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Investigation of a measles outbreak in Cordillera, northern Philippines, 2013

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Introduction: Measles is a highly infectious viral illness that remains one of the leading causes of death among children worldwide. In the Philippines, decreasing routine vaccination coverage from 2007 to 2011 led to local measles outbreaks. A team investigated a measles outbreak reported in Cordillera of the Philippines in May 2013.

Methods: Measles case data with symptom onset from 2 February to 27 May 2013 were obtained from official sources and verified on site. Data included age, sex, residential address, signs and symptoms and vaccination status. Active case-findings were also conducted for contacts of these cases. The living environments of the cases were investigated. A survey was conducted with the cases and caregivers to understand their knowledge and attitudes about measles.

Results: There were 50 measles cases identified with an age range from six months to 32 years (median: 16 years). Thirty-two were male (64%). Twenty (40%) were hospitalized with one death. Thirty-two (64%) cases were laboratory confirmed, and 36 (72%) received a single dose of measles vaccine. Overcrowded living environments were observed among many cases. The majority of respondents (46/48, 96%) knew about measles, but there were misconceptions about the cause of measles and how it can be prevented and managed.

Conclusion: This measles outbreak occurred in an area with low immunization coverage. Achieving 95% measles immunization coverage and strengthening routine immunization strategies to address high-risk populations are recommended. Also, we recommend health education campaigns to include components that address misconceptions about measles.

Measles, a highly infectious viral illness, remains one of the leading causes of death among children worldwide.[1] It is caused by an RNA virus of the paramyxoviridae family which belongs to the genus morbillivirus. Its incubation period ranges from 7 to 21 days (rash appears after 14 days of exposure).[2] In 2012, an estimated 122 000 deaths caused by measles infections were reported globally.[3]

In the Philippines, measles was targeted for elimination by 2008. Routine immunization coverage of at least 95% of infants is considered the most important strategy to control measles in the country.[4] The first dose of measles-containing vaccine (MCV1) is administered nine months after birth, and the second dose (MCV2) is given at 12 to 15 months. A decrease in routine measles vaccine coverage was observed in recent years. Also, the coverage of nationwide supplementary immunization activities targeting children aged nine months was 94–95% in 2007 but decreased in 2011,[5] probably leading to a measles outbreak in 2013.

Baguio city, a mountainous city in Benguet province of the Philippines, has a cool climate which attracts tourists the entire year. In the 2012 fully immunized child report, Baguio city had a measles immunization coverage of 78.3%, while Benguet province's coverage was only 66.7%.[6] On 28 May 2013, the Philippine Event-based Surveillance and Response Unit received a report of 28 measles cases from the health officials of the Cordillera region that includes Benguet province and Baguio city. This study documents the investigation of the outbreak conducted by a team from the Philippines Field Epidemiology Training Program.

METHODS

Measles case data with symptom onset from 2 February to 27 May 2013 were obtained from a line-list prepared by the Philippine Event-based Surveillance and Response Unit. Data collected from the line-list included age, sex, residential address, signs and symptoms and vaccination status of the cases. The investigation team verified the

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Table 1. **Characteristics of the measles cases, Cordillera, Philippines, 2013 (*n* = 50)**

Characteristics	*n*	%
Sex		
Male	32	64
Female	18	36
Age group (years)		
< 1	3	6
1–5	9	18
6–10	3	6
11–15	19	38
16–20	11	22
21–25	1	2
> 25	4	8
Case type		
Laboratory-confirmed	32	64
Clinically confirmed	3	6
Epidemiologically linked	1	2
Suspected but not confirmed	14	28
Outcome		
Not hospitalized	29	58
Hospitalized	20	40
Died	1	2
Vaccination status		
None	10	20
MCV1 only	36	72
MCV1 + MCV2	0	0
Unknown	4	8
Reasons for not vaccinated (n = 10)		
Too young	4	40
Belief against vaccination	2	20
Fear of adverse events	2	20
Forgot vaccination schedule	1	10
Vaccine unavailability	1	10

MCV, measles-containing vaccine.

measles cases and their vaccination status by visiting the listed cases on site. Active case-findings were also conducted for contacts of the listed cases.

We followed the definitions of the United States Centers for Disease Control and Prevention (CDC) for measles in this study.[7] A suspected measles case was defined as a previously well individual from Cordillera with a history of fever for at least one day; generalized maculopapular rash with any of the following: cough, coryza and conjunctivitis; and with symptom onset from 2 February to 27 May 2013. A laboratory-confirmed measles case was defined as a suspected case with a positive measles immunoglobulin M (IgM) test. An epidemiologically linked case met the suspected case definition and was epidemiologically linked to a laboratory-confirmed case. A clinically confirmed case met the suspected case definition but with no adequate blood specimen. We obtained serum samples from the subjects and sent them to the national reference laboratory for measles IgM detection by enzyme-linked immunosorbent assay (Siemens Healthineers enzygnostic anti-measles IgM test, Erlangen, Germany).

Residential environments of the cases were inspected to determine the environmental factors that might contribute to measles transmissions. Knowledge and attitudes about measles were collected through a survey by interviewing the case or his/her caregivers if the case was below 15 years.

Epi-Info version 3.5.4 (CDC, Atlanta, USA) was used for all data analyses.

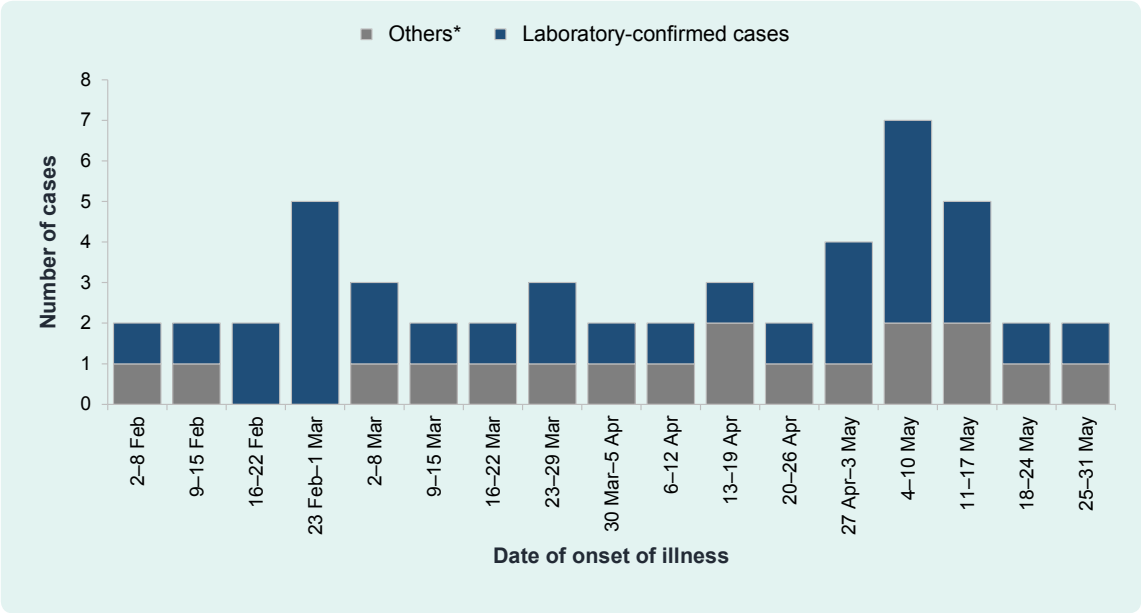
RESULTS

Measles cases

There were 50 suspected measles cases identified throughout the study period. A total of 40 serum samples were collected from 40 cases; 32 of them were positive for measles IgM. The cases were not re-tested after their illness. There was also one (2%) epidemiologically linked case and three (6%) clinically confirmed cases. The ages of the cases ranged from six months to 32 years (median: 16 years), and there were more male (32/50, 64%) than female cases. The most affected age group was 11 to 15 years (19/50, 38%). Twenty cases (40%) were hospitalized and one died (case fatality ratio = 2%) (**Table 1**). The majority of cases had cough (45/50, 90%) and coryza (37/50, 74%). One case developed measles one week after MCV1 vaccination. Cases started to emerge on 2 February 2013 in Benguet province and 5 March 2013 in Baguio city. The number of cases peaked during the period 22 to 26 February 2013 (**Figure 1**).

Thirty-six (72%) of the 50 measles cases were vaccinated with a single dose of measles vaccine. Four (8%) had an unknown vaccination history.

Figure 1. **Distribution of the measles cases by onset date of illness, Cordillera, Philippines, 2013 (n = 50)**



* Including suspected, clinically confirmed and epidemiologically linked cases.

Ten (20%) were unvaccinated; of the unvaccinated cases, four were too young (40%), two (20%) had beliefs against vaccination, two (20%) feared adverse effects, one (10%) forgot vaccination schedule and one (10%) was due to vaccine unavailability (**Table 1**).

Sixteen measles cases (of which 12 were confirmed cases) were from one secondary school in Benguet. Twelve of them (75%) were males aged 13 to 16 years. The index case among these 16 cases was a 14-year-old female from the same school who attended school during manifestations. Among the 16 school cases, 15 (94%) received a single dose of measles vaccine, including one clinically confirmed case.

Environmental investigation

All the cases were living in houses that were constructed of concrete or wood or a combination of both. The houses were dim, poorly ventilated and close to each other; overcrowding was observed in most of the houses. The majority of the cases (35/50, 70%) lived with extended families composed of four to 11 individuals. For those who were living in apartments, each floor of the apartments had one common kitchen with six to eight rooms for accommodation.

Knowledge of measles

In total, 48 subjects were interviewed. The majority (46/48, 96%) knew that measles is an infectious disease. Sources of information about measles were mainly relatives (20/48, 42%), neighbours (8/48, 17%) and health centres (8/48, 17%). Twenty-four interviewees (50%) did not know the cause of measles. For those who claimed that they knew the cause, their answers were unsanitary environment (11/48, 23%), exposure to sick person (8/48, 17%) and lack of sleep (2/48, 4%). The majority (29/48, 60%) believed that measles is contagious. Thirty-four (71%) feared measles as they believed that measles is a fatal disease (20/48, 42%) and contagious (10/48, 21%). Ten (21%) of them did not know what to do if a family member was infected with measles. Twelve (12/38, 32%) claimed that the family member should consult a doctor, while nine (9/38, 24%) said that measles patients should not be exposed to cold weather (**Table 2**).

DISCUSSION

Nation-wide measles resurgence in the Philippines can be attributed to the insufficient measles elimination strategies previously implemented. In this study, measles outbreaks occurred among inadequately vaccinated

Table 2. **Measles knowledge and attitudes of the measles cases and their caregivers, Cordillera, Philippines, 2013 (n = 48)**

Knowledge and attitudes towards measles	n	%
Source of information about measles		
Relatives	20	42
Neighbours	8	17
Health centres	8	17
Media	6	13
Previous measles infection	2	4
School teacher	2	4
Do not know	2	4
Believe measles is contagious		
Yes	29	60
No	19	40
Know the cause of measles		
Yes – unsanitary environment	11	23
Yes – exposure to sick person	8	17
Yes – lack of sleep	2	4
Yes – cold air	2	4
Yes – poor health	1	2
No	24	50
Fear of measles		
Yes – measles is a fatal disease	20	42
Yes – measles is contagious	10	21
Yes – others	4	8
No	14	29
Know what to do if a family member was infected with measles		
Yes	38	79
No	10	21
What to do if a family member was infected with measles (n = 38)*		
Consult a doctor	12	32
Do not expose to cold weather	9	24
Isolate patient	8	21
Do not bathe	5	13
Eat healthy foods	3	8
Take medicine	3	8
Eat egg	2	5
Proper hygiene	2	5
Wear black	1	3
Immunization	1	3

* Multiple responses were allowed.

groups with low measles immunization coverage. Low coverage has resulted in an accumulation of measles-susceptible children and young adults. The failure of previous campaigns to provide sufficient population immunity against measles contributed to a shift in the at-risk population from young children to various age groups.[5]

Insufficient measles immunization coverage in the Philippines has created the build-up of susceptible populations: those unimmunized and those who received just a single dose of measles vaccination. One dose of MCV alone cannot be attested to providing sufficient immunity. This can be further exemplified by the affected age groups: the school-age children and adolescents born before the introduction of two-dose measles vaccine in the vaccination programme in 2009. Nevertheless, a previous study showed that measles outbreaks can occur even in fully vaccinated populations.[8]

We revealed a cluster of measles-infected cases in a secondary school. We established exposure linkages of all student cases to the index case before their symptom onset. A previous study in Germany also reported similar age patterns for measles among the young adult age group.[9] Measles infection among this age group may be associated with the absence of previous measles exposure or failure of previous measles vaccination campaigns; as in this cluster, we found nearly all cases received just a single dose of measles vaccine.

In this study, most of the measles cases were living with an extended family. Overcrowded living environments significantly increased the risk of measles infections. This confirms that increased exposure to measles cases also increases the likelihood to develop the disease.[10] Also, measles viruses remain contagious in the air or on infected surfaces for up to two hours.[11] The living conditions hastened the transmission through suspended droplets that are easily inhaled in closed areas.

We found that cases and caregivers had misconceptions about the cause of measles and how it can be prevented and managed. In India, one barrier

identified for poor measles coverage was inadequate knowledge of the disease and measles vaccine.[12] National programme managers should strengthen the measles education campaigns, especially to streamline those targeting hard-to-reach areas.

Several limitations had been identified in the study. Our active case-findings were limited to only contacts known by the measles cases. Also, some cases might be missed due to remote geographic locations that the investigation team could not reach. Immunization status of the subjects was only verbally validated. The majority of cases had no vaccination card or proof, and recall bias was inevitable. Despite these limitations, this outbreak investigation verifies the measles infections pattern among school-age groups and the occurrence of measles outbreaks in overcrowded areas.[13,14]

Based on the investigation, immunization strategies should be designed and implemented to address measles-susceptible populations in the Philippines. School-based immunization programmes for measles are recommended. Efforts should be taken to achieve 95% MCV1 and MCV2 coverages in the country by strengthening the existing vaccination programmes. Also, we recommend health education campaigns to include components that address misconceptions about measles.

Conflicts of interest

None declared.

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Trends in the incidence of acute watery diarrhoea in the Lao People's Democratic Republic, 2009–2013

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Diarrhoeal disease is the second leading cause of death in children under age 5 worldwide, with rotavirus being the main etiology. In the Lao People's Democratic Republic, acute watery diarrhoea (AWD) was introduced as one of the national notifiable diseases in 2004. We retrospectively reviewed the aggregate (n = 117 277) and case-based (n = 67 755) AWD surveillance data from 2009 to 2013 reported weekly from 1115 health facilities nationwide. Rotavirus rapid test data from all eight sentinel sites in Vientiane Capital in 2013 were also collected for analysis. The incidence of AWD ranged between 215 and 476 cases per 100 000 population and increased from 2009 to 2012 when it levelled off. The most affected age group was children under 5 who were about seven to nine times more likely to have AWD than the rest of the population ($P < 0.0001$). In children under 5, 74.8% of the cases were aged 0–24 months and AWD was 1.28 times more common in males ($P < 0.0001$). Among the 230 stool specimens tested in children under 5 in 2013, 109 (47.4%) tested positive for rotavirus. The increased AWD incidence over the study period may reflect a true increase in AWD or an improved sensitivity of the system. We recommend new mothers breastfeed up to two years after birth, which is known to reduce AWD morbidity and mortality in young children. We also recommend conducting rotavirus disease burden and cost-effectiveness studies to explore the benefits of introduction of rotavirus vaccine.

Diarrhoeal disease is the second leading cause of death in children under age 5 worldwide and is estimated to kill 700 000 children annually.[1,2] In the past few decades, efforts to improve diarrhoea prevention and management have significantly reduced the number of diarrhoeal deaths in developed countries.[1] However, diarrhoeal disease remains a significant disease burden and one of the leading causes of death in children under age 5 in less developed countries where there are ongoing problems with poor nutrition and sanitation and access to safe water.[1, 3]

Acute watery diarrhoea (AWD), which can last several hours to several days, is defined as the passage of three or more loose or liquid stools within 24 hours.[4] Severe and fatal diarrhoea occur when depleted body fluids are not replenished, leading to severe dehydration. The major causes of AWD in less developed countries include bacterial, viral and parasitic pathogens spread by the fecal–oral route through contaminated food, water or fomites as a result of poor hygiene.[5] In children under age 5, rotavirus is the leading cause of AWD globally and contributes to 38.3% of the hospitalization for diarrhoeal diseases.[5]

In the Lao People's Democratic Republic, it has been estimated that 11% of the under-5 mortality is due to diarrhoea.[6] In 2004, AWD was added to the list of the National Notifiable Diseases, and the epidemiological trends of AWD are monitored through an indicator-based surveillance (IBS) system. In this system, all AWD cases presenting to health facilities are reported weekly to the National Center for Laboratory and Epidemiology (NCLE). In 2008, an electronic reporting system, Lao People's Democratic Republic Early Warning and Response Network (LAOEWARN), was introduced and replaced the previous paper-based reporting system, as described previously.[7] LAOEWARN is an Access-based (Microsoft Corporation, Redmond, WA, USA) electronic database in which weekly reports of all 17 nationally notifiable diseases and syndromes, including AWD, are entered and stored. This system also generates automated early warning alerts. To monitor the etiology of diarrhoeal diseases, eight diarrhoea sentinel surveillance sites were established in Vientiane

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Capital in 2013. These sites collect stool specimens from diarrhoea patients; specimens from patients under age 5 collected during the dry winter season (from October to April) are sent to NCLE for rotavirus testing.

Since the introduction of LAOEWARN, there has been no formal analysis of AWD data over time, and little is known about the geographic distribution of AWD in the Lao People's Democratic Republic. In this study, we aim to describe the trends of AWD in the Lao People's Democratic Republic from 2009 to 2013 with a particular focus on the prevalence of rotavirus-related morbidity in children under age 5.

METHODS

We conducted a review of AWD notification data by person, place and time. We also analysed the laboratory results from all eight diarrhoea sentinel sites in the Lao People's Democratic Republic.

Data source

Case definition

An AWD case was defined as any patient passing loose or watery stools three or more times within 24 hours, which is consistent with World Health Organization (WHO) guidelines.[4]

IBS case-based data and LAOEWARN aggregated data for AWD

IBS passively collects aggregated and case-based reports of AWD cases from a total of 1115 health-care facilities nationwide. Weekly, information of AWD cases is first reported from 949 health centres and 142 hospitals to their district health offices by fax, telephone or in person and compiled into a line list. Together with the compiled data from 17 provincial and seven central hospitals, information is reported to the provincial level by email or fax. All the line lists are then compiled into an overall AWD line list (case-based data) that is emailed to NCLE, and a record of the aggregated AWD cases that is entered into LAOEWARN (aggregated data). The case-based data are in Excel format (Microsoft Corporation, Redmond, WA, USA) and contain data of demographics, location, onset date and the date of hospitalization of the cases. The aggregated data contain four variables: number of cases and deaths, location and the week of reporting. Both case-based and aggregated data in 2009–2013 were analysed in this study.

Diarrhoea laboratory sentinel surveillance

We reviewed the 2013 laboratory data from all eight diarrhoea sentinel surveillance sites, which are all based in Vientiane Capital. Patients under age 5 with acute diarrhoea presenting to one of these sites during the dry season (October to April) were tested for rotavirus infections. Stool specimens collected from these cases were sent to NCLE for rotavirus rapid testing (Standard Diagnostics Inc., Gyeonggi-do, Republic of Korea). On rare occasions, some specimens were not tested due to the unavailability of technicians or test kits.

Data analysis

We conducted descriptive analysis of AWD data using Excel. Overall, age- and sex-specific incidence rates were calculated for individual years using population figures from NCLE. Relative risks and 95% confidence intervals (CI) were calculated using Epi Info version 7.1.4 (Centers for Disease Control and Prevention, Atlanta, GA, USA). We mapped the geographical distribution of case notification rates by location using ArcView GIS version 3.2a (ESRI, Redlands, CA, USA).

Since all data collected were de-identified secondary data, ethical approval was waived.

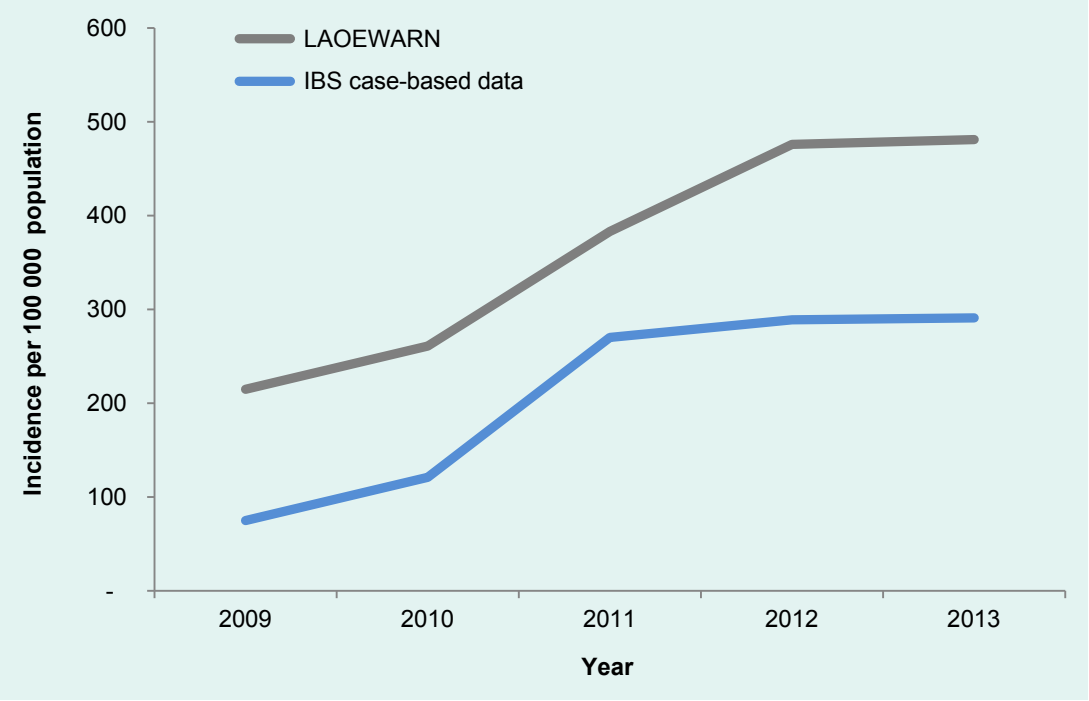
RESULTS

Descriptive epidemiology

Between 2009 and 2013, a total of 117 277 and 67 755 AWD cases were reported through LAOEWARN and IBS case-based reports, respectively. The incidence ranged for the LAOEWARN data (Fig. 1) between 215 and 476 per 100 000 population and increased from 2009 to 2012 when it levelled off. IBS case-based data follow the same trend but yield consistently lower AWD incidence than LAOEWARN aggregated data.

Through LAOEWARN, a total of 37 deaths were also reported. Case notification had a seasonal trend and peaked around March in all years (except 2011 where cases peaked in February) (**Fig. 2**); a quarter

Fig. 1. **Incidence of AWD cases using LAOEWARN and IBS case-based data, Lao People's Democratic Republic, 2009–2013**



AWD: acute watery diarrhoea; IBS: indicator-based surveillance; LAOEWARN: Lao People's Democratic Republic Early Warning and Response Network.

(*n* = 30 149, 25.7%) of the total cases occurred during March–April. Reported incidence increased over the study period in almost all provinces (**Fig. 3**) with the highest incidence rates reported from Bolikhamxay (771/100 000 to 1384/100 000 population) and Sekong provinces (691/10 000 to 1689/10 000 population).

Among the case-based data, 35 709 (52.7%) were from children under age 5. The incidence increased from 310/100 000 population in 2009 to 1298/100 000 population in 2013 (**Fig. 4**). For the cases under age 5, the majority (*n* = 26 722, 74.8%) were aged 0–24 months. The overall relative risk of the under 5 age group compared to others was 7.81 (95% CI: 7.69–7.93, $P < 0.0001$) (**Table 1**) and remained consistent year-to-year throughout the study period (range: 7.00–8.82). The median age of AWD cases for males was 2.1 years, and 7.0 years for females. Males under age 5 were more at risk (RR = 1.28, 1.25–1.31, $P < 0.0001$) for AWD than females under 5, but males aged 5 years or older were less at risk (RR = 0.87, 0.85–0.89, $P < 0.0001$) than females over 5 (**Table 2**). This pattern also remained consistent throughout the study period (under 5 years: RR range = 1.24–1.33; 5 years or older: RR range = 0.84–0.89).

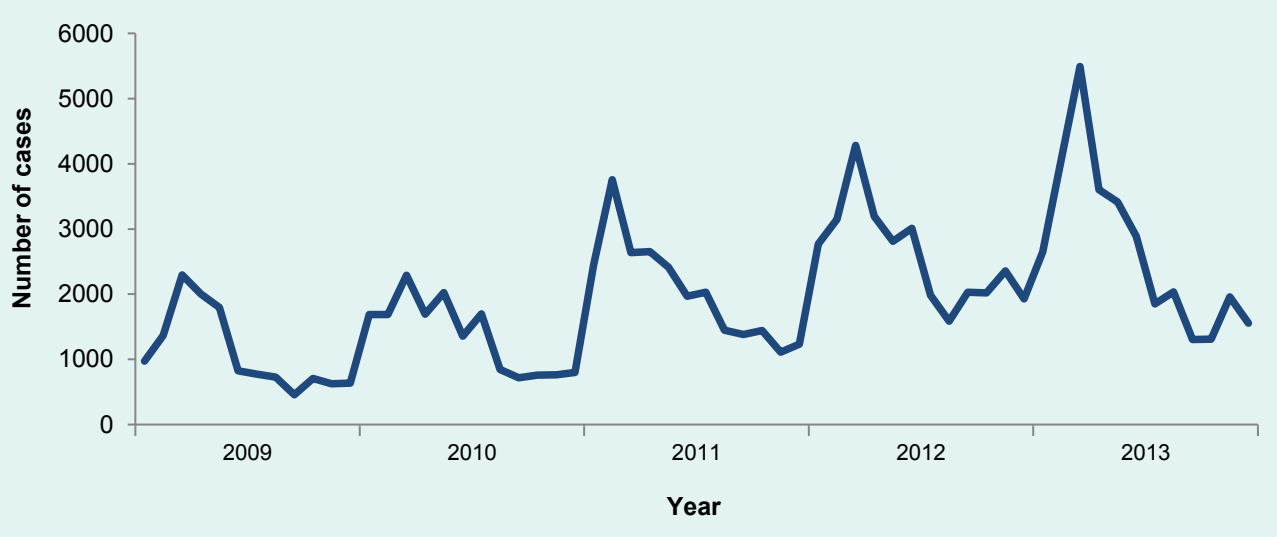
Laboratory surveillance

In 2013, a total of 656 stool specimens were submitted to the laboratory sentinel surveillance system (**Fig. 5**). The number of specimens peaked in March and April in 2013 (180/656, 27.4%). The majority (412/656, 62.8%) were from children under 5 years; half (331/656, 50.5%) of the cases were aged 0–24 months. Among the 412 stool specimens from children under 5, 264 (64.1%) were collected during the dry season. NCLE tested 230 (87.1%) of them for rotavirus, and 109 (47.4%) tested positive.

DISCUSSION

In this study, we investigated the trends of AWD from the national IBS system from 2009 to 2013. Although a health facility-based IBS system can only capture cases that seek health care, and the captured data depend on many factors such as each case's condition, financial situation and distance from health facilities, it is useful for monitoring disease trends over time.

Fig. 2. **Secular and seasonal trends of AWD cases using LAOEWARN data, Lao People's Democratic Republic, 2009–2013***



AWD: acute watery diarrhoea; LAOEWARN: Lao People's Democratic Republic Early Warning and Response Network.

The reported number of AWD cases from the case-based data was lower than that in the LAOEWARN data, presumably due to underreporting given the higher workload associated with additional information required as well as needing a stable Internet to send spreadsheets. Also, the number of fatal AWD cases is much lower than the published estimates for the Lao People's Democratic Republic.[6] It is likely that a high number of AWD deaths occurred outside of health-care facilities. Possible reasons may include that those living in rural areas have limited health-care access and the cultural practice of transporting critically ill patients back home before death.

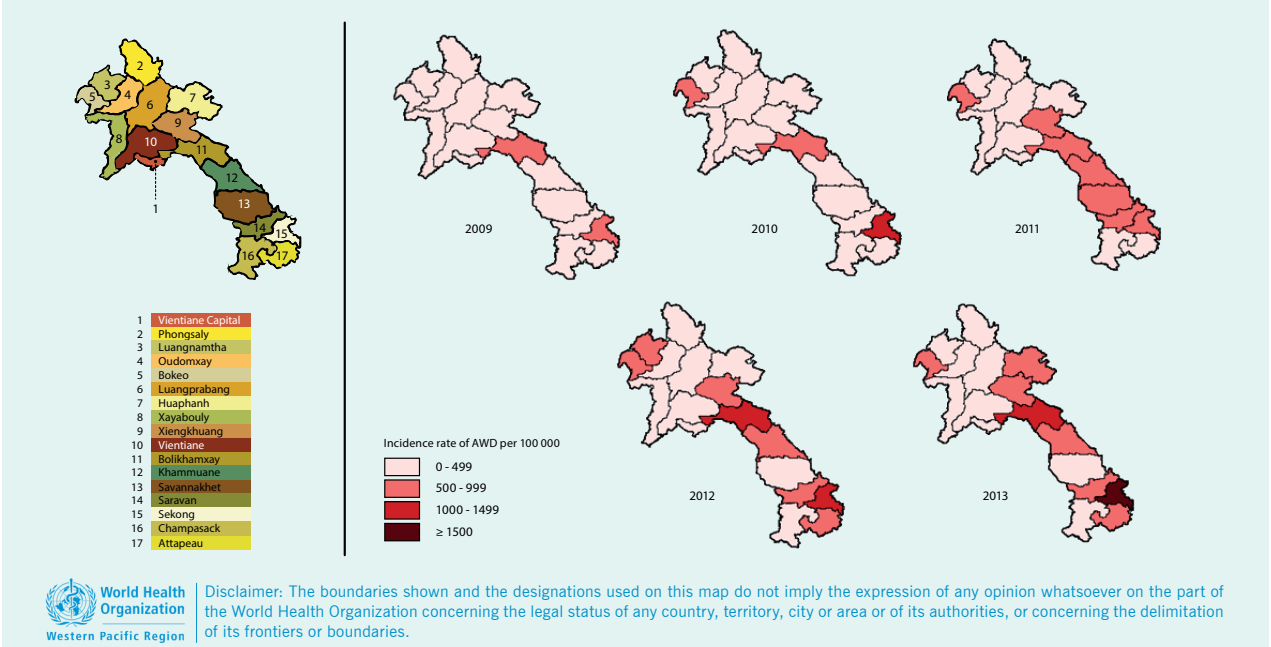
We showed that AWD notification is the highest early in life as documented previously.[8] We identified the under-5 population at the greatest risk for AWD, with annual relative risk consistently ranging from seven to almost nine times higher than those 5 years or older. With nearly half of AWD in the under-5 group attributed to rotavirus, this pattern could be explained by the protective immunity developed after initial exposure to rotavirus early in life.[9] It is well known that breastfeeding can significantly reduce morbidity and mortality due to AWD.[2] WHO recommends that mothers breastfeed exclusively up to six months and continue breastfeeding up to two years.[10] However, in the Lao People's Democratic Republic, only 40.4% of the mothers breastfeed exclusively up to six months; 40.0% of the mothers breastfeed up to two years.[11] Promoting breastfeeding practice could be one way to reduce the AWD incidence in these young children.

We identified males under age 5 being more at risk, a trend that also is seen in other studies including those conducted in Indonesia and Guinea-Bissau; however, the reason is unclear.[12,13] A similar sex trend was seen among under-5 diarrhoea cases in a large nationwide household survey conducted in 2011–2012 in the Lao People's Democratic Republic regardless of whether they sought health care;[11] therefore, a difference in health-care-seeking behaviour for the two sexes is unlikely to offer the full explanation.

Sekong and Bolikhamxay provinces have the highest incidence of AWD. Although the reason for this is unclear, this finding is consistent with the national event-based surveillance data where AWD outbreaks most frequently occur in these two provinces (unpublished, NCLE, 2016). Based on a national social indicator survey conducted in 2011–2012,[11] Sekong province has one of the highest prevalences of open defecation (52.1% of the households), and Bolikhamxay is known to have inadequate water treatment of unimproved water sources. These could be potential contributing factors explaining the higher disease incidences.[11]

Our findings indicated that rotavirus is the etiology for almost half of the under-5 AWD cases during the dry winter season, consistent with worldwide estimates of 39.4% of diarrhoeal episodes in this age group being attributed to rotavirus.[5] Based on existing literature describing

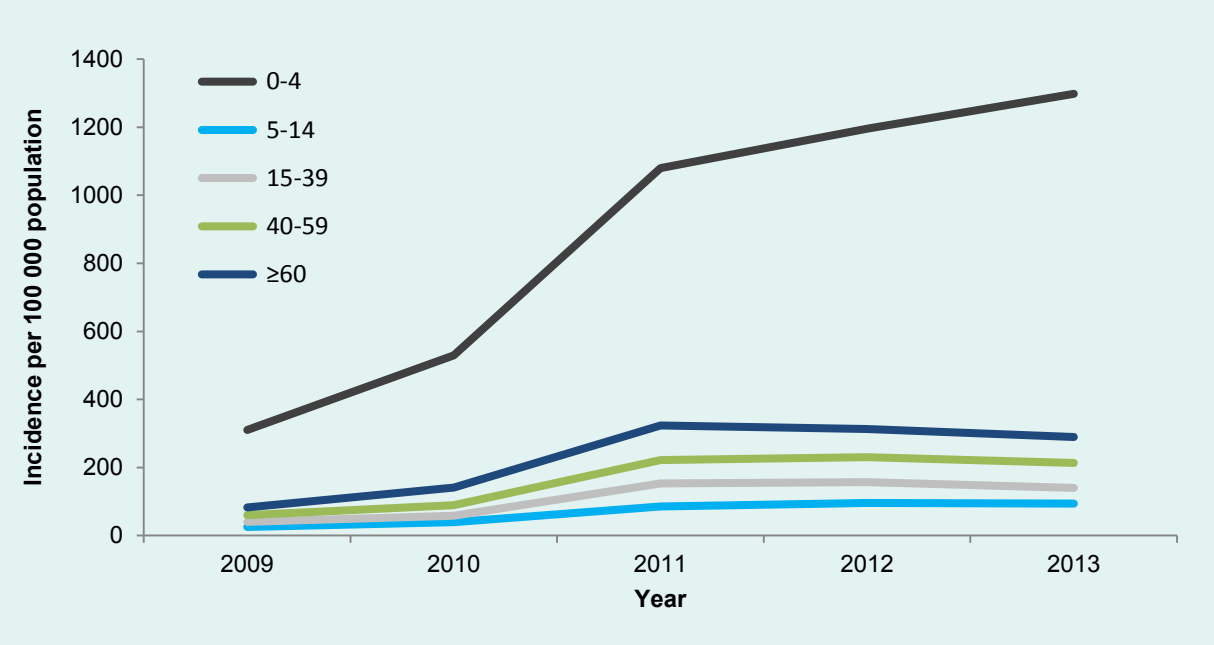
Fig. 3. **Geographical distribution of AWD incidence using LAOEWARN data, Lao People's Democratic Republic, 2009–2013**



Province code	Province name	2009		2010		2011		2012		2013	
		Cases	Incidence (Per 100 000 population)	Cases	Incidence (Per 100 000 population)	Cases	Incidence (Per 100 000 population)	Cases	Incidence (Per 100 000 population)	Cases	Incidence (Per 100 000 population)
1	Vientiane Capital	400	51	360	45	1444	174	3396	398	2242	255
2	Phongsaly	39	23	45	26	49	28	96	54	391	218
3	Luangnamtha	242	151	471	287	547	325	959	556	736	417
4	Oudomxay	484	166	781	261	1377	450	1091	348	743	231
5	Bokeo	331	206	983	596	1681	995	1189	686	1290	726
6	Luangprabang	418	98	597	138	752	172	1110	251	1293	288
7	Huaphanh	117	39	190	63	209	68	1028	331	1712	544
8	Xayabouly	251	70	212	58	271	73	156	41	148	39
9	Xiengkhuang	949	372	910	352	1642	626	2462	925	1824	676
10	Vientiane	1538	336	1947	416	2012	421	2214	454	1997	401
11	Bolikhamxay	1958	771	2059	787	2615	971	3539	1275	3958	1384
12	Khammuane	1067	289	530	141	2280	592	2960	752	3253	808
13	Savannakhet	2707	300	2556	278	4862	517	4746	494	4679	476
14	Saravan	905	253	1263	345	2031	541	2631	684	3174	806
15	Sekong	670	691	1120	1118	757	730	1328	1238	1877	1689
16	Champasack	896	136	1299	193	1179	172	1229	176	1502	211
17	Attapeau	211	169	999	777	814	616	985	724	1312	938
	Total	**13 183**	**215**	**16 322**	**261**	**24 522**	**383**	**31 119**	**476**	**32 131**	**481**

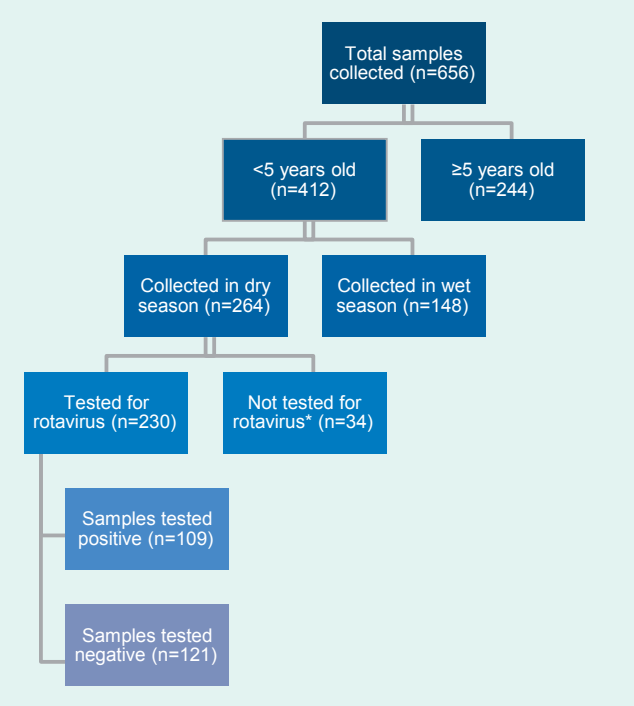
AWD: acute watery diarrhoea.

Fig. 4. **Age-specific incidence of AWD using IBS case-based data, Lao People's Democratic Republic, 2009–2013**



AWD: acute watery diarrhoea; IBS: Indicator-based surveillance.

Fig. 5. **Flowchart of samples tested for rotavirus in all eight diarrhoeal sentinel sites, Lao People's Democratic Republic, 2013**



* On rare occasions, some specimens were not tested due to the unavailability of technicians or test kits.

the pattern of rotavirus transmission in other tropical countries, we believe the peak AWD notifications in the dry winter seasons may be primarily driven by rotavirus. The seasonality of rotavirus has been well studied and is known to vary by region and climate.[14] It has been shown in similar tropical countries that disease transmission for rotavirus increases with decreasing humidity and temperature;[15,16] previous studies have hypothesized that the dried fecal matter containing rotavirus may become airborne during this time, driving disease transmission.[16,17]

There are several limitations in this study. First, there may be a degree of under-ascertainment from cases who visited private health facilities and were not reported to this system. Also, this system cannot capture cases who sought traditional healers or self-medication instead of formal health care or deaths which occurred outside the health-care facilities, leading to underestimates of the incidence and mortality rate. Second, secular trends of increasing notification of AWD in the Lao People's Democratic Republic may represent the increasing sensitivity of AWD surveillance associated with the electronic LAOEWARN system rather than an underlying changes in the trend of AWD. The representativeness of etiological data in this study may be limited because all sentinel sites were located in Vientiane Capital; specimens were only tested

Table 1. **Incidence of AWD by age using IBS case-based data, Lao People's Democratic Republic, 2009–2013**

Age group	Incidence and RR	Year					Overall
		2009	2010	2011	2012	2013	
< 5 years old	Total population*	764 940	781 532	798 598	816 152	834 211	3 995 433
	Total AWD cases	2370	4141	8619	9750	10 829	35 709
	Incidence of AWD (per 100 000 population)	310	530	1079	1195	1298	894
≥ 5 years old (reference)	Total population*	5 363 262	5 478 325	5 596 620	5 718 253	5 843 329	27 999 789
	Total AWD cases	2216	3449	8631	9149	8601	32 046
	Incidence of AWD (per 100 000 population)	41	63	154	160	147	114
	RR	**7.50**	**8.41**	**7.00**	**7.47**	**8.82**	**7.81**
	95% CI	**7.08–7.95**	**8.04–8.80**	**6.79–7.21**	**7.26–7.68**	**8.57–9.07**	**7.69–7.93**
	P-value	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**

AWD: acute water diarrhoea; IBS: indicator-based surveillance; CI: confidence intervals; RR: relative risk.

*Data source: Official population data, Ministry of Health, Lao People's Democratic Republic

Table 2. **Incidence of AWD by age and sex using IBS case-based data, Lao People's Democratic Republic, 2009–2013**

Age group	Sex	Incidence and RR	Year					Overall
			2009	2010	2011	2012	2013	
< 5 years old	Male	Total population*	388 590	397 018	405 688	414 605	423 779	2 029 680
		Total AWD cases	1345	2323	4862	5648	6158	20 336
		Incidence of AWD (per 100 000 population)	346	585	1198	1362	1453	1002
	Female (reference)	Total population*	376 350	384 514	392 910	401 547	410 432	1 965 753
		Total AWD cases	1025	1818	3757	4101	4671	15 372
		Incidence of AWD (per 100 000 population)	272	473	956	1021	1138	782
		RR	**1.27**	**1.24**	**1.25**	**1.33**	**1.28**	**1.28**
		95% CI	**1.17–1.38**	**1.16–1.32**	**1.20–1.31**	**1.28–1.39**	**1.23–1.33**	**1.25–1.31**
		P-Value	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**
≥ 5 years old	Male	Total population*	2 649 451	2 706 293	2 764 730	2 824 817	2 886 605	13 831 896
		Total AWD cases	1031	1596	3994	4117	3989	14 727
		Incidence of AWD (per 100 000 population)	39	59	144	146	138	106
	Female (reference)	Total population*	2 713 811	2 772 032	2 831 890	2 893 436	2 956 724	14 167 893
		Total AWD cases	1185	1853	4637	5032	4612	17 319
		Incidence of AWD (per 100 000 population)	44	67	164	174	156	122
		RR	**0.89**	**0.88**	**0.88**	**0.84**	**0.89**	**0.87**
		95% CI	**0.82–0.97**	**0.83–0.94**	**0.85–0.92**	**0.80–0.87**	**0.85–0.92**	**0.85–0.89**
		P-Value	**< 0.0001**	**< 0.001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**

AWD: acute watery diarrhoea; IBS: indicator-based surveillance; CI: confidence intervals; RR: relative risk.

*Data source: Official population data, Ministry of Health, Lao People's Democratic Republic; sex ratios for < 5 years old (male = 50.8%, female = 49.2%) and ≥ 5 years old (male = 49.4%, female = 50.6%) used for the calculation were derived from 2005 Census.

for rotavirus during the dry season and we only examined rotavirus rapid test data in 2013.

To our knowledge, this is the first time the epidemiological trend of AWD has been studied in the Lao People's Democratic Republic. Based on the results, we encourage new mothers to breastfeed for up to two years per the WHO recommendation to reduce incidence of AWD in young children.[2,10] We also recommend integrating hygiene and sanitation health education into nursery and primary schools, so children can bring their knowledge home to benefit the entire family. Many questions remain that are critical to the planning of targeted control and prevention strategies for AWD. Therefore we recommend: 1) conducting further study of diarrhoea-associated mortality, such as through community-based verbal autopsy studies to capture deceased cases outside the health facilities; 2) exploring risk factors for AWD during dry seasons in different regions; 3) expanding laboratory sentinel sites to increase geographic diversity; and 4) conducting rotavirus disease burden and cost–effectiveness studies to explore introducing rotavirus vaccine into the routine immunization schedule.

Conflicts of interest

All authors declared no conflicts of interest for this study.

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Enhanced syndromic surveillance for mass gatherings in the Pacific: a case study of the 11th Festival of Pacific Arts in Solomon Islands, 2012

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Mass gatherings pose public health challenges to host countries, as they can cause or exacerbate disease outbreaks within the host location or elsewhere. In July 2012, the 11th Festival of Pacific Arts (FOPA), a mass gathering event involving 22 Pacific island states and territories, was hosted by Solomon Islands. An enhanced syndromic surveillance (ESS) system was implemented for the event. Throughout the capital city, Honiara, 15 sentinel sites were established and successfully took part in the ESS system, which commenced one week before the FOPA (25 June) and concluded eight days after the event (22 July). The ESS involved expanding on the existing syndromic surveillance parameters: from one to 15 sentinel sites, from four to eight syndromes, from aggregated to case-based reporting and from weekly to daily reporting. A web-based system was developed to enable data entry, data storage and data analysis. Towards the end of the ESS period, a focus group discussion and series of key informant interviews were conducted. The ESS was considered a success and played an important role in the early detection of possible outbreaks. For the period of the ESS, 1668 patients with syndrome presentations were received across the 15 sentinel sites. There were no major events of public health significance. Several lessons were learnt that are relevant to ESS in mass gathering scenarios, including the importance of having adequate lead in time for engagement and preparation to ensure appropriate policy and institutional frameworks are put in place.

Mass gatherings are congregations of large numbers of people in a specific location or locations for a defined period of time – examples are major sporting events or festivals.[1] Planned mass gatherings are common occurrences in Pacific Island countries and territories. One of the risk areas of these gatherings is the potential for communicable diseases to spread efficiently and rapidly, causing outbreaks or amplifying existing outbreaks in the host country.[2]

Solomon Islands hosted the 11th Festival of Pacific Arts (FOPA) from 1 to 14 July 2012 in Honiara, the country's capital. It was the largest event ever hosted by Solomon Islands, involving more than 3000 artists and performers from around the Pacific. Most visitors arrived the week before the event and departed up to one week after the festival.

Syndromic surveillance (SS) is used for the early detection of and response to potential public health threats.[3,4] Case definitions in SS are based on clinical signs and symptoms rather than laboratory confirmation for the early detection of outbreaks while preserving limited resources.[4] Solomon Islands' SS system, established in 2011, monitors four syndromes at the National Referral Hospital (NRH).

Enhanced syndromic surveillance (ESS) is increasingly being used for mass gatherings, although it generally has been limited to high-income countries.[5] ESS usually involves expanding the number of sentinel sites and syndromes tracked as well as moving from aggregated to case-based reporting and from weekly to daily reporting. In low- and middle-income countries, ESS for mass gatherings has the potential to strengthen existing SS systems in a sustainable manner.[3,4]

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In 2012 the Solomon Islands Ministry of Health and Medical Services (MHMS) requested the Pacific Community (SPC) to provide technical assistance for ESS at the FOPA. The objectives were:

1. to provide a simple surveillance system for detecting and responding to disease outbreaks in a timely and effective manner,
2. to sustain the surveillance system improvements beyond the mass gathering.

This paper reports on that experience.

METHODS

The approach that SPC takes for ESS systems for mass gatherings has three stages: (1) preparation, (2) operation and (3) sustainability. These stages, as they were implemented for the FOPA, are described below.

Stage 1 – preparation

Formalize agreement with MHMS

The Solomon Islands MHMS and SPC agreed that SPC would provide ESS during and around the FOPA, starting two months before the event.

System and disease risk assessment

The existing SS system was assessed two months before the event to identify its strengths and weaknesses for a mass gathering and areas of enhancement needed for ESS. The assessment included a literature review of the disease patterns within the country, an assessment of disease databases, a reflective self-assessment with the public health and laboratory surveillance teams, interviews with key informants and focus group discussions with key stakeholders. A risk assessment was conducted that included assessing: the size, duration and characteristics of the event; priority communicable diseases of concern; medical resources and surge capacity; and the political will of decision-makers.

Stage 2 – operation

The plan for ESS was developed in May 2012. The ESS system commenced one week before the FOPA (June 25) and concluded eight days after the event (July 22). The system included:

- Data sources: Expanded from one to 15 sentinel sites in Honiara comprising the NRH, nine public clinics, two private clinics and three temporary clinics set up primarily for the FOPA.
- Syndromes: Existing syndromes were diarrhoea, acute fever and rash (AFR), prolonged fever (PF) and influenza-like illness (ILI). To increase the likelihood of capturing outbreak-prone diseases that are common in the region, acute fever and neurological symptoms (AFN), fever and jaundice (F&J) and heat-related illness (HRI) were added; watery diarrhoea (WD) and non-watery diarrhoea (NWD) were reported separately in the new list. The new list of eight syndromes is shown in **Table 1**. Although HRI is not outbreak prone, it was included due to the risk of it occurring.
- Reporting forms: Developed for data capture at sentinel sites. Forms were case-based and included: name, age, sex, country of origin, province of origin, zone location in Honiara, syndrome, malaria smear result and whether laboratory sample(s) had been taken and sent to the laboratory.
- Web-based database: Developed for data entry, storage and analysis. This was hosted on an SPC server in Noumea.
- Data flow: Moved from aggregated reporting on a weekly basis to case-based reporting on a daily basis. Each afternoon sentinel sites completed the daily reporting form that was collected by the surveillance team the following morning and entered into the web-based system. Data were exported by SPC staff for analysis and preparation of daily situational reports that were returned to the Honiara team for vetting and dissemination.
- Response: For most syndromes the response point was based on team discussion. Exceptions were WD, F&J and AFN where a single case was investigated immediately (**Table 1**).
- Training: Nurses from sentinel sites were trained on the ESS system case definitions and reporting; the response team was trained on outbreak investigation.

Table 1. **The eight syndromes endorsed for surveillance, 11th Festival of Pacific Arts, Solomon Islands, 2012**

Syndrome	Case definition	Important diseases to consider	Threshold
Influenza-like illness (ILI)	Sudden onset of fever* plus cough and/or sore throat	Influenza; other viral or bacterial respiratory infections	No specific threshold set**
Prolonged fever (PF)	Any fever* lasting three or more days	Typhoid fever; dengue; leptospirosis; malaria; other communicable diseases	No specific threshold set**
Non-watery diarrhoea (NWD)	Three or more loose stools in 24 hours	Viral and bacterial gastroenteritis, including food poisoning, ciguatera fish poisoning	No specific threshold set**
Acute fever and rash (AFR)	Sudden onset of fever* plus acute non-blistering rash	Measles; dengue; rubella; meningitis; leptospirosis	No specific threshold set**
Watery diarrhoea (WD)	Three or more watery, loose stools in 24 hours	Cholera	1 case
Acute fever and neurological symptoms (AFN)	Sudden onset of fever* with neurological symptoms; altered mental state; confusion; delirium; disorientation; seizure	Meningococcal meningitis; viral meningitis; other viral encephalitis (e.g. West Nile virus)	1 case
Fever and jaundice (F&J)	Any fever* plus jaundice	Hepatitis A infection	1 case
Heat-related illness (HRI)	Dehydration due to heat; heavy sweating; paleness; muscle cramps; dizziness; headache; nausea or vomiting; fainting; extremely high body temperature (> 40 °C); rapid, strong pulse	Heat cramps; heat exhaustion; heat stroke	No specific threshold set**

*Fever defined as a temperature of 38 °C/100.4 °F or higher.

**The point at which to respond is based on discussions among the team

- Feedback: Regular feedback of surveillance results was provided to sentinel sites to explain how data were used to prevent and respond to potential outbreaks.

Stage 3 – sustainability

Towards the end of the ESS period, a focus group and a series of key informant interviews were conducted with staff who were involved in data collection, entry and analysis. The purpose of these sessions was to discuss the strengths and challenges of the system, lessons learnt about it and to explore how elements of the system could be sustained.

RESULTS

Epidemiological findings

For the period of ESS, 1668 patients presented with one or more syndromes across the 15 sentinel sites. The average daily number of cases seen with one or more syndromes was 60; this decreased from 67 in the first half of the period to 52 in the last half of the period. Of those with one or more syndromes, 804 (48%) were female and 864 (52%) were male. The mean age of these cases was 13.2 years (range: 1 month to 82 years); 229 (13.7%) cases were infants aged less than 1 year and 803 (48%) were children aged less than 5 years.

The results are described by syndrome in **Table 2**. Of the patients with one or more syndromes, ILI was the most common syndrome (n = 727, 44%), followed by PF (n = 402, 24%), NWD (n = 387, 23%) and AFR (n = 204, 12%). Cases for each of the four most frequently occurring syndromes were relatively equally distributed between the sexes and had a broad age range with a mean age of between 12 and 15 years.

The total daily number of syndrome cases peaked eight times throughout the surveillance period (**Fig. 1**); four peaks occurred during the FOPA. This peak pattern was largely due to an influx of patients on Mondays to clinics that had been closed for the weekend. The peaks were in ILI, PF and NWD that peaked at over 30, 20 and 15 daily cases, respectively, several times. AFR peaked at over 10 daily cases several times in the first half of the period. This was most likely due to the end of a rubella outbreak that had commenced before the ESS period.

Table 2. **Summary of enhanced syndromic surveillance cases, Solomon Islands, 25 June to 22 July 2012**

Syndrome	Number of cases	Average number of cases per day	Percentage female	Mean age (range)	Percentage < 1 year	Percentage < 5 years
Influenza-like illness (ILI)	727	26	46% (n = 337)	13.7 (0.1–76)	16% (n = 114)	49% (n = 358)
Prolonged fever (PF)	402	14	50% (n = 199)	12.1 (0.1–64)	13% (n = 54)	49% (n = 198)
Non-watery diarrhoea (NWD)	387	14	49% (n = 188)	12.4 (0.1–82)	16% (n = 60)	61% (n = 235)
Acute fever and rash (AFR)	204	7	54% (n = 111)	12.9 (0.2–60)	6% (n = 13)	22% (n = 44)
Watery diarrhoea (WD)	91	3	42% (n = 38)	14.9 (0.1–68)	12% (n = 11)	42% (n = 38)
Acute fever and neurological symptoms (AFN)	3	0.1	67% (n = 2)	2.1 (0.6–4)	33% (n = 1)	100% (n = 3)
Fever and jaundice (F&J)	3	0.1	33% (n = 1)	37.3 (22–50)	0% (n = 0)	0% (n = 0)
Heat-related illness (HRI)	1	0.04	100% (n = 1)	21	0% (n = 0)	0% (n = 0)

Only a small number of the WD cases had laboratory samples taken. *Vibrio cholerae* was not found. Samples from NWD cases showed multiple enteric etiologies, including shigellosis and amoebiasis. Six cases of rubella and one case of dengue fever were confirmed during the period. A dengue fever preparedness and control plan for Solomon Islands was initiated. No other public health events of significance occurred.

Focus group discussion and interviews

The focus group discussion and key informant interviews with staff who were involved in data collection, entry and analysis revealed several ESS areas that worked well and areas that were more challenging. Participants generally felt that the ESS was relatively simple and operated successfully and that it played an important role in the early detection of possible outbreaks.

Several strengths in the ESS were identified. Daily reporting from sites was generally carried out on time as was the data analysis and the preparation of daily situation reports. Staff felt that the regular feedback visits to the clinics were extremely useful; they provided an overview of the analysis results and checked the nurses' understanding of the case definitions for quality assurance. The focus group discussion and informant interviews revealed that clinic staff attitudes changed markedly after the regular feedback visits started.

A major challenge noted in the ESS process was that some clinical staff were not clear on when and how to collect specimens. Many participants felt that some of the ESS improvements for early detection of and response to potential public health threats may not be sustainable beyond the mass gathering. Reasons given were limited human resources and limited transportation for samples, feedback visits and collecting data. Participants also said that updating Solomon Islands' communicable disease policy and developing standard operational procedures for the SS system would be important for the sustainability of effective surveillance in Solomon Islands.

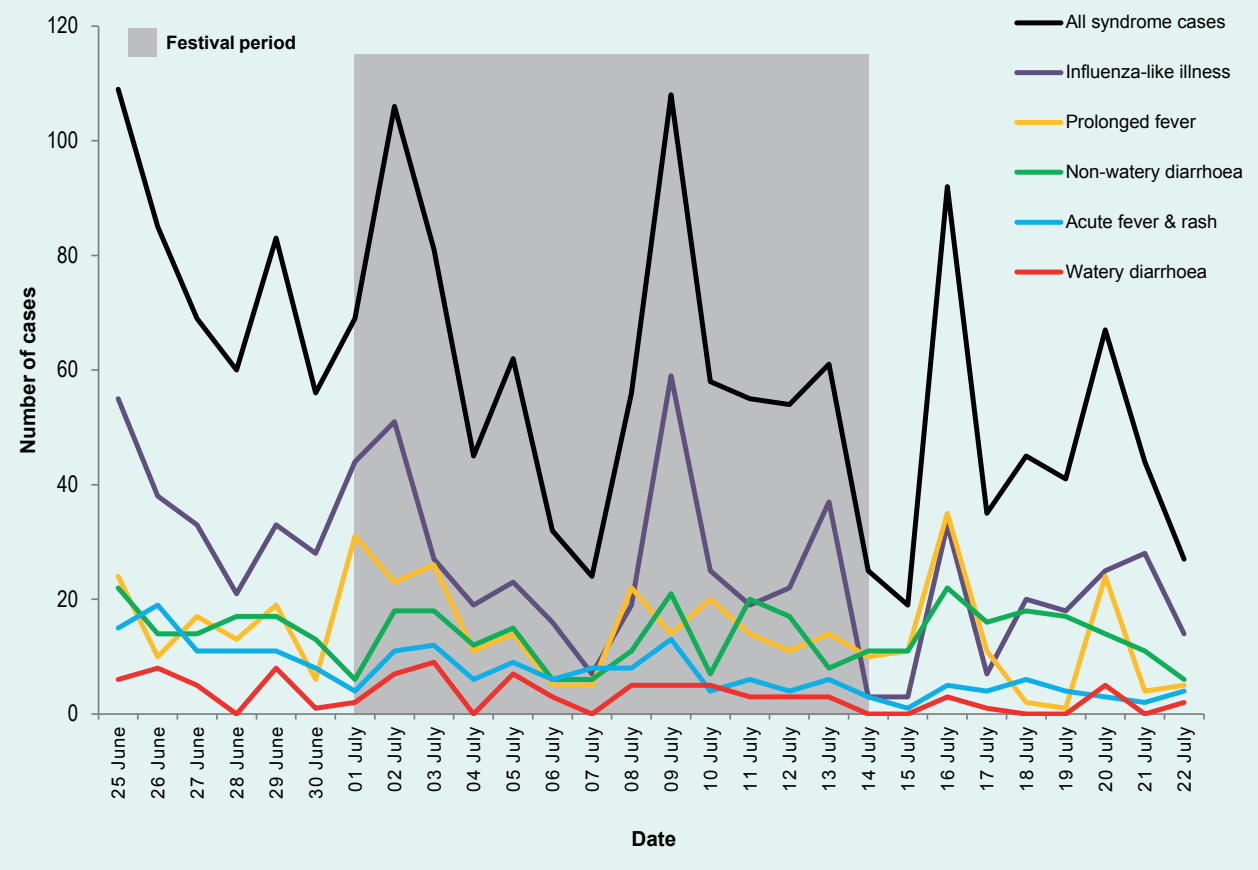
DISCUSSION

Through the analysis of the ESS that was operated at the FOPA, we have demonstrated that an ESS works relatively well for mass gatherings in resource-constrained settings. More than 1600 cases were captured across the 15 sentinel sites. The frequency of syndrome cases was tracked on a daily basis, triggering several outbreak investigations and informing public health promotion strategies.

Strengths

The ESS provided the necessary elements for detecting and responding to disease outbreaks in a timely and effective manner. The existing SS system was expanded

Figure 1. **Number of syndrome cases seen over the ESS period, 25 June to 22 July 2012, Solomon Islands**



from one to 15 sentinel sites, from four to eight syndromes, from aggregated to case-based reporting and from weekly to daily reporting. A web-based database was established to expedite data entry, analysis and reporting. This enhanced information led to more efficient field investigations and responses. Therefore, it is possible that ESS contributed to early detection of diseases in Solomon Islands and in the broader region. While ESS for a mass gathering is resource-intensive, the improvements are not likely to be costly to sustain if electronic disease surveillance software is used.[6]

Challenges and lessons learnt

There were several potential biases of the surveillance system. Graph peaks were largely influenced by an influx of patients on Mondays after clinics had been closed for the weekends. Some clinicians may have been more actively engaged in the system and thus more likely to report. There are likely to have been some misclassification of cases, particularly for those syndromes with similar case definitions.

The laboratory surveillance element of ESS was considered one of the main challenges. Several staff were unclear about specimen collection. Laboratory staff often did not communicate laboratory results back to sentinel sites, restricting the ability of clinic staff to undertake outbreak response. Laboratory and clinic staff should be given more training, including reinforcing the roles of each.

Many country delegate groups brought their own health personnel who often were the first people consulted by the delegation if they became ill. Consequently, clinics were not always accessed; thus, the ESS system may have missed a significant number of cases. A critical element in ensuring the sustainability of an ESS system is to have adequate lead in time for engagement and preparation (ideally at least 12 months). This should ensure that the appropriate policy and institutional frameworks, such as policy and standard operating procedures, are firmly in place in advance of the event. It will also enable the system users to become familiar with the system before the event.

CONCLUSIONS

The 11th FOPA saw large crowds of people gather in Honiara for a public event. This implied an increased risk for the transmission of communicable disease, both at the event and across the region. An ESS system was used to strengthen the early detection and response to potential public health threats. The ESS system was considered a success, and it played an important role in the early detection of possible outbreaks. No major events of public health significance were experienced. Several lessons were learnt for the delivery of ESS in mass gathering scenarios. These included the importance of using a structured approach such as the one identified above, and engaging in planning for the SS of the event at least 12 months prior to ensure that appropriate and necessary policy and institutional frameworks are in place well before the event.

Conflicts of interest

None declared.

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Perceptions on the risk communication strategy during the 2013 avian influenza A/H7N9 outbreak in humans in China: a focus group study

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Objective: To identify the general public's perceptions of the overall risk communication strategy carried out by Chinese public health agencies during the first wave of avian influenza A(H7N9) outbreak in humans in 2013.

Methods: Participants were recruited from communities in Beijing, Lanzhou and Hangzhou, China in May and June 2013 by convenience sampling. Demographics and other relevant information were collected using a self-administered questionnaire. Focus group interviews were conducted using a set of nine pre-developed questions and a tested moderator guide. The interviews were audio recorded and were transcribed verbatim. The constant comparative method was used to identify trends and themes.

Results: A total of nine focus group interviews, with 94 participants recruited from nine communities, were conducted. Most participants received H7N9 information via television and the Internet. A majority of the participants appreciated the transparency and timeliness of the information released by the government. They expressed a sense of trust in the recommended public health advice and followed most of them. The participants suggested that the government release more information about clinical treatment outcomes, have more specific health recommendations that are practical to their settings and expand the use of new media channels for risk communication.

Conclusion: The public perceived the overall risk communication strategy by the Chinese public health agencies as effective, though the moderator had a governmental agency title that might have biased the results. There is a need to expand the use of social media for risk communication in the future.

Effective risk communication is an essential element for outbreak management and health emergency response for pandemics.[1,2] Successful risk communication should (1) instruct, inform and motivate self-protective behaviour; (2) update risk information; (3) and build trust.[3] Based on previous experience in handling disease outbreaks with pandemic potential, risk communication strategies in China have evolved in the last decade. After the 2003 severe acute respiratory syndrome (SARS) outbreak, the Chinese government's awareness of and capacity to respond to health emergencies substantially improved.[4] China established a new mechanism for emerging infectious disease response with improvements in command and decision-making, organization and collaboration, monitoring and early warning and protection and communication. This new mechanism allowed China to successfully manage the avian influenza H5N1 and the pandemic influenza A/H1N1 outbreaks in 2005 and 2009, respectively.[5]

Human infection with the avian influenza A(H7N9) virus were first identified in China in March 2013.[6] H7N9 is a strain of influenza that causes mild disease in poultry but can be severe in humans. The World Health Organization reported 133 cases in the first wave of the H7N9 outbreak in China from February to May 2013; however, the number of cases decreased in the following summer.[7] There is no vaccine to prevent human infection with H7N9 virus, and population immunity was low for this novel virus. Human-to-human transmission of H7N9 was uncertain at the early stage of the outbreak, and there was much concern that human infection with H7N9 virus could rapidly spread the disease, resulting in a pandemic threat.[8,9] Given that concern, in this study

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we conducted focus group interviews in three cities in China to assess China's risk communication responses to the 2013 H7N9 outbreak in humans from the general public's perspective.

METHODS

Study design

Focus group analysis was used to gain qualitative data on audience perceptions, feelings and opinions about health information provided during the outbreak.[10,11] Prior to the interviews, participants were also requested to complete a short self-administered questionnaire which collected demographic information, awareness of H7N9 and major channels through which the participants received or sought H7N9 information.

Study sites

To achieve a reasonable representation of humans infected with H7N9 virus in China, we selected Beijing, Hangzhou (capital city of Zhejiang Province) and Lanzhou (capital city of Gansu Province) for the study. These cities represent areas with low human H7N9 case numbers, high case numbers and no identified cases, respectively, as well as different geographic locations in China. As of 31 May 2013, the number of human H7N9 cases in Shanghai city, Zhejiang Province and Jiangsu Province in east China accounted for 81.5% of the total number of cases.[12] Hangzhou reported 30 confirmed cases;[13] two cases were identified in Beijing[14] but no cases were reported from Gansu Province.

Study participants

According to the general focus group planning strategies,[10] we decided the size of the focus group to be 8–13 individuals for ample discussion. We conducted three focus group interviews in each city to reach information saturation. Subjects were recruited by convenience sampling. Inclusion criteria were people who were aged 16 years or above, resided in the community and had normal oral conversation ability. Eligible individuals were invited by community committee workers through telephone or face-to-face communications to participate in the study. Subjects were then randomized into different focus groups according to the order of recruitment. Specific occupational groups such as health-care workers or poultry workers did not have higher priority in the recruitment process.

Table 1. **Open-ended focus group interview questions, H7N9 perception study, China, 2013**

	Questions
1.	Have you previously heard of H7N9?
2.	Do you worry about H7N9? Why?
3.	What information do you feel you need the most about H7N9?
4.	What information sources do you consider to be credible?
5.	What H7N9 related information released by government is most helpful for you?
6.	What public health recommendations have you adopted? Why?
7.	Are you satisfied with the government's information release and communication practice?
8.	In terms of the government's information release and health education relevant to H7N9, what aspects do you consider to be good practice? Why?
9.	What recommendations do you have to improve the government's information release and communication practice about H7N9?

Focus group interviews

The interviews were conducted in May and June 2013 at local community facilities (e.g. community residents' activity centres and community health centres) easily accessed by the participants. Each participant received information about the objectives and procedures of the study and signed a consent form before participating. All interviews were run by one experienced moderator following a tested moderator guide with nine major questions (**Table 1**). The moderator guided the discussion by asking pre-developed, open-ended questions and encouraged all the participants to contribute opinions by using probes. The questions were arranged in the order of introductory question (question 1), which normally is the easiest question for everyone to answer, transition question (question 2), key questions (questions 3–8) and ending question (question 9).[15] The interviews lasted from 60 to 90 minutes and were audiotaped with the consent of all the participants. While the interviews were being audio recorded, the interviewees' identities were ensured to be anonymous. The moderator had experience conducting many focus group interviews with the Chinese public on various public health issues as well as having expert knowledge in risk communication. Participants were allowed to quit the study at any time

Table 2. **Demographics of the study participants, H7N9 perception study, China, 2013 (*n* = 94)**

Characteristics	*n*	%
Sex		
Male	22	23.4
Female	72	76.6
Age (years)		
16–30	27	28.7
31–50	34	36.2
51–73	33	35.1
Education		
Middle school and below	26	27.7
High school	27	28.7
College and above	41	43.6
City		
Beijing	33	35.1
Hangzhou	34	36.2
Lanzhou	27	28.7

without giving any reasons. Each participant received an incentive of 50 yuan (equivalent to approximately US$ 8) after the interview.

Data analysis

The data from the self-administered questionnaire were analysed using SAS (SAS 9.3, Cary, NC). Use of social media/Internet was defined as use of short message service (SMS), web portals (e.g. Baidu), microblogging (e.g. Sina Weibo) and WeChat (a mobile instant text messaging communication application) for information on H7N9. The audio files were transcribed verbatim from the focus group interviews. The transcripts were reviewed and coded by the first author (who was also the assistant moderator and field note taker). The constant comparative method[10] was used to identify trends and themes. The team had summary discussion after each interview to reach preliminary consensus of key findings.

Ethics

The proposal of this study was submitted to the Center for Global Health (CGH) of Centers for Disease Control and Prevention for project determination and approval. It was deemed as "not human subjects research" and "does not require human subject research review beyond CGH".

RESULTS

In total, 145 eligible individuals were approached and 94 participants were recruited to this study. The response rate was about 65%. The majority were female (76.6%), aged 30 years or above (71.3%), and more than half of them (56.4%) had a high school education level or below. Participants were evenly distributed across the three cities (**Table 2**). Awareness of the H7N9 outbreak was very high due to broad media coverage, and most participants reported that they received their first information about the H7N9 outbreak during late March to early April 2013 via TV (67.0%), Internet/social media (48.8%) or newspaper (37.2%) (**Table 3**). The information sought by participants most was

Table 3. **Source of H7N9 information, H7N9 perception study, China, 2013***

Information source	First heard of H7N9		Searched for more information	
	n	(%)	*n*	(%)
TV	63	(67.0)	49	(62.8)
Newspaper	35	(37.2)	27	(34.6)
Health agencies	19	(20.2)	17	(21.8)
Web portal	18	(19.1)	44	(56.4)
Weibo	13	(13.8)	0	
Family and friends	12	(12.8)	8	(10.3)
Radio	9	(9.6)	5	(6.4)
SMS from friends	7	(7.4)	0	
Subscribed SMS service	5	(5.3)	0	
Search engine	3	(3.2)	0	

* Information was obtained in late March/early April in 2013, 2–3 months after the first reported human H7N9 case. Multiple selection of information sources was allowed.

SMS, short message service.

prevention of H7N9 (78.2%), transmission routes (70.5%), safe consumption of eggs/chicken (42.3%) and overall situation of the outbreak (32.0%).

Outbreak information dissemination

The majority of participants thought H7N9 outbreak information was released in a transparent and timely manner. All participants in Beijing and Lanzhou and the majority of the Hangzhou participants commented that the outbreak information was released quickly and updated frequently. For example, one participant said, *"Sometimes new patients were just found in the morning and the TV news reported it in the afternoon."* In addition, participants across groups praised H7N9 communication as transparent by comparing it with the communication response to SARS. *"This time is much better than SARS, no information was hidden."*

Participants from the site with high prevalence of human infection with H7N9 virus had higher expectations of timely announcements of the emergence of the disease. Two participants from Hangzhou criticized the delay of the first announcement of the outbreak. One of them stated, *"I do not think the government announced the disease in time. We first heard about the disease at the end of March, but the patients were hospitalized and even died almost one month earlier. It should have been announced earlier. This reminds me of SARS, when intentional underreporting was not uncommon. Who knows how many H7N9 patients have really been found …"*

Outbreak information needs

When asking what information released by health agencies was most helpful, almost all participants mentioned preventive methods. *"The information telling us how to protect ourselves from getting infected is most helpful, such as washing hands more frequently, avoiding direct contact with birds and chickens, and things like that."* Some participants also valued the information about the evolving outbreak trends which helped them assess the disease severity. *"I paid very close attention to the overall outbreak situation, it helped me to judge if the disease was spreading very quickly just like SARS did."* Some participants expressed their appreciation for information about H7N9 transmission routes. One said, *"When I heard that H7N9 does not transmit from person to person, I felt so relieved."* Another explained, *"When I heard that the majority of the patients had close contact with poultry, I just felt very relieved, I was sure I would not get the disease because I never directly touch chickens or ducks at all …"*

Some participants indicated their interest in knowing more about the clinical treatment status of the confirmed cases. *"I want to know how many patients have died, how severe their symptoms are, and if there is effective medication that could cure this disease."*

Perception of information from government

Participants perceived government agency information sources to be trustworthy. The most trusted information channels reported by the participants included China Central Television, major web portals, national and local newspapers, local TV channels, community information boards (which are typically located in the centre of residential communities and regularly updated by the community committee) and health education materials (posters and pamphlets) disseminated by health authorities. Participants had different comments on the credibility of social media; social media was more acceptable to young participants. Some participants recalled that much of the H7N9 information received had been via microblogs and SMS, and they described the information as *"spurious and anecdotal"*. Some young participants suggested the government should use more social media to release health messages. One participant said, *"I want to recommend sending disease information more frequently via microblogging and WeChat. We young people almost always have the mobile phone in hand; it is very convenient for us [to get health messages]."*

Acceptability of the health recommendations

Most of the participants reported that all of the public health recommendations they received were clear and easy to follow. The concern for being infected by the H7N9 virus resulted in some behaviour changes, either by forming new behaviours or improving current behaviours. For example, one participant said, *"All recommendations such as [open the windows] to air your room, wash hands, etc., are very easy to do. Actually I do these things almost every day, but since the start of this bird flu, I have been washing my hands more frequently and more carefully. I also remember to wash hands after touching raw eggs. I*

did not have this kind of habit before."

However, one Hangzhou participant complained that the handwashing message was not practical, he said, *"… to be honest, I cannot do that six-step-hand-washing process. I cannot memorize all those steps plus it wastes a lot of time. I do not think it will make a lot of difference from the way I wash my hands."*

Factors affecting participants' anxiety level

Disease severity

The severity and consequences of H7N9 infections were factors effecting people's anxiety level. Some of the participants indicated that they were scared because the majority of the reported H7N9 cases were either in critical condition or deceased.

Distance from the outbreak sources

Although many Lanzhou participants reported that they never felt worried about the H7N9 outbreak since *"It is very far [away from Lanzhou]",* the majority of the participants in the other two cities felt worried during the first 2–3 weeks of the outbreak, but the anxiety eased afterwards. The rest of the participants from Beijing and Hangzhou reported that they *"were not worried at all".*

Media coverage

The high intensity of media coverage about H7N9 in the early stage of the outbreak made the public vigilant and concerned about the situation. One participant said, *"At the very beginning when I heard there were H7N9 patients, I did not think too much about it, but later when there were more and more media started reporting about this issue, I started worrying. It reminded me of SARS. It is scary if the situation cannot be controlled …"*

However, when the media coverage decreased, people interpreted it as a sign of that the outbreak was contained. *"I was worried at the beginning; however, recently I noticed that less media report this event, so I think this is not a big deal anymore. It must already be controlled."*

Transmission route of H7N9

The Chinese health authorities stated that there had been no proof of human-to-human transmission for H7N9, which successfully eased people's anxiety. *"Right now, I do not worry at all, because we cannot get this bird flu from people, I do not touch any live birds, chickens or ducks."*

Trust in government's competence

The participants who *"do not worry at all"* indicated it was their trust in the government's competency that made them worry-free: *"We all know that China is more developed and stronger now. I am quite positive that our government absolutely has the capability to control this disease."*

Recommendations for communication practice

One focus group in each city had full satisfaction with the H7N9 communication response by the Chinese government. The other groups suggested that public health recommendations be more specific and practical. As one participant stated, *"We were just told to wear masks when going to crowded places but we do not know what kind of mask works for this disease. Do we need to wear N95 masks?"*

One participant expressed his strong desire for more information about clinical treatment status. *"There is very limited information about treatment. I want to know if there are any serious consequences for the survivors."*

Some participants complained that there was a lack of credible inquiry channels to seek help. One Hangzhou participant said, *"My neighbour has some pigeons at his home, and they fly around. I wanted to know if these birds are dangerous, but I do not know where to go for this question."*

DISCUSSION

The goal of risk communication is to provide useful, relevant, accurate and needed information for a particular audience to make informed decisions about the risks they encounter.[16,17] Our results indicated that the majority of the participants felt their information needs were met concerning preventive measures, transmission routes and

the evolving trends of the outbreak.

Trust is the cornerstone of effective risk communication. Being open, transparent and timely in communication will help to earn the trust of the audience.[18,19] Many participants commented that the H7N9 outbreak information was released and updated in a transparent and timely manner. However, people in epidemic areas might have much higher expectations for the timely release of information. The one-month time window between hospitalization and announcement of the first human H7N9 case made people question the timeliness of the information release and the openness of the government. More information about why the first announcement was not made earlier would have been helpful to avoid suspicion.

Normally when there is a health emergency, the information people need most is about preventive measures;[20] the same information need was reported by the participants. Similar to a previous study,[21] the participants had strong information needs about clinical treatment that was not sufficiently provided. Participants also requested more specific and practical public health recommendations. This is similar to Vaughan's study that instructions for personal protective equipment usage should be clear and workable.[3] To dispel ambiguity, fill information gaps and increase compliance to public health recommendations, more efforts should be taken to collect public feedback on the recommendations to make them specific, feasible and clear.

In a 2014 study,[22] the majority of the participants stated that they believed government agencies had the capability to control the H7N9 outbreak and regarded official information sources as the most credible ones. While successful risk communication should motivate appropriate self-protective behaviour,[3] the general population's acceptance of behavioural advice is strongly influenced by perceptions of integrity, credibility and competency of the authority.[23] The majority of the participants reported that they followed the public health recommendations to wash hands, open the windows more frequently, thoroughly cook food and avoid direct contact with poultry and wild birds.[24]

Our results suggest that the intensity of the media coverage is proportional to the public's anxiety level about the reported health risk, similar to a study from the United States of America.[25] At the beginning of the outbreak, high mass media coverage about H7N9 successfully gained public attention. Mass media plays a large role in communicating health risks to the public,[26] and the participants in this study indicated that mass media were the major channels to receive H7N9 information. Mass media also could be used to disseminate public health recommendations to the population. Internet-based channels, including web portals and social media, were reported as preferences among the young population. Although the Chinese online community's reaction to H7N9 was profound,[27] young participants still urged the government to communicate H7N9 information via social media. Health agencies may consider having an official presence on social media and using it routinely for health information delivery other than in emergencies so as to effectively reach the younger population.

Some participants reported they had difficulties in finding information to address their concerns or questions. A stronger two-way communication strategy should be applied. This helps to provide channels for the public to obtain specific information that they are concerned about and avoid misconceptions and rumours.

There were several limitations to our study. The results might not be representative as the participants were convenience sampled and were female dominant. The qualitative data analysis was done by only one researcher and later discussed with a team of researchers which might potentially limit the validity of the results. Although the moderator of the focus group is skillful and experienced, his governmental agency title might have caused some participants to hesitate in criticizing the government's communication. Nevertheless, participants were open and felt comfortable enough to suggest how to improve the risk communication response.

CONCLUSION

In conclusion, the majority of the focus group participants were satisfied with the Chinese health agency risk communication response to the 2013 H7N9 outbreak. They appreciated the transparent and timely information release and felt that their information needs had been met. Although some participants felt that the public health recommendations lacked feasibility and were not specific or clear enough, many participants reported behaviour change that conformed to public health recommendations. Social media should be more broadly used during public health emergencies to better reach

the young population. Two-way inquiry channels, such as public health hotlines, should be more accessible to the public to help address questions, dispel rumours and clarify misunderstandings.

Conflicts of interest

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the United States Centers for Disease Control and Prevention.

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Measles prevention in adolescents: lessons learnt from implementing a high school catch-up vaccination programme in New South Wales, Australia, 2014–2015

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Introduction: In response to a significant increase of measles cases and a high percentage of unvaccinated adolescents in New South Wales, Australia, a measles high school catch-up vaccination programme was implemented between August and December 2014. This study aimed to explore the factors affecting school-based supplementary immunization activities (SIAs) and to inform future SIA and routine school-based vaccination programme implementation and service provision.

Methods: Focus group analysis was conducted among public health unit (PHU) staff responsible for implementing the SIA catch-up programme. Key areas discussed were pre-programme planning, implementation, resources, consent materials, media activity and future directions for school vaccination programme delivery. Sessions were audio recorded, transcribed verbatim and reviewed. Thematic analysis was conducted to identify the major themes.

Results: Two independent focus groups with 32 participants were conducted in January 2015. Barriers to the SIA implementation included lead time, consent processes, interagency collaboration, access to the targeted cohort and the impact of introducing a SIA to an already demanding curriculum and school programme immunization schedule. A positive PHU school coordinator rapport and experience of PHU staff facilitated the implementation. Consideration of different approaches for pre-clinic vaccination status checks, student involvement in the vaccination decision, online consent, workforce sharing between health districts and effective programme planning time were identified for improving future SIA implementation.

Conclusion: Although many barriers to school programme implementation have been identified in this study, with adequate resourcing and lead time, SIAs implemented via a routine school vaccination programme are an appropriate model to target adolescents.

In March 2014, the World Health Organization announced that measles elimination had been achieved in Australia.[1] While this is a significant accomplishment for public health in Australia, consistent high measles vaccination coverage of over 95% for a single dose and over 90% for two doses for each new birth cohort is required to achieve herd immunity and maintain measles elimination.[2]

Measles elimination does not mean the absence of the disease, rather it signifies the absence of ongoing local measles transmission. Due to measles' highly infectious nature, the non-immune status of many young adult travellers was seen as a risk to maintaining elimination. Many of the 40 cases notified in New South Wales (NSW) in early 2014 were associated with overseas travel or contact with those who had recently returned from countries such as the Philippines, Indonesia and other parts of Asia where large measles outbreaks were occurring.[3] Teenagers and young adults are a high-risk cohort because they may have missed vaccination and/or the second dose was not recommended in the National Immunization Schedule during their childhood.[4] They are also of an age when travel to countries with endemic measles is common.

In 2014, it was determined that almost 40% of NSW teenagers were recorded as not fully vaccinated against measles on the Australian Childhood Immunisation Register (ACIR).[5] The rate of full vaccination was lowest among senior high school students, while junior high school students had acceptable levels in most districts.

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Ongoing measles transmission in NSW was also noted to be associated with young adult travellers.[3] Consequently, a supplementary immunization activity (SIA), the NSW Measles High-school Catch-up Vaccination Program, was delivered between August and December 2014. The SIA was implemented by NSW public health unit (PHU) staff, located in 15 local health districts (LHDs), with an essential role in delivering the routine annual school vaccination programme to students in their first year of high school.

In May 2014, PHUs were asked to select schools in their district where high numbers of unvaccinated students were expected to attend. The aim was to prioritize offering vaccination to senior high school students before they completed their schooling at the end of 2014.[6,7] A media campaign was conducted which included a PHU hotline and dedicated website. A parent information kit was developed which included a parental recall section regarding their child's measles, mumps and rubella (MMR) vaccination history. Of the 90 800 students enrolled in the 145 targeted schools, parental consent was provided for over 19 000 (21%) students and over 11 000 (12%) were vaccinated.

While school-based vaccination programmes have been implemented by NSW Health since 2003, there has never been a study conducted to explore the attitudes and perceptions of NSW PHU staff toward school vaccination services. This study aimed to explore the delivery of immunization through time-limited SIAs and to identify factors affecting their success.

METHODS

A qualitative study involving focus groups was undertaken in January 2015. An invitation to participate was sent to PHU staff who were involved in school vaccination programme administration and implementation. The focus groups were scheduled to coincide with their annual immunization professional development day.

An interview guide was developed by the investigators to identify key areas of interest for the study. Questions covered key areas which included pre-programme planning, implementation, resources, consent materials, media activity and future directions for school vaccination programme delivery. Written informed consent was obtained, and participants were randomly assigned to a focus group using *Random Number Generator* (GraphPad Software Inc., La Jolla, CA, USA) software. The focus groups were facilitated by a senior policy analyst in the NSW Health Immunization Unit. At the end of the sessions, the facilitator summarized and reported participants' views to the group to ensure they were accurately recorded.

The focus group sessions were audio recorded, transcribed verbatim and reviewed as a whole along with field notes. To find repeated patterns of meaning across all data sets, repeated reading, coding and thematic analysis was undertaken by one coder. A proportion of the data (30%) was coded by an independent coder and the findings were compared with the initial results for data validation. Text was organized within the identified themes of the developed framework using NVIVO Version 10 (QSR International Pty Ltd, Victoria, Australia).The results were presented according to the major themes that were identified.

Ethics approval was obtained from the University of New South Wales Human Research Ethics Medical Panel (HREA PANEL Reference: 2014-7-66) for this study.

RESULTS

Two independent focus group discussions were conducted in January 2015 with 32 staff from 15 PHUs. There were 30 female and two male participants whose occupations included immunization coordinators, school programme coordinators, nurses and team leaders and administrative support staff. The majority of the participants were highly experienced with over five years' experience in school programme planning and implementation (24/32, 75%) (**Table 1**). The duration of the two focus group discussions was 60 minutes and 50 minutes, respectively.

Identifying the target schools

Participants spoke about difficulties in accurately identifying their target schools. Several participants thought that the ACIR data provided to identify schools were inaccurate as many of the children had relocated. This made it difficult to select the high priority schools. Others commented that offering the programme in all LHDs concerned them as they believed that the programme should only have focused on specific metropolitan areas where there had been recent measles outbreaks. One participant described it as "*just drawing straws basically to do it*". Only one participant thought that the data were

Table 1. **Characteristics of the subjects who participated in the school-based SIA focus group sessions, NSW, Australia, 2015**

Characteristics	*n*	%
Sex		
Male	2	6.3
Female	30	93.8
Level of experience for school vaccination programme		
High	24	75.0
Medium	6	18.8
Low	2	6.3
Position		
District Immunization Coordinator	12	37.5
School Programme Coordinator	7	22.0
School Programme Team Leader	4	12.5
School Programme Registered Nurse	4	12.5
Administrative support	5	15.6
Total	**32**	**100.0**

SIA, supplementary immunization activity.

useful to select the schools and confirm the knowledge of MMR coverage in the area.

Identifying and vaccinating eligible students

When asked about performing the pre-clinic ACIR checks, one participant advised that to not do so would be a *"waste of the health dollar"* and that as a *"registered nurse costs 44 Australian dollars per hour, putting them in a school for quite a while"* to vaccinate students, many of whom do not need to be vaccinated, was deemed *"wasteful"*. For one PHU, it was reported that of the 400 consent forms distributed to a school, 100 students were consented; however, post-ACIR checks revealed that only 21 required vaccination. Another participant reported that *"80% of students did not need to be vaccinated"* after ACIR checking. The checks however were considered to be a *"huge imposition"* as it was reported that many school programme staff did not have ACIR data access and different student details on the consent form made it difficult to identify them on the register.

Many reported that access to Year 12 students was very restricted by the schools due to impending Higher School Certificate trials and exams: *"We could not get to Years 11 and 12. We did Years 9 and 10 because the majority of schools … wouldn't let us in for 11 and 12" and "… they asked us to rethink our cohort … and because we had to … we chose a younger group."* On the other hand, it was agreed by many that if some students received a third dose of MMR vaccine due to inaccurate parental recall, this was more acceptable than delaying the clinic and potentially losing the opportunity to vaccinate this high-risk cohort.

New approaches to informing parents

The majority of participants reported the hotline as a useful initiative for new vaccination programmes. However, many felt that the message was long at just over three minutes and was thought to interfere with other PHU calls. Participants were very positive towards the pre-programme coverage in newspapers and on social media sites; however, some commented that reading newspapers was less common and recommended more social media activity. They all agreed that the measles campaign website was *"absolutely essential"* to refer callers to when introducing new vaccination programmes.

Strategies to engage parents and schools

Nearly all participants agreed that the parent information kit content was generally *"easy and straightforward"*; however, one felt that an information kit specific for Aboriginal people would have been beneficial. In some areas, the nurses delivered the kits to the schools that they identified as a positive networking opportunity to build a rapport with school staff and address any concerns. One PHU sent the kits directly to parents in an attempt to improve consent rates.

Some participants believed that many students completed the consent form and asked their parent to *"just sign it"* and that it was the students who made the vaccination decision, which participants identified as a major factor for the kits reaching the parents to provide consent for their child to be vaccinated.

Validity of parent recall

Participants reported that parents were "confused" by the parental recall section on the consent form. Nearly all agreed that the 'two dose' box on the form was superfluous as many parents ticked it and signed the form to have their child vaccinated. Parental confusion regarding previously documented doses of MMR was thought to be due to vaccination records documenting Priorix, which was not identified as an MMR vaccine.

Many agreed that, because of this, several children may have received a third dose of MMR vaccine. To counteract this, one PHU distributed a letter to parents that documented the MMR vaccine brands.

School coordination

The pre-clinic ACIR checks resulted in a much lower number of students being vaccinated than were consented and was reported as *"wasteful"* and *"unappreciated"* by some school staff as they had planned their clinic according to consented student numbers. Additionally, some school year coordinators considered the SIA an *"inconvenience"* due to interruptions to the curriculum, particularly at short notice. However, a previous measles outbreak in a school correlated with a positive acceptance of the SIA. Conversely, feedback was reported from several unsatisfied parents of students attending non-targeted schools as they were required to attend their primary care physician for vaccination which was viewed as an *"inconvenience".*

Workforce

Introducing the SIA at short notice was reported to compound staffing arrangements for the routine school programme. A shared casual pool of nurse immunizers was suggested for future SIAs. Concerns were raised about prioritizing the SIA against the ever increasing competing demands on PHU immunization coordinators. *"We have lots of things that are taking our focus hugely now, and it's getting bigger and bigger ... the resourcing needs to be looked at really as to what are the priorities..."*

It was argued however that if only one non-immunized student was vaccinated then it would be *"extremely worthwhile"* as *"just one infectious person with measles can contaminate many more".*

Informing school staff about the programme was reported as a challenge in areas with multiple immunization teams. Furthermore, improved communication from NSW Health to primary care physicians (about school vaccination services) was recommended. One participant said, *"I spoke with a [physician] last night because we were doing a measles clinic ... and he thought [the vaccine] wasn't available free for them."*

Inter-agency collaboration

In this SIA, PHUs were required to liaise with school coordinators with whom they had no previous contact or professional relationship (as the routine programme involves only Year 7 students). Those who reported a positive PHU-school coordinator relationship identified a positive impact on student access and clinic planning. Those with a less positive rapport described it as a *"struggle",* particularly with the limited planning period.

DISCUSSION

Although in one study, routine school-based vaccination programmes were found to be successful in facilitating high vaccination coverage of a cohort that do not routinely access medical services;[8] adding MMR vaccine to the routine school programme does not guarantee high uptake in unvaccinated adolescents when compared to an SIA targeting the same group. Future SIAs should continue to be targeted at the at-risk cohort.

SIAs have made a significant contribution towards the successful elimination of measles in the European Region.[9] In the United Kingdom of Great Britain and Northern Ireland, a school catch-up programme offered MMR vaccine to targeted school-leavers in 12 high schools in conjunction with a school leavers' vaccinations programme. It was concluded that this model was logistically convenient and may reduce the extent of future outbreaks.[10] Some previous measles SIAs implemented in NSW have specifically targeted at-risk ethnic groups, while others were outbreak control initiatives conducted by physicians or PHU staff.[11-13] While there has never been a state-wide school-based SIA implemented and examined in NSW, this study has highlighted factors affecting school-based SIAs and has shown that future SIAs implemented via a routine school vaccination programme could be an appropriate model to target adolescents.

For identifying and vaccinating eligible students, we found that there was confusion among PHU staff regarding the purpose and mechanisms of the programme. For example, some did not understand that the most recent recorded residential addresses were used to identify postcode areas with low vaccination coverage. In the future, more time should be spent ensuring that PHU staff fully understand the data and imperatives

underpinning an SIA. The location of adolescent SIAs also needs to be carefully considered. If the school setting is selected, clinic scheduling needs to be considered, particularly to maximize access to students in the final year.

Despite its short lead time and duration, this SIA successfully vaccinated over 11 000 (12%) students enrolled in the targeted schools. It is unlikely such a high uptake would have been achieved using an alternative model.[11,14] A physician-delivered community programme in the United Kingdom in 2013 vaccinated 10.77% (95% CI: 6.97–14.57) of the targeted unvaccinated population; however, heterogeneity in coverage was identified.[15] The United Kingdom study concluded that efforts should have been focused on populations with low coverage rather than implementing national campaigns. This is in line with our study's finding that many of the consented students did not need to be vaccinated. While some PHU staff expressed concern about delivering a state-wide SIA, the associated supports, such as mass media, programme website and hotline, were seen as facilitating uptake. However, effective public communication support is only achievable if SIAs are coordinated across the state and not feasible if PHUs undertake ad hoc catch-up programmes.

For the concerns reported by some school coordinators about PHUs vaccinating fewer students than had consented, it could be addressed in future programmes by including routine communication to the school coordinator before the clinic day. On the other hand, the process of requiring parents to return consent forms needs to be reviewed to maximize vaccine uptake.[16] A study revealed that a more reliable method for distribution of consent forms, along with pre-campaign educational programmes, was needed along with prior notice of the programme and suitable venue.[17] Online parental consent could be pursued; however, how equitable access can be maintained and how parental consent can be verified should be considered before system implementation.

A well-established school vaccination programme can overcome many barriers such as cost, access and time for parents.[16] Effective planning is essential,[18] and a school's commitment to the vaccination clinics has also been found to effect the pre-vaccination logistics.[19] The SIA in this study was conducted over a short time period as it needed to be scheduled in the last two school terms of the academic year, which influenced the planning timeframe. Despite the short lead time, this SIA was deemed to be successful due to the experience of PHU staff in planning and delivering school-based programmes and positive school coordinator attitudes and rapport with the PHU.

Implementing a time-limited, school-based SIA at short notice is a challenge that requires an innovative approach to engage parents and students. A study from the United States of America found that parents of adolescents have competing priorities and poor participation rates in a school vaccination programme were related to busy parents; some parents had limited knowledge and language skills to consent for their child to be vaccinated.[20] Another study found that adolescents have an increasing role in decision-making regarding vaccinations and that parents respect their child's right to refuse to be vaccinated.[21] A theme of 'joint decision-making', between students and their parents has been identified as an influencing factor in decision-making for school-based human papillomavirus vaccination of adolescents.[22,23] Educating students could encourage them to advocate for parental consent and reduce anxiety.[16] Although teachers have no obligations for school vaccination programme education,[8] a student resource, such as an advice card with appropriate language and graphics explaining the importance of the vaccine, is recommended.

In this SIA, parental consent depended on their recall of their child's previous measles vaccinations. However, when conducted, ACIR pre-clinic checks found parental recall to be inaccurate. A similar study also found underreporting of vaccinations through parental recall.[24] Provider validation of parent-reported vaccinations is required to ensure accurate surveillance of vaccination coverage of adolescents. One school vaccination programme[25] presumed that the risks of under-vaccination exceeded the risks of over-vaccination. If parents were unsure about their children's vaccination status but consented for vaccination, students were vaccinated. It is known that approximately 5% of recipients fail to seroconvert to their first dose of MMR vaccine.[26] Given poor parental recall and incomplete MMR vaccine seroconversion, the parental recall section on the consent form should be removed in future school-based SIAs to facilitate vaccination of all consented students without

pre-programme ACIR checks.

The PHU staff members were targeted for the focus group discussions as they are essential school programme facilitators who communicate with school staff, immunization teams, parents and students. They were highly representative of the NSW school vaccination programme workforce. Focus groups were considered more logistically feasible than individual interviews with similar research outcomes due to participants' location, availability and time constraints. In this study, 16 participants in each focus group exceeded the recommended six to 10 participants for a standard focus group interview;[27] however, we believe that exceeding this recommendation did not negatively impact on the discussions. While participants were randomly assigned to each group, it was difficult to ensure an even mix of personalities and experience; however, each group was manageable, and participation of each participant was equally high and engaging in general. Meanwhile, the facilitator who had a key responsibility for coordinating this SIA, had regular contact with the cohort regarding non-school-based vaccination programme matters. This could have influenced the responses of participants in the interviews and should be noted.

CONCLUSION

Future SIAs should be carefully considered regarding their lead time, location, targeted year group, available resources and workforce. The benefits of implementing the SIA through an already established programme by experienced staff outweigh the disadvantages. With adequate resourcing and lead time, SIAs implemented via a routine school vaccination programme are an appropriate model to target adolescents.

Conflicts of interest

None declared.

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Responding to the syphilis outbreak in Japan: piloting a questionnaire to evaluate potential risk factors for incident syphilis infection among men who have sex with men in Tokyo, Japan, 2015

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In Japan, notifications of syphilis reported through the national surveillance system have been increasing recently[1,2] similar to many other developed countries.[3,4] During 2013–2014, this increase was associated with men who have sex with men (MSM).[1,2] In response to this increase, the Ministry of Health, Labour and Welfare of Japan has been raising awareness and disseminating prevention messages. Recent reports indicated that factors associated with syphilis among MSM were low educational attainment, sex with casual partners without a condom and coinfection with other sexually transmitted infections (STIs).[5,6] Using mobile phone applications and the Internet to seek sex partners has also been reported as potential risk factors for STIs, including syphilis, among MSM.[7,8] There has been no study regarding potential predictors for syphilis acquisition in Japan. To investigate the possible reasons for the syphilis outbreak among MSM in Tokyo, a case-control study based on a questionnaire assessing potential risk factors for incident syphilis was proposed. To pretest the tool, we piloted the questionnaire and report key findings. We remind those in public health practice of the importance of pretesting questionnaire tools whenever possible.

The pilot was conducted at the same clinic proposed for the case-control study, located in central Tokyo, the epicentre of the syphilis outbreak in Japan. The clinic serves sexual minority populations, and the majority of the patients are MSM from the metropolitan Tokyo area. This clinic serves about 500 HIV-positive patients annually. It also reported the largest number of syphilis cases from a single facility in Tokyo in 2013 (n = 76, 18% of cases from Tokyo).[9]

With or without acquisition of syphilis, the first six MSM who attended the clinic for any reason on the afternoon of Wednesday, 7 January 2015, were invited to participate. The questionnaire was developed based on those from recent studies[5,6] and adapted to the Japanese context. The questions were about socio-demographics; health conditions, including a past STI history; sexual activities, including partner characteristics; and an open-ended question for comments and suggestions to improve the tool. The self-administered questionnaire was completed by the respondent in a private location within the facility. Participants were asked if they had ever had sex with men, and the information was verified by chart review. The institutional ethics committee of the National Institute of Infectious Diseases in Japan reviewed and approved the study protocol.

All (6/6) invitees agreed to participate in the study. All questions were responded to with no missing data. The median age was 38 (range 27–48) years; all had their sexual debut with another male by 20 years of age. History of STIs other than HIV or syphilis (e.g. anogential

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Table 1. **Characteristics of six MSM who visited an STI clinic in central Tokyo, Japan, 2015**

	Participants					
	1	2	3	4	5	6
Socio-demographic characteristics						
Age (years)	29	32	27	43	45	48
Highest level of education	University degree	High school diploma	University degrees	University degree	University degree	High school diploma
Employment status	Part time	Student	Student	Full time	Full time	Full time
Age of first sex with a male (years)	17	16	15	20	13	15
STI status						
Syphilis status	Negative	Past infection	Negative	Negative	Negative	Negative
HIV infection status*	Positive	Positive	Negative	Negative	Positive	Positive
Past STIs other than syphilis and HIV	None	Hepatitis B, Anogential HPV	Chlamydia	Anogential HPV	Anogential HPV	Hepatitis B
Sexual activity in the past six months						
Number of partners	1	4	8	None	None	None
Partner type	Steady	All casual	All casual	–	–	–
Method of seeking sexual partners	Internet	Internet	Mobile phone applications; cruising spots; public baths	–	–	–
Average frequency of sex (anal or oral)	< 1/month	≥ 1/month and < 1/week	1/week	–	–	–
Anal sex type	Insertive, Receptive	Insertive, Receptive	Insertive, Receptive	–	–	–
Oral sex type	Insertive, Receptive	Insertive, Receptive	Insertive, Receptive	–	–	–
Condom used during anal sex	Every time	Occasionally	Every time	–	–	–
Condom used during oral sex	Every time	Occasionally	Every time	–	–	–
Alcohol intake during sex	None	None	3–5 servings of beer	–	–	–
Recreational drug use during sex	None	None	None	–	–	–
Sex toy use during sex	None	Anal toy	Anal, oral toy	–	–	–

* Median CD4 count of the four HIV-positive participants was 416 (range 284–1018) /μl and HIV-RNA was well suppressed (all were receiving antiretroviral therapy at the time of study).

AIDS, acquired immunodeficiency syndrome; HIV, human immunodeficiency virus; HPV, human papillomavirus; MSM, men who have sex with men; and STI, sexually transmitted infection.

human papillomavirus [HPV] infections) was common (**Table 1**). Three reported sexual activity in the past six months, and included both insertive and receptive anal and oral sex. Methods for seeking partners were diverse, including the Internet, mobile phone applications, cruising spots and public baths. Among the recently sexually active participants, one with a history of syphilis reported using a condom "occasionally", while the other two reported using it every time. One participant (participant 3), who was the most sexually active with eight casual partners, sought partners via multiple approaches and reported use of a sex toy and alcohol intake during sex; however, he reported condom use "every time".

Within this small pilot sample, important themes emerged. First, large variations in responses were obtained, and we found that the participants used a variety of methods to seek sex partners. While temporally correlated, the recent rise in syphilis may be more complex than a singular attribution to the increase in partner-finding mobile phone applications as recently reported among MSM in Asia.[8] Such findings underscored the rationale for a thoughtfully designed questionnaire to address this concern along with other potential risk

factors. Notably, anogential HPV prevalence was high in our sample, which has also been reported recently among MSM in Japan,[10] so we added "anogential HPV" as one of the choices under the STI history section in the revised questionnaire.

Our experience iterated the importance of pretesting tools that deal with sensitive topics among hard-to-reach populations. One participant commented that the terminology used for partner-seeking methods could be improved to better reflect the language used among the target population; thus, for the question regarding methods of seeking sexual partners, three distinct categories were collapsed into one "cruising spots (outdoors/playing rooms)" in the revised questionnaire. Such modifications are important outcomes of pretesting to improve the validity of measurements, especially with marginalized groups. Better understanding of the target group's language can also help in risk communication.

This study had several limitations. First, the sample size was small. Nevertheless, this pilot achieved its aim to pretest the questionnaire to assess for usability, including qualitative feedback and to capture key themes. Second, while convenience sampling was used for practical reasons, we attempted to minimize selection bias by choosing a regular weekday afternoon and invited the first six patients who attended the clinic to participate. However, in our sample, HIV prevalence was higher (4/6) than that of the overall MSM clinic patient population (37% during 2007–2011 [Itoda I, Shirabaka Clinic, unpublished data, 2011]). As HIV-positive patients visit the clinic frequently for routine monitoring, their chance of being selected could have been high. Stratified or purposive sampling to select MSM by HIV seropositivity could have been useful to approach certain themes by HIV status. A focus group session may also have captured additional important thematic elements. While none of the six had incident syphilis, this should not affect our objective to pretest the tool as controls are also needed for a case-control study.

Our pilot study indicated that there are currently multiple avenues of seeking sex partners, highlighting the need for a careful evaluation of risk factors for syphilis acquisition. Our experience also iterated the importance of pretesting to better reflect the actual language used among the target demographic. As questionnaires are commonly used to test hypotheses and target interventions in outbreak responses, pretesting should be considered an essential part of the response whenever feasible. This process also helps us better understand relevant social issues and potential entry points for control. Currently, the revised questionnaire is being implemented in the case-control study among MSM in Tokyo, and we hope that the findings will lead to evidence-based prevention messages and interventions.

Conflicts of interest

None declared.

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