken from patients. Public health agencies launched an investigation and instituted control

measures. During July 18 to August 4, 2012, there were 110 inmates with influenza-like illness, yielding an attack rate of 16.7% (110/661). Public health agencies intervened rapidly at the start of the outbreak, and antiviral agents were provided to ill patients. However, the outbreak was not controlled because the correctional facility did not implement isolation correctly and execute all control measures recommended. The outbreak was only controlled with continued public health agency intervention and guidance in implementing aggressive control measures. This outbreak shows that correctional facilities must increase personnel infection control competency, and ensure proper implementation of disease surveillance and reporting. Furthermore, public health agencies must also strengthen their supervision and auditing of these facilities at times with no outbreaks, and provide timely intervention and guidance during outbreaks. Hopefully these outbreaks can be avoided in the future.

Keywords: influenza, correctional facility, antivirals

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