ELIMINATING MEASLES AND STRENGTHENING ROUTINE IMMUNIZATION IN CHINA:

status, barriers and recommendations

World Health Organization
Western Pacific Region

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ACRONYMS

AEFI	adverse events following immunization
BCG	Bacille Calmette–Guérin
CDC	Centers for Diseases Control and Prevention
DPT	diphtheria–pertussis–tetanus
DT	diphtheria–tetanus
EPI	Expanded Programme on Immunization
IPV	Inactivated polio vaccine
JE	Japanese encephalitis
MCV	measles containing vaccine
MCV1	first dose of measles-containing vaccine
MCV2	second dose of measles-containing vaccine
MM	measles–mumps
MMR	measles–mumps–rubella
MR	measles–rubella
MV	measles vaccine
NHFPC	National Health and Family Planning Commission of China
NIP	National Immunization Programme
OPV	oral polio vaccine
PCR	polymerase chain reaction
PCV	pneumococcal conjugate vaccine
RCV1	first dose of rubella-containing vaccine
SIA	supplementary immunization activities
TAG	Technical Advisory Group on Immunization and Vaccine-Preventable Diseases in the Western Pacific Region
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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EXECUTIVE SUMMARY

The National Health and Family Planning Commission of China requested a joint national and international consultation on measles elimination and strengthening routine immunization. The request was based, in part, on a recommendation made in 2012 by the Technical Advisory Group on Immunization and Vaccine-Preventable Diseases of the Western Pacific Region of the World Health Organization. From 3 to 14 June 2013, a team of national and international consultants examined data on measles epidemiology and programme capabilities and performance, and conducted field visits to a total of eight provinces. Based on the data and field observations, the team drew conclusions and made a set of recommendations.

Conclusions

The consultants produced 16 conclusions based on information provided and field observations: **1.** China's Expanded Programme on Immunization (EPI) has achieved great, long-lasting accomplishments; **2.** the period 2013 to 2015 is critically important for measles elimination in China, and programme enhancements need to be made; **3.** the recent increase in measles cases is not evidence of measles vaccine failure; **4.** China's measles elimination strategy is sound; **5.** the recent increase in measles cases is due to failure to provide measles vaccine for some children at the recommended ages; **6.** difficulties in identifying and enrolling children who are new to an area are leading to lack of timely immunization; **7.** missed opportunities to immunize, including false contraindications to vaccination, are leading to lack of timely immunization and sometimes permanently precluding vaccination; **8.** surveillance is critically important; **9.** the very high proportion of measles cases classified as sporadic cases indicates that investigation practices and analysis should be improved; **10.** current measles outbreak response tends to focus on cases rather than on population gaps in immunity; **11.** timely, routine vaccination is the foundation of the strategy for eliminating measles; **12.** filling immunity gaps is important, and the most important immunity gap is among young children of vaccination age; **13.** the school-entry vaccination check is an extremely valuable adjunct to the immunization programme; **14.** using administrative vaccination data for estimating coverage is not a sufficiently valid method given China's current stage in measles elimination and programme implementation; **15.** reducing transmission of measles in hospitals is important, but not the most important strategy for measles elimination; and **16.** China's immunization programme appears to be under-resourced, relative to its responsibilities and expectations.

Recommendations

The consultants proposed 17 recommendations for the National Health and Family Planning Commission, which, if implemented, could strengthen China's EPI and enable it to eliminate measles.

Recommendations for measles policies: **1.** Maintain the current strategy for protection of infants: a dose of measles–rubella vaccine at 8 months and a dose of measles–mumps–rubella vaccine at 18–24 months; **2.** a nationwide, adult-targeted mass vaccination campaign is not recommended at this time; **3.** a nationwide, child-targeted supplementary immunization activity is not recommended at this point; **4.** consider streamlining the measles-containing vaccines available for use in China in order to simplify vaccine choices and management and to align vaccine policy with WHO measles, rubella and mumps vaccine recommendations;

5. consider including measles and rubella serological testing in serological surveys conducted in China; and **6.** reduce nosocomial transmission of measles through guideline implementation.

Recommendations for programme strengthening: **7.** Strengthen the capacity of the Chinese Center for Disease Control and Prevention for policy and programme evaluation, research and timely implementation of evidence-based immunization policy; **8.** update and strengthen standards for immunization practices; **9.** identify and develop effective methods to reach out to children who are new to a clinic's and health department's jurisdiction; **10.** implement a comprehensive response to missed immunization opportunities; **11.** strengthen the school-entry vaccination check and referral strategy; **12.** develop valid, records-based assessment of coverage of children in China; and **13.** continue to strengthen laboratory networks for vaccine-preventable diseases.

Recommendations for communications: **14.** Develop a strategy to communicate with the public, immunization stakeholders and policy-makers to maintain confidence in vaccines and immunization; and **15.** communicate with immunization stakeholders about the importance of routine immunization and the goal to eliminate measles.

Recommendations for immunization financing: **16.** Ensure stability and reliability of resources for EPI by making EPI its own funding line, removed from competition with other public health programmes; and **17.** invest sufficient resources into China's EPI to cover its responsibilities and expectations.

Summary of the consultation

Strategically sound measles immunization policies that are implemented by a capable routine immunization programme are essential to rid a country of indigenous measles and maintain elimination. The process of eliminating measles can, in turn, reveal programme areas in need of strengthening, leading to a higher-capacity immunization programme for delivery of all vaccines. *(1)* China is very close to the goal of eliminating measles, but it will require additional capacity and effort. Children in China will be the beneficiaries of a strong immunization programme that is extending its record of success, consistently achieving national and global immunization goals.

Introduction

The case for eliminating measles is compelling. *(2, 3, 4)* Measles causes enormous suffering and death among children throughout the world, yet it has been preventable for decades with highly effective vaccines. Elimination of indigenous measles transmission has been achieved and sustained by large and small countries with varying degrees of economic development, resulting in improved child health and survival.

The high transmissibility of measles virus allows its circulation among relatively well-vaccinated populations, exposing population immunity gaps. Elimination of indigenous transmission requires very high and sustained coverage with two doses of effective measles vaccines. High coverage levels can only be attained and sustained through strong, carefully monitored immunization programmes. Eliminating measles also requires high-quality disease surveillance with laboratory support, *(5, 6)* and immunization policies that can be updated based on analyses of surveillance data and programme monitoring. *(7)*

China has made remarkable progress toward the elimination of indigenous measles transmission with the implementation of the 2006–2012 measles action plan. *(8)* The number of cases of measles dropped from 130 000 cases in 2008 to 6000 cases in 2012 – a change in incidence from over 90 per million total population to less than 5 per million. Decreases in incidence were seen across all age groups, including ages not targeted for measles vaccination.

Beginning in late 2012 and continuing through the first half of 2013, the incidence of measles in China increased from its nadir in 2012. During the first half of 2013, there were 16 000 cases of measles in China, exceeding the total number of cases in 2012, for an annualized incidence of 30 cases per million population – a five-fold increase in incidence from 2012. Most of the recent cases were among young, incompletely vaccinated children and among adults.

In August 2012, the Technical Advisory Group (TAG) on Immunization and Vaccine-Preventable Diseases in the Western Pacific Region of the World Health Organization (WHO) recognized China's remarkable progress toward elimination of measles, but it also recognized that further efforts would be needed. Given the country's diversity in epidemiology, demography, geography, and health systems by province, TAG recommended that China implement tailored strategies for each province based on in-depth review. The TAG further recommended that a joint national and international consultation might be helpful.

China's immunization programme has recently developed a measles action plan for 2013–2015. Recognizing the importance of this time frame for measles elimination, the National Health

and Family Planning Commission (NHFPC) of China requested a joint national and international consultation on measles elimination, as recommended by TAG. NHFPC also recognized that achieving specific vaccine-preventable disease goals – measles, tetanus and polio elimination and accelerated control of hepatitis B – relies on a strong routine immunization programme. Therefore, the scope of the measles consultation included recommending ways to strengthen China's routine immunization programme.

The goal of the consultation was to provide strategic advice to China's immunization programme on eliminating indigenous measles in China and maintaining measles elimination by strengthening the routine programme, augmented with additional measles activities as needed.

From 3 to 14 June 2013, a team of national and international consultants evaluated measles epidemiology and routine immunization at the national level and in eight provinces. The eight provinces were selected to represent the diversity of measles epidemiology and programme capacity. In each province, a team visited health bureaus and CDCs at the province, prefecture and county levels, immunization clinics, hospitals, public health laboratories and schools. The team had access to data and immunization records, and was able to interview immunization leadership, technical staff, immunization providers and parents.

This report puts forth the observations, conclusions and recommendations of the joint national and international consultation.

Overview of China's EPI structure, capabilities and performance

The EPI in China is a government-run, vertically integrated programme that falls under the responsibility of the Bureau of Disease Control of NHFPC. The EPI division is responsible for laws, regulations and policies, identification of immunization priorities, and development of goals and strategies. Technical support for programme implementation is managed through China's system of CDCs. EPI clinics are generally operated by village doctors, township hospitals or county CDCs, and EPI providers are supported with government funding. The EPI in China is separate from the routine, curative health-care system, and is a programme set within the public health system.

China's immunization programme currently protects children from 12 vaccine-preventable diseases: diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, hepatitis A, hepatitis B, Japanese encephalitis, invasive meningococcal disease and tuberculosis. Tables 1 and 2 show the recommended immunization schedule and when new vaccines were added to the programme, respectively.

Table 1. Routine immunization schedule for EPI vaccines in China, 2013

Vaccine	Birth	1 m	2 m	3 m	4 m	5 m	6 m	8 m	18 m	2 y	3 y	4 y	6 y
Hepatitis B	×	×					×						
BCG	×												
Polio			×	×	×							×	
DPT				×	×	×			×				
DT										×			
MR (MV)*								×					
MMR (MM, MV)*									×				
JE- live attenuated								×		×			
or JE-inactivated								×,×	×				
Meningococcal A							×,×						
Meningococcal A+C										×	×		
Hepatitis A-live attenuated									×				
or hepatitis A-inactivated									×	×			

* If recommended vaccine is not available, vaccines in parentheses are substituted.
BCG, bacille Calmette–Guérin; DPT, diphtheria–pertussis–tetanus; DT, diphtheria–tetanus; JE, Japanese encephalitis; m, months; MM, measles–mumps, MMR, measles–mumps–rubella; MV, measles vaccine; y, years.

Source: China CDC

Table 2. Introduction of vaccines to China's EPI and licensing of Type 2 vaccines, 1978–2009

Year of introduction or licensing	Type 1 (included in EPI) vaccines	Type 2 vaccines	Notes
1978	OPV, DTP, MV, BCG		Start of EPI in China
2002		Rotavirus	
2003		Hib	
2003		Varicella	
2003		Influenza	
2006		PCV	
2002	Hepatitis B		
2008	MR, MMR, MCV-AC, JE, hepatitis A		Total of 12 vaccine-preventable diseases in EPI
2009		IPV (imported)	

BCG, bacille Calmette–Guérin; DPT, diphtheria–pertussis–tetanus; Hib, Haemophilus influenza type B; IPV, inactivated polio vaccine; JE, Japanese encephalitis; MCV, measles-containing vaccine; MMR, measles–mumps–rubella; MR, measles–rubella; MV, measles vaccine; OPV, oral polio vaccine; PCV, pneumococcal conjugate vaccine.

Source: China CDC

EPI vaccines are provided at no cost to parents, with no fee for vaccine administration. They are administered by approximately 250 000 government-operated clinics. In urban areas, EPI clinics in hospitals or community health centres deliver immunization services on a daily or weekly basis. In rural areas, village and township clinic doctors deliver immunization services once a week or once a month. In poor, remote areas and among nomadic populations, delivery of immunization services may be less frequent, occurring once every one to two months. Immunization providers in EPI clinics are individuals who have completed an immunization-training programme and are authorized by county-level health bureaus. Immunization standards and guidelines are provided by the EPI division of the Bureau of Disease Control of NHFPC. Clinic oversight and continuing education for immunization providers are delivered by township hospitals and county CDCs.

All EPI vaccines are domestically produced. Provincial health departments purchase EPI vaccines and manage the vaccine supply chain through the CDC system (province, prefecture, county), to township hospitals and EPI clinics.

Surveillance and laboratory support for vaccine-preventable diseases is conducted by the immunization programmes in the CDC system. Cases of vaccine-preventable diseases are reported by hospitals and clinicians through an Internet-based, real-time surveillance system. Investigation of outbreaks is the responsibility of county-level CDCs with support from higher-level CDCs, as needed.

Technical support for the EPI system is provided by China CDC's National Immunization Programme through dissemination of guidelines for prevention, provision of supervision, and management and analysis of surveillance and adverse events following immunization (AEFIs) reporting systems.

Specific areas of technical support provided by China CDC's National Immunization Programme include:

1. vaccine and vaccine-preventable disease expertise;
2. surveillance for vaccine-preventable diseases;
3. cold chain expertise;
4. clinic standards development;
5. immunization information system support;
6. coverage monitoring;
7. and risk communication.

Laboratory support for viral vaccine-preventable diseases is provided by China CDC's Institute of Viral Diseases Control and Prevention. *(9)* China CDC serves as a regional reference laboratory for measles, rubella, polio and Japanese encephalitis. China's 31 provincial laboratories are part of the WHO laboratory networks for polio, measles and rubella in the Western Pacific Region. *(10)* China CDC's National Measles Laboratory has been a WHO regional reference laboratory since 2003, with continuous, annual recertification since then. A full range of laboratory services are provided, including serological testing, polymerase chain reaction (PCR), and genotype analysis. In 2013, real-time PCR was extended to the prefecture level.

Although China's immunization programme is vertically integrated, the programme has an important partnership with China's education system. The current (2005) immunization law in China mandates that for every child enrolling in kindergarten or school, the immunization status must be checked, and if the child needs one or more vaccines, he or she is referred as appropriate for vaccination. Referral sites for vaccination depend on existing arrangements between schools and clinics, hospitals or county CDCs.

Funding for the EPI system in China is provided by the Ministry of Finance as part of a block grant administered by NHFPC. The grant covers 10 other basic public health services, such as chronic disease control, maternal and child health care, and health education. Funding allocations are made by NHFPC; however, provincial and lower-level governments can provide additional funding. Immunization clinics receive funding that is based on their workload and the number of children vaccinated, as determined by a performance evaluation.

China's EPI has delivered remarkable achievements. Polio was eliminated from China by 2000, and China's status as a polio-free country has been maintained continuously since then, according to the Western Pacific Regional Committee on the Certification of Polio Eradication. In 2012, China was verified by the WHO Regional Director for the Western Pacific, Dr Shin Young-soo, to have reduced the prevalence of chronic hepatitis B infection to less than 1% among children under five years of age – exceeding the regional goal of 2%. Also in 2012, China was verified by WHO to have eliminated maternal and neonatal tetanus.

Measles policy and programme performance

Policy

The history of measles vaccine policy development and implementation in China has been recently described. *(11)* China licensed and began using a liquid measles vaccine in 1965, following a single-dose schedule. The single dose of measles vaccine was to be administered at 8 months of age. This schedule was used in some but not all provinces. In 1978, with the establishment of China's EPI, vaccination with a lyophilized measles vaccine was implemented throughout China. In 1986, a second dose of measles vaccine was added to the schedule. The first dose was to be administered at 8 months of age, and the second dose at 7 years of age. Each dose was 0.2 ml in volume. In 2007, the schedule was changed again, calling for 0.5 ml of measles–rubella (MR) vaccine at 8 months of age, followed by 0.5 ml of measles–mumps–rubella (MMR) vaccine between 18 and 24 months of age. Table 3 shows the history of measles vaccination policy.

Table 3. National measles vaccine schedule in China, 1978–2007*

Year	DOSE 1 Vaccine and volume (age)	DOSE 2 Vaccine and volume (age)	Notes
1978	MV, 0.2 ml (8 months)	Not recommended	
1986	MV, 0.2 ml (8 months)	MV, 0.2 ml (7 years)	Second dose of MV added.
2005	MV, 0.5 ml (8 months)	MV, 0.5 ml (18–24 months)	Age for MV2 changed.
2007	MR, 0.5 ml (8 months)	MMR, 0.5 ml (18–24 months)	Guidelines for shortages: If no MR, replace with MV; if no MMR, replace with MM or MV.

* Some provinces recommend additional doses.

MM, measles–mumps; MMR, measles–mumps–rubella; MR, measles–rubella; MV, measles vaccine.

Source: China CDC

Measles supplementary activities

In addition to routine measles vaccination, supplementary immunization activities (SIAs) are conducted frequently in China (Table 4). From 2004 to 2009, a total of 27 provinces conducted province-wide, non-selective (i.e. vaccination irrespective of vaccination history) SIAs using a total of 186 million doses of measles vaccine. In 25 provinces, SIAs targeted children ranging in age from 8 months to 14 years; in five provinces, the age range was 8 months to 6 or 7 years. Evidence of impact has been shown for SIAs in some provinces, such as Guangxi province, *(12)* which has helped provide justification for subsequent SIAs.

In 2010, a nationwide, non-selective SIA was conducted and reached all provinces. The children targeted for this SIA ranged in age from 8 months to 4 years in 19 provinces (Anhui, Chongqing, Fujian, Gansu, Guangdong, Guizhou, Hubei, Hunan, Inner Mongolia, Jiangsu, Jiangxi, Liaoning, Ningxia, Shaanxi, Shanghai, Shanxi, Sichuan, Xinjiang and Zhejiang); from 8 months to 6 years in six provinces (Hainan, Jilin, Qinghai, Shandong, Tibet and Yunnan); and from 8 months to 14 years in five provinces (Beijing, Guangxi, Hebei, Heilongjiang, and Henan). In less than one month, a total of 650 000 vaccinators working in 570 000 vaccination sites had vaccinated 103.4 million children with measles vaccine. The reported coverage rate of the SIA target population was 97.5%. This was almost certainly the largest measles SIA ever conducted in the history of the world.

Table 4. History of measles SIAs in China, 2004–2010

Year	AGE GROUP 8 months to 14 years				AGE GROUP 8 months to 6 years			
	# Provinces	# Targeted *(in millions)*	# Vaccinated *(in millions)*	Coverage *(%)*	# Provinces	# Targeted *(in millions)*	# Vaccinated *(in millions)*	Coverage *(%)*
2004	2	13.0	12.9	99.23	-	-	-	-
2005	2	5.7	5.6	98.25	-	-	-	-
2006	4	6.9	6.6	95.65	-	-	-	-
2007	2	16.4	16.1	98.17	-	-	-	-
2008	5	35.2	34.7	98.58	4	16.1	15.7	97.52
2009	10	90.3	88.2	97.67	3	6.2	6.0	96.77
2010	30*	106.1	103.4	97.52				

Note: In 2010, synchronized SIAs were conducted in 30 provinces, excluding Tibet, which conducted a separate SIA in May 2010. SIAs in the 30 provinces covered different age groups as described in the text.

Source: China CDC

From 2011 to 2013, measles SIAs have been conducted in more than 400 counties per year among high-risk populations. Selection of high-risk areas has been based on measles surveillance data, with SIAs targeting areas with the highest measles incidence rates.

Reported coverage

EPI vaccination coverage levels are determined by administrative data and are reported to WHO and the United Nations Children's Fund (UNICEF) annually. Figure 1 shows national reported coverage with the first and second doses of measles-containing vaccine (MCV1 and MCV2) and the first dose of rubella-containing vaccine (RCV1) from 2000 to 2012, and Table 5 shows reported coverage with MCV1 and MCV2 by province. Administrative coverage levels are determined by dividing the number of clinic-reported doses administered by the clinic-reported target population. Using administrative data, 98% of townships and 98% of counties report coverage that is cascaded through the CDC system to arrive at nationally reported rates. Coverage for MCV1 and MCV2 has been reported to be 98% or more for the last four years. RCV1 coverage has been reported since 2009, showing a range of 96% to 98%. Coverage for MCV1 and MCV2 was reported to be 99% and 98% in 2009, respectively, and 100% for both in 2010. *(13)* Smaller local surveys that use records of individual, sampled children show lower coverage, ranging from less than 70% to 91%. *(14, 15)* Surveys of migrant children show substantially lower coverage. *(15, 16, 17)*

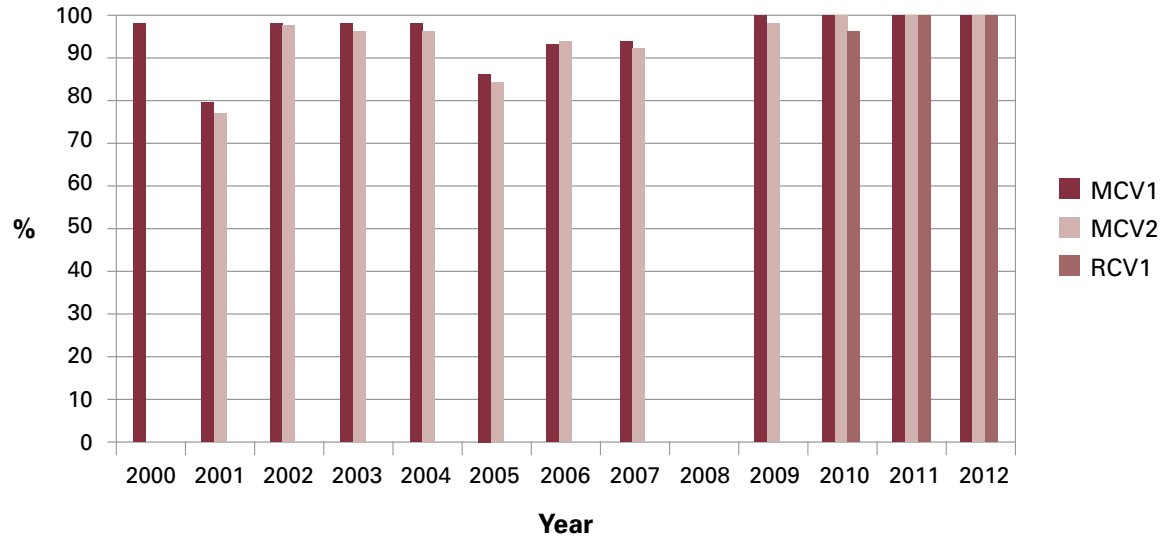


Figure 1. Reported coverage with MCV1, MCV2 and RCV1 by year, China, 2000–2012

MCV, measles-containing vaccine; RCV, rubella-containing vaccine.
Source: http://apps.who.int/immunization_monitoring/globalsummary
Note: no data reported for 2008

Table 5. Reported coverage with MCV1 and MCV2 by province, China, 2011 and 2012

Province	2011		2012	
	MCV1 *(%)*	MCV2 *(%)*	MCV1 *(%)*	MCV2 *(%)*
National	99.55	99.47	99.65	99.59
Beijing	99.98	99.99	99.97	99.99
Tianjin	99.79	99.74	99.84	99.79
Hebei	99.40	99.33	99.61	99.57
Shanxi	99.89	99.88	99.89	99.92
Inner Mongolia	99.49	99.49	99.54	99.36
Liaoning	99.63	99.63	99.69	99.71
Jilin	99.33	99.10	99.04	98.84
Heilongjiang	99.93	99.93	99.95	99.96
Shanghai	99.88	99.90	99.86	99.87
Jiangsu	99.79	99.74	99.85	99.84
Zhejiang	99.80	99.76	99.81	99.73
Anhui	99.68	99.69	99.59	99.59
Fujian	99.59	99.60	99.81	99.81
Jiangxi	99.75	99.76	99.83	99.80
Shandong	99.34	99.12	99.79	99.78
Henan	99.65	99.56	99.70	99.57
Hubei	99.60	99.38	99.68	99.66
Hunan	99.76	99.73	99.83	99.82
Guangdong	99.31	99.09	99.31	99.30
Guangxi	98.82	98.50	99.35	99.26
Hainan	99.90	99.87	99.96	99.95
Chongqing	99.76	99.72	99.82	99.81
Sichuan	99.37	99.31	99.34	99.26
Guizhou	99.55	99.62	99.70	99.61
Yunnan	99.57	99.55	99.69	99.70
Tibet	96.83	92.79	95.59	91.86
Shaanxi	99.88	99.86	99.90	99.90
Gansu	99.74	99.74	99.81	99.65
Qinghai	99.25	99.14	98.81	99.02
Ningxia	99.74	99.82	99.83	99.85
Xinjiang	98.93	98.44	99.57	98.63

Source: China CDC

Measles surveillance

The history and status of surveillance for measles have been recently described. *(11, 18)* Measles has been a notifiable disease in China since the 1950s, prior to the measles vaccine era. Guidelines for measles surveillance were updated in 1997 as part of the measles action plan. Case-based measles surveillance was recommended for all provinces in 2003, and starting in 2009, case-based, online-reporting measles surveillance was conducted in all provinces. China reports measles surveillance quality indicators on a monthly basis to the WHO Regional Office for the Western Pacific, and these reports are publicly available. *(19)* Surveillance quality indicators have steadily improved from 2009 to 2013 (Table 6). In 2013, China's surveillance quality indicators exceed the minimum criteria set by the WHO Regional Office. *(20)* Surveillance quality indicators do not address completeness of reporting, and there has been no evaluation of completeness of case reporting in China, such as would be done with a capture–recapture study. However, the surveillance system has been able to detect several imported cases of measles against the background of indigenous measles, providing some assurance of surveillance sensitivity.

Table 6. Measles surveillance indicators, China, 2009–2013 *(19)*

Year	Discarded Non-Measles *Rate per 100,000 population*	% Second-Level Units *With ≥ 1 Discarded Cases*	% Suspected Cases With *Adequate Investigation*	% Suspected Cases With *Adequate Blood Specimens*	% Clinically Confirmed *Cases*
2009	1.34	54.84	86.90	70.10	43.99
2010	1.39	51.61	88.87	76.63	31.13
2011	1.84	70.97	93.30	90.37	9.98
2012	2.34	70.96	98.26	97.30	1.54
2013	2.15	90.00	98.89	96.78	Not Available

Indicator targets: Discarded non-measles rate: 2 per 100 000; % second level units with more than 1 discarded case: 80%; % suspected cases with adequate investigation: 80%; % suspected cases with adequate blood specimens: 80%; % clinically confirmed cases: < 10%.

Source: China CDC

Recent measles epidemiology

The epidemiology of measles from 2005 to 2012 has been described by China CDC. *(8)* In recent years, the peak incidence of measles occurred in 2008, when there were more than 130 000 cases of measles, an annual incidence of 9.8 per 100 000 total population. Before 2009, all provinces in China had annual measles incidence rates greater than 1 per million total population, but in 2012, 15 provinces had annual measles incidence rates of less than 1 per million. Similarly, the percentage of counties with measles cases declined from more than 90% in 2008 to 36% in 2012. The number of measles-related deaths declined from 103 deaths in 2008 to nine deaths in 2012. See Table 7.

Table 7. Measles incidence, measles cases and measles-related deaths by year, China, 2005–2013 (January–May)

	2005	2006	2007	2008	2009	2010	2011	2012	2013, Jan–May*
Measles incidence *(per 100 000 population)*	9.47	7.62	8.29	9.95	3.95	2.86	0.74	0.46	1.29
Total number of measles cases	123 136	99 602	109 023	131 441	52 461	38 159	9 943	6 183	17 906
Number of measles-related deaths	56	35	67	103	37	27	10	9	22

* Incidence for 2013 is annualized incidence.
Source: China CDC

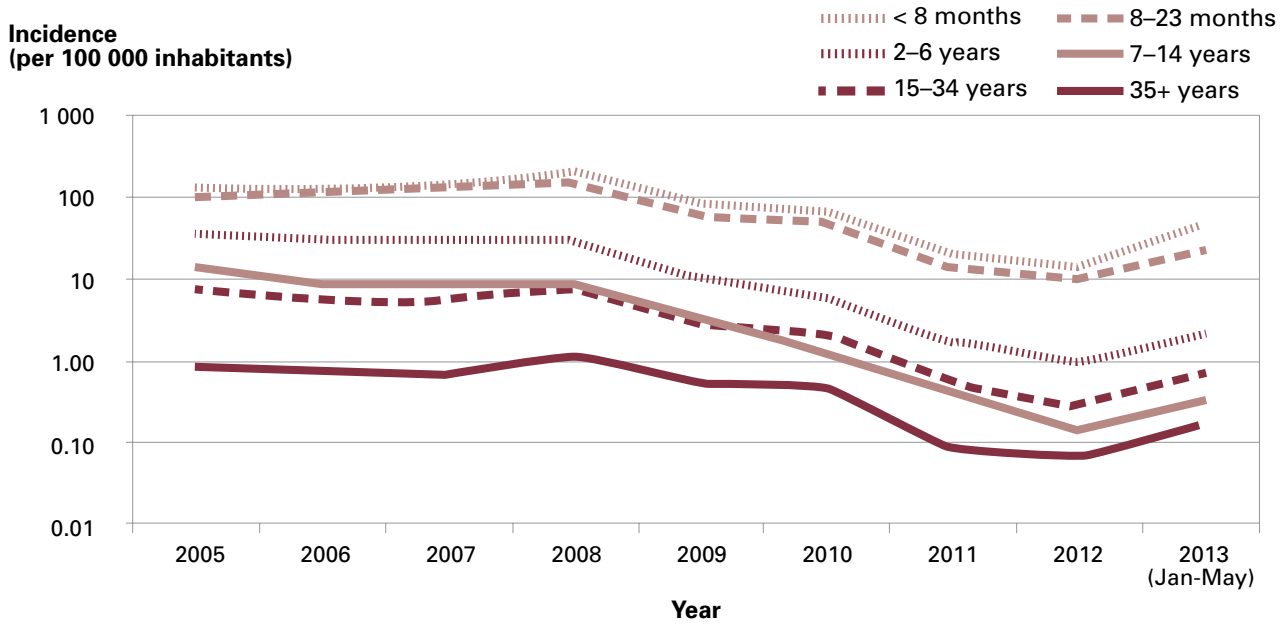
Between 2008 and 2012, the annual incidence of measles declined markedly in all age groups – those targeted for vaccination (young children over 8 months of age), and those not targeted for vaccination: 99% decline among children aged 7–14 years; 97% decline among children aged 2–6 years old; 94% among children under 8 months of age who were too young to vaccinate; 96% among 15- to 34-year-olds; and 94% among adults 35 years of age and older.
See Table 8a and Figure 2.

Table 8a. Measles vaccination status of measles cases by age group, 2009–2012

Age group	0 doses N (row %)	1 dose N (row %)	≥ 2 doses N (row %)	Unknown N (row %)	Total N (column %)
< 8 months	18 616 (84.7)	216 (1)	12 (0.1)	3 128 (14.2)	21 972 (20.6)
8–23 months	16 607 (53.3)	7 649 (24.5)	613 (2)	6 290 (20.2)	31 159 (29.2)
2–6 years	3 931 (25.9)	3 248 (21.4)	2 998 (19.8)	4 975 (32.8)	15 152 (14.2)
7–14 years	1 121 (16.5)	1 093 (16.1)	1 430 (21.1)	3 148 (46.3)	6 792 (6.4)
15 years	7 398 (23.5)	1 379 (4.4)	653 (2.1)	22 241 (70.1)	31 671 (29.6)
Total	47 673 (44.7)	13 585 (12.7)	5 706 (5.4)	39 782 (37.2)	10 6746 (100)

Source: China CDC

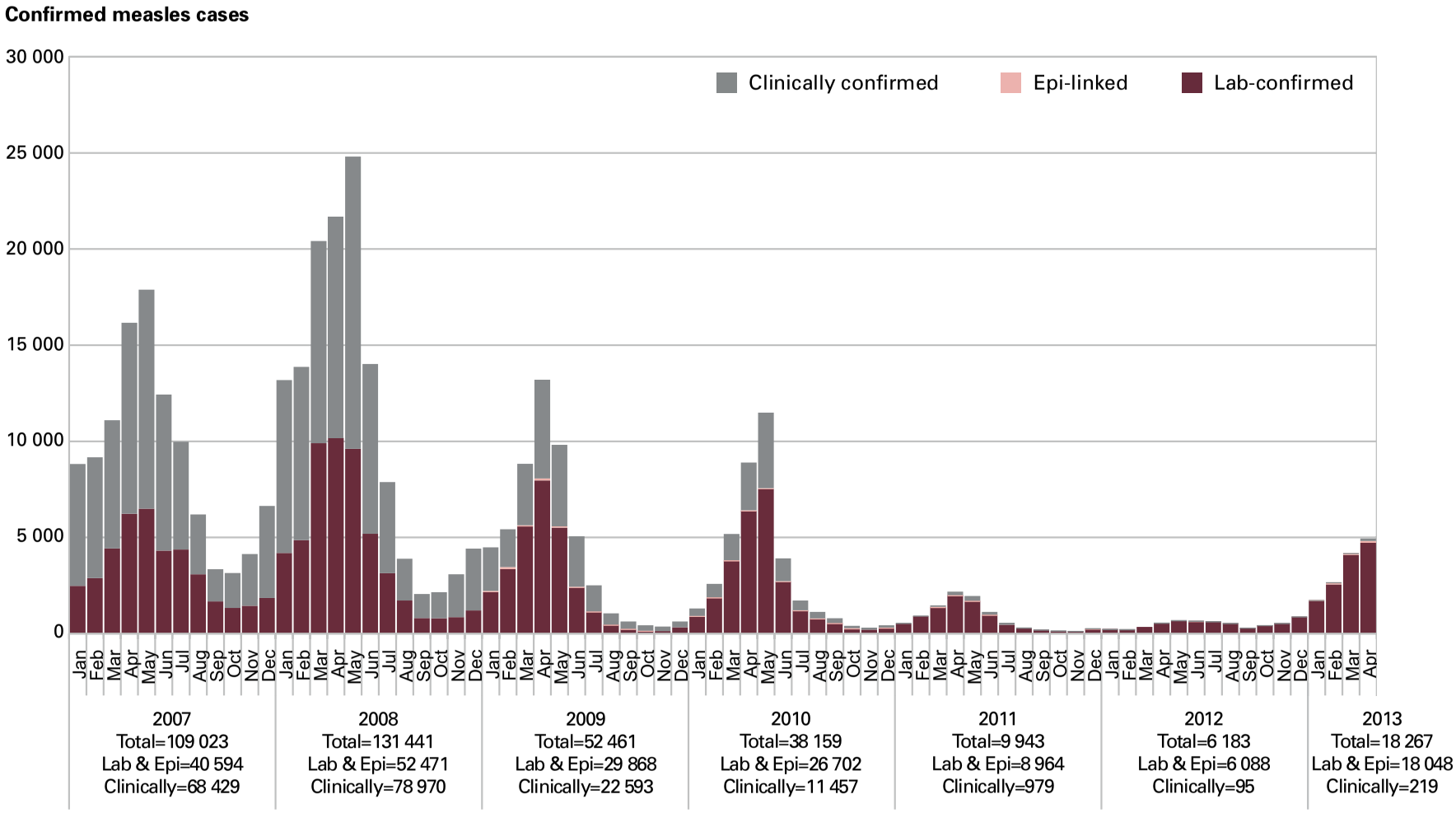
Figure 2. Measles incidence by age group by year, China, 2005–2013*



* Incidence shown for 2013 is annualized incidence.
Source: China CDC

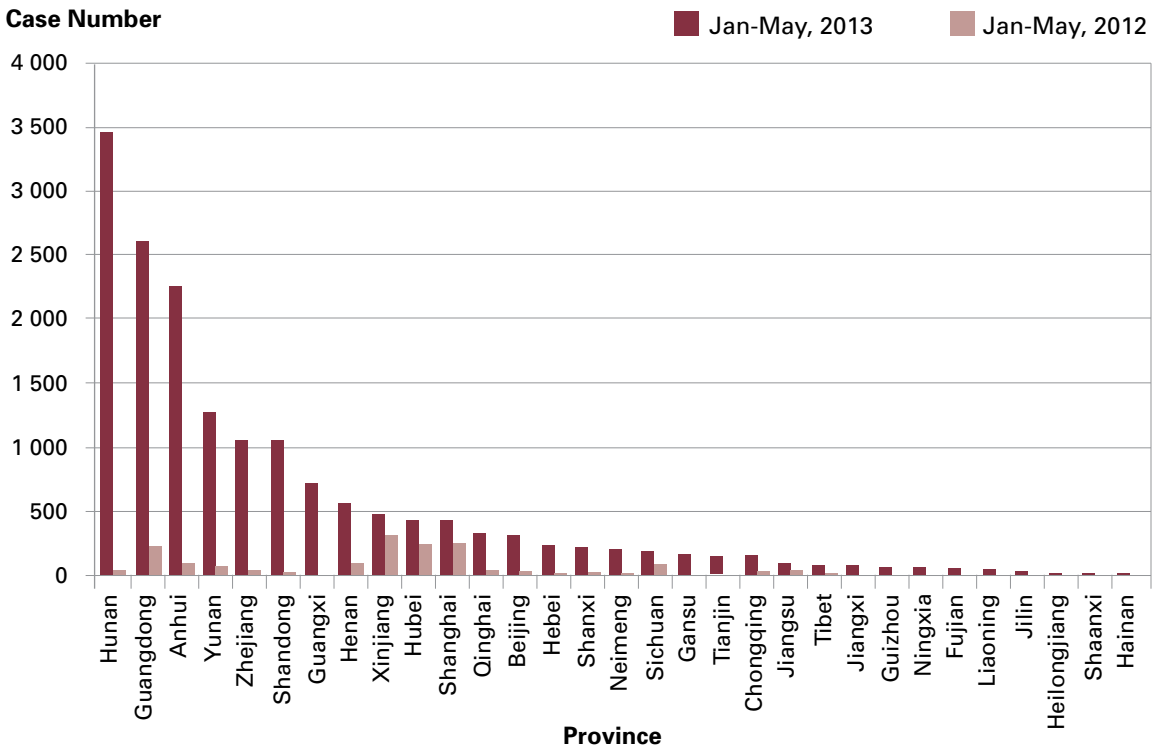
The year 2013 saw a substantial increase in measles cases, relative to 2012 (Figure 3), which varied markedly by province (Figure 4). China's annualized incidence of measles during the first half of 2013 was 30 cases per million total population per year – approximately one third of the 2008 annual incidence of 90 cases per million per year, but significantly higher than the 2012 nadir incidence of less than 5 cases per million per year. Measles cases in 2013 were primarily among preschool-aged, unvaccinated children, with some adult cases. In general, few cases were among school-aged children, and most of the cases among young children were among infants too young to vaccinate (Figures 5a and 5b). In 2013, the vaccination status of measles cases among children 2 to 6 years of age showed that 51% had zero doses; 13% had one dose; 16% had two doses; and 20% had unknown measles vaccination status (Figure 6a and Table 8b). Figure 6b shows the vaccination status of cases during infancy.

Figure 3. Measles case counts by month, China, 2007 to May 2013



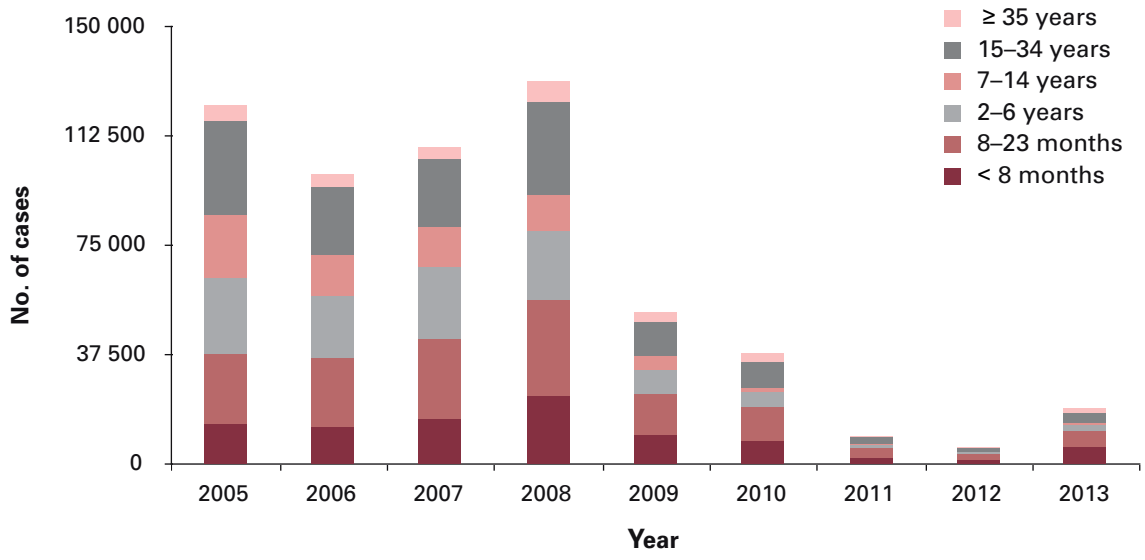
Source: China CDC

Figure 4. Comparison of measles case counts by province, China, 2012 and 2013



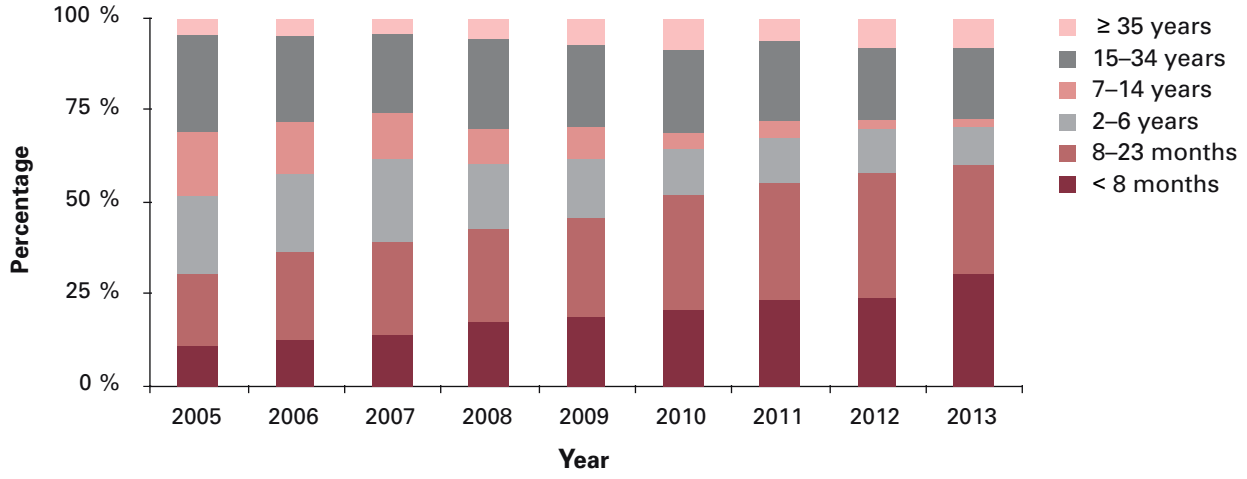
Source: China CDC

Figure 5a. Measles incidence (case counts) by age group, China, 2005–2013



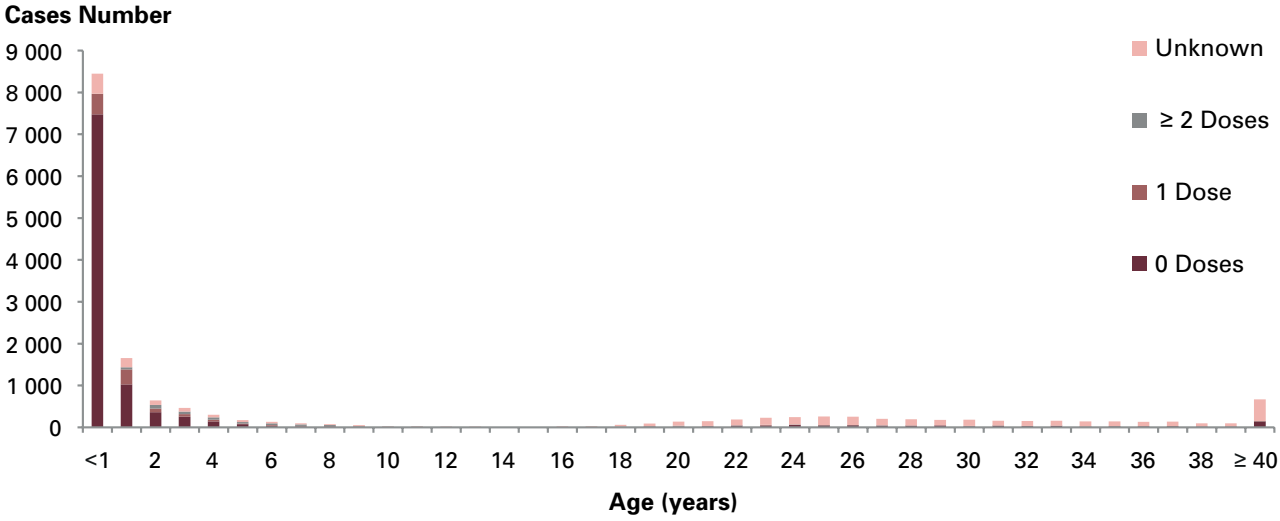
Source: China CDC

Figure 5b. Measles incidence (proportions) by age group, China, 2005–2013



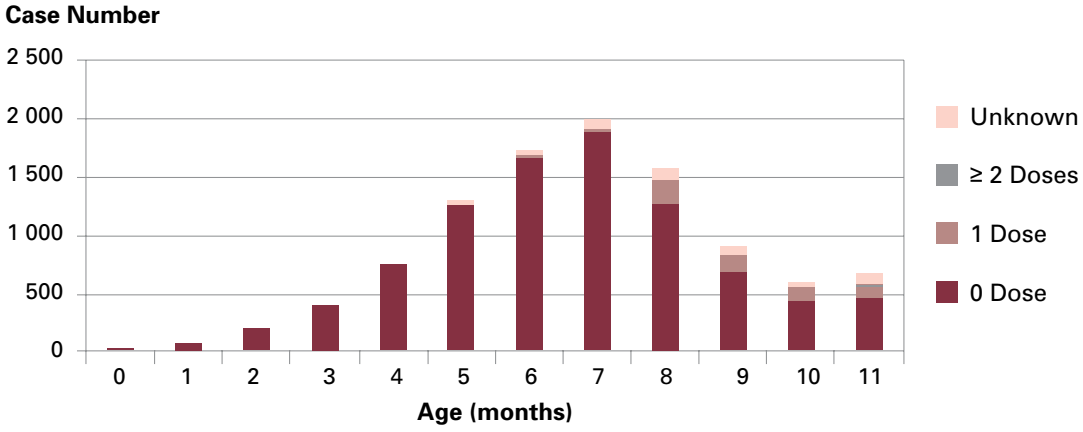
Source: China CDC

Figure 6a. Age-grouped measles cases with vaccination status, by year of age, 2013



Source: China CDC

Figure 6b. Age-grouped measles cases with vaccination status, by month of age, 2013



Source: China CDC

Table 8b. Measles vaccination status of measles cases by age group, Jan–May 2013

Age group	0 doses	1 dose	≥ 2 doses	Unknown	Total
< 8 months	5 156 (96.3)	15 (0.27)	0 (0.00)	183 (3.42)	5 354 (32.45)
8–23 months	3 349 (70.52)	830 (17.48)	54 (1.14)	516 (10.86)	4 749 (28.79)
2–6 years	881 (51.19)	220 (12.78)	281 (16.33)	339 (19.7)	1 721 (10.43)
7–14 years	86 (24.78)	46 (13.26)	94 (27.09)	121 (34.87)	347 (2.10)
≥ 15 years	837 (19.36)	165 (3.82)	49 (1.13)	3 273 (75.69)	4 324 (26.21)
Total	10 309 (62.5)	1 275 (7.73)	479 (2.9)	4 432 (26.87)	16 495 (100)

Source: China CDC

Genotype

The H1 measles genotype is the only genotype indigenous to China. The H1 genotype is known to have circulated continuously in China for over 20 years. *(21)* In recent years, however, imported measles viruses have been detected, indicating that the measles surveillance system is sensitive enough to detect imported cases against the background of indigenous genotype circulation. Between 2009 and 2012, genotype information was available for 946 confirmed cases of measles, and among these cases, 98.2% (929 cases) were H1. Among the non-H1 cases, one was D4 (isolated in Shanxi province in 2009), one was D8 (isolated in Shanghai in 2012), one was D11 (isolated in Yunnan province in 2011), and 15 were D9 (one from Sichuan province in 2009, one from Ningxia in 2010, and 13 from Yunnan province in 2012). Through May 2013, all cases for which genotype information is available were H1.

Outbreaks

In China, an outbreak is defined as the occurrence of two or more confirmed measles cases in a village/district/school or similar unit within 10 days, or five or more confirmed measles cases in a township-level unit within 10 days. The number of outbreaks reported to China CDC decreased from 322 in 2008 to 11 in 2012, and the average size and duration of outbreaks also declined during that period of time. However, only a small proportion of cases were reported as part of an outbreak: less than 5% in 2008 and less than 1% in 2012. *(8)* The vast majority were reported as sporadic cases, not epidemiologically linked to other cases.

Nosocomial transmission of measles

Nosocomial transmission of measles is a global challenge, even after elimination of measles. *(22)* In China, nosocomial transmission was linked to a recent outbreak of measles in Wenzhou city. An evaluation of this outbreak showed that weak routine immunization and transmission in an intravenous drip room were factors associated with sustaining the outbreak. *(23)*

Field observations

The national and international consultants were divided into four teams, each of which visited two provinces. The eight provinces had been selected to represent the diversity in China's measles epidemiology and routine immunization programme. In the provinces, teams visited immunization clinics, schools, hospitals and CDCs at the province, prefecture and county levels.

The team members were consistently impressed with the helpfulness of the immunization professionals and with their willingness to share data and information about measles and routine immunization. It was observed that China professionals at health bureaus, CDCs, clinics, hospitals and schools were consistently dedicated, hard-working and committed to protecting children through immunization. Their cooperation was an essential element of the consultation.

Immunization clinic observations

The clinics ranged in size from small, rural clinics to clinics with catchment areas covering more than 100 000 people. Vaccine storage and handling in clinics and vaccine distribution centres was observed to be of a high standard. No expired vaccine was found. Storage units had temperature monitoring equipment. Several different presentations of MCV were stocked at clinics, including measles vaccine, MR vaccine, MMR vaccine, and MM vaccine.

In some provinces, clinic vaccination records were computerized, with clinic staff entering web-based data into a database serving a larger population (i.e. immunization information systems). In other provinces, clinic records were recorded on paper and later entered by township hospitals into a population database. In other provinces, records were completely paper based. The different immunization information systems allow sharing of immunization data among clinics in a province; however, they do not link with the systems of other provinces or non-EPI health records systems.

Computerized vaccination records were retrievable for analysis, but in some places, useful functions such as generation of a list of children in need of vaccination, or generating a clinic coverage assessment, were not available in the system. Immunization clinics using hybrid paper–computer systems, which were common in most provinces, did not routinely receive lists of children in need of vaccination. Computerized vaccination systems recorded the dates

of upcoming appointments. However, the systems seen by the consultants only recorded vaccination-related information; they did not record information about visits during which a vaccine was not administered. By not recording all visits, it was difficult to evaluate rates of, and reasons for, missed immunization opportunities.

Identifying and enrolling children who are new to a jurisdiction was consistently stated to be a major challenge for assessing access to vaccination services. Some clinics had established relations with public security officials, who would share information about adults and children new to the area. In at least one province, children transferring to a new clinic without a vaccination card were sent away from the clinic rather than obtaining the vaccination history from the previous clinic or reinitiating the vaccination series.

Many immunization clinics missed opportunities to vaccinate due to the unavailability of simultaneous vaccination, the use of false contraindications that delayed or even precluded vaccination, and short-term stock-outs of preferred vaccine presentations. One clinic required screening for egg allergies at least one month prior to vaccination against measles.

Clinic personnel felt that they had to be very cautious about vaccination due to heightened parental concerns about AEFIs and possible liability. Often, clinic personnel did not administer all of the vaccines required at a single visit out of concern that they would confuse AEFI associations with specific vaccines administered.

Schools

In most provinces visited, vaccination checks and referrals prior to elementary school served very well as an immunization safety net. The school-entry vaccination check is required of schools and students, but complete vaccination is not a condition of participation in school. Implementation of the school-entry vaccination check varied from "outstanding" (checking, referring and assuring vaccination) to "partially implemented" (checking and referring, but not assuring vaccination).

Immunization records of students were stored at the school or at a partnership hospital, and records were readily available for review. Upon enrolment, typically 10% to 20% or more of children needed at least one dose of measles vaccine in order to be fully vaccinated. In some provinces, the vaccination status was tracked through the school year, and schools were able to assure vaccination of children in need of one or more doses of vaccine.

Training and education of school personnel for the immunization-checking process was generally done by the township hospital or the county CDC. In some schools, teachers assessed immunization records; in other schools, hospital doctors assessed immunization records.

Hospitals

Consultants found that hospitals varied in their implementation of respiratory or measles infection-control guidelines. Some hospitals displayed excellent use of comprehensive guidelines for case management and prevention of transmission, while others had no guidelines addressing measles. Hospitals also varied in their ability to separate potentially infectious patients from healthy individuals. Some hospitals admitted all patients with measles, regardless of clinical status and potentially exposing others in the hospital, rather than quarantining the patients at home. Some hospitals recommended measles vaccination of health-care workers, but not all hospitals kept records of which staff members were and were not vaccinated. There were several anecdotal reports of measles among health-care workers.

Laboratories

The laboratory network for measles and rubella is well established and highly capable. There are four levels of service: sample collection at the county level, serological testing and real-time PCR at the prefecture level, virus isolation at the province level (with some provinces able to do genotyping), and genotyping and quality control at the national level. Quality assurance is provided through systematic review by each laboratory to the laboratory one level below.

Observed challenges for the laboratories include:
1. assuring quality control at the prefecture and county levels for serological and molecular biological methods;
2. communicating more closely with epidemiologists if laboratory results are inconsistent; and
3. improving human and financial resources for the laboratory.

CDC at provincial, prefecture and county levels

The impact of routine measles vaccination efforts varied by province, with some provinces reporting high coverage and few cases among unvaccinated young children, and other provinces reporting lower coverage and many cases among young children. The sensitivity of measles surveillance is likely to be suboptimal, as some acute febrile rash cases were not reported by doctors as suspected measles and laboratory testing was not performed.

Although routine surveillance detected many cases of measles, virtually all of the cases were described as sporadic cases that were not linked epidemiologically. This pattern was seen in provinces that had cases clustering in time and geography, highly indicative of an outbreak. Response to measles cases generally amounted to vaccination around the cases – i.e. ring vaccination. This was likely due to having almost all cases viewed as sporadic, unrelated cases.

The impact of measles SIAs was reported to be variable. The 2010 nationwide SIA was followed by declines in incidence of measles in 2011 and 2012, which is consistent with beneficial impact. However, some provinces reported that they were conducting many measles SIAs but seeing little effect on measles incidence in the target age groups. Evaluations assessing the degree to which previously unvaccinated children were vaccinated in SIAs were not available, precluding formal evidence of impact. The China EPI system conducts many SIAs each year, providing opportunities to assess SIA impact and improve SIA effectiveness and efficiency.

In general, administrative data were used to determine routine immunization coverage in the provinces, prefectures and counties, and almost always, the data showed unrealistically high coverage – often 100% coverage for both doses of measles vaccine. In some provinces, the school-entry immunization check provided different results, with 10% to 20% or more of children missing at least one dose of measles vaccine.

When asked about challenges associated with eliminating measles and strengthening the immunization programme, CDC and clinic leadership respondents consistently identified limited resources – both human resources and financial resources. In some places, lack of sufficient space was mentioned as a challenge. Low pay for immunization clinic staff was consistently mentioned as a challenge for recruiting new staff. The per-dose vaccine administration fee was generally about 2 RMB.

Conclusions based on observations and information provided

Conclusions were formulated during a two-day, in-person meeting through informal discussion of the observations by all four teams. Consensus on the conclusions was obtained.

1. **China's EPI has achieved great, long-lasting accomplishments.** WHO recently recognized the routine immunization programme and its achievements, namely: markedly reducing prevalence of chronic hepatitis B among young children; achieving polio elimination and sustaining polio elimination for more than 13 years; rapidly and effectively responding to the 2011 Xinjiang importation outbreak of polio; contributing to the elimination of maternal and neonatal tetanus; and reducing measles cases by over 90%.

2. **The period 2013 to 2015 is critically important for measles elimination in China, and programme enhancements need to be made.** Without programme enhancements, the number of children susceptible to measles will increase, leading to further outbreaks and larger population immunity gaps.

3. **The recent increase in measles cases is not evidence of measles vaccine failure.** The recent epidemiology of measles is consistent with use of an effective vaccine. The number of MCV1 and MCV2 failures is consistent with relatively high coverage with an effective vaccine.

4. **China's measles elimination strategy is sound.** The epidemiology of measles in China is consistent with good-to-excellent implementation of a sound strategy. The trajectory of the epidemiology of measles is consistent with a pathway to the elimination of measles in China. Strong evidence of direct protection and indirect protection is seen in the trends of measles incidence by age group. Between 2008 and 2012, the incidence of measles declined markedly in all age groups – those targeted for vaccination (young children over 8 months of age) and those not targeted for vaccination: a 99% decline among children aged 7–14 years old; a 97% decline among children aged 2–6 years old; a 94% decline among children under 8 months of age who were too young to vaccinate; a 96% decline among 15- to 34-year-olds; and a 94% decline among adults aged 35 years and older.

5. **The recent increase in measles cases is due to failure to provide measles vaccine for some children at the recommended ages.** Nationally, and in most provinces, the increase in cases was caused by infection of unvaccinated young children who were of vaccination age. There were also cases among older children and adults who were not vaccinated during their young childhood.

6. **Difficulties in identifying and enrolling children who are new to an area are leading to lack of timely immunization.** Population mobility and large-scale urbanization have made it difficult for China's EPI to assure access to vaccination services for many children. Developing effective methods to identify children and provide them with vaccines is a critically important challenge to meet.

7. **Missed opportunities to immunize, including false contraindications to vaccination, are leading to lack of timely immunization and sometimes permanently precluding vaccination.** Some of the contraindications observed in China are not recognized as valid contraindications in other countries or by WHO. A missed opportunity to immunize lengthens the period of vulnerability to vaccine-preventable diseases for a child.

8. **Surveillance is critically important.** Identifying a high proportion of all measles cases, investigating the measles cases to understand how measles was acquired, and being able to link cases together to identify outbreak patterns are essential to the successful elimination of measles. High-quality case and outbreak investigation can find gaps in immunity, routine programme weaknesses, and specific causes for failure to vaccinate – information leading to action.

9. **The very high proportion of measles cases classified as sporadic cases indicates that investigation practices and analysis should be improved.** Since measles is only spread person to person, with all cases being clinically apparent, the lack of epidemiological linkages among the many cases in China (often in small geographical areas) indicates incomplete investigation and analysis of cases. As a consequence, local evidence of immunity gaps cannot guide outbreak responses effectively.

10. **Current measles outbreak response tends to focus on cases rather than on population gaps in immunity.** Outbreak response generally involves vaccinating individuals who are geographically proximate to a case of measles – similar to ring vaccination. In an area with a high vaccination coverage rate, people living near a sporadic case are likely to already be vaccinated. Revaccinating these individuals is ineffective and wasteful, and may provide an incorrect message to parents that the vaccine is thought to not be effective. Rather than vaccinating people geographically near a case of measles regardless of their vaccination status, conducting a thorough case investigation to find immunity gaps and routine programme weaknesses, and intervening to close the immunity gap and raise vaccination coverage is more effective.

11. **Timely, routine vaccination is the most effective strategy for eliminating measles.** Timely, routine immunization is the most sustainable means to achieve high population immunity against measles, and the most efficient means to implement routinely recommended vaccines. China's routine immunization programme is generally of high quality. However, the challenges for routine immunization in China are great, and the quality of programmes varies by province and within provinces.

12. **Filling immunity gaps is important, and the most important immunity gap is among young children of vaccination age.** The age group most affected by the increase in measles cases in 2013 is young children, indicating that a modest but significant proportion of young children are not receiving their first or second doses of measles vaccine at the recommended ages. Lack of timely vaccination results in an immunity gap that grows in size as the number of susceptible children increases, thereby jeopardizing measles elimination.

13. **The school-entry vaccination check is an extremely valuable adjunct to the immunization programme.** Schools work in partnership with clinics, hospitals or CDCs to assess the immunization status of school entrants and facilitate immunization of children in need of recommended vaccines. This safety net for immunization has almost certainly helped reduce the incidence of measles among schoolchildren.

14. **Using administrative vaccination data for estimating coverage is not a sufficiently valid method given China's current stage in measles elimination and programme implementation.** The administrative method provides unrealistically high coverage assessments that are not consistent with current measles epidemiology or school-entry assessments. This method is challenged by moving populations and age-based recommendations of more than one dose of vaccine. Unrealistically high estimates of coverage ultimately undermine confidence in vaccination strategies by giving false assurance that children are protected and a false sense that the programme cannot improve coverage, leading to a lack of understanding about why outbreaks are occurring.

15. **Reducing transmission of measles in hospitals is important, but it is not the most important strategy for elimination of measles.** Hospitals are known sites for transmission of measles in China and in the rest of the world. Preventing spread from potentially infectious patients to others and investigating breakdowns in infection control are important for eventual elimination of measles. Even after measles is eliminated in China, and until measles is eradicated from the world, nosocomial infection will continue to be a concern. Although reducing transmission of measles in hospitals is important, of more importance is assuring on-time, routine, two-dose measles vaccination for all children in China.

16. **China's immunization programme appears to be under-resourced relative to its responsibilities and expectations.** Persistent and pervasive unmet human and financial resource needs will lead to underachievement relative to the programme's potential to keep children healthy in China.

Recommendations

Recommendations were formulated during a two-day, in-person meeting through informal discussion of the observations and conclusions by all four teams. Consensus on the recommendations was obtained.

Measles strategy and policy recommendations

1. **Maintain the current strategy for protection of infants: a dose of MR vaccine at 8 months and a dose of MMR vaccine at 18–24 months.** The vast majority of children are protected through routine immunization; children too young to vaccinate are being protected indirectly. Changing the first dose to 6 months is not recommended due to concerns of lower vaccine effectiveness at younger ages. The timing of the first dose of measles vaccine can be optimized after obtaining and considering the lines of evidence recommended by WHO: relative seroconversion rates at 12 months versus current vaccination age, ages at which vaccination actually occurs, projected vaccination coverage levels, and age-specific measles incidence. Vaccinating women of childbearing age to boost antibody levels in newborn babies is also not recommended. Based on biological considerations, the strategy is not likely to be successful. Furthermore, there is no experience with the strategy and it may cause in major medico-legal problems due to the unintended vaccination of pregnant women with a vaccine contraindicated in pregnancy.

2. **A nationwide, adult-targeted mass vaccination campaign is not recommended at this time.** The current measles elimination strategy protects susceptible adults indirectly by lowering and interrupting circulation of measles virus. At this point, it is not possible to predict whether the adult immunity gap is of sufficient size to sustain circulation of measles virus and preclude elimination of measles in China. Analysis of outbreaks to find immunity gaps among adults is important. Decisions to fill identified immunity gaps among adults should be based on epidemiological considerations, which could include serological surveys because coverage surveys among adults are not feasible. *(24)*

3. **A nationwide, child-targeted SIA is not recommended at this point.** The impact of the 2010 nationwide SIA is evident. Depending on the epidemiology and identified immunity gaps, province-wide SIAs, smaller area SIAs, or screen-and-vaccinate efforts will be needed. *(24)* SIAs and screen-and-vaccinate efforts should be of high quality in order

to successfully vaccinate children missed by routine immunization efforts. Screen-and-vaccinate efforts can also help identify opportunities to improve the routine programme since vaccination status is assessed during the process. To improve SIA effectiveness, SIAs future that will be conducted should be evaluated for their ability to vaccinate incompletely vaccinated children.

4. **Consider streamlining the measles-containing vaccines available for use in China.** Measles, rubella and mumps vaccination policies interact with each other due to overlapping vaccine presentations. The current policy of having several presentations of these vaccines should be reviewed. Consideration should be given to using only MMR vaccine routinely and only MR vaccine in campaigns. A two-dose MMR policy would also address the difference between the WHO recommendation of two doses of mumps-containing vaccine and the current China policy of one dose of mumps-containing vaccine. Changes in programme vaccines need to be coordinated with China FDA and the vaccine manufacturers, and time must be allowed to conduct clinical trials for licensure changes that may be necessary.

5. **Consider including measles and rubella serological testing in serological surveys conducted in China.** A planned serological survey for 2014 should include measles, rubella and mumps. This would help identify immunity gaps for diseases that may require programmatic action.

6. **Reduce nosocomial transmission of measles through guideline implementation.** NHFPC should work with infection-control professional associations and appropriate divisions in the Ministry of Health to incorporate measles-related prevention strategies into the core components of infection-control guidelines. Promote guideline use with infection-control professional associations. Guidelines should support health-care professional education, promote health-care worker vaccination against measles, and prevent unnecessary hospital admission for measles.

Immunization programme recommendations

7. **Strengthen China CDC's capacity for policy and programme evaluation, research and timely implementation of evidence-based immunization policy.** Eliminating measles and strengthening routine immunization require not only China-specific evidence, but also a process for updating immunization policy in a timely manner based on new evidence or events, such as the licensing of a new vaccine. Additional resources and professional training are necessary for China's immunization programme to make effective use of available data for management and programme decisions. Increasing the analytical capacity of China CDC and provincial immunization programmes, China CDC's Field Epidemiology Training Programme, and academic institutions will help generate needed new knowledge.

8. **Update and strengthen standards for immunization practices.** Effective policy implementation relies on effective, evidence-based practice standards, including proper storage and handling of vaccine, use of proper vaccination technique, following only true contraindications to vaccination, communicating effectively with parents about benefits and risks of vaccination, enrolling newborn children and migrant children into EPI, assessing missed opportunities to immunize, and operating recall/reminder systems to assure timely vaccination.

9. **Identify and develop effective methods to conduct outreach to children new to a clinic's and health department's jurisdiction.** Many models of outreach are in use in China. Some enlist the help of population registration authorities to identify children who are new to an area and who need immunization services. Conducting workshops, perhaps jointly with population registration authorities, could be used to identify and develop effective practices for sharing as guidelines.

10. **Implement a comprehensive response to missed immunization opportunities.** The immunization schedule is designed to protect children at the earliest time feasible, prior to risk of vaccine-preventable disease. It is in the best interest of the child to be protected through timely vaccination rather than leaving a clinic unprotected due to a misconception about the safety or advisability of vaccination. However, concerns about vaccines and AEFIs must be addressed in order to assure confidence in vaccines and immunization. Fear of liability from AEFIs may increase the use of false contraindications to vaccination. Since China is working to update the vaccine injury compensation programme, the timing may be very good for developing a comprehensive approach to reducing missed immunization opportunities. Contraindications for vaccines in China could be compared with vaccine contraindications recommended by WHO and used in other countries. Developing a method for basing vaccine contraindications on evidence, updating immunization standards that define true and false contraindications, promoting updated standards, and conducting outreach to parents and the media may be useful components of a comprehensive response to missed opportunities.

11. **Strengthen the school vaccination check and referral strategy.** China's school-entry vaccination check and referral strategy was observed by the consultants to be effective when implemented well. It provides both an assessment of protection and an intervention to encourage vaccination. The system works for all vaccines routinely recommended for preschool children. Uneven implementation of this evidence-based strategy should be overcome through evaluation by CDCs with feedback to implementing schools and clinics. For example, evaluating the completeness of children's vaccination at school entry and the completion of follow-up vaccination of those in need of one or more doses of vaccine would help assure full immunization of schoolchildren. Consideration should also be given to developing a school-entrant coverage surveillance system to identify communities in need of additional vaccination efforts.

12. **Develop valid, records-based coverage assessment of children in China.** Uniformly high coverage is essential for elimination of measles. Once measles is eliminated in China, cases of measles will no longer be indicators of immunity gaps. Coverage assessment serves as a leading indicator, rather than a lagging indicator. Records-based coverage assessments can identify barriers to vaccination and indicate programme areas to improve. School-based surveys can be developed as inexpensive but effective means to identify areas in need of additional vaccination efforts or programme improvement.

13. **Continue to strengthen vaccine-preventable diseases laboratory networks.** The use of laboratory networks has been critically important to China's success in eliminating and controlling vaccine-preventable diseases. Improving quality control capabilities at the county and prefecture levels, standardization of real-time PCR, and assuring human and financial resources for vaccine-preventable disease laboratories will allow laboratories to fulfil their essential role in achieving immunization goals.

Communications

14. **Develop a strategy to communicate with the public, immunization stakeholders and policy-makers to maintain confidence in vaccines and immunization.** Maintaining parental, provider and policy-maker confidence in vaccines and immunization programmes is essential to the long-term success of the programme. A programme should be developed to identify and address parental concerns about vaccines.

15. **Communicate with immunization stakeholders about the importance of routine immunization and the goal to eliminate measles.** Broad public and political support is needed to achieve immunization goals and objectives since many sectors of society are involved in programme activities.

Immunization programme financing recommendations

16. **Ensure stability and reliability of resources for EPI by making EPI its own funding line, removed from competition with other public health programmes.** Immunization programmes have to function at a high level, consistently, day in and day out in order to meet the immunization needs of new children. The ebb and flow of funding can damage immunization programmes. Competition with other public health programmes can subject the immunization programme to unanticipated funding decreases because of problems unrelated to immunization. Non-competitive funding could provide reliability in funding that would help programme planning and implementation.

17. **Invest sufficient resources into China's EPI to cover its responsibilities and expectations.** China's immunization programme is responsible for protecting the world's largest population from vaccine-preventable diseases. Commitments to eliminate measles, maintain elimination of polio and tetanus, and provide accelerated control of hepatitis B are high-profile, important expectations of China. Vaccine-preventable diseases cost money to the health-care system and cause suffering to society. China's Government pays for both treatment and prevention of vaccine-preventable diseases. Prevention through immunization is much less expensive than treatment and provides a noticeable benefit to society. China's immunization programme has a proven track record that makes it a wise investment of government resources.

REFERENCES

1. Orenstein, WA. The role of measles elimination in development of a national immunization program. *Pediatr Infect Dis*. 2006;26:1093-1101.

2. Strebel PM, Cochi SL, Hoekstra E, Rota PA, Featherstone D, Bellini WJ, et al. A world without measles. *J Infect Dis*. 2011;204 Suppl 1:S1-3.

3. World Health Organization. Proceedings of the global technical consultation to assess the feasibility of measles eradication, 28–30 July 2010. *J Infect Dis*. 2011;204 Suppl 1: S4-S13.

4. Christie AS, Gay A. The measles initiative: moving toward eradication. *J Infect Dis*. 2011;204 Suppl 1:S491-S498.

5. Featherstone DA, Rota PA, Icenogle J, Mulders MN, Jee Y, Ahmed H, et al. Expansion of the global measles and rubella laboratory network 2005-09. *J Infect Dis*. 2011;204 Suppl 1:S491-S498.

6. Rota PA, Brown KE, Hubschen JM, Muller CP, Icenogle J, Chen MH, et al. Improving global virologic surveillance for measles and rubella. *J Infect Dis*. 2011; 204 Suppl 1:S506-S513.

7. Hinman AR, Orenstein WA, Papanya MJ. Evolution of measles elimination strategies in the United States. *J Infect Dis*. 2004 ;289 Suppl 1:S17-S22.

8. Ma C, Hao L, Zhang Y, Su Q, Rodewald L, An Z, et al. Monitoring progress towards the elimination of measles in China: an analysis of measles surveillance data. *Bull World Health Organ*. 2014;92(5):340-7.

9. Xu W, Zhu Z, Jiang X, et al. Establishment and running status of measles laboratory network in China. *Zhongguo Yi Miao He Mian Yi*. 2006;12(1):1-6.

10. Measles and rubella laboratory network. In: WHO Western Pacific Region Expanded Programme on Immunization [website]. Manila: WHO Western Pacific Regional Office; 2014 *(www.wpro.who.int/immunization/laboratory/ measles_rubella/en, accessed 13 February 2014)*.

11. Ma C, An Z, Hao L, Cairns KL, Zhang Y, Ma J, et al. Progress toward measles elimination in the People's Republic of China, 2000 - 2009. *J Infect Dis*. 2011;204 Suppl 1:S447-S454.

12. Zhuo J, Geng W, Hoekstra E, Zhong G, Liang X, Zhang J. Impact of supplementary immunization activities in measles-endemic areas: a case study from Guangxi, China. *J Infect Dis*. 2011;204 Suppl 1:S455-S462.

13. World Health Organization. Progress towards measles elimination in the Western Pacific Region, 2009 - 2012. *Wkly Epidemiol Rec*. 2013;88:233-40.

14. Cui F, Gofin R. Immunization coverage and its determinants in children aged 12-23 months in Gansu, China. *Vaccine*. 2007;25(4):664-71.

15. Hu Y, Chen E, Li Q, Chen Y, Qi X. Determinants of childhood immunization uptake among socio-economically disadvantaged migrants in East China. *Int J Environ Res Public Health*. 2013;10(7):2845-56.

16. Hu Y, Chen E, Li Q, Chen Y, Qi X. Immunization coverage and its determinants among children born in 2008-2009 by questionnaire survey in Zhejiang, China. *Asia Pac J Public Health*. 2011.

17. Hu X, Xiao S, Chen B, Sa Z. Gaps in the 2010 measles SIA coverage among migrant children in Beijing: evidence from a parental survey. *Vaccine*. 2012;30(39):5721-5.

18. Ma C, Su Q, Hao L, Zhang Y, Xu W, Huiming L. Performance of measles surveillance system in the People's Republic of China, 2011. *Zhongguo Yi Miao He Mian Yi*. 2012;18(6):481-484.

19. Regional and country profiles of measles elimination. In: World Health Organization Western Pacific Region Expanded programme in immunization [website]. Manila: WHO Regional Office for the Western Pacific; 2014 *(www.wpro.who.int/immunization/documents/measles_ regional_ country_profile/en, accessed 12 February 2014)*.

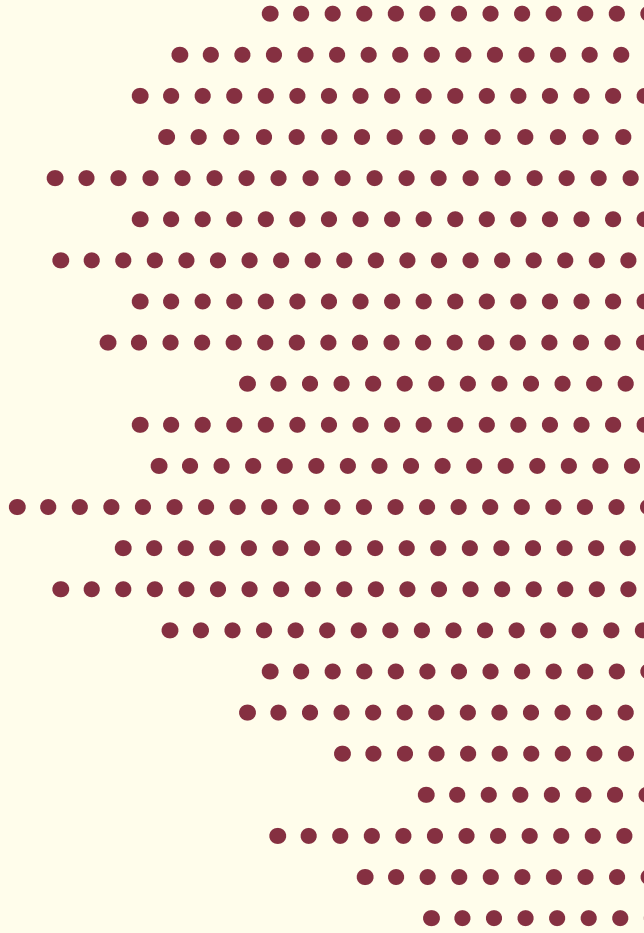
20. Measles elimination: China [country profile]. Manila: WHO Regional Office for the Western Pacific; 2009 *(www.wpro.who.int/immunization/documents/measles_country_profile_ may2013_ CHN.pdf, accessed 12 February 2014)*.

21. Zhang Y, Xu S, Wang H, Zhu Z, Ji Y, Liu C, et al. Single endemic genotype of measles virus continuously circulating in China for at least 16 years. *PLoS One*. 2012; 7(4):e34401.

22. Botelho-Neversa E, Gautreta P, Biellik R, Brouquia P. Nosocomial transmission of measles: an updated review. *Vaccine*. 2012;30(27):3996-4001.

23. Gao J, Chen E, Wang Z, Shen J, He H, Ma H, et al. Epidemic of measles following the nationwide mass immunization campaign. *BMC Infect Dis*. 2013;13: 139. doi: 10.1186/1471-2334-13-139.

24. World Health Organization. Measles vaccines: WHO position paper. *Wkly Epidemiol Rec*. 200;84(35):349-60.



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