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The Evaluation of the San-Ma-Yi-Fong:Progress with the Programs to Eradicate Measles, Rubella, Congenital Rubella Syndrome, and to Eliminate Neonatal Tetanus

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Abstract

The program to eradicate poliomyelitis, measles, rubella, congenital rubella syndrome (CRS), and to eliminate neonatal tetanus (NNT), San-Ma-Yi-Fong, from Taiwan was begun in 1991. In the ensuing 19 years the immunization program has matured and has been fully integrated into the countries health care delivery system. Interim goals were established and met.

Recent program strategies have been directed to maintain and sustain polio eradication; to strengthen measles, rubella and CRS eradication efforts through further increases in MMR vaccine coverage and case containment; to complement clinical efforts to eliminate NNT maintain the high coverage rates of DTP/DTaP vaccines; ensure the age appropriate vaccination of each successive cohort of children; to take every opportunity to vaccinate vulnerable females in the reproductive age group; and to undertake special vaccination activities where lower coverage was recognized or cases have occurred.

The purpose of this evaluation was to review the progress of the San-Ma-Yi-Fong; to assess what needs to be done to complete the eradication/elimination efforts, to begin preparation of the documentation for the WHO certification of the eradication of measles, rubella, CRS, and the elimination of neonatal tetanus and the Annual Report on sustaining the eradication of poliomyelitis for WHO.

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By active and passive surveillance, through May 2008, no indigenous polio or congenital rubella syndrome had been reported for 3 years; no indigenous measles cases have been reported for 2 years; 6 cases of rubella were reported in 2007 and 3 during the first 5 months of 2008. No virologically confirmed wild polio cases have been reported in Taiwan since 1983. Poliomyelitis was declared eradicated in Taiwan in 2000 by the WHO and vigilance is sustained. No imported polio cases have occurred. Imported cases of measles, rubella and congenital rubella syndrome have been recognized and potential spread prevented or contained. No indigenous cases of neonatal tetanus have been reported between 2004 and 2008.

Additional strengthening and confirmatory actions should be undertaken to ensure the completion of the eradication/ elimination of the San-Ma-Yi-Fong diseases.

Keywords: San-Ma-Yi-Fong, vaccination, eradication / elimination, poliomyelitis, measles, rubella, congenital rubella syndrome (CRS), neonatal tetanus (NNT)

Introduction

A country strategy to eradicate (eliminate the indigenous transmission of) poliomyelitis, measles, rubella, prevent congenital rubella syndrome (CRS), and eliminate neonatal tetanus (NNT), the San-Ma-Yi-Fong, was established in 1991 by the Department of Health (DOH) under the direction of Chun-Jen Shih MD, then Director General of the DOH. In the ensuing 19 years the immunization and surveillance programs have matured and have been fully integrated into the health care delivery system.

Under the San-Ma-Yi-Fong program, measures were implemented to strengthen surveillance, case investigation and vaccine coverage. These included the establishment of the surveillance of rash illness with practicing physicians, active surveillance of cases of acute flaccid paralysis with acute care hospitals, and laboratory surveillance of enteroviruses enlisting clinical laboratories. Mass immunization with OPV was conducted to raise coverage levels high enough to interrupt transmission. Rubella vaccination began with 7th grade girls. MMR vaccine was introduced into the routine infant immunization program in 1992 for children over 15 months of age; a second dose was begun in 2001. Subsequently rubella vaccination was expanded to all women of reproductive age.

While the surveillance system for notifiable communicable disease was established in the 1940's, real time surveillance was incorporated via the internet in 2001. Polio,

AFP, measles and rubella, are to be reported within 24 hours of diagnosis. CRS and neonatal tetanus are to be reported within one week of diagnosis and viral isolation and/or serology is used for confirmation. For NNT clinical confirmation is used for confirmation. Vaccine coverage is determined through the National Immunization Information System from which vaccination data are derived. Data from all health stations, hospital and other sites of vaccination are consolidated in a single data base which is accessible to health staff wherever a child appears for vaccination.

By active and passive surveillance, no indigenous polio or congenital rubella syndrome have been reported for 3 years; no indigenous measles cases for 2 years; 6 cases of rubella were reported in 2007 and 3 in the first 5 months of 2008. Imported cases of measles, rubella and congenital rubella syndrome have been recognized and potential spread contained. No virologically confirmed wild polio case has been reported in Taiwan since 1983. Poliomyelitis was declared eradicated in Taiwan in 2000 by the WHO. No imported cases of polio have occurred. No cases of neonatal tetanus have been reported between 2004 and 2008.

Recent program strategies have been to sustain polio eradication; to strengthen measles, rubella and CRS eradication efforts; to further increase the high coverage rates for MMR vaccine; to maintain the high coverage rates of DTP/DTaP vaccines; to ensure the age appropriate vaccination of each successive cohort of children; to take every opportunity to vaccinate susceptible females in the reproductive age group; and to undertake special immunization activities where lower coverage or cases have occurred.

The purpose of this evaluation was to review the progress of the San-Ma-Yi-Fong; to assess what remains to be done to complete the eradication/elimination efforts, and to begin preparation of documentation for the WHO certification of the eradication of measles, rubella, CRS and the elimination of neonatal tetanus and the WHO Annual Report on sustaining the eradication of poliomyelitis. The evaluation was limited to the data available up to May 2008 (at the time of the review). The vaccination schedule is in Table 1.

Poliomyelitis

The elements of the maintenance program of polio eradication includes active surveillance of acute flaccid paralysis (AFP) and circulating vaccine-derived poliovirus (cVDPV), containment of wild poliovirus should it occur; if necessary, environmental surveys to determine whether wild polio is circulating; and maintaining greater than 95% coverage with polio vaccine assessed through the NIIS and by annual survey at school entry. In addition, in preparation for global eradication all laboratory storage facilities are to complete their inventory and destroy all specimens that could contain wild poliovirus [1].

The maintenance activities for sustaining polio-free status, including AFP surveillance, polio vaccine coverage and age-appropriate vaccination by county were reviewed. The AFP incidence, secular trends in AFP reporting and case investigations were reviewed to determine whether surveillance continues to be adequate, the minimal rate of non-polio AFP of >1/100,000 population <15

Table 1. Immunization Schedule in Taiwan, 2009

Vaccine \ Age	≥24 hr	2-5 days	1 months	2 months	4 months	6 months	9 months	12 months	15 months	18 months	24 months	27 months	30 months	36 months	6 years	≥65 years
BCG	BCG															
Hepatitis B		HepB1	HepB2			HepB3										
Diphtheria, Tetanus, Pertussis				DTP1	DTP2	DTP3				DTP4					Tdap&	
Polio				OPV1	OPV2	OPV3				OPV4					OPV5	
Varicella*								Var								
Measles, Mumps, Rubella¤								MMR1							MMR2	
Japanese Encephalitis **									JE1、JE2			JE3			JE4	
Influenza						Influenza（yearly）										
Hepatitis A#											HepA1		HepA2			

* Varicella vaccine is given to children born after January 2003 and aged 12 months or older.

** Two weeks interval between dose1 to dose2.

In selected aboriginal areas.

¤ From 2006 onward, Measles vaccine is removed from the immunization program and the age for receiving the first dose of MMR has been revised to be 12 months in April, 2009.

&Tdap vaccine is used in place of the routine use of Td vaccine for the first grade students during the spring semester 2009.

years of age has been sustained, and whether stool samples continue to be obtained for viral isolation and specimens were transported adequately. The viral isolation from AFP cases was reviewed to determine whether there were vaccine-derived or wild type polio virus associated with paralysis [2, 3].

Observations

OPV coverage: Coverage with OPV was 95% for the primary dose and 92% for the booster doses (doses administered for infants born in 2006 for the primary series, and for infants born in 2005 for boosters). Immunization coverage among primary school entrants in September 2007 was 99% for the primary series and 98% for the boosters. Age appropriate immunization for OPV3 at 9 months (up to 3 months delay) varies between counties and ranges from 80-95%.

AFP surveillance: 2,734 reporting sites continue to report weekly. Negative reporting of AFP has been maintained at all reporting

sites. The reported AFP cases and the non-polio AFP rate are shown in Figure 1. A total of 251 confirmed AFP cases were reported from 2004 to 2008 including one death in 2005.

In the most recent two years (2006 and 2007) 66 and 51 cases were reported, respectively, yielding an incidence of 1.24 /100,000 <15 years old in 2007, a decline compared to the rate in 2006 (1.57/100,000). Nearly half (46.9%) of reported AFP cases were in the 1-4 years age group. Seventeen cases were diagnosed as Guillian-Barre Syndrome, myositis or myelitis; 3 were characterized as polio-like syndrome, but isolation of virus was negative. None of the reported AFP cases were considered imported. Of the 3 with a polio-like presentation all were completely immunized with OPV and one with OPV and 1 dose of IPV. All three were completely investigated.

Vaccine-derived polio virus was detected from two AFP cases in 2001: an 8 year old immunodeficient boy diagnosed as vaccine-associated paralytic polio who excreted iVDPV for 10 months without evidence of spread to contacts; the second a 4 month old infant diagnosed as having neuritis [2]. In 2002 a contact of an AFP case, a 2 year old child was culture positive for cVDPV and asymptomatic.

A total of 7 polio vaccine viruses were isolated in 2004-2008; one to three isolates each year during 2004 -2006 and none in 2007 and 2008. Four isolates were P2 vaccine-like, 3 P3 vaccine- like; none were vaccine-derived poliovirus. Over 94% of laboratory reports were received within 28 days. The transportation of stool specimens from AFP cases was monitored for safety, temperature and promptness; 2 specimens were obtained from most cases. The 60 day follow-up to determine whether there was residual disease or a death was not reported on the case investigation forms. The timeliness of AFP notification (diagnosis to notification) has fallen since 2002. The timeliness of case investigations (notification to investigation) has improved dramatically since 2005.

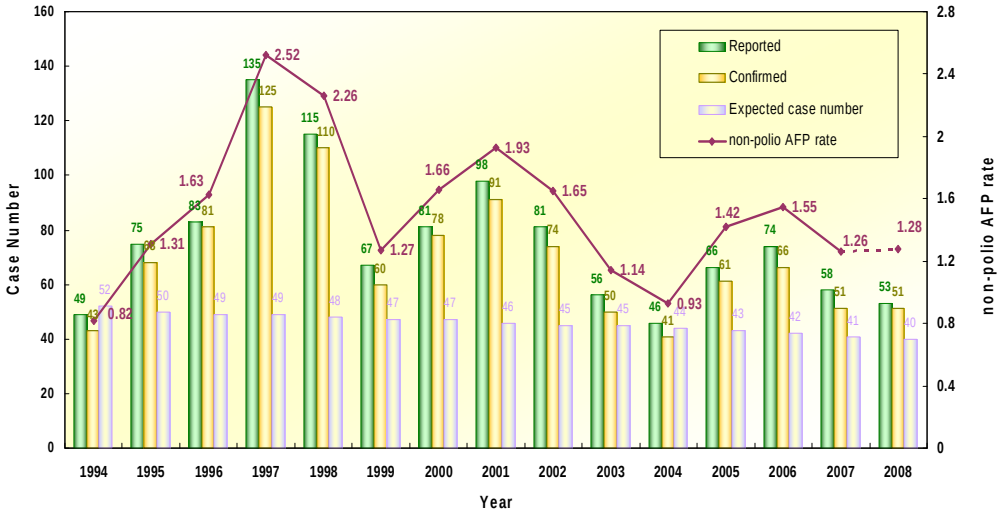

Figure 1. Non-polio AFP rate in Taiwan, 1994-2008*

Source: Taiwan CDC

* Data for 2008 is through May 27, 2008

During each of the years 2000-2005 the laboratory completed the WHO proficiency testing with a score of 100%.

Discussion and Recommendations

All indicators for adequate AFP surveillance performance continued to be met: zero reporting greater than 80% surveillance sites; non polio AFP rate >1 per 100,000 persons <15 years of age; at least 80% of AFP reported cases have case investigations including adequate stool specimens. Until polio is eradicated globally the risk of importation and the establishment of circulation of vaccine-derived polio virus remains a threat if coverage is compromised [4]. Polio virus introduction and indigenous transmission must be guarded against, and the infrastructure developed over the last 19 years sustained [5]. Guidelines for a response to a wild polio importation should be reviewed and prepared for.

Case investigation of the AFP cases appear to have received less attention than in the past: they are often incomplete, and cases have limited follow-up. Efforts should be increased to ensure that case investigations are completed fully on all AFP cases, 2 adequate stools obtained and a 60 day follow up is completed. The 3 “polio-like” AFP cases reported between 2004 and 2008 particularly need further investigation. The AFP case that died should be revisited and carefully investigated. Analysis of AFP by township or village for the 3 prior years was not available. Such information will be necessary for identifying clustering of AFP cases. Careful laboratory evaluation should be continued to uncover any vaccine-derived virus from an AFP case.

The confirmation of the true absence of polio would require continuing the active search for acute paralytic disease (AFP) among hospitals, physicians, especially neurologists, and public health nurses in all tertiary care centers in the country, maintaining the surveillance of AFP at no less than one AFP case /100,000 persons < 15 years of age, and continuing review of coverage for polio vaccination in all counties by each data reporting method (the NIIS and doses administered) to search for unreached/unvaccinated children and to reconcile the differences in coverage observed with each system [6]. A search should be undertaken for unvaccinated children by township and village using GIS maps to determine whether there are clusters of such children especially among moving people/migrant workers who could enable an outbreak. These unvaccinated children should be vaccinated.

Measles

The eradication of measles depends on active community (physicians and public Health nurses) and hospital-based surveillance of cases, rapid identification and containment of outbreaks and maintenance of a high level of measles vaccine coverage, case investigations aim at finding a source and spread cases, differentiating indigenous and imported cases and identifying the chain of transmission. Maintaining an age appropriate coverage with two doses of MMR vaccine in greater than 95% of young children is necessary to completely interrupt transmission. Case confirmation by serological testing of all

suspected cases of measles or rubella is essential in the eradication effort [7, 8]. Special attention to prevention of importation by travelers (adults and children), foreign workers and foreign brides may help early identification of cases. Special immunization activities are necessary if areas of low coverage are identified.

In this evaluation, we reviewed (1) the incidence and secular trends of measles cases, hospitalizations, deaths obtained by passive surveillance and outbreaks by township and village for the past three years; the case investigation forms to determine the vaccination status of cases, the serology performed, the results of serology, and epidemiologic linkages if any, e.g. importation or areas of clusters of cases or low coverage. We examined whether an active search for uncovered unreported cases, and whether cases of measles occurred among the military and their families; (2) MMR vaccine coverage by township and village for each of the past three years, age appropriate vaccination of MMR for individuals born in the last three birth cohorts and special immunization activities if low coverage areas were identified; and (3) the operation of the cold chain, and the frequency of monitoring and evaluation [9, 10].

To evaluate the prevention and control of the importation of cases, policies to recommend vaccination of travelers intending travel outside of Taiwan were also reviewed.

Observations

Measles vaccine was introduced in Taiwan in 1968. The secular trend of measles for 1996 - 2008 is seen in Figure 2 and Table 2.

Between 2004 and 2008, 217 suspected cases of measles were reported, 26 of these were confirmed: 7 were indigenous and 19 imported. Of the indigenous cases, 5 were in

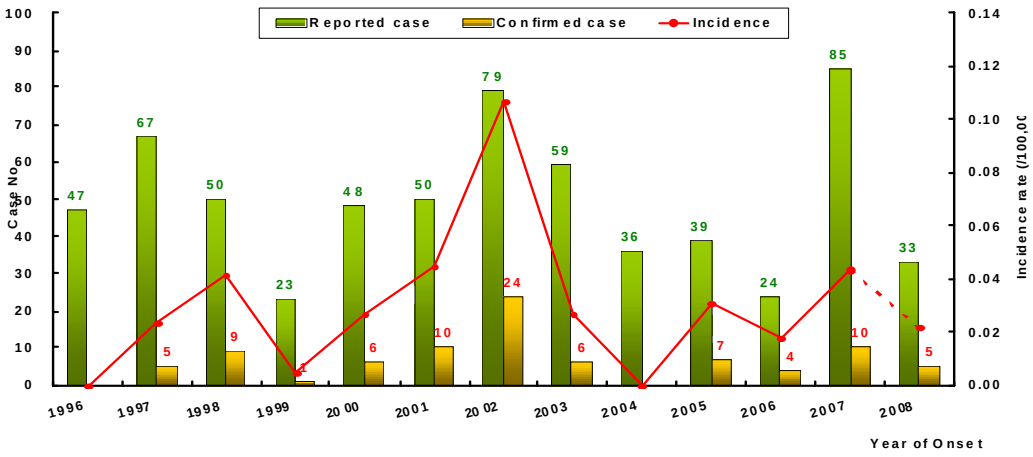

Figure2. Trends of confirmed Measles in Taiwan, 1996-2008*

Source: Taiwan CDC

* Data for 2008 is through May 27, 2008

** Incidence rate for indigenous cases in 2005 and 2006 were 0.031 and 0.017

Table2. Measles in Taiwan, 2004-2008*

Year	Indigenous		Imported		Total
	Primary Cases	Epi-linked	Primary Cases	Epi-linked	
2004	-	-	-	-	-
2005	5	1	1	-	7
2006	1	-	3	-	4
2007	-	-	10	-	10
2008	-	-	5	-	5
Total	6	1	19	0	26

Source: Taiwan CDC

* Data for 2008 is through May 27, 2008

2005 with 1 spread case and 1 in 2006 with no spread cases. No confirmed indigenous cases were reported in 2007 or 2008. The notification was made on the same day of onset in 24 of the 26 cases. The longest interval was two days.

Indigenous cases: The 7 indigenous cases occurred in 2005 (6 cases, 5 primary and 1 spread) and in 2006 (one primary case without spread); 4 were 1-4 years of age (potentially preventable by vaccination); the other two were 30 and 44 years of age. The one spread case was 10-14 years of age. Five of the 6 indigenous cases were unvaccinated; one was too young to be vaccinated. No hospitalizations or deaths due to measles have been reported in 2006-2008.

Imported cases: The 19 imported cases (1 in 2005; 3 in 2006; 10 in 2007; and 5 in 2008) resulted in no spread. Of the imported cases only 3 were potentially preventable (in the age group in which they could have been vaccinated under the current schedule –aged 1-4). Five were under one and the remainder over 15 years of age.

All cases of rash illness were tested for both measles and rubella IgM and IgG. Of the 26 cases of confirmed cases of measles from 2004 to 2008, 22 were confirmed by IgM and the remaining four by an elevated IgG. The overall timing of specimens appeared to be appropriate. Coverage with one dose of MMR was 96% for infants born in 2006. Immunization coverage among primary school entrants in September 2008 for one dose of MMR was 99%. Age appropriate immunization for MMR1 at 18 months (up to 3 months delay) varies between counties and ranges from 80-89%.

Discussion and recommendations

Eradication of the indigenous transmission of measles is close. Performance indicators should be tracked as confirmation of measles eradication is approached: coverage maintained nationally above 95% for both MMR 1 and MMR 2; notification within 24 hours of rash onset; > 80% of case investigations completed within 48 hours of notification; at least 95% of reported cases should be investigated; at least 90% of reported cases should have blood samples collected; laboratory results of blood samples reported in less than 7 days after arrival in the laboratory; and national reporting of rash illness other

than measles as recommended by WHO is at least 2 per 100,000 population.

Until measles is eradicated globally the risk of importation remains a threat [11]. Efforts should be made to maintain surveillance and laboratory capability including testing serum samples from all reported rash and fever cases for both measles and rubella. Acute and convalescent serology samples should be obtained, when possible, with appropriate timing.

Some case investigation forms of the measles cases were incomplete. However, the absence of spread cases suggests adequate surveillance and control measures. Each form requires a review for completeness.

To ensure the complete understanding of the circulation of measles and identify vulnerable populations, a retrospective review of tertiary care hospitals including the military for the last 5 years to determine the occurrence of measles, measles hospitalizations or measles deaths should be done. To understand current measles virus circulation and risk of importations the prospective active search for measles, measles hospitalizations and measles deaths should continue including the military.

Maintenance of vaccine coverage requires ongoing review of coverage for measles vaccination in all townships and villages by each data collection method (NIIS and doses administered) using GIS maps to search for unreached/unvaccinated children and determining whether there are clusters of such children especially among moving people/migrant workers who could enable an outbreak. Reconcile the differences in coverage observed with each record system during the review. Some villages and townships have delays in the appropriate age of vaccination. Supplementary immunization programs should be focused on these localities.

Given that all measles cases in recent years were imported by travelers, and importation has been the principal source of rubella outbreaks and CRS (see Rubella section below), the prevention strategy should include required vaccination with MMR of students, business men and women and their families who travel abroad. In addition, MMR should be required for foreign laborers and household helpers as well as foreign bride prior to arrival in Taiwan.

Rubella and Congenital Rubella Syndrome

The eradication of CRS depends upon the interruption of the circulation of rubella virus in the community and the protection of each woman in the reproductive age group [12]. Rubella vaccine was introduced in 1972 when it was given to 7th grade girls. MMR was included in routine infant immunization in 1992; the second dose of MMR at 6 years of age was introduced in 2001. A rubella containing vaccine was subsequently recommended to premarital and post partum women [13]. Eradication depends on maintaining > 95% age appropriate coverage with each of two doses of MMR in children [14]. Because of the spectrum of illness and the difficulties in making the clinical diagnosis of rubella, all cases of suspect rash illness require serological testing for confirmation as rubella. CRS may present as only deafness or cataracts, and surveillance in places where such children are seen is needed to confirm the eradication of CRS [15].

The following was reviewed for rubella

and congenital rubella syndrome: (1) the incidence and secular trends of rubella cases, outbreaks, and congenital rubella syndrome over the last three years by township and village; the case investigations; the proportion of suspected cases in which the diagnosis was confirmed serologically; and the vaccination status of confirmed cases; (2)the implementation of rubella vaccine vaccination policy for men and women: 15 months, college entry, premarital and postpartum by county.

Observations

The secular trends for the occurrence of rubella, and reported cases are in Figure 3 and Table 3. Cases of CRS between 2004 -2008 are shown in Table 4.

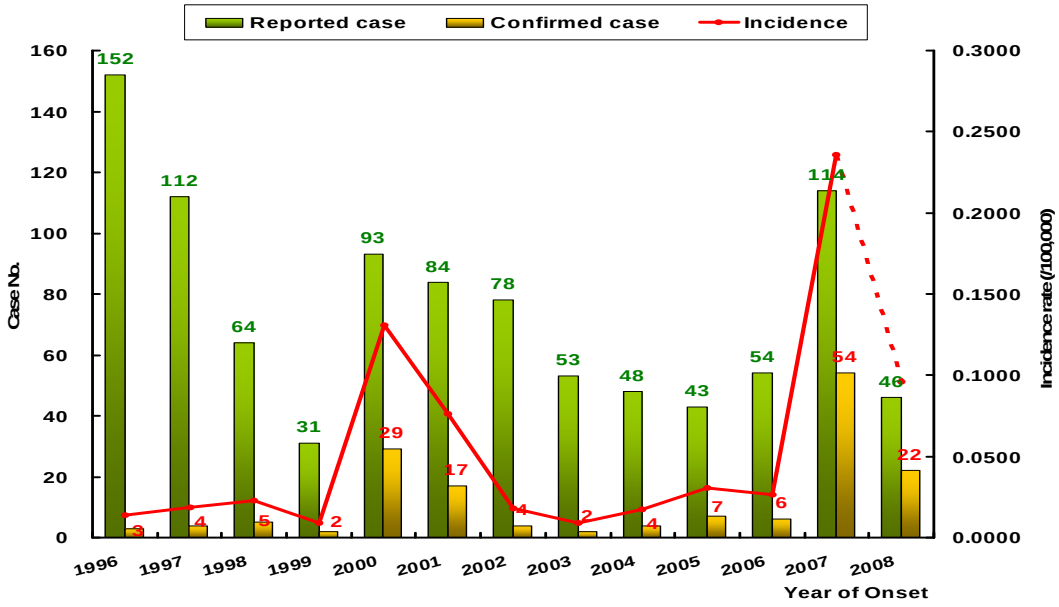

Figure 3. Trends of confirmed Rubella in Taiwan, 1996-2008*

Source: Taiwan CDC

* Data for 2008 is through May 27, 200

Table 3. Rubella in Taiwan, 2004-2008*

Year	Indigenous		Imported		Total
	Primary Cases	Epi-linked	Primary Cases	Epi-linked	
2004	4	-	-	-	4
2005	4	-	3	-	7
2006	3	-	3	-	6
2007	6	-	3	45	54
2008	2	1	3	16	22
Total	19	1	12	61	93

Source: Taiwan CDC

* Data for 2008 is through May 27, 2008

Table 4. CRS in Taiwan, 2004-2008*

Year	Reported case	Confirmed case		
		Total	Indigenous	Imported
2004	2	-	-	-
2005	3	-	-	-
2006	2	-	-	-
2007	3	1	-	1
2008	1	1	-	1
Total	11	2	-	2

Source:Taiwan CDC
* Data for 2008 is through May 27, 2008

Table 5. Age-appropriate Vaccine Coverage in Taiwan, 2001-2007

Birth cohort	Vaccine		
	DTP3 (9M)	OPV3 (9M)	MMR1 (18M)
2001	89.83%	89.78%	85.53%
2002	89.67%	89.58%	85.91%
2003	90.04%	89.83%	82.60%
2004	89.65%	89.50%	84.23%
2005	89.96%	89.79%	84.97%
2006	90.92%	90.82%	88.62%
2007	91.82%	91.70%	93.27%

Source: National Immunization Information System
*The value was calculated in October 2009.
Denominator: the number of infants registered.
Numerator: the number of infants who have completed DTP3 and OPV3 by 9 months of age and MMR1 by 18 months of age.

Between 2004 and 2008, a total of 305 suspected cases of rubella were reported, all were serologically tested, 93 were confirmed; 20 were indigenous and 73 were imported. Of the 20 indigenous cases 19 were primary cases and one spread case. Imported cases occurred each year between 2005 and 2008. Of the 73 imported cases 12 were primary and 61 spread cases (Table 3); all were over 15 years of age. Between 1996 and 2008, women in the reproductive age group have been at greatest risk of rubella.

Three outbreaks of rubella occurred in 2007and 2008 resulting in 56 cases [16]. The index case for each of the three outbreaks was imported. All index cases were confirmed by IgM. Importations occurred principally from Vietnam, Malaysia, and Thailand. Control and containment was carried out effectively.

Only one of the 93 confirmed cases reported between 2004 and 2008 was potentially preventable with the current vaccination schedule (a child 1-4 years of age); all 92 other cases were 15 years of age or older; 71(80%) had never been vaccinated.

Coverage for MMR in infants born in 2006 was 96%. Coverage among primary school entrants in September 2007 was 99%. Age appropriate immunization for MMR1 at 18 months (up to 3 months delay) varies between

counties and ranges from 80-89. Age-appropriate vaccine coverage form 2001 through 2007 is shown in table 5.

The gender distribution of cases differed significantly between indigenous and imported cases; 45% of indigenous cases as compared to 93% of imported cases were male. All cases of rash illness were tested for both measles and rubella IgM and IgG.

No confirmed cases of CRS occurred between 1996 and 2001. Three cases of CRS were confirmed in 2001. Between 2004 and 2008 (Table 4), eleven cases of CRS were reported, 2 were confirmed (one each in 2007 and 2008). Both of these confirmed cases were imported i.e. the mothers contracted rubella while abroad. Both were confirmed by their clinical presentation and IgM and IgG serology. There have been no confirmed indigenous cases of CRS since 2001.

Discussion and recommendations

The primary objective of the rubella immunization program is the prevention of CRS. The principal components of the rubella and CRS eradication strategy are active surveillance for CRS and its manifestations, and achieving and maintaining high vaccination levels for infant, children and adults, especially women of the childbearing age. At this time data are insufficient to prove that congenital rubella is not occurring. Cases could be unrecognized. Until rubella is eradicated globally, the risk of importation remains a threat. Rubella introduction and indigenous transmission must be guarded against, and the policies and infrastructure developed over the last 20 years must be sustained.

Rubella eradication is close. To demonstrate the interruption of indigenous transmission active surveillance for all rash illness with fever should continue to be vigorously undertaken. All practitioners, hospitals, pediatricians, pediatric cardiologists, ophthalmologists and public health nurses and others who might see children with birth defects need to be reminded of the potential for the occurrence of CRS. In addition, other possible sites should be alerted (e.g. teachers, obstetricians, family planning clinics, and abortion sites,) for the opportunity to vaccinate women. Single manifestations of CRS such as microcephaly, cataracts and congenital glaucoma, congenital heart disease (especially PDA, pulmonary stenosis), hearing impairment, and hepatomegaly in the newborn could be a hallmark of CRS.

A survey of schools for the deaf to determine how many young children have their deafness as a result of rubella during their mother's pregnancy may uncover unrecognized CRS. Neonatologists and neonatal audiologists who may be testing infant's hearing at birth could identify newborns that should be investigated for CRS. Neonatal ophthalmologists who see cataracts of the newborn could identify CRS.

An active search for the past 10 years would confirm the incidence of CRS. Using the "capture-recapture" statistical technique the "true" number of CRS cases during the last ten years and especially during 2007 and 2008 would give confidence to the determination of the absence of CRS [17].

Unreached/unvaccinated children and unvaccinated women in the reproductive age group should be vaccinated to interrupt

indigenous transmission, and to protect this population from spread from imported cases. A search should be undertaken for unvaccinated children by township and village to determine whether there are clusters of such children especially among moving people/migrant workers who could enable an outbreak and spread. In addition, some villages and townships have delays in the appropriate age of vaccination. The age appropriate vaccination with MMR of the last three cohorts of children should be reviewed.

Untraditional sites should be considered for vaccination of women to ensure coverage among women of reproductive age. Health care worker should be vaccinated to prevent the spread of measles or rubella to patients especially pregnant women.

The case investigation forms of the rubella and CRS cases are often incomplete. Ensure that case investigation forms are completed fully on all rash illness with fever. Ensure that serum samples from all rash and fever cases continue to be tested for both measles and rubella. Acute and convalescent serology samples should be obtained, when possible, with appropriate timing.

Performance indicators for rubella should continue to be tracked and evaluated (coverage maintained at least 95%; notification within 24 hours of rash onset; investigation within 72 hours of reporting; investigation in at least 95% of reported cases; at least 90% of reported cases to have blood specimens. Performance indicators for CRS should continue to be tracked and evaluated: notification within one week of diagnosis; investigation within one week; investigation of all cases, and obtaining laboratory specimens on all cases.

Importation has been the principal source of the only rubella recent outbreaks and CRS in Taiwan. The prevention strategy should include vaccination with MMR for foreign laborers, and foreign brides and the many business men and women and their families who travel abroad as a condition of entry/reentry. They and their husbands, wives and children are at risk and they have the potential of bringing the disease back to Taiwan [18, 19, 20, 21].

Neonatal Tetanus (NNT)

Because tetanus spores are universally present in the environment, eradication cannot be entertained [21]. However, the disease can be eliminated. The goal of the program is to protect all persons through vaccination against tetanus. Protection begins with the universal administration of DTP/DTaP beginning at 2 months of age and completing a 3 dose course with a booster at school entrance with TDaP, followed by decennial boosters with Td. Newborns are protected from NNT by tetanus antitoxin antibodies passed from the mother through the placenta [22]. Prevention of maternal and neonatal tetanus depends on births occurring in a clean birthing environment and the cutting of the umbilical cord in an hygienic way. The near universal delivery of women in hospital, the clean cutting of the cord and the absence of NNT has not required the vaccination of pregnant women with tetanus toxoid as a national policy.

Vaccination with DTP began in Taiwan in 1955 [23]. In 1961 a booster was added for older children and the military. Between 1983 and 1989 ten cases of NNT were reported. In

prior years, tetanus and NNT reporting was not separated. The majority of cases were said to have occurred in rural areas as a result of births occurring without the attendance of qualified personnel. Over the last two decades nearly 100% of women were delivered in hospital. Few infants are born outside of hospital.

A limited serosurvey in 1993 showed protective levels of antitoxin antibodies in all age groups through 65 years [24]. However, some 13% of persons >65 years had antibody titers below protective levels.

To evaluate whether elimination of neonatal tetanus has been attained [25], we reviewed: (1) The incidence and secular trends of neonatal tetanus cases, the surveillance procedures to determine whether they are adequate to identify cases, the case investigations to determine whether cases were born in hospital, and the vaccination status of mothers; (2) The DTaP/DTP coverage and the age appropriate vaccination in the last three birth cohorts of children by township and village and the completeness of the decennial booster.

Observations

The last case of neonatal tetanus was confirmed in 2001. One additional case was reported in 2007, but not confirmed. The 2001 case was born to a Vietnamese foreign bride who delivered at home and_used an unsterile scissors to cut the infant's cord.

Surveillance for cases occurred at all tertiary care centers. All infant deaths between 0 and 28 days of age and all infants born outside of hospital were followed up. Surveillance of infant deaths within 4 weeks of birth began in 2006; none of the 26 deaths in 2006, 354 in 2007 and 86 to date in 2008 were related to neonatal tetanus.

The number of infants born outside of hospital was 4 in 2004 and 3 in 2005, 7 in 2006, 213 in 2007 and 136 in 2008. All were reviewed. Neonatal tetanus was not diagnosed in any of these. No data was available on the rare unregistered (without birth certificates) live births that died in less than 4 weeks.

DTP/DTaP coverage is seen in Table 5 [26]. Age appropriate immunization for DTP3 at 9 months (up to 3 months delay) varies between counties and ranges from 80-95%.

Discussion and recommendations

Women who have zero antenatal visits present a risk of not having received decennial boosters, and delivering outside the hospital. With essentially all women delivering in hospital in a clean birthing environment, and the review of births that occurred outside of hospital not uncovering any NNT, NNT elimination has likely been accomplished. However, infants whose cord is cut with an unclean instrument, or who are delivered in an unclean environment are continually at risk of NNT. The vigilance of the MCH system surrounding clean deliveries and cord cutting must be maintained and the infrastructure of public health nurses capable of home care for deliveries and family guidance must be sustained. Special vigilance will have to continue to be given to the birthing practices of foreign brides. A single case of NNT may indicate a failure of the MCH service delivery system.

To demonstrate its elimination, active surveillance for NNT should continue to search

among infants born outside of hospital, those who died within 4 weeks of delivery, and who died within 4 weeks without a birth or death certificate. A review of the records of tertiary care hospitals for the discharge diagnosis of NNT for the past five years would help confirm elimination.

Review of coverage data showed counties with under immunized children. Review should focus on villages and townships that have lower coverage for DTP3 using GIS maps. Active searches should continue for these uncovered children and to determine whether they are clustered or they represent “zero dose children” representing a threat to the eradication/elimination efforts. Focused special vaccination efforts should be directed at these localities. Coverage data on decennial booster should be reviewed [27].

Other observations

Limited observation of the cold chain suggest that reasonable care is taken to ensure the safety of the cold chain through the monitoring of temperatures, back up and supervision capability. Potency testing of MMR vaccine for measles and rubella in 2007 of 114 samples showed that all lots tested were potent. Periodic checks of the refrigeration including potency testing of all vaccines should be made, and an annual evaluation carried out from the center to the periphery including refresher training for involved personnel.

Additional attention should be given to vaccine safety and the occurrence of adverse events. No place has been made in the NIIS system for the recording of adverse events that can be readily drawn to the attention of the doctor or nurse clearing the child for vaccination or administering vaccine. When adverse events information is recorded it is not used for decision making and no attention seems to be paid to its presence. No apparent use is made of the information when it is recorded. A review of the safety system for recording, retrieval, reporting and reviewing adverse events should be undertaken.

A school leaving immunization card should be considered that updates the childhood immunization record that documents that the adolescent has received all recommended vaccines and boosters. This would ensure particularly the coverage for measles and rubella eradication programs, and ensure the adolescent Td booster.

Determine which children/physicians are not part of the NIIS and make efforts to incorporate all children into the system (including military families).

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Effectiveness Evaluation of 1922 Communicable Disease Reporting and Consultation Hotline

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Abstract

Lessons learnt from 2003 SARS outbreak indicated that during an infectious disease epidemic, effective communication with the public is crucial to avoid misinterpretation on government's action, disease control, and prevention policies. In response to possible

future infectious disease outbreaks as well as the huge loading of customer service center and for better mobility, Taiwan CDC instituted “1922 Communicable Disease Reporting and Consultation Hotline” on February 17, 2004, which provides 24-hour service on disease report, communicable disease consultation, prevention policy promotion, and control measure education to the public throughout the year.

The operation is widely used by the public. This hotline has served as a contact point between the public and government, e.g. news event of an infectious TB patient leaving from the hospital without permission, and information security incident. From 2004 to July 2008, the Call Center currently serves over 200,000 person-times, and the majority users are from northern Taiwan. On average, the center received 4100 calls each month, and 33.3% of them (approximately 1,000 calls) were transferred to service representative to answer. The most consulting concerns are enterovirus, followed by influenza, and influenza vaccination. Average call completion rate is 99.0%, and successful response rate is 98.0%. During the enterovirus outbreak in June 2008, the 1922 Call Center successfully served as a platform of communication, this evidenced the best feature for the call center.

Conclusion: It is necessary to construct a single consultation window for infectious disease control, works on 24-hour. The platform could assure a smooth and universal notification of communicable disease, it also provides consultation services. Since the customer service affair is not the expertise of Taiwan CDC, the call service center is established by contracting to the professionals. That could save personnel and building costs, could expand the lines quickly in accordance to epidemic needs. Since most of the public consultation is responded by the service representatives in call center, the infectious disease professionals can focus on the epidemic investigation and policy implementation, which could share the responsibility and cooperate to combat against the epidemic.

In the future, for the management and rapid information exchange, the system will expand its capacity and promote for the 1922 hotline. Furthermore, Taiwan CDC plans to provide multi-language versions to the remote areas and language minorities. As for long-term goal, Taiwan CDC will actively promote and communicate the control measures with the public.

Keywords: 1922 hotline, Consultation service center, communicable disease notification, infectious disease control

Introduction

In September 1999, Taiwan CDC (TCDC) constructed a toll free hotline, 0800-024582, which transferred to a staff in TCDC headquarter and/or branch offices to answer the inquiries. During SARS outbreak in 2003, the consultation hotline experienced extremely high volume calls, since the shortage of telephone lines and manpower; the phone line status appeared frequently busy and can not satisfy to the public’s interests. The TCDC received complaints, due to lines congestion; it is not possible to maintain the direct channel for the public to obtain the disease notification.

Therefore, TCDC requested assistance of toll free hotline system from Bureau of National Health Insurance, and gained mitigation for the line congestion situation.

Since the hotline number 0800-024582 was too complicated to be memorized for the public, TCDC requested special 4 digits number of "1922" from National Communications Commission (former Directorate General of Telecommunications, Ministry of Transportation and Communications), which was easy to remember and could integrate other service consultation hotlines in CDC. The hotline service began on May 2003.

Due to the SARS outbreak and in response to future epidemics or outbreaks, TCDC constructed "1922 Communicable Disease Reporting and Consultation Hotline" (service center) on February 17, 2004. This is firstly implemented Call Center for public infectious disease notification and response to the public inquiry consultation, which solves line congestion problems and can directly communicate with the general public.

Call Center adopts computer system to integrate the Interactive Voice Response (IVR), Knowledge Management (KM), Voice Dialing System (VDS), Telephone Marketing, and related accessories systems, and the center has the capacity to expand for call loads and better mobility. The system could provide the general public one-stop service, which is more active than conservative actions. The Call Center was widely adopted in the insurance industry, financial holding, telecommunication, as well as stock companies. However, in the international societies, choosing the call center as crucial roles for infectious disease control was only published in recent years. The China Department of Health established the 12320 National Public Health Hotline in 2005 [1] based on Hong Kong experience of 1823 hotline, and covered service area to nationwide on January 1 2006, which was used for public health emergency notification, prevention service inquiries, as well as public health regulations and laws consultation [2]. The Beijing Health Bureau integrated public complaints hotline, service hotline, and city disease control hotline to construct Management Center for 12320 Public Health Hotline, which provided 24-hour service [3-4].

In November 2007, AHRQ (Healthcare Research and Quality) in the Department of Health and Human Services (DHHS, USA) issued instructions and indicated the community should expand the Call Center to prepare for the public health emergency and provide the general public essential information to help the public recognize the risk and to make appropriate decision [5-7].

Comparing the aforementioned international experiences, Taiwan CDC has 1922 Call Center constructed in 2004, and is the pioneer of the integrated call center.

Services

1. Infectious disease consultation: travel information and general consultation.
2. Infectious disease notification: Receiving from general public to report the cases. In 2008, under the cross strait tourism policy, the Call Center was the contact point of fever events for Tourism Bureau, Ministry of Transportation and Communications.
3. Contact point for special and emergency events: For example, in July 2007, an event

of a multi-drug resistance tuberculosis patient leaving country without permission; in November 2007, tuberculosis information security incident; in May 2008, seeking for a missing multi-drug resistance tuberculosis patient.

System construction

1.Concerning hardware and software equipments, human resource costs, and space maintenance, TCDC establishes the service center by contracting. The vendor should have professions in customer service, telecommunication, and information technology.

2.Personnel training: All service representatives should receive the education of infectious disease control and qualification test. After qualification, the staffs should obtain continuous training programs.

3.Service indicators and service hours:

Since TCDC focuses on communicable disease control, in responding to the emerging outbreaks, TCDC would allocate resources and mobilize manpower by the level of severity. In response to different levels of emergencies, the 1922 Call Center has the capacity of telephone lines, hardware and software equipments, as well as the manpower allocation to maintain the service quality.

(1) Answer rate-IVR: average over 97%.

(2) Answer rate-agent: average over 90%.

(3) To achieve the requirements of call completion rate and successful response rate, the contractor should adjust the manpower, software and hardware equipments. When lifting the infectious disease alert levels, the Call Center should complete the adjustments within 2 days after receiving the requests from TCDC.

Service hours: 24 hours a day, 7 days a week. Open year round.

4.Information systems:

(1) Interactive Voice Response (IVR): Provide Mandarin Chinese, Taiwanese, and English service for infectious disease notification and consultation. The services included consultations, e.g. enterovirus, dengue fever, H5N1 avian flu, HIV AIDS, as well as tuberculosis; policy promotions, e.g. flu vaccination, harm reduction program for injection drug users, directly observed treatment, short-course program for tuberculosis patients, and exit control for infectious TB patients. Furthermore, in response to emerging outbreaks, e.g. acute conjunctivitis, the Call Center needs to design audio description on disease information.

(2) Knowledge Management: In 2006, the Call Center constructed the KM system to gather frequently asked questions and set up standard operation procedure to respond to the public's inquiries for the service representatives.

(3) Public inquiry information management webpage: At the time when lifting the infectious disease alert levels, TCDC needs to know what are the public concerns and inquiries promptly for policy decision making. In May 2008, the Call Center constructed portal webpage for information management, which linked the service receiving and

management systems in the Call Center. The webpage could manage and search for inquiry from the general public, and export in charts, graphs, and statistical numbers, which could monitor the callers' concerns in real time, and transfer to jurisdiction branch offices to download and update the status of action taken.

(4) Record system: All received inquiries were recorded automatically and which could be retrieved if needed.

(5) Three-party systems (multi-conference system): If needed, the Call Center could activate three-party systems to connect the service representative, caller, and professionals to response to the inquiries in time.

Caller analysis

1. Utterance location: According to statistics, the majority of utterance location was not provided / unknown (approximately 38.8%), which might be the caller would like to keep confidentiality and setup caller identification as not shown, or would not provide contact phone number. The following callers were from Taipei City, 18.7%, Taipei county, 9.6%, Taoyuan county, 5.4%, and Kaohsiung City, 3.4%; the less was from Kinmen, Penghu and Lienchiang counties, which were islands outside of Taiwan (Figure 1).
2. Statistics of Interactive Voice Response (IVR):
   (1)Service languages: The majority service language was Mandarin Chinese, 64.1%, and the next following was Taiwanese, 30.6%, and English, 5.2%.
   (2)Service items: The majority service was transfering to service representatives or infectious disease notification, 57.5%, and the following was consultation, 21.6%, mostly on dengue fever and enterovirus, then communicable disease policy and promotions, 20.8%, mostly regarding flu vaccination.

Service effectiveness

1. Since the construction of Call Center, the total amount of service had reached over 200,000 person-times. In 2008, the service person-times had increased over 65%. The average receiving calls had reached 4,100

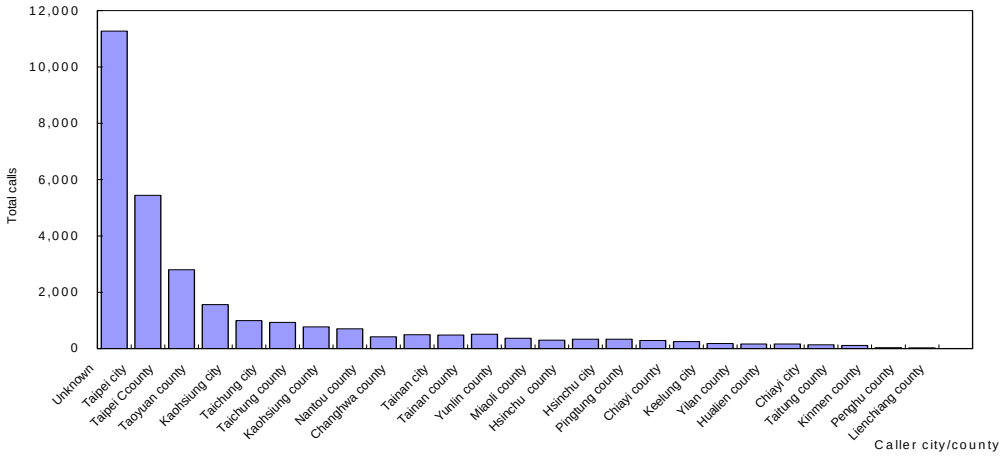

Figure 1: Caller geographic distribution from 2006 to July 2008

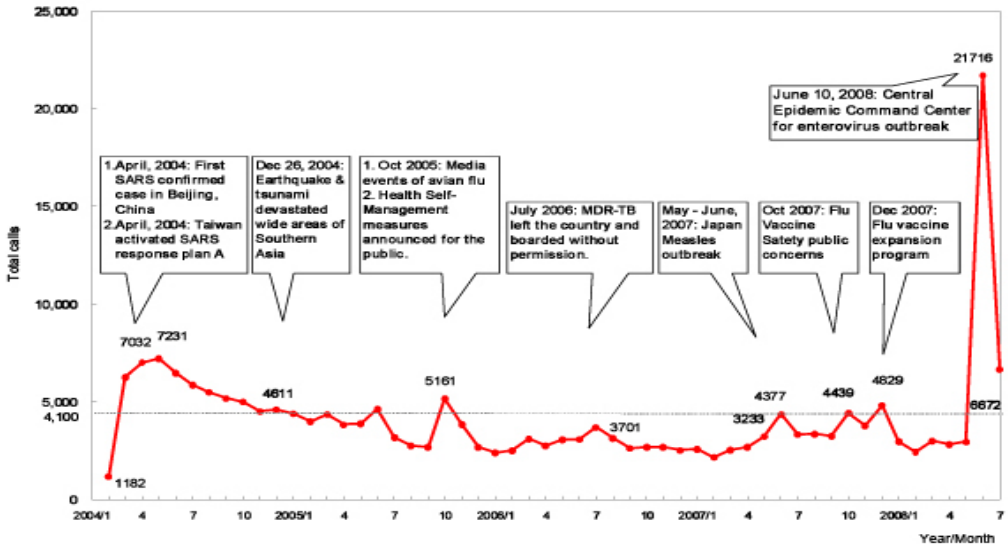

Figure 2. Total incoming calls from February 2004 to July 2008

calls a month, and one third of which (approximately 1,000) was transferred to service representatives. The key factors of influencing calls were the communicable disease alert level, media effects, and new policy implementation. The Enterovirus outbreak in June 2008 was the most significant example, the total incoming calls and amounts to transfer to service representatives were five times than average (Figure 2). The average call completion was 99%, and call successful response rate was 98%.

2. Transfer to service representatives: The majority was the consultation service, 63%, followed by irrelevant calls, 32%, and other services, such as inquiries, non CDC responsibility affairs (4.2%), and infectious disease notification (less than 1%). Among the consultation services, the majority was the general inquiry, 93%, followed by international travel information, 2.3%, and domestic communicable disease situation inquiry, 1.5%.

(1) Since 2006, the Call Center established infectious disease statistics and categorized consultation inquiries. From 2007 to July, 2008, the most general public consultation topics were enterovirus (42.8% of top 10 major infectious diseases), and followed by flu and flu vaccination (19.9%), international travel advisory for communicable diseases (11.1%), tuberculosis (7.3%), and HIV/AIDS (6.5%) (Figure 3). Among the enterovirus issues, the general public concerned disease symptoms the most, followed by prevention measures and enterovirus severe case care network. Among the flu and flu vaccine issues, the general public concerned contracted vaccination clinic or hospitals the most, followed by vaccination population and priority program. Among international travel advisory, the general public concerned contracted hospitals the most, followed by communicable disease situations of travel destination, and international vaccination program.

(2) Irrelevant calls (including caller hang up, harassment calls, wrong number, and non response after connecting): The majority of those irrelevant calls was caller hanging up (38.2%), mostly hanging up right after connecting, and followed by harassment calls (33.0%), mostly were children placing calls, religious propaganda, sexual harassment and political critics (Figure 4).

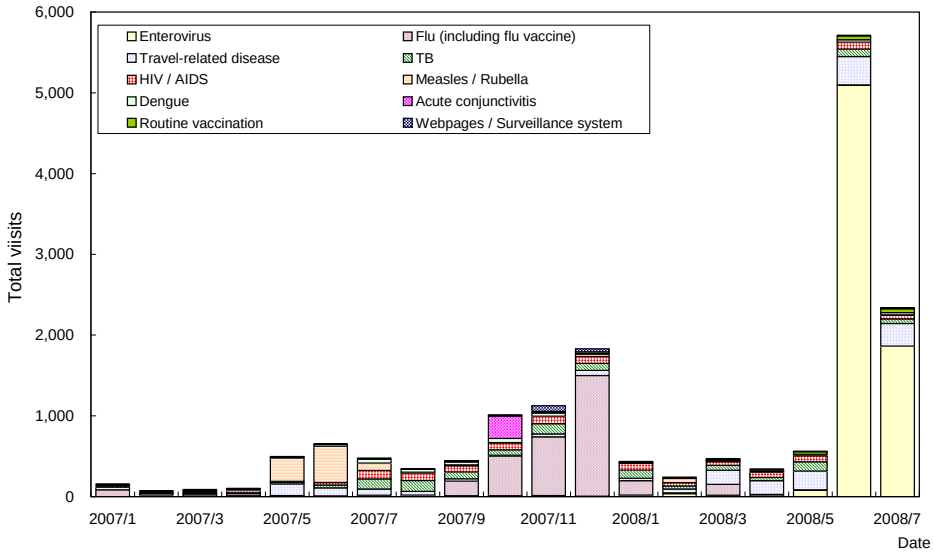

Figure 3: Statistics of consultation category from 2007 to July 2008

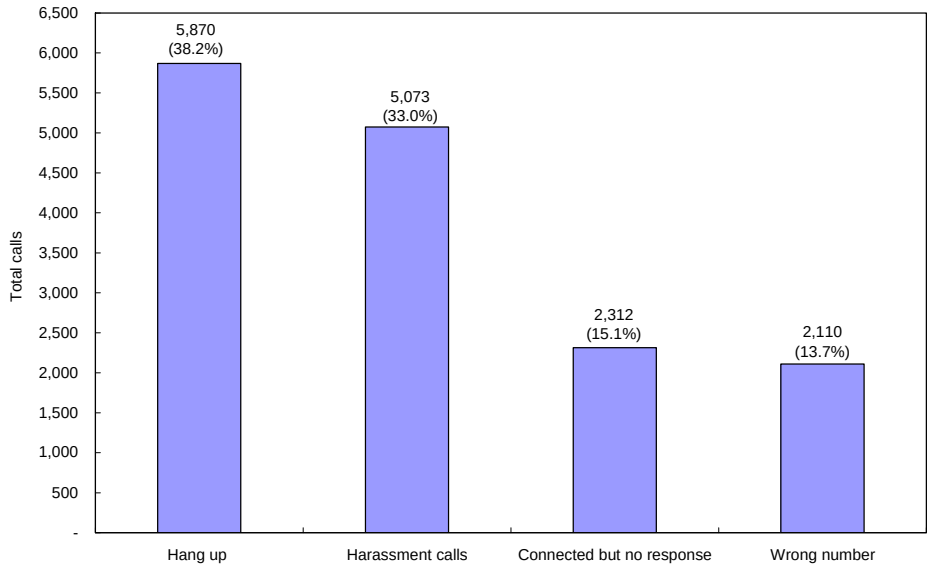

Figure 4: Statistics of irrelevant calls from April 2005 to June 2008

3. Experiences in epidemic – Example of enterovirus outbreak in June 2008

In June 2008, the enterovirus 71 outbreak was more active than previous years, and the severe cases increased. On June 10, TCDC constructed a Central Epidemic Command Center (CECC); on June 12, publishing Regulations on the Suspension of Classes for kindergarten, elementary grade 1 and 2 students; on June 22, publishing Regulations on the Suspension of Playgrounds in medical facilities; from June 19 to 22, with the assistances from National Communication Commission, TCDC requested the telecoms to send enterovirus information through mobile message; from June 23 to 25, TCDC sent the care phone calls for children to registered household telephone number. During the enterovirus outbreaks, the 1922 Call Center served as platform for general public and government, gather public concerns, complaints, suggestions and comments for policy making references.

(1) Total incoming calls achieved highest volume: Due to the expected public concerns would increase significantly, TCDC requested the Call Center to increase lines, service representatives, to prepare for enterovirus frequently asked questions, and procedures for complicated cases. From June 16, the total incoming calls showed increasing trend. Due to the mobile phone text message dispatch, on June 21, the total incoming calls received over 3,600 calls, which was the highest volume from 2004 to July 2008, 10 times more than average, since the establishment of 1922 Call Center (Figure 5). Since its initial preparation, the successful response rate (answer rate-IVR) was over 97%.

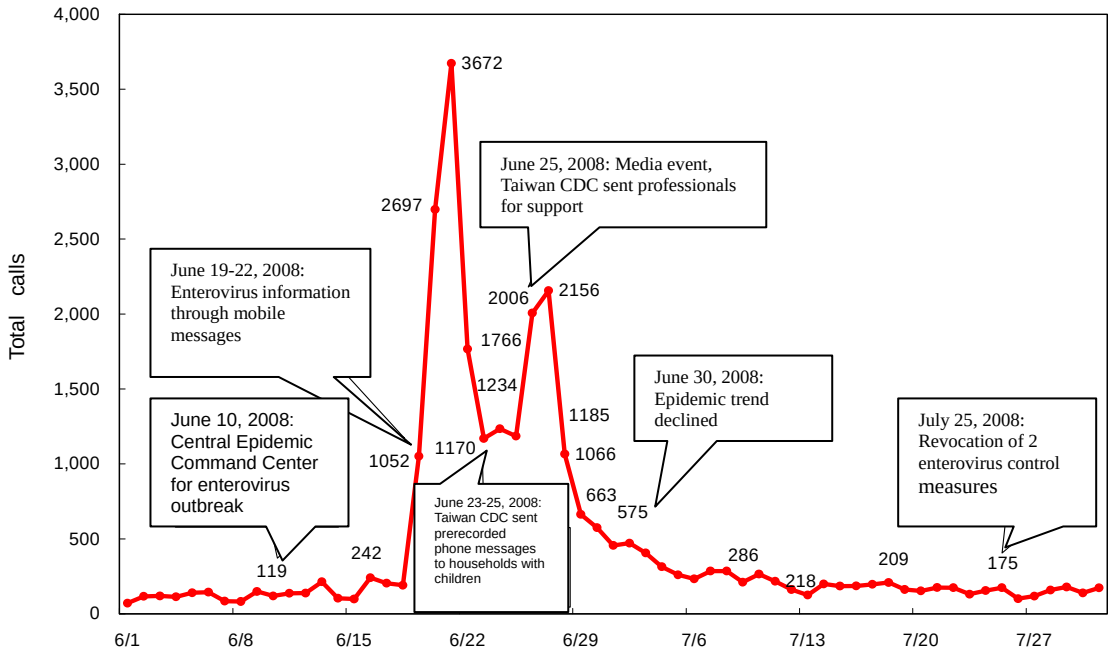

Figure 5: Total incoming calls on enterovirus outbreak from June to July 2008

(2) Total transfer to service representatives achieved highest volume: On June 25, the press media kept reporting that 1922 Call Center could not answer the inquiries regarding enterovirus severe case care network in time, the incoming calls increased significantly. On June 27, the total transferring to service representatives amounts achieved over 700 calls, which was the highest ever recorded from 2004 to July 2008. Since the early manpower allocation, the successful response rate (answer rate-agent) was over 97%.

(3) Communication platform between the general public and government: Since the press media reported the outbreaks of enterovirus, which caused the public panic. From June to July 31, the incoming enterovirus inquiries to 1922 Call Center calls to transfer to service representatives achieved 4,985 calls, which was 60.0% of total service representatives calls (Figure 6). Among which, requests for investigation on schools not following regulations of class suspension due to enterovirus outbreak achieved over 150 events, treatment remedy, enterprise cooperation proposals, complaints, and policy suggestions reached over 100 events; those were references for the CECC policy making.

(4) Other responses: On June 25, the media reported negative impression of 1922 Call Center and questioned the professionalisms of service representatives. TCDC promptly provided support and assistances, and allocated infectious disease control professionals to support and also assigned medical officers stationed at service center to answer the public inquiries directly. In addition, many callers indicated that after connecting, the advocacy of health education occupied direct response time and prolonged the waiting period; the Call Center changed the settings in time for transferring to service representatives as the first option, and provided more efficient services.

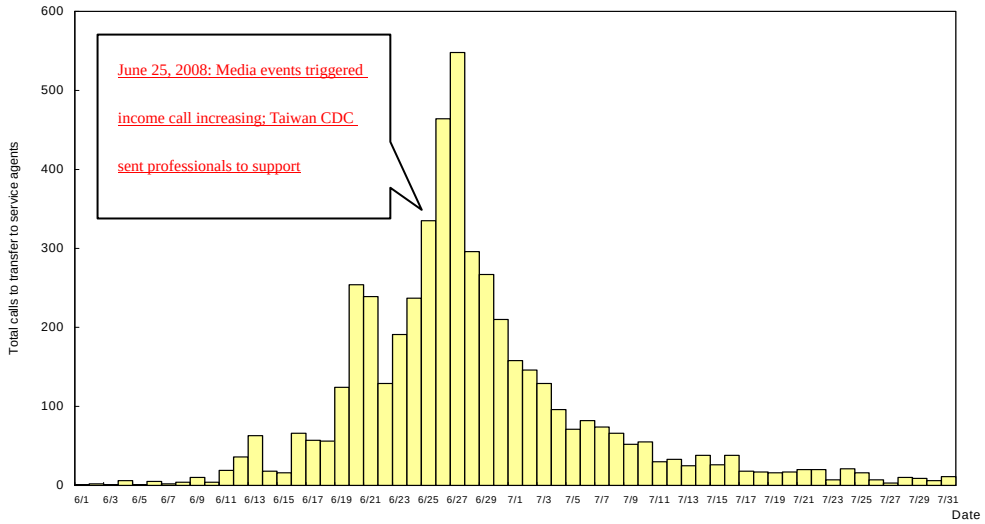

Figure 6: Statistics of incoming enterovirus consultation calls transferring to service representatives from June to July 2008

Conclusions

1. Since the establishment of 1922 Call Center in 2004 to July 2008, it has been serving over 200,000 person-times. In response to the rising standard of living and the increasing travel abroad, the infectious disease control issues becomes more significant. Installing a 24-hour communicable disease reporting and consultation hotline would be necessary for general inquiries or during disease outbreak periods. The Call Center could provide consultation services and notification of infectious disease to control the epidemic from spreading.
2. To provide a better customer service to public, TCDC contracted through vendor to construct the service center, and to use its professions of telecom, customer service, and information technology to assist the implementation of infectious disease affairs. This approach could not only save the costs of construction and personnel, but also could provide flexibility and mobility if needed to quickly response to infectious disease outbreaks. However, routine exercises could help service representatives to respond quickly to communicable disease emergencies.
3. After continuous training for the service staffs, they could directly answer some of the general public inquiries. The enterovirus outbreak experience in June 2008 showed that service agents could share the workload and health professions could focus on disease investigation, policy making, and auditing. However, the first line service representative should have sustained training courses and for those inquiries could not respond in time, the service staffs should seek for related information or assistance from TCDC.
4. The experience of outsourcing and running model of 1922 Call Center draws attention from other agencies or departments. TCDC received many inquiries regarding the construction experiences and related questions.

Future directions

1. The knowledge management system in 1922 Call Center has accumulated general public inquiries and frequently asked questions for 3 years, which is transcribed in local languages and could be references for infectious disease control. However, due to the firewall settings, the system could be used by the staffs in Call Center only. In 2009, TCDC proposed to have connections with TCDC IT systems to share the resources and standardize answers to frequently asked questions.
2. Due to the space limitation, the 1922 Call Center was constructed in telecom site, which only allows telephone call to realize on-site status. In 2009, TCDC was building web-cam system, which could not only realize the current status in service center in time, but also provide immediate assistance. Through web-cam system to connect 1922 Call Center and Epidemic Intelligence Center, this model shall provide effective communication platform in infectious disease epidemics.
3. According to users' analysis, the people in northern Taiwan used the system most and the remote islanders used least. Therefore, TCDC could promote the use of 1922 Call

Center and expand services through multilingual versions.

4. The 1922 Call Center became popular by media promotions. However, the interaction approach was conservative and could be improved and integrated with IT systems by providing active health education on communicable disease using current foundation. The platform could gather public opinions, suggestions, and comments on infectious diseases for policy making references.
5. In the future, TCDC could be represented by the unique number 1922 and use voice system to connect branch offices to expand services. However, TCDC should update relevant equipments to be compatible in different systems and solve potential huge phone bills.

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The infectious disease involved many disparate issues, and the general public inquiries were complicated as well. The authors wished to appreciate CDC staffs in different divisions who provided professional supports; as well as to the telecom actively assisted the infectious disease control affairs.

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