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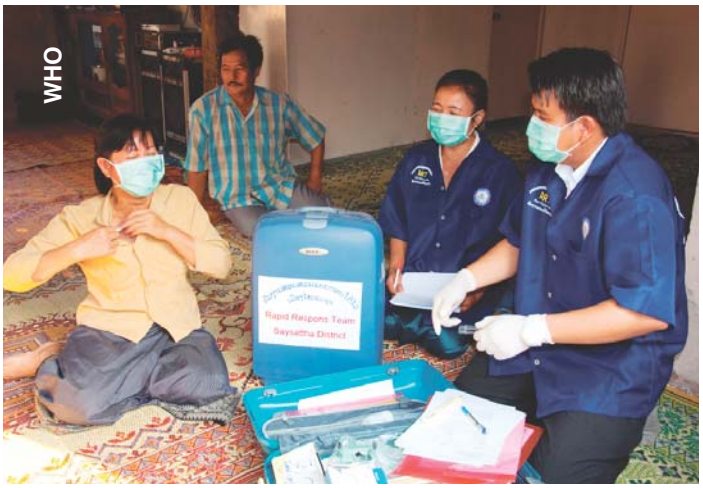

To contact us:

Western Pacific Surveillance and Response
World Health Organization
Office for the Western Pacific Region
United Nations Avenue
1000 Manila, Philippines
wpsar@wpro.who.int
www.wpro.who.int/wpsar

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Improving ethnocultural data to inform public health responses to communicable diseases in Australia

Emma Quinn,[ab] Peter Massey,[c] Alexander Rosewell,[d] Mitchell Smith[e] and David Durrheim[cf]

Correspondence to Emma Quinn (e-mail: equin@doh.health.nsw.gov.au).

It is well established that ethnocultural groups of migrants are associated with a differential risk of communicable disease, including measles, tuberculosis and hepatitis B. Global public health agencies[1] are now focusing on improving the collection of ethnocultural data to better define communicable disease risk in migrant populations to support community-level disease prevention and control.

In Australia, there is no national strategy to support the collection of ethnocultural data in communicable disease surveillance. Ethnocultural data refers to any data that identifies an individual's cultural heritage, background or affiliation, e.g. country of birth (COB); language spoken at home (LSH) or religious affiliation etc. In Australia, Aboriginal and Torres Strait Islander status is routinely collected in communicable disease surveillance. COB is commonly collected for most notifiable diseases, however other variables used to describe the ethnocultural identity of cases vary (**Box 1**). These data are collected either via general practitioners recording this information on the disease notification form and/or public health unit staff recording the data during follow-up interviews with individual cases.

Ethnocultural identity is a self-constructed phenomenon related to the many social and cultural factors that influence people's lives including migration status, religious affiliation, language, cultural practices and political ideologies.[2] Collecting valid ethnocultural data can be challenging because ethnocultural identity is not a singular and easily defined concept. Ethnocultural identity may change over time and it often changes unpredictably over subsequent generations.[2] Therefore, Australian standards[3] for the collection of such data reflect the need for a multidimensional concept of ethnocultural identity, including several variables to ensure reasonable specificity and sensitivity.

Box 1. **Ethno-cultural data collected in routine notifiable diseases surveillance in Australia**

State/territory	Ethnocultural data collected*
Australian Capital Territory	Indigenous status, COB
New South Wales	Indigenous status, COB, LSH
Northern Territory	Indigenous status
Queensland	Indigenous status and COB†
South Australia	Indigenous status only‡
Tasmania	Indigenous status and COB
Victoria	Indigenous status, COB, year arrived in Australia§
Western Australia	Indigenous status, COB, EO

COB – country of birth, LSH – language spoken at home, EO – ethnic origin/ethnicity (Indigenous status or other). Indigenous status includes options of Aboriginal only, Aboriginal and Torres Strait Islander, Torres Strait Islander only or neither Aboriginal or Torres Strait Islander for identification purposes.

* As listed on the state or jurisdiction-specific notifiable diseases form online and/or through personal communication with state and territory Health Departments.

† Data on ethnicity and whether English is the preferred language spoken at home (Y/N) are collected in Queensland for some notifiable diseases.

‡ COB and LSH not routinely collected in South Australia but included for some priority notifiable diseases, i.e. sexually transmitted infections and food-related diseases.

§ Only collected for individuals born overseas.

Despite these challenges, the ethnocultural data currently collected during routine communicable disease surveillance have assisted in disease prevention and control in Australia. Collecting COB data, though limited in scope, has helped to identify a differential disease

[a] New South Wales Public Health Officer Training Program, New South Wales Ministry of Health, Australia.
[b] School of Public Health and Community Medicine, University of New South Wales, Australia.
[c] Population Health, Hunter New England Local Health District, New South Wales, Australia.
[d] Communicable Diseases Branch, Health Protection, New South Wales Ministry of Health, North Sydney, Australia.
[e] New South Wales Refugee Health Service, Sydney, Australia.
[f] Hunter Medical Research Institute, Newcastle, New South Wales, Australia.

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burden in recently arrived migrants or refugees, leading to national targeted prevention and treatment programmes for migrants emigrating from countries with high-burden disease, e.g. tuberculosis and chronic hepatitis B in South Asian migrants.[4]

While COB helps to identify disease risk in newly arrived refugees or migrants, communicable disease risk related to ethnocultural group remains underexplored for generations of Australian-born residents. This is an important issue in a context where net overseas immigration increased two to threefold in the past decade, and second and third generation Australians now make up 20% and 53% of the population, respectively.[5]

The ad hoc collection of ancestry data as determined by the Australian Bureau of Statistics (ABS) in a recent outbreak investigation in New South Wales has illustrated its utility over COB and LSH for defining at-risk populations for selected diseases. During the 2012 measles outbreak in New South Wales, ancestry data revealed that 21% of all notifications were associated with Australians of Pacific Islander ethnicity, and 17% occurred in Pacific Islanders with Samoan ethnicity.[6] This understanding enabled a quantification of the measles risk for this ethnocultural group at more than 50 times the non-Samoan population (notification rates of 189 per 100 000).[6] This led to targeted public health action, including vaccination clinics in churches and schools attended by a large number of young-adult Pacific Islanders, particularly for those of Samoan descent. Culturally specific and language-appropriate communication materials were also developed.

Foodborne disease outbreaks caused by the consumption of culture-specific foods are also common in New South Wales.[7] The utility of collecting data on the ethnocultural background of cases has been highlighted in New South Wales as it prompts the inclusion of ethnic food-specific questions into routine investigation tools. These specific food-related risks are inadequately identified by COB or LSH alone. To further explore which additional data variables might be useful to accurately represent ethnocultural identity, we used previously established surveillance criteria[8] to review commonly used variables. As shown in **Table 1**, COB and LSH have conceptual validity, objectivity and are relatively easy to define. However, the inherent strengths of variables such as ethnicity or ancestry include self-determination of cultural identity and the ability to describe the ethnocultural background of non-Aboriginal and Torres Strait Islander Australian-born residents.

A national approach to ethnocultural data collection may enable the strengthening of disease control for at-risk populations. We recommend that surveillance of COB and LSH be maintained in New South Wales and considered in other relevant jurisdictions. However, the collection of data on ancestry or ethnicity for defining communicable disease risk in multicultural groups (above and beyond COB and LSH) is warranted in Australia, particularly as social and cultural practices influence disease risk, in combination with a variety of other factors.[9]

The collection of data according to the ABS Australian Standard Classification of Cultural and Ethnic Groups[10] in our routine communicable diseases surveillance would be valuable for estimating disease risk in generations of Australians that identify with particular cultural and/or ancestral groups. Denominator data would be available online from the ABS website via the population census carried out every five years. Estimation of disease risk related to ancestry would be helpful during outbreaks of notifiable diseases where transmission risk is associated with social or cultural practices, e.g. consumption of culturally-specific foods, cultural gatherings or family-related travel to disease-endemic countries. This type of information would help inform specific community-level prevention and control activity.

Further discussion is needed regarding acceptability, database development needs, resource implications and training required to introduce new variables into the routine surveillance of communicable diseases in Australia. The development of strategies to collect these data could follow existing best practice guidelines on how to implement, collect and use data appropriately on Aboriginal and Torres Strait Islander peoples. Consideration of enhanced surveillance of ethnocultural background could initially be given for a small number of specific diseases such as measles and meningococcal disease, which cause significant morbidity and/or mortality, where notifications are routinely followed up by public health staff and where socio-cultural practices may play a role in transmission.

Table 1. **Advantages and disadvantages of collecting various ethnocultural data according to established surveillance[7] criteria***

Variable/Description	Advantages	Disadvantages
Country of birth		
Based on the country where the individual was born	• Relatively easy to define and valid in measurement • Objective and exhaustive • Reliable – categories related to specific countries unlikely to change over time • Denominator data available online through ABS website	• Potential discrepancy between 'nationality' and 'country of birth' • Provides no information about cultural or social differences • Provides no information about the ethnocultural group of Australian-born residents
Main language spoken at home		
Based on the main language (other than English) spoken by the individual in their home on a regular basis	• Objective and conceptually valid • Potential for consistency in assessment • Can be exhaustive and exclusive • Can help determine need for language or interpreter services • Denominator data available online through ABS website	• People who speak the same language might come from different countries or cultural and social backgrounds etc. • Does not capture any information about proficiency in language of home country (i.e. English) or other languages spoken in the home.
Country of nationality		
Based on the individual's passport/citizenship	• Easy to define and objective to measure • Can be exhaustive and exclusive • Reliable – categories of nationality unlikely to change • Conceptually valid • Denominator data available online or upon request from DIBP	• Issues about classifying people with several nationalities or people without passports (e.g. some refugees) • Provides no information about ancestry or ethnicity for Australian-born residents • Provides no information about cultural or social differences (e.g. religion, lifestyle)
Ethnicity/ancestry		
Based on the individuals self-perceived ethnic group – which could be a country, region, religious or cultural group, etc.	• Allows respondents to self-identify their own ethnicity based on whatever classification they see fit • Conceptually valid from the point of view of the respondent • Flexible for the respondent • Denominator data available online through ABS website	• Multiple response categories may present difficulties for analysis • Self-reported ethnicity may change over time • May not be exclusive • More of a process than a static well-defined concept • Question may lead to offence, particularly among refugees where racial, ethnic or religious tensions exist in the community
Length of stay in current country		
Based on the length of time (years) that the individual has resided in their current country from arrival	• Objective and conceptually valid • Potential for reliability and consistency in assessment • Potential to distinguish between newly arrived and long-term migrants • Denominator data available online through ABS website • Year of arrival may be sufficient here	• May be sensitive for recently arrived migrants/refugees and therefore may not be asked consistently by surveillance staff • May require discussion around why this information was being collected (in terms of meaningfulness to respondents) • Provides no information about cultural or social differences (e.g. religion, lifestyle)
Proficiency in English		
Based on the individual's self-assessed ability to speak English when the main language spoken at home was a language other than English	• Conceptually valid • Can be exhaustive and exclusive	• Potential for great measurement bias – meant to only represent spoken English (not reading, writing or listening) • Reliability/objectivity may be compromised • May require discussion around why this information was being collected (in terms of meaningfulness to respondents)
Religious affiliation		
Based on the individuals self-identified main religious belief or the religious group to which they belong	• Conceptually valid • Potential for valid and reliable measurement over time if religious groups do not change markedly • Self-assessed, i.e. individual declares affiliation	• Can result in sensitivity if individuals do not understand the value in collecting these data • People with the same religious affiliation may come from different countries or have different ancestry or ethnocultural backgrounds.

ABS – Australian Bureau of Statistics; DIBP – Department for Immigration and Border Protection.

* The criteria include[8] conceptual validity, measurement validity, exclusivity/exhaustiveness, meaningfulness, reliability, consistency and flexibility.

Conflicts of interest

None declared.

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The ARM Network – a model for infectious disease surge response capacity in the Western Pacific Region

Shoaib Hassan,[a] Martyn Kirk,[b] Tony Stewart,[c] and C. Raina MacIntyre[a]
Correspondence to Raina MacIntyre (e-mail: r.macintyre@unsw.edu.au).

The United States Centers for Disease Control and Prevention (US CDC) through its Epidemic Intelligence Service (EIS) programme provides a model for field epidemiology training programmes (FETPs) and has spawned FETPs worldwide.[1] The unique training provided by FETPs equips graduates to respond to public health emergencies in the field, including establishing surveillance and investigating outbreaks of disease. The EIS and other FETPs have well-established networks of alumni that provide capacity for responding to public health disasters.

In 1989, the Commonwealth Government of Australia funded two initiatives, the Communicable Diseases Network of Australia (which has an advisory and national communication and coordination function rather than an operational response function) and the National Centre of Epidemiology and Population Health (NCEPH) at ANU. Australia's FETP based at the Australian National University (ANU) was established in 1991. The two-year research programme, based on the EIS model, leads to a Masters qualification in Applied Epidemiology (MAE). Historically, the MAE programme has provided surge capacity through FETP trainees for national and international infectious diseases outbreaks and emergencies, but with only around 20 trainees at any one time, the scope of this capacity is limited. Response to international events focuses on the World Health Organization (WHO) Western Pacific Region where many countries do not have their own FETPs. The Western Pacific Region includes approximately 50% of the world's population. The Region also has difficult-to-access small island countries with populations spread over large distances. Some of these countries have national organizations, institutes and FETPs, while other small countries rely on international public health support.[2] The Region suffers a disproportionate burden of disease from preventable infections, and has variable response capacity. Infectious diseases such as measles, vector-borne diseases and cholera have a potential to spread rapidly and are a challenge in the Region.[3,4]

Natural disasters and the regional response capacity

Over the last decade, the Western Pacific Region has faced various natural disasters resulting in public health emergencies affecting both developed and developing countries. Such events have ranged from earthquakes in New Zealand to a typhoon in the Philippines and a nuclear disaster in Japan.[5] The Solomon Islands recently had earthquakes and flash floods that had a major impact on public health systems.[5]

Such emergencies are often beyond the state and national governments' capacities, and regional or cross-jurisdictional responses are required. Management of these events ranges from preparedness to acute-phase response and recovery, all of which demand financial and technical commitments. Natural disasters can turn into complex emergencies, especially in the presence of a pre-existing or growing burden of communicable and noncommunicable diseases. Risk mitigation and preparedness for such challenges at national levels can be achieved by regional efforts.[6,7] Public health emergencies due to an outbreak or natural disaster may cross national borders and even spread to other regions in a short period of time. No country is free from

[a] School of Public Health and Community Medicine, University of New South Wales, Sydney, New South Wales, Australia.
[b] National Centre for Epidemiology and Population Health, The Australian National University, Canberra, Australian Capital Territory, Australia.
[c] Burnet Institute, Melbourne Victoria, Australia.
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such risks, but countries without FETPs may be more vulnerable. Australia, as a high-income country with a long-established, high-quality FETP, has the skills and capacity to provide assistance in the Region.

Australian response capacity

Australia is a federation of six states and two territories, with national expert committees in infectious diseases and a national incident room but no equivalent of the US CDC or national field response capacity. To strengthen response to emerging infectious disease threats in the Asia Pacific region, the AusReady Facility was funded by the Australian Agency for International Development from 2006 to 2010. The facility was tasked to manage a database of experts and focus on outbreak prevention and preparedness, but it did not establish extensive partnerships with other networks, had a relatively low number of deployments and lacked ongoing funding.[8]

The states of New South Wales and Victoria have had public health officer training programmes. Currently, only the New South Wales programme remains. These programmes, while loosely based on the EIS model, offer broad-based public health and policy training but are not focused on infectious diseases field epidemiology.[9] Further, state-based responses to local outbreaks are constrained within state boundaries, and rarely deploy staff for international response. The MAE programme has produced over 160 trained field epidemiologists, participated in over 300 national and international outbreak responses and established or evaluated a variety of surveillance systems over the past 25 years.[10] The MAE programme is working well, with eight to 10 scholars being recruited each year into field placements, and it continues to provide some surge capacity to Australian and regional governments. Other than the limited capacity provided by the MAE programme, there is no national mechanism to harness and deploy Australia's skilled public health workers for international response.

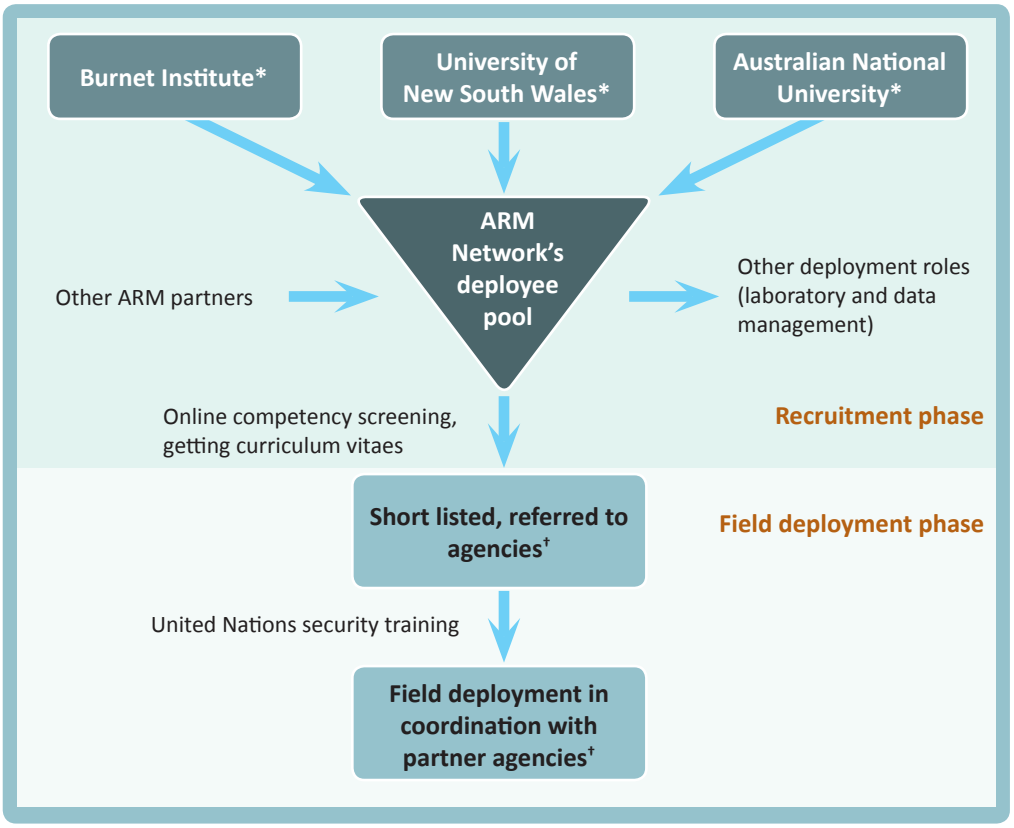
Australian Response MAE Network

With many skilled public health professionals and a high-quality FETP, Australia is ideally placed to contribute to the control of infectious diseases regionally. While Australia has response capacity for trauma and emergencies, there was no nationally funded mechanism for deploying qualified professionals for infectious diseases outbreak responses that cross national and international borders. In May 2012, at a national forum on field epidemiology at the University of New South Wales (UNSW), a critical gap in national and international field epidemiology response capacity was identified.[11] The momentum set at this meeting, with continued engagement of interested stakeholders into 2013, led to the genesis of the Australian Response MAE (ARM) Network.

The ARM Network was established by three MAE alumni to address this gap and to support Australia's regional responsibility and role in assisting in public health emergencies.[12] The ARM Network was founded by ANU, Burnet Institute and UNSW to identify experienced Australian public health professionals with skills in field epidemiology, applied public health and emergency response.[12] All three founding partner institutions are members of WHO's Global Outbreak Alert and Response Network (GOARN) and receive alerts and requests for assistance. ARM partners maintain their own networks of public health professionals, including students and graduates of FETPs or other relevant programmes, to provide surge capacity when required. Other suitably skilled public health professionals may apply to join ARM Network; there has been a high level of interest, and over 50 new members from around Australia have joined in the six months since the ARM Network was established.

The ARM Network was first used in response to Typhoon Haiyan in the Philippines in November 2013. Through the ARM Network, at least five field epidemiologists were deployed to assist with response to the public health emergency through GOARN. The ARM Network uses an operational model to identify, screen and mobilize experienced public health professionals with skills in field epidemiology, applied public health and outbreak response in the event of global, regional or cross-jurisdictional public health emergencies (**Figure 1**). ARM members are connected through a private online network where deployment opportunities and other resources are posted. This network also allows discussion and feedback following deployment. ARM Network works with partners such as GOARN and Registered Engineers for

Figure 1. **ARM Network operational model for assessment and deployment of public health professionals**



ARM - Australian Response MAE (Master of Applied Epidemiology)

* Founding partners of the ARM Network.

† Agencies include World Health Organization, Global Outbreak Alert and Response Network (GOARN), Registered Engineers for Disaster Relief (RedR), Australian Medical Assistance Teams (AUSMAT) and other potential partners.

Disaster Relief (RedR). ARM Network provides a focal point for Australian infectious diseases surge response capacity.

The ARM Network operates with the in-kind support of three institutions, linked by the common thread of FETP training, which recognizes the important contribution of field epidemiology to national and international response capacity. Stakeholders in the national and international public health community have been made aware of the ARM Network that is being formally launched on 16 June 2014.[12] To widen the engagement and awareness, a public website accepts requests from anyone with relevant skills to join ARM Network.[12] When ARM Network receives a request for assistance, a senior network member is assigned as the contact for the requesting agency. A call for assistance is sent to ARM Network members through the private members online network. Suitable candidates applying for field deployment are then referred to a partner agency such as GOARN, Australian Medical Assistance Teams or RedR for deployment. ARM Network will evaluate the usefulness of deployment to ensure continuous feedback and improvement.

Way forward

ARM Network offers an organizational model for FETPs and alumni in the Region to assist with public health and infectious diseases emergencies. Our experience has been that there is a large body of skilled professionals who are willing to contribute to surge response capacity, and ARM Network provides a mechanism for them to do so. The network's operational model has the capacity to grow and the scope may broaden over time. ARM Network provides the Western Pacific Region with

skilled professionals who can support management and control of infectious diseases during public health and civil emergencies.

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Conflicts of interest

The authors are the founders of ARM Network.

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Response to a large rotavirus outbreak on South Tarawa, Kiribati, 2013

Teanibuaka Tabunga,[a] Maryanne Utiera,[a] Rosemary Tekoaua,[a] Tebikau Tibwe,[a] Teatao Tira,[a] Tebuka Toatu,[b] Sala Elbourne Duituturaga,[b] Eric Nilles[c] and Adam Craig[c]

Correspondence to Teanibuaka Tabunga (e-mail: teanibuaka.tebunga@gmail.com).

Introduction: In July 2013, during annual independence celebrations in Kiribati, staff at Tungaru Central Hospital on South Tarawa reported an increase in children presenting with severe diarrhoea. This report describes the outbreak investigation, findings and response.

Method: After notification of the outbreak, all health facilities on South Tarawa began reporting cases of acute diarrhoea and/or vomiting through the early warning syndromic surveillance system on a daily basis. Community awareness was raised and the public was encouraged to present to a health facility if ill with acute gastroenteritis. Specimens were collected and sent for laboratory testing.

Results: Between 10 and 24 July 2013, 1118 cases of gastroenteritis were reported; 103 were hospitalized and six died. The median age of cases was one year (range: 0–68 years); 93.4% were aged less than five years. Rotavirus was identified in 81% of specimens tested. The outbreak response included enhanced surveillance, community education, clinical training and changes to in-hospital patient management for infection control.

Discussion: This outbreak was the largest diarrhoea outbreak in Kiribati in five years. Factors that may have contributed to the magnitude and severity of the outbreak included high household density, inadequate sanitation infrastructure and a mass gathering – all increasing the chance of transmission – as well as limited clinical response capacity. The current outbreak highlights the importance of clinical management to minimize severe dehydration and death. Rotavirus vaccination should be considered as an adjunct to other comprehensive enteric disease control measures as recommended by the World Health Organization.

Kiribati is located in the Pacific Ocean and consists of one volcanic island and 32 low-lying atolls. Despite being spread over 3.5 million km^2 of ocean, the total land area is only 811 km^2.[1] The population of Kiribati in 2010 was 103 058 people, with an average population density of 128 per km^2. Almost half (48.7%) of the population live on the capital islands – the islets that make up South Tarawa and the atoll of Betio.

South Tarawa (including Betio) is a string of low lying islets that stretches 23 km from Betio to Tanaea (**Figure 1**). South Tarawa is less than 3 m above the sea level, with an average width of 450 m, has a total of 16 km^2, of which 10 km^2 is usable.[2] The population density on South Tarawa is 3184 persons per km^2 with a household density of seven to eight people per household, making South Tarawa among the most densely populated areas of the world.[2,3] Residents of South Tarawa (and especially the islet of Betio) experience high rates of respiratory infections, diarrhoea and dysentery. High incidence of these illnesses have been linked to overcrowding.[1,2] Kiribati's routine childhood vaccination programme does not include rotavirus vaccine.

In mid-July each year Kiribati celebrates its independence with a weeklong national holiday. Celebrants visiting South Tarawa result in further overcrowding and increased pressure on water, environmental and food hygiene infrastructures.

On 10 July 2013, mid-way through the 2013 independence celebrations, staff from the Tungaru Central Hospital (TCH) on South Tarawa reported to the Ministry of Health and Medical Services (MHMS) Public Health Division through the established syndromic

[a] Ministry of Health and Medical Services, Public Health Division, Kiribati.
[b] Secretariat of the Pacific Community, Public Health Division.
[c] World Health Organization Division of Pacific Technical Support, Emerging Disease Surveillance and Response Unit, Suva, Fiji.
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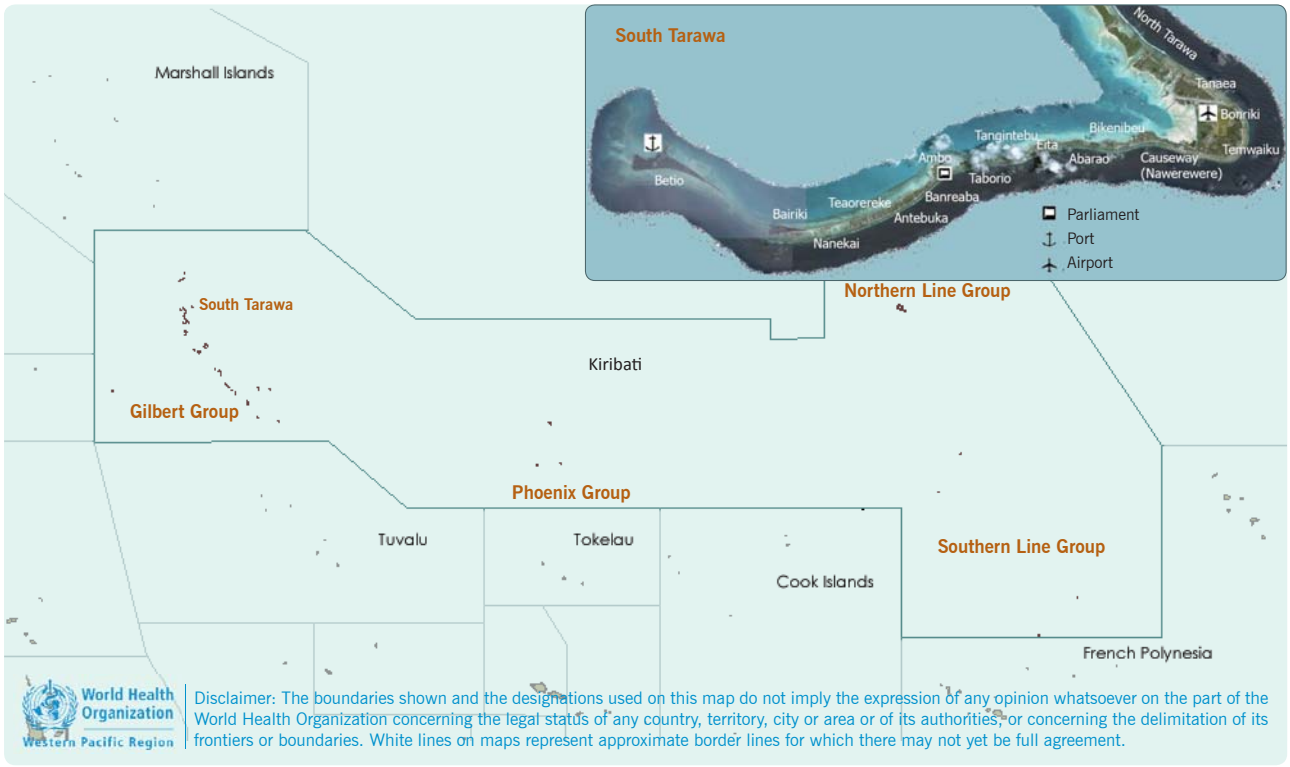
Figure 1. **Map of South Tarawa, Kiribati**



Note: Inset map of South Tarawa, Kiribati was adapted from: http://commons.wikimedia.org/wiki/File:06_Map_of_South_Tarawa,_Kiribati.jpg.

surveillance system that 20 children had presented with severe acute diarrhoea. This potential outbreak was subsequently investigated, and this report describes the outbreak investigation, findings and response.

METHODS

The Kiribati Syndromic Surveillance System, which is part of the regional Pacific Syndromic Surveillance System, was enhanced for this investigation by adding a specific outbreak case definition. All health facilities (two hospitals and 14 community clinics) on South Tarawa reported cases that met the case definition through the existing reporting mechanisms. The outbreak case definition was: "any person presenting to a health facility on South Tarawa with acute diarrhoea and/or vomiting after 10 July 2013". Health facility staff applied the outbreak case definition along with their routine syndromic surveillance activities for the duration of the outbreak. Health facilities reported the number of presentations, as well as any unusual events (e.g. particularly severe cases or deaths) to the National Health Information Systems Unit (HIS) for collation, analysis and dissemination of information.

Rotavirus enzyme-linked immunosorbent assay testing was performed at the Fiji Centre for Disease Control Laboratory on suspect-case stool samples. Genotyping of rotavirus-positive samples was conducted at the WHO Collaborating Centre, Murdoch Childrens Research Institute, Melbourne, Australia.

Clinical and public health control measures were implemented at the health facilities and in the community. Control measures included health promotion and enhancement of clinical care capacity.

RESULTS

Epidemiological investigation

From 10 to 24 July 2013, 1118 cases met the outbreak case definition on South Tarawa (attack rate: 2.3%), of which 103/1118 (9.2%) required hospitalization and 6/1118 died (case fatality rate: 0.54%). Males constituted 566 cases (50.6%), and the median age was one year (mean: 2.9 years; range: zero to 68 years). Most cases (1044/1118, 93.4%) and all deaths were less than five years old; the attack rate among this group was 13% (**Table 1**).

Table 1. **Number of suspected cases and incidence proportion by sex, age and village of residence**

	Population (2010)	Number of suspected cases	Proportion of suspected cases (%)	Rate (per 10 000 population)
Sex				
Male	24 233	566	50.6	233.6
Female	25 949	551	49.3	212.3
Unknown	NA	1	0.1	ND
Age groups (years)				
< 5	8043	1044	93.4	1298.0
5–14	9076	30	2.7	33.1
15–49	25 222	33	3.0	13.1
50+	5841	9	0.8	15.4
Unknown	NA	2	0.2	ND
Village of residence				
Abariao	1665	26	2.3	156.2
Ambo	2200	34	3.0	154.5
Antebuka	1087	16	1.4	147.2
Bairiki	3524	80	7.2	227.0
Banreaaba	1969	21	1.9	106.7
Betio	15 755	548	49.0	347.8
Bikenibeu	6568	78	7.0	118.8
Bonriki	2355	19	1.7	80.7
Causeway (Nawerewere)	2054	26	2.3	126.6
Eita	3061	86	7.7	281.0
Nanikai	988	6	0.5	60.7
Taborio	1282	24	2.2	187.2
Tanaea	279	3	0.3	107.5
Tangintebu	89	8	0.7	898.9
Teaoraereke	4171	48	4.3	115.1
Temwaiku	3135	41	3.7	130.8
Unknown	NA	54	4.8	ND
Total	**50 182**	**1118**	**100.0**	**222.8**

NA – not applicable; ND – not determined.

Note: Some columns may not add up to 100% due to the rounding off of decimal places.

The first reported case presented to the emergency department of TCH on 10 July 2013. The number of new presentations peaked on 18 July 2013 and returned to pre-outbreak levels by 24 July 2013 (**Figure 2**). Most cases (n = 988; 88.5%) reported suffering acute diarrhoea, and 759 cases (67.9%) reported acute vomiting. Fever was reported in 21 (1.9%) cases.

The majority of cases resided in the villages of Betio and Bairiki at the western end of South Tarawa and Tangintebu and Eita on central South Tarawa. The other 45.4% of cases resided in villages geographically dispersed along South Tarawa (**Figure 1**; **Table 1**).

Laboratory investigation

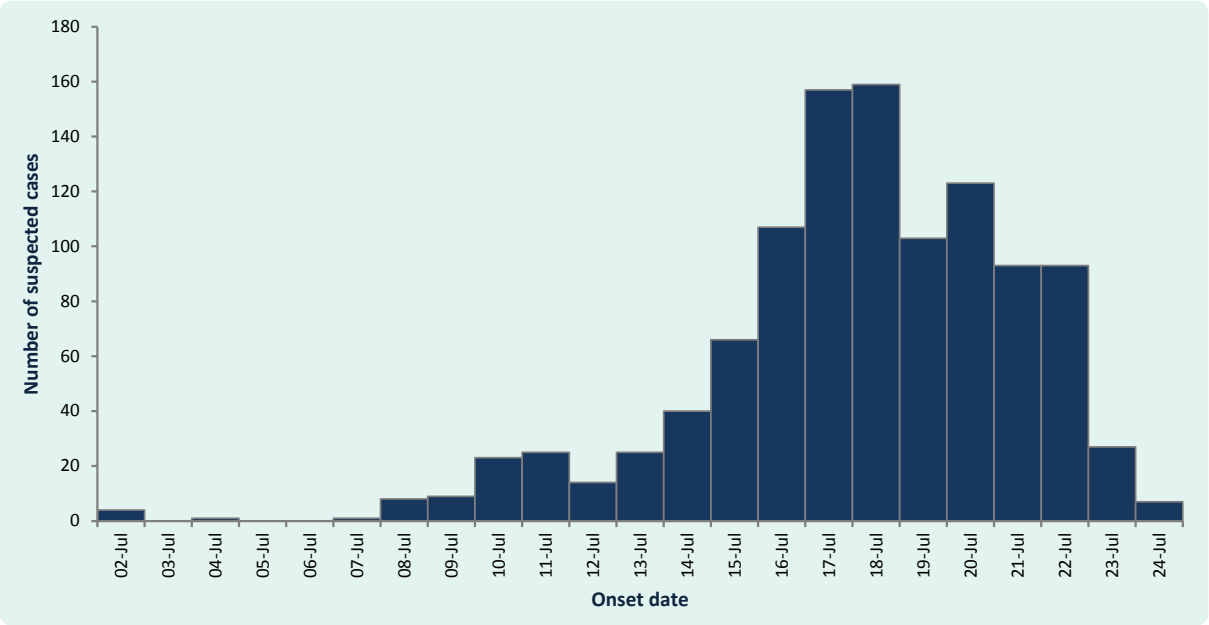
Of the 20 specimens collected, 16 returned a result with 13 (81%) positive for rotavirus. Eight rotavirus-positive specimens were forwarded for genotyping and were all identified as G3P. Tests for other infectious agents returned negative results.

Control measures

The clinical response to the outbreak included:

- providing clinical staff with training on appropriate diagnosis and case management;

Figure 2. **Outbreak epidemic curve of the number of suspected cases, by reported date of illness onset, South Tarawa, Kiribati, July 2013**



- implementing a modified triage system at hospitals;
- increasing ward space to accommodate admitted patients and to prevent hospital-based transmission; and
- increasing staff numbers at hospitals by transferring clinical staff from community clinics.

Community clinics extended their hours of operation (with four open 24 hours a day) to enhance health care accessibility. Pharmacy supplies were distributed to all health facilities on South Tarawa.

A health promotion campaign for hand hygiene, environmental sanitation and food safety was conducted through local radio village talks, announcements during church services and in locations where risk of transmission is high (i.e. kava bars, child care centres, primary schools). This campaign continued for approximately three weeks after the number of cases had returned to pre-outbreak levels and was extended to reach outlining islands.

Surveillance was enhanced on atolls neighbouring South Tarawa, with atoll health facilities notified and requested to report patients that met the outbreak case definition. A short-lived slight increase in the number of presentations with acute diarrhoea increased in the period immediately after the South Tarawa outbreak was reported.

During the outbreak the MHMS issued situation updates once a day to relevant government and non-government stakeholders. The updates also formed the basis of public communication messages released by MHMS.

DISCUSSION

This outbreak was the largest diarrhoeal outbreak experienced in Kiribati in five years, with 1118 cases and an incidence proportion of 13%. Rotavirus G3P, a common genotype of rotavirus circulating globally, was implicated in the majority of suspected cases tested. Rotavirus is the most common cause of severe diarrhoeal disease among infants and young children globally and is estimated to be responsible for over two million hospitalizations (mainly for severe dehydration) and 527 000 deaths annually with 85% of deaths occurring in low-income countries, usually due to late presentation to hospital or inadequate capacity to provide appropriate clinical care.[4] Rotavirus is primarily transmitted by the faecal-oral route and may be present in contaminated water.[5]

The outbreak response caused significant strain on both the clinical and public health systems of Kiribati and raised anxiety among the population; however, it

was considered effective. The outbreak demonstrated the importance of having strong management structures for public health events, including a designated event commander to oversee response activities and preparedness plans. Having pre-approved and protocol-driven surveillance and response arrangements in place before the outbreak occurred made the response easier to manage. Such arrangements must be easily activated, understood by all involved and adaptable to account for ever-changing situations. The MHMS has invested much effort to develop the national health system's preparedness for public health emergencies. These capacities have been developed to help meet Kiribati's obligations to the International Health Regulations (2005).[6] Reference laboratory testing was facilitated by the laboratory network of the Pacific Public Health Surveillance Network.[7]

Communication between the event commander and relevant response managers was critical for coordination. The early detection of this outbreak highlighted the role played by early warning syndromic surveillance in Kiribati. Further, the reach of the Kiribati Syndromic Surveillance System (all health facilities on South Tarawa) and the ability to use the system's well-established reporting mechanisms meant that enhanced surveillance was implemented quickly across all sites and data were reported to the HIS in a streamlined manner. This greatly enhanced the speed at which data were shared and lessened the burden of data capture and management placed upon staff at the national level. It is noted that as the outbreak case definition was based on presentations to a health facility, the number of cases identified is likely to be less than the true number of people affected.

Mortality from childhood diarrhoea is overwhelmingly secondary to severe dehydration. This outbreak highlights the importance of a systematic and rapid assessment for dehydration followed by either oral or intravenous rehydration, or resuscitation based upon findings. Most cases of childhood diarrhoea can be managed with zinc and low-osmolality oral rehydration solution (ORS), but a small proportion of severely dehydrated children – or children with persistent vomiting – will require intravenous rehydration or occasionally urgent intravenous resuscitation. Breast milk is an excellent rehydration fluid and should be encouraged, together with ORS, for children still breastfeeding. In addition to fluid replacement, children with diarrhoea should continue to be fed during their illness as food intake supports fluid absorption, and helps maintain nutritional status and the body's ability to fight infection. Zinc treatment may be used to help reduce the duration and severity of diarrhoea and hence fluid loss.[5,8] Severely ill children requiring hospitalization should remain under medical supervision until recovered or risk of relapse has passed.

This outbreak highlights the importance of rotavirus as an epidemic pathogen and a potentially important role for rotavirus vaccination as one element in a comprehensive programme to control causes of diarrhoeal disease. In 2009, WHO recommended that rotavirus vaccine be included in all national immunization programmes and considered a priority, particularly in countries with high rotavirus gastroenteric-associated mortality rates;[8] to date, rotavirus vaccine has not been implemented in Kiribati. Given the high rate of infection in low-income countries and reported high level of protection offered by the rotavirus vaccination, consideration of vaccine use is recommended. Rotavirus vaccination is reported to offer 40–90% protection against rotavirus gastroenteritis after one and/or two years of follow up.[8] WHO provides guidelines for the implementation of population-wide rotavirus vaccination.

This outbreak coincided with a mass gathering on South Tarawa, an event that likely affected the spread and severity of the outbreak. The gathering likely changed the outbreak transmission dynamics by increasing the density of the population on the atolls and increasing the chance of poorly handled, cooked or stored food. Health facility staff vacations for the gathering reduced response capacity. In the future, risk assessment to identify and determine the impact mass gatherings may have on health and health systems capacity as well as pre-emptive public health planning is advised.

Conflicts of interest

None declared.

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New South Wales annual vaccine-preventable disease report, 2012

Alexander Rosewell,[a] Paula Spokes[a] and Robin Gilmour[a]

Correspondence to Alexander Rosewell (e-mail: arosw@doh.health.nsw.gov.au).

We aim to describe the epidemiology of selected vaccine-preventable diseases in New South Wales (NSW) for 2012. Data from the NSW Notifiable Conditions Information Management System were analysed by: local health district of residence, age, Aboriginality, vaccination status and organism, where available. Risk factor and vaccination status data were collected by public health units for cases following notification under the NSW Public Health Act 2010. The largest outbreak of measles since 1998 was reported in 2012. Pacific Islander and Aboriginal people were at higher risk as were infants less than 12 months of age. Notifications of invasive pneumococcal disease (IPD) in children less than five years declined; however, the overall number of notifications for IPD increased. Mumps case notifications were also elevated. There were no *Haemophilus influenzae* type b case notifications in children less than five years of age for the first time since the vaccine was introduced. Invasive meningococcal disease case notifications were at their lowest rates since case notification began in 1991. Case notification rates for other selected vaccine-preventable diseases remained stable. Vaccine-preventable disease control is continually strengthening in NSW with notable successes in invasive bacterial infections. However, strengthening measles immunization in Pacific Islander and Aboriginal communities remains essential to maintain measles elimination.

New South Wales (NSW) is the most populous state in Australia with a resident population of approximately 7.3 million. The objectives of vaccine-preventable disease surveillance in NSW are, at an individual level, to identify events that may require immediate public health control measures and, at a population level, to identify risk factors such as age and geographic location that inform better targeted immunization efforts. This report describes case notification data for measles, pertussis, rubella, *Haemophilus influenzae* type b invasive infection, invasive meningococcal disease (IMD), mumps, tetanus and invasive pneumococcal disease (IPD) in NSW, Australia, in 2012 and provides comparison with recent trends.

METHODS

The case notification requirements for medical practitioners, hospital general managers and laboratories under the state's public health legislation have been previously described.[1] On receipt of a case notification, a public health unit surveillance officer determines whether or not the case notification meets the definition of a case of vaccine-preventable disease according to national criteria[2] and if so enters data gathered on each case into the NSW Notifiable Conditions Information Management System (NCIMS). Data describing cases in NCIMS were extracted for selected vaccine-preventable diseases according to the date of onset, with 2012 data compared with data for recent years. Rates were calculated using Australian Bureau of Statistics population estimates and are presented as annual rates per 100 000 total population or population in age groups.[3] Risk factor and vaccination status data were collected for cases through public health unit follow-up with general practitioners and other sources such as case or caregiver reports. The incidence of cases were analysed by geographic area of residence. All analyses were performed using SAS Enterprise Guide 6.1 (SAS Institute Inc., Cary, NC, USA) and Microsoft Excel 2010 software (Microsoft Corporation, USA).

RESULTS

Haemophilus influenzae type b invasive infection

In 2012, two cases of *Haemophilus influenzae* type b infection were notified; this was the lowest number of cases notified within the last decade and the first time since the introduction of the vaccine in 1993 that no

[a] Health Protection Unit, New South Wales, Australia.
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Table 1. **Number and rate per 100 000 population of case notifications for selected vaccine-preventable diseases, New South Wales, Australia, 1991 to 2012**

Age group (years)	*Haemophilus influenzae* type b infection		Measles		Meningococcal disease		Mumps		Pertussis		Pneumococcal disease (invasive)		Rubella		Tetanus	
	n	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate
1991	208	3.5	492	8.3	127	2.2	8	0.1	47	0.8	NN	NN	57	1.0	5	0.1
1992	216	3.6	802	13.5	121	2.0	23	0.4	218	3.7	NN	NN	321	5.4	2	0.0
1993	123	2.0	2339	39.0	153	2.5	13	0.2	1531	25.5	NN	NN	1181	19.7	5	0.1
1994	61	1.0	1479	24.4	142	2.3	11	0.2	1403	23.2	NN	NN	227	3.7	4	0.1
1995	29	0.5	594	9.7	113	1.8	14	0.2	1367	22.3	NN	NN	2315	37.8	0	0.0
1996	13	0.2	191	3.1	161	2.6	27	0.4	1152	18.6	NN	NN	628	10.1	1	0.0
1997	17	0.3	271	4.3	218	3.5	29	0.5	4233	67.4	NN	NN	153	2.4	3	0.0
1998	11	0.2	119	1.9	187	2.9	38	0.6	2300	36.3	NN	NN	78	1.2	3	0.0
1999	13	0.2	34	0.5	217	3.4	32	0.5	1413	22.0	NN	NN	45	0.7	1	0.0
2000	8	0.1	31	0.5	251	3.9	91	1.4	3693	56.9	NN	NN	190	2.9	3	0.0
2001	7	0.1	30	0.5	231	3.5	28	0.4	4437	67.9	ID	ID	58	0.9	0	0.0
2002	10	0.2	7	0.1	215	3.3	29	0.4	2013	30.6	880	13.4	35	0.5	0	0.0
2003	6	0.1	18	0.3	198	3.0	36	0.5	2767	41.8	796	12.0	23	0.3	1	0.0
2004	4	0.1	12	0.2	149	2.2	64	1.0	3560	53.5	898	13.5	17	0.3	0	0.0
2005	7	0.1	5	0.1	139	2.1	109	1.6	5788	86.5	635	9.5	9	0.1	1	0.0
2006	11	0.2	60	0.9	106	1.6	154	2.3	4895	72.6	560	8.3	37	0.5	2	0.0
2007	7	0.1	3	0.0	111	1.6	317	4.6	2085	30.5	520	7.6	8	0.1	2	0.0
2008	8	0.1	39	0.6	81	1.2	76	1.1	8735	125.8	545	7.8	17	0.2	1	0.0
2009	6	0.1	19	0.6	95	1.3	39	0.6	12 514	177.4	474	6.7	7	0.1	1	0.0
2010	6	0.1	26	0.4	75	1.0	40	0.6	9307	130.3	491	6.9	13	0.2	1	0.0
2011	4	0.1	90	1.2	72	1.0	68	0.9	13 160	182.3	526	7.3	17	0.2	1	0.0
2012	2	0.0	172	2.4	65	0.9	105	1.4	5838	80.0	579	7.9	10	0.1	1	0.0

NN, not notifiable; ID, incomplete data.

cases were notified in children less than five years of age (**Table 1**).

Measles

There were 172 cases of measles notified in NSW in 2012 compared to 90 in 2011. Of the outbreak associated cases, 12 (7.1%; 5.8 per 100 000 population) were identified as Aboriginal people (**Figure 1**) with Pacific Islander people disproportionately affected, particularly people of Samoan ancestry (17.3%; 188.7 per 100 000 population). Age group and local health district-specific measles notification rates varied considerably (**Tables 2** and **3**). Many (21.4%) notifications acquired their illness in health facilities. Of the 172 cases, 102 (59.3%) were unvaccinated, 41 (23.8%) were vaccinated and 29 (16.9%) had missing vaccination status. Of the 41 cases reported as vaccinated, two had two documented doses of measles-containing vaccine, 15 had one documented dose only and the remainder did not have documented evidence on the number of doses of vaccine that they had received. Of the 172 cases, two (1.2%) were acquired overseas, 169 (98.3%) were epidemiologically or virologically linked to a Thailand-acquired case (measles virus genotype D8) and one case (0.6%) had no link to an overseas-acquired case.

Meningococcal disease (invasive)

In 2012, 65 cases of IMD were notified in NSW (64 confirmed and one probable [clinical evidence only]) compared with 72 cases notified in 2011; 65 is the lowest number of cases since 1991. Three deaths among cases were notified in 2012 across a wide age range, including one seven-month-old infant,

Figure 1. **Case notifications of measles and IMD per 100 000 population, by Aboriginality, New South Wales, Australia, 2002 to 2012**

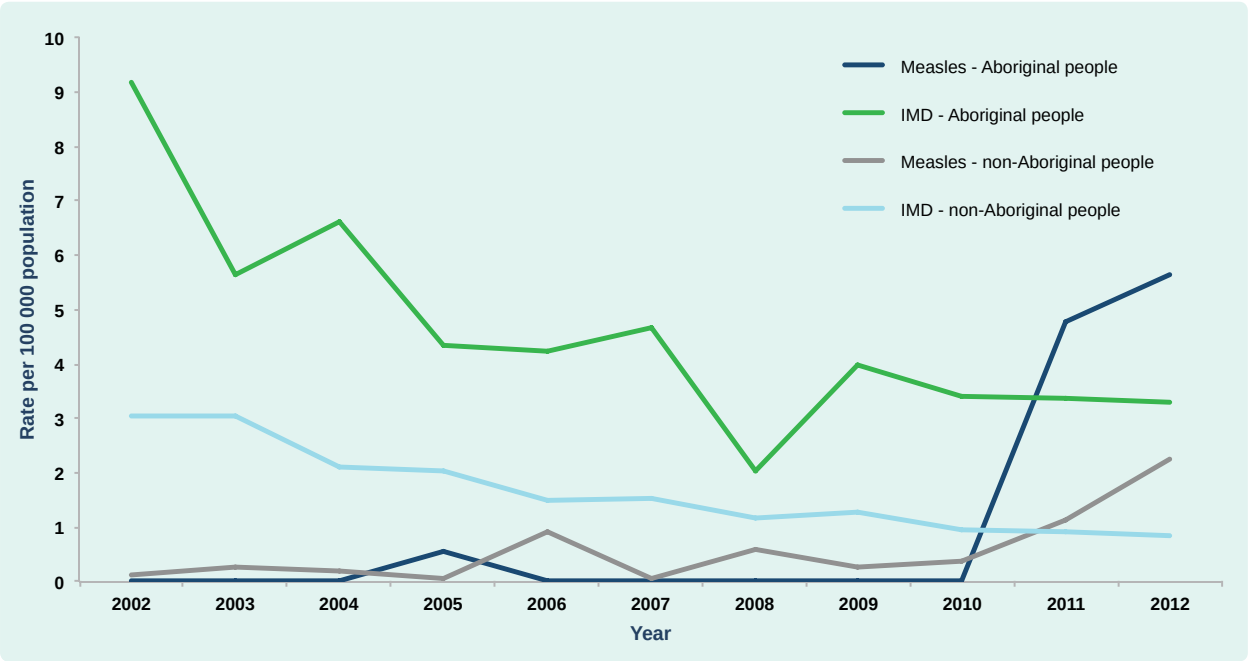


Table 2. **Number and rate per 100 000 population of case notifications for selected vaccine-preventable diseases, by age group, New South Wales, Australia, 2012**

Age group (years)	*Haemophilus influenzae* type b infection		Measles		Meningococcal disease (invasive)		Mumps		Pertussis		Pneumococcal disease (invasive)		Rubella		Tetanus	
	n	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate
0–4	0	0.0	58	12.2	22	4.6	5	1.1	1187	250.1	66	13.9	3	0.6	0	0.0
5–9	1	0.2	11	2.4	4	0.9	3	0.7	1549	339.8	16	3.5	0	0.0	0	0.0
10–14	0	0.0	20	4.5	2	0.4	2	0.4	910	204.5	8	1.8	0	0.0	0	0.0
15–19	0	0.0	29	6.3	8	1.7	8	1.7	154	33.3	11	2.4	0	0.0	0	0.0
20–24	0	0.0	10	2.0	7	1.4	7	1.4	117	23.3	8	1.6	1	0.2	0	0.0
25–29	0	0.0	10	1.9	3	0.6	10	1.9	136	25.9	14	2.7	2	0.4	0	0.0
30–34	0	0.0	19	3.7	1	0.2	27	5.3	176	34.5	27	5.3	2	0.4	0	0.0
35–39	0	0.0	8	1.6	0	0	15	3.0	257	51.4	32	6.4	1	0.2	0	0.0
40–44	0	0.0	4	0.8	0	0	11	2.1	306	59.5	27	5.3	0	0.0	0	0.0
45–49	0	0.0	2	0.4	8	1.6	5	1.0	210	43.0	26	5.3	1	0.2	0	0.0
50–54	0	0.0	0	0	1	0.2	5	1.0	173	35.1	33	6.7	0	0.0	0	0.0
55–59	0	0.0	0	0	1	0.2	2	0.5	156	35.2	35	7.9	0	0.0	0	0.0
60–64	0	0.0	1	0.3	2	0.5	1	0.3	152	38.2	41	10.3	0	0.0	0	0.0
65–69	0	0.0	0	0	1	0.3	0	0.0	139	41.0	46	13.6	0	0.0	0	0.0
70–74	0	0.0	0	0	0	0	0	0.0	109	43.1	40	15.8	0	0.0	0	0.0
75–79	0	0.0	0	0	0	0	1	0.5	51	26.1	47	24.0	0	0.0	1	0.5
80–84	1	0.7	0	0	1	0.7	3	2.0	35	23.3	45	39.3	0	0.0	0	0.0
85+	0	0.0	0	0	4	2.7	0	0.0	20	13.5	56	37.9	0	0.0	0	0.0

Table 3. **Number and rate per 100 000 population of case notifications for selected vaccine-preventable diseases, by local health district, New South Wales, Australia, 2012**

Local health district	*Haemophilus influenzae* type b infection		Measles		Meningococcal disease (invasive)		Mumps		Pertussis		Pneumococcal disease (invasive)		Rubella		Tetanus	
	n	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate
Sydney	0	0.0	2	0.3	2	0.3	16	2.8	253	43.6	32	5.5	2	0.3	0	0.0
South Western Sydney	0	0.0	126	14.2	7	0.8	13	1.5	455	51.2	61	6.9	2	0.2	0	0.0
South Eastern Sydney	1	0.1	1	0.1	6	0.7	23	2.6	508	58.5	64	7.4	1	0.1	0	0.0
Illawarra Shoalhaven	0	0.0	5	1.3	7	1.8	4	1.0	439	113.3	44	11.4	0	0.0	0	0.0
Western Sydney	0	0.0	30	3.5	8	0.9	10	1.2	770	89.2	57	6.6	3	0.3	0	0.0
Nepean Blue Mountains	0	0.0	2	0.6	4	1.1	5	1.4	400	113.9	41	11.7	0	0.0	0	0.0
Northern Sydney	0	0.0	2	0.2	3	0.3	21	2.4	601	69.5	65	7.5	1	0.1	0	0.0
Central Coast	0	0.0	0	0.0	4	1.2	3	0.9	235	72.2	32	9.8	0	0.0	0	0.0
Hunter New England	0	0.0	0	0.0	9	1.0	2	0.2	594	67.1	68	7.7	0	0.0	0	0.0
Northern NSW	0	0.0	0	0.0	2	0.7	3	1.0	329	113.7	25	8.6	0	0.0	0	0.0
Mid North Coast	0	0.0	3	1.4	4	1.9	0	0.0	157	75.4	11	5.3	0	0.0	0	0.0
Southern NSW	1	0.5	0	0.0	3	1.5	0	0.0	249	125.5	19	9.6	0	0.0	0	0.0
Murrumbidgee (including Albury LHD)	0	0.0	0	0.0	3	0.7	1	0.3	377	130.9	27	9.4	1	0.3	0	0.0
Western NSW	0	0.0	0	0.0	3	1.1	3	1.1	451	165.2	28	10.3	0	0.0	0	0.0
Far West	0	0.0	0	0.0	0	0.0	1	3.2	10	31.9	3	9.6	0	0.0	1	3.2
Justice Health	0	0.0	1	n/a	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

one 47-year-old and one 85-year-old (all caused by serogroup B). This compares to four deaths in 2011 (all caused by serogroup B).

Of the 65 cases notified in NSW in 2012, a serogroup was recorded for 54 (83.1%) (**Figure 2**). Of these 54 cases, 43 (79.6%) had disease caused by serogroup B infection (for which there was no vaccine), 42.9% of these cases were aged less than five years, 14.3% were aged 15–19 years and 14.3% were aged 45–49 years. For five cases (9.3%), disease was caused by serogroup Y infection; two of these five cases (40%) were aged 85 years or older with others aged between 20 and 49 years of age. For four cases (7.4%), disease was caused by serogroup W135 infection (of these people one was aged one year, two were aged 60–64 years and one at least 85 years of age). Only two cases (3.7%) had disease caused by serogroup C infection, and both were ineligible for vaccination under the National Immunization Programme and were not vaccinated.

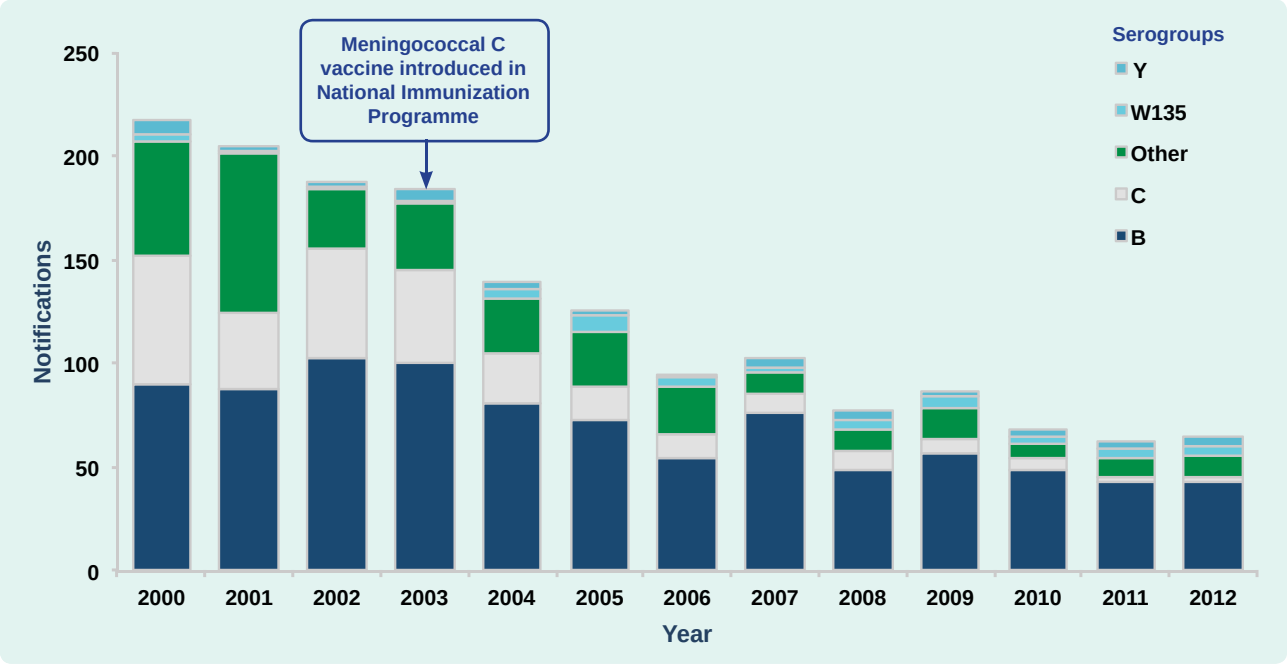
Mumps

There were 105 cases of mumps notified in NSW in 2012, compared to 68 in 2011. The highest mumps case notification rate was among young adults aged 30–34 years (27 cases, 5.3 per 100 000 population). In NSW, notified cases of mumps are not routinely followed up by public health units.

Pertussis

In 2012, 5838 cases of pertussis were notified in NSW, compared with 13 183 in 2011. One death was reported in an unvaccinated seven-week-old infant from the Illawarra Local Health District. In 2012, 2625 cases (45.0%) were male. Of the 1182 cases aged zero to

Figure 2. **Annual case notifications of laboratory-confirmed IMD by serogroup, New South Wales, Australia, 2000 to 2012**



four years (who are followed up by public health units), 69 (5.8%) were Aboriginal children with 12% missing/unknown.

Of the 247 cases aged less than 12 months, 157 (63.6%) were infants too young to have received three doses of vaccine (i.e. aged six months or less at onset of illness). Of the 935 cases who were children aged zero to four years, 71 (7.6%) were reported to be not immunized, 24 (2.6%) reported less than three doses of vaccine, and 798 (85.4%) reported three or more doses. Data on vaccine doses were not reported for the remaining 42 (4.5%) cases.

Pneumococcal Disease

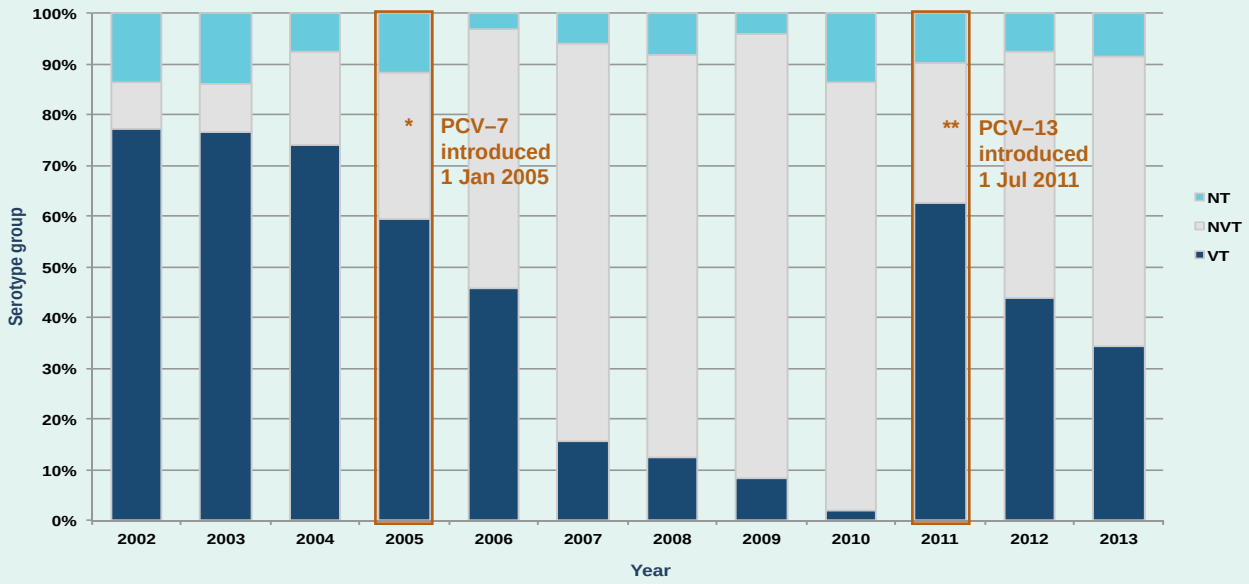
In 2012, 583 cases of IPD were notified compared to 524 in 2011 (**Figure 3**). Forty-four deaths were identified in 2012. There were no deaths reported in children. Of the 383 cases aged either zero to four years or older than 50 years (age groups which are followed up by public health units), 14 (3.7%) were notified in Aboriginal people among whom case notification rates were significantly higher than in non-Aboriginal people (24.8 and 13.0 per 100 000, respectively).

Vaccination data were available for 94% (61 cases) of notifications under the age of five years. Forty-four (72%) cases were fully vaccinated and 17 (28%) cases were either partially vaccinated or too young to have received their first dose. There were two vaccine failures, and both cases were fully vaccinated and both cases' disease was caused by serotype 19F. Since 1 July 2011, 13-valent pneumococcal conjugate vaccine (PCV-13) replaced 7-valent pneumococcal conjugate vaccine (PCV-7) on the NSW immunization schedule. The PCV-13 vaccine includes protection for additional serotypes 1, 3, 5, 6A, 7F and 19A. The rate of disease in children under the age of five years in NSW after the introduction of PCV-13 declined from 19.0 per 100 000 pre-vaccine (2010) to 12.2 per 100 000 (2012). The proportion of vaccine-related disease fell by 16% post introduction; however, the proportion of non-vaccine-related disease increased by 12% (**Figure 3**).

Rubella

In 2012, 10 cases of rubella were notified in NSW compared to 17 in 2011. Cases were aged between 12 months and 46 years. There were no case notifications of congenital rubella.

Figure 3. **Percentage of children less than five years with IPD who have a serotype covered by the current pneumococcal vaccine, New South Wales, Australia, 2002 to 2012**



* PCV–7 includes serotypes 4,6B, 9V, 14, 18C, 19F and 23F introduced into immunization schedule.

** PCV–13 includes serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F and 23F introduced into immunization schedule.

NT, isolate not typed; NVT, non vaccine type (percentage of disease caused by serotypes not included in the vaccine); VT, vaccine type (percentage of disease caused by serotype included in the vaccine).

Tetanus

One case of tetanus was notified in NSW in 2012. This case resided in the Far West Local Health District and was an elderly female who reported never receiving a tetanus vaccination.

DISCUSSION

Prior to the commencement of immunization, *Haemophilus influenzae* type b was an important cause of invasive bacterial disease in children.[4] Since the introduction of the vaccine, case notifications have declined substantially. In 2012, there were no case notifications in children aged less than five years for the first time in NSW. Infants should receive a *Haemophilus influenzae* type b containing vaccine at six to eight weeks, four and six months of age followed by a final dose at 12 months.[5]

Endemic measles transmission has been eliminated in Australia since 1999.[6] In NSW, outbreaks occur in association with international travel but are usually of limited size and duration.[7] In 2012, an outbreak associated with travel to Thailand resulted in sustained measles transmission for nine months, the largest outbreak since 1997. Similar to some measles outbreaks in 2011,[8] the outbreak disproportionately affected Aboriginal and people of Pacific Islander background, particularly those of Samoan heritage.[9] Higher measles notification rates in Aboriginal people may have been associated with suboptimal vaccination timeliness and coverage in selected locations; however several notifications also occurred in infants too young to be vaccinated. Improved timeliness and coverage are currently being addressed through various initiatives, including the 'Save the Date to Vaccinate' campaign and the recently created Aboriginal Immunization Health Worker positions based in Local Health Districts. As with other outbreaks in elimination settings, the highest case notification rates were seen in infants too young to be vaccinated (less than one year old).[10] However, adolescents aged 15–19 years were also a feature of the outbreak, with high case notification rates possibly reflecting the lower immunity identified in children aged 10–14 years old in NSW in a recently published serosurvey from 2007.[11] Recent measles epidemiology highlights the need for supplementary targeted vaccination efforts in teenagers and in people of Pacific Islander background and for increased measles immunity among residents travelling overseas.

Pertussis transmission is cyclical in Australia with outbreaks occurring every three to four years.[5] The highest number of pertussis case notifications was reported in 2011 (a continuation of the 2010 epidemic period). Case notifications declined substantially in 2012 to the lowest number since 2008 (when a more sensitive test became widely adopted). Vaccination remains the cornerstone of pertussis prevention and control and aims to prevent severe pertussis and deaths which mostly occur in infants less than two months of age.[12] Recent evidence generated in NSW and internationally indicates that adult vaccination is most effective at preventing pertussis in babies when given to women planning a pregnancy or in the third trimester of pregnancy.[13] Whooping cough vaccination is strongly recommended for adults in contact with babies too young to be vaccinated.[5]

In Australia, the number of IMD case notifications continues to decline since the introduction of the meningococcal C vaccine in 2003.[14] The greatest reduction in notified cases of meningococcal disease has been for serogroup C, from 45 cases (29% of those with known serogroup) in 2003 to less than 10 cases annually over the past five years and two cases (4% of those with known serogroup) in 2012. Neither of the two cases of meningococcal C disease was eligible for vaccination in Australia. The number of cases of meningococcal disease associated with serogroup B has also decreased over time but remains the most commonly identified serogroup. The case notifications of other serogroups (W135 and Y) have remained low and stable in recent years. A meningococcal B vaccine has recently been added to the Register of Therapeutic Goods but is not included in the National Immunization Programme Schedule. Given that all meningococcal deaths in 2011 (n = 4) and 2012 (n = 3) were caused by serogroup B disease, there is potential for mortality reduction if parents choose to vaccinate their children.

Following the introduction of PCV-7 in 2005 for children under five years, there has been a reduction in IPD due to these seven serotypes. There was a steady increase in IPD due to other serotypes (predominantly serotypes 1, 3, 6A, 7F and 19A) before the introduction of PCV-13 vaccine in 2011. The overall reduction in IPD in children under five years is however not as significant as the reduction seen in 2005 with the introduction of PCV-7. Reductions in case notifications for other age groups are not yet evident. In fact, the overall number of IPD cases increased in 2012 compared with 2011; however, this could be as a result of the severe influenza season experienced by NSW in 2012, as influenza is a risk factor for IPD.[15] Replacement disease with non-vaccine serotypes is already apparent and will need to be monitored for future impact on disease burden.

CONCLUSION

Vaccine-preventable diseases are generally well controlled in NSW; however, high vaccination coverage and timely vaccination for infants and children remain crucial to maintain low rates of disease. While the lack of *Haemophilus influenzae* type b case notifications among young children for the first time since vaccination was introduced reflected the success of the immunization programme, supplementary initiatives are required to improve adolescent vaccination coverage in specific ethnic populations, particularly people of Pacific Islander background in parts of metropolitan Sydney. Pertussis case notifications have declined; however, vaccination remains strongly recommended for adults in contact with babies too young to be vaccinated. The burden of travel-associated vaccine-preventable diseases highlights the need for travellers to ensure they are appropriately vaccinated before their departure.

Ethics statement

Surveillance summaries are exempt from ethics approval with the NSW Health system.

Conflicts of interest

None declared.

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Implementing hospital-based surveillance for severe acute respiratory infections caused by influenza and other respiratory pathogens in New Zealand

Q Sue Huang,[a] Michael Baker,[b] Colin McArthur,[c] Sally Roberts,[c] Deborah Williamson,[acd] Cameron Grant,[d] Adrian Trenholme,[e] Conroy Wong,[e] Susan Taylor,[e] Lyndsay LeComte,[e] Graham Mackereth,[a] Don Bandaranayake,[a] Tim Wood,[a] Ange Bissielo,[a] Ruth Seeds,[a] Nikki Turner,[d] Nevil Pierse,[b] Paul Thomas,[f] Richard Webby,[f] Diane Gross,[g] Jazmin Duque,[g] Mark Thompson[g] and Marc-Alain Widdowson[g]

Correspondence to Q Sue Huang (e-mail:Sue.Huang@esr.cri.nz).

Background: Recent experience with pandemic influenza A(H1N1)pdm09 highlighted the importance of global surveillance for severe respiratory disease to support pandemic preparedness and seasonal influenza control. Improved surveillance in the southern hemisphere is needed to provide critical data on influenza epidemiology, disease burden, circulating strains and effectiveness of influenza prevention and control measures. Hospital-based surveillance for severe acute respiratory infection (SARI) cases was established in New Zealand on 30 April 2012. The aims were to measure incidence, prevalence, risk factors, clinical spectrum and outcomes for SARI and associated influenza and other respiratory pathogen cases as well as to understand influenza contribution to patients not meeting SARI case definition.

Methods/Design: All inpatients with suspected respiratory infections who were admitted overnight to the study hospitals were screened daily. If a patient met the World Health Organization's SARI case definition, a respiratory specimen was tested for influenza and other respiratory pathogens. A case report form captured demographics, history of presenting illness, co-morbidities, disease course and outcome and risk factors. These data were supplemented from electronic clinical records and other linked data sources.

Discussion: Hospital-based SARI surveillance has been implemented and is fully functioning in New Zealand. Active, prospective, continuous, hospital-based SARI surveillance is useful in supporting pandemic preparedness for emerging influenza A(H7N9) virus infections and seasonal influenza prevention and control.

The 2009 influenza A(H1N1)pdm09 pandemic highlighted the need for disease surveillance to monitor severe respiratory disease to support pandemic preparedness as well as seasonal influenza prevention and control.[1,2] Information generated from this type of surveillance enhances our understanding of how epidemiology and etiology differ between countries and regions of the world. The accumulated data collected in a standard and consistent way will allow rapid assessment for each influenza season and future pandemics within and among countries.[2]

The 2009 pandemic and seasonal influenza epidemics demonstrated the importance of having an established real-time respiratory disease surveillance system in the southern hemisphere to inform the northern hemisphere countries about newly emerging pandemic or seasonal influenza.[3,4] A surveillance system can provide critical data on the epidemiology, burden, impact, circulating influenza, other respiratory pathogens and effectiveness of influenza prevention and control measures at a time when similar data in the northern hemisphere are not available.

New Zealand is an excellent location for population-based research with its predominantly public funded health-care system. All New Zealanders are assigned a unique identifier allowing tracking of health-care utilization over time and linkage to multiple databases. Primary-care providers have highly computerized information systems

[a] Institute of Environmental Science and Research, Wellington, New Zealand.
[b] University of Otago, Wellington, New Zealand.
[c] Auckland District Health Board, Auckland, New Zealand.
[d] University of Auckland, Auckland, New Zealand.
[e] Counties Manakau District Health Board, Auckland, New Zealand.
[f] WHO Collaborating Centre, St Jude Children's Research Hospital, Memphis, United States of America.
[g] Centers for Disease Control and Prevention (CDC), Atlanta, United States of America.
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and patient records with detailed demographic, risk factor and immunization information. The New Zealand population is extremely well characterized regarding demographic structure, particularly by ethnicity and socioeconomic status. Indigenous Maori and Pacific peoples (collectively about 20% of the population) are particularly vulnerable to influenza and other respiratory infection-related hospitalizations.[3,5]

In October 2011, led by the Institute of Environmental Science and Research (ESR), a multicentre and multidisciplinary project – Southern Hemisphere Influenza and Vaccine Effectiveness Research and Surveillance (SHIVERS) – was established for a five-year period (2012–2016). This multiagency collaboration is between ESR, Auckland District Health Board (ADHB), Counties Manukau District Health Board (CMDHB), University of Otago, University of Auckland, WHO Collaborating Centre at St Jude Children's Research Hospital and the United States Centers for Disease Control and Prevention (US CDC). SHIVERS, the largest and most comprehensive influenza research initiative in the southern hemisphere, aims to: (1) understand severe acute respiratory infections; (2) assess influenza vaccine effectiveness; (3) investigate interaction between influenza and other respiratory pathogens; (4) ascertain the causes of respiratory mortality; (5) understand non-severe respiratory illness; (6) estimate influenza infection through a serosurvey; (7) determine influenza risk factors; (8) study immune responses to influenza; and (9) estimate influenza-associated health care and societal economic burden and vaccine cost–effectiveness.[6]

A major component of the SHIVERS project is to conduct hospital-based surveillance for severe acute respiratory infections (SARI). This report describes the implementation of this hospital-based surveillance system and provides some preliminary results from the first influenza season of its operation.

PURPOSE OF THE SURVEILLANCE SYSTEM

The specific aims of the hospital-based surveillance are to:[7]

(1) establish active, prospective, continuous, population-based surveillance for hospitalized SARI cases, including intensive care unit (ICU) admissions and in-hospital deaths;

(2) understand influenza's contribution to those assessed patients not meeting the SARI case definition;

(3) measure incidence, prevalence, demographics, clinical spectrum and outcomes for SARI and associated influenza cases;

(4) identify etiologies of SARI cases attributable to influenza and other respiratory pathogens;

(5) compare surveillance data with the data generated from New Zealand's hospital discharge coding system; and

(6) describe any possible increased risk of influenza-related hospitalization.

IMPLEMENTATION OF THE SURVEILLANCE SYSTEM

Population under surveillance

All residents from ADHB (central Auckland) and CMDHB (east and south Aukland) were under surveillance. Cases were reported from Auckland City Hospital and the associated Starship Children's Hospital and Middlemore Hospital and the associated Kidz First Children's Hospital. These four hospitals serve all residents of ADHB and CMDHB, have emergency departments and inpatient general and speciality medical services and provide all inpatient care for acute respiratory illness. The age, ethnicity and socioeconomic distribution of the urban population of 838 000 under surveillance were broadly similar to the New Zealand population (**Table 1**).

Case definition

Cases included in the surveillance were overnight inpatients with suspected respiratory infections. An overnight admission is defined as: "A patient who is admitted under a medical team, and to a hospital ward or assessment unit."[7] These cases were further identified as those meeting the SARI case definition and those not meeting the SARI case definition (non-SARI). All SARI cases and a subset of non-SARI cases were enrolled.

Table 1. **Population distribution by age, ethnicity and socioeconomic group in New Zealand and surveillance population**

Characteristics	Percentage of total (%)		Ratio†
	New Zealand*	Study area*	
Age group (years)			
< 1	1.4	1.6	1.1
1–4	5.4	5.9	1.1
5–19	22.2	22.7	1.0
20–34	19.6	23.3	1.2
35–49	22.6	22.8	1.0
50–64	16.5	14.6	0.9
65 & above	12.3	9.2	0.7
Ethnic group			
Asian	8.5	19.2	2.3
European	66.9	46.9	0.7
Maori	14.0	11.6	0.8
Pacific peoples	5.6	15.3	2.7
Other	0.8	1.4	1.7
Unknown	4.2	5.5	1.3
NZDep2006‡			
1	10.3	9.6	0.9
2	10.2	10.1	1.0
3	10.2	9.8	1.0
4	10.0	8.6	0.9
5	9.9	8.2	0.8
6	9.9	7.9	0.8
7	9.9	8.3	0.8
8	9.8	9.9	1.0
9	10.0	11.3	1.1
10	9.8	16.2	1.6
Unknown	0.1	0.1	0.5
Total (n)	**100.0 (4 027 929)**	**100.0 (837 696)**	

* New Zealand population census 2006

† Ratio – percentage study area over percentage New Zealand

‡ NZDep 2006 Index of Deprivation is an area-based, census-derived measure of socioeconomic status which divides the population into deciles, where 10 represents areas with the most deprived population and 1 is the least deprived.

Note: Some columns may not add up to 100% due to the rounding off of decimal places.

The WHO SARI case definition was used for all age groups:[2]

An acute respiratory illness with:

- a history of fever or measured fever of 38 °C, AND
- cough, AND
- onset within the past 10* days, AND
- requiring inpatient hospitalization.

* Note: onset within the past seven days was used in the 2012 study protocol.

Expected number of cases

The discharge data for hospitalized patients in ADHB and CMDHB during the period 2006–2010 showed that the average annual number of overnight respiratory disease admissions (ICD-10 J00–99) was 9431 and influenza and pneumonia and acute lower respiratory tract infections (ICD-10 J09–22) was 5033 (**Table 2**). Thirty-six per cent of these admissions occurred for children under 15 years. Based on an average annual increase in respiratory disease admissions of 2.6% from 2006 to 2010, it was expected that the number of respiratory disease hospitalizations would increase by ~10% in 2012. Therefore, it was estimated that in 2012, 10 374 patients (ICD-10 J00–99) and 5537 patients (ICD-10 J09–22) would be admitted overnight with respiratory diseases.

While it was difficult to accurately predict the expected number of annual SARI cases based on discharge data, an early study in the Starship Children's hospital indicated that approximately 50% of the preschool-aged children with a discharge diagnosis of pneumonia or bronchopneumonia met the WHO case definition for pneumonia.[8] The ADHB laboratory data during 2010–2011 showed that 15.2% (175/1145) of respiratory specimens were positive for influenza virus.[9]

An average of 5500–10 000 annual cases of hospitalized respiratory diseases with 50% meeting the WHO SARI case definition would result in ~2800–5000 hospitalized SARI cases. Based on the ~10% positive detection rate, about 280–500 laboratory-confirmed influenza cases would be expected among these hospitalized SARI patients.

Case ascertainment and data collection

Case ascertainment followed a surveillance algorithm. The presence of the components of the case definition was determined by reviewing clinicians' admission diagnoses and interviewing patients. Records of all acutely admitted patients were reviewed daily to identify

Table 2. **Overnight hospital admissions for respiratory infections and related conditions (principal diagnosis in the J00–99 range*) in Auckland District Health Board and Counties Manukau District Health Board during 2006–2010**

Conditions	IC10 codes	Average per year	Average per week (summer)	Average per week (winter)
Acute upper respiratory infections	J00–06	873	14	22
Influenza and pneumonia	J09–18	2790	38	84
Acute bronchitis	J20	91	1	3
Acute bronchiolitis	J21	1246	15	42
Unspecified acute lower respiratory tract infection	J22	906	13	26
Chronic bronchitis and emphysema	J40–43	155	2	4
Chronic obstructive pulmonary disease	J44	1560	25	39
Asthma	J45–46	1430	25	32
Bronchiectasis	J47	301	5	7
Respiratory failure	J96	79	2	2
Total		**9431**	**140**	**261**

* The following respiratory conditions (roughly 1352 cases per year) were excluded because most of them are not likely to be classed as acute respiratory infections: J30–39, J60–70, J80–84, J90–94, J95, J97–99.

Summer – December to March; Winter – June to September.

any overnight inpatient with a suspected respiratory infection. These patients were categorized into one of 10 admission diagnostic syndrome groups. Research nurses interviewed these patients, documented the components of the case definition that were present and differentiated patients into SARI and non-SARI cases.

A case report form for each assessed patient captured patient demographics, presenting symptoms and illness, pre-hospital health care, medication usage, influenza vaccination history, co-morbidities, disease course and outcomes, epidemiological risk factors and laboratory results.

Clinical specimens were taken from all SARI and some non-SARI patients (for clinical management purposes) (**Figure 1**). The preferred respiratory specimens for adult and paediatric patients were nasopharyngeal swabs and nasopharyngeal aspirates, respectively. Where possible, at least one lower respiratory tract sample (tracheal aspirate, bronchial wash or bronchoalveolar lavage) was collected from all ventilated patients.

Laboratory component

Influenza and other non-influenza respiratory viruses

The ADHB laboratory and ESR used US-CDC's real-time RT–PCR protocol for influenza virus.[10] CMDHB laboratory used the Easy-Plex PCR assay for influenza virus (AusDiagnostic Pty Ltd, New South Wales, Australia).[11] Comparison between AusDiagnostic with US CDC's assays showed that AusDiagnostic assay had a sensitivity of 100% and specificity of 96.6% when US CDC method was used as a gold standard.

All SHIVERS samples were forwarded to ESR for further characterization/storage. The WHO standard manual was used to conduct antigenic, genetic and antiviral characterization.[12] Any unsubtypeable influenza A viruses were forwarded to WHO collaborating centres in Melbourne or Atlanta.

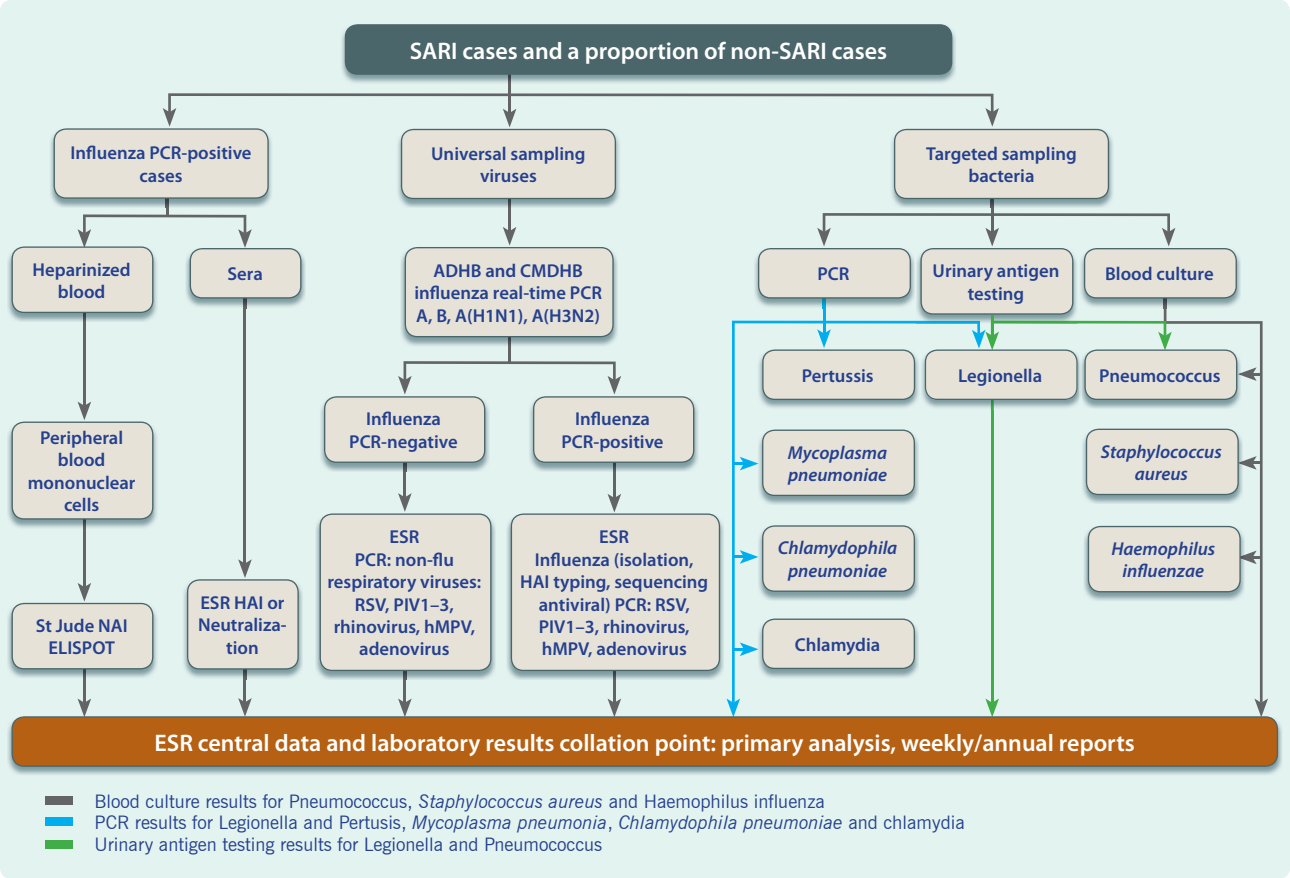
US CDC's real-time RT–PCR for non-influenza respiratory viruses was performed for respiratory syncytial virus, parainfluenza virus 1–3, human metapneumovirus, rhinovirus and adenovirus.[13,14]

Respiratory bacteria

Sampling and testing for respiratory bacteria was based on the hospital clinical management and diagnostic protocols.

Urinary antigen tests (a rapid immuno-chromatographic test) from Binax (Auckland, New Zealand) were used for all strains of *Streptococcus pneumoniae* and *Legionella pneumophila* serogroup 1.

Figure 1. **Specimen collection and testing for SARI cases and a proportion of non-SARI cases**



ADHB – Auckland District Health Board; CMDHB – Counties Manukau District Health Board; ELISPOT – enzyme-linked immunosorbent spot; ESR – Institute of Environmental Science and Research; HAI – haemagglutination inhibition assay; hMPV – human metapnemovirus; NAI – neuraminidase inhibition assay; PIV1–3 – parainfluenza virus types 1–3; PCR – polymerase chain reaction; RSV – respiratory syncytial virus.

The ADHB laboratory used blood culture media, BD Bactec-plus aerobic/F and Bactec Lytic/10 anaerobic/F from Becton, Dickinson and Co. (Auckland, New Zealand). The CMDHB laboratory used BacT/ALERT-FA-Plus, FN-Plus and PF-Plus bottles from BioMérieux (Auckland, New Zealand).

The CMDHB laboratory used AusDiagnostic PCR assay (Bordetella and atypical pneumonia, Cat. 3078) to detect: pan-Legionella; *Legionella longbeachae*, *Legionella pneumophila*, *Mycoplasma pneumoniae*, pan-Chlamydia, *Chlamydophila pneumoniae*, *Bordetella pertussis*, *Bordetella parapertussis* and *Pneumocystis jiroveci*.

Data analysis and dissemination

The total number of all hospital acute admissions and assessed and tested patients, including ICU admissions and deaths and census data, were collected. This allowed calculation for population-based incidence for SARI and associated influenza cases by overall and stratified population (age, sex, ethnicity and socioeconomic status) for the ADHB and CMDHB population (2006 census data). This also allowed calculation for proportion of SARI and associated influenza cases, including ICU admissions and deaths, by overall and stratified patients among all acute admissions. An acute admission is an unplanned admission on the day of presentation at the admitting health-care facility. Admission may have been from the emergency or outpatient departments of the health-care facility, a transfer from another facility or a referral from primary care.

Weekly reports during May–September and monthly reports during October–April were produced.

Annual reports described epidemiologic, clinical, virologic/microbiologic characteristics, risk factor analysis of SARI and associated influenza and other

respiratory pathogen cases, and antigenic, genetic and antiviral characterization of influenza viruses.

Ethics

Ethics approval was obtained from the Northern A Health and Disability Ethics Committee (NTX/11/11/102 AM02). Written consent is not necessary for non-sensitive data from routine in-hospital clinical management and diagnostic testing. Verbal explanation of the reason for additional information and its use was given to each patient, consistent with the New Zealand Code of Health and Disability Services Consumers' Rights (Right 6: Right to be fully informed).[15]

PRELIMINARY RESULTS

From 30 April to 30 September 2012 there were 59 124 acute admissions to ADHB and CMDHB hospitals. A total of 4417 (7.5%) patients with suspected respiratory infections were assessed. Of these, 2023 (45.8%) met the SARI case definition. Of the 1430 SARI cases from whom nasopharyngeal specimens were collected, 324 (22.7%) had influenza viruses. A small proportion of influenza-positive cases (7.1%, 21/294) were identified from patients with onset in the past seven to 10 days, so the case definition was expanded to onset within the past 10 days for subsequent study years (2013–2016). A small proportion (8.8%, 37/419) of influenza-positive cases was from non-SARI cases tested for clinical purposes.

DISCUSSION

Value of SARI surveillance

Hospital-based SARI surveillance has been implemented and fully functioning in New Zealand since 30 April 2012. WHO is encouraging Member States to establish SARI surveillance that meets WHO global standards.[2] To our knowledge, New Zealand is among the first developed countries to do this, providing better understanding of the epidemiology, transmission and impact of influenza locally and globally.

New Zealand's existing hospital-based disease surveillance is well suited to strategic surveillance functions.[16] However, such systems are not suited to control-focused surveillance where it is necessary to identify and respond in a timely manner to individual events.[16] Thus, the active, prospective, continuous, hospital-based SARI surveillance provided by the SHIVERS project is particularly useful in supporting both pandemic preparedness for emerging influenza A(H7N9) virus and seasonal influenza prevention and control. SARI surveillance has been a valuable platform for the study of other common respiratory pathogens and preparing for emerging respiratory viral diseases such as novel coronavirus, MERS-CoV.

Limitations and potential improvements to SARI surveillance

The WHO SARI case definition, based on clinical symptoms and signs, will miss some illnesses caused by influenza infection and include some illnesses caused by non-influenza infections.[2,17] The SHIVERS SARI surveillance system provides a comprehensive and thorough algorithm for case ascertainment and testing for all SARI and some non-SARI cases. It offers a unique opportunity to define cases of influenza not captured currently from patients who do not meet WHO SARI case definition, thus enabling further refinement of the WHO case definition. Additionally, the SHIVERS SARI surveillance system offers an opportunity to evaluate sensitivity and specificity of the WHO SARI case definition and predicting symptoms for capturing non-influenza respiratory viruses.

SARI surveillance is limited in identifying influenza virus-infected patients with atypical clinical presentations (respiratory and non-respiratory). Influenza infection can lead to more severe illness and complications such as primary viral pneumonia, secondary bacterial pneumonia, cardiac complications and neurological complications. Influenza infection can also cause exacerbations of underlying diseases such as chronic lung disease or cardiovascular disease. Some of the complications and exacerbations may occur after typical influenza-related clinical symptoms have resolved, and influenza infection may not be suspected as a cause in these complications.

SARI surveillance can characterize socio-demographic risk factors (age, sex, ethnicity and socioeconomic deprivation) as the distribution of these characteristics is well defined in census data in New Zealand. For other more specific risk factors, there are limited data available on their distribution in the population. As SARI surveillance is a case-finding

surveillance for hospitalized inpatients, it is limited to quantify the impact of these specific risk factors for SARI-related influenza infections without their baseline distributions. Consequently, it is necessary to identify a suitable comparison/control population. During 2013, a hospital-based control population without respiratory illness will be added to investigate specific risk factors for influenza and other respiratory diseases.

The case report form captures information by interviewing patients/caregivers through their recall, which generates bias. An important example is influenza vaccination status, which is crucial for estimating vaccine effectiveness. The Ministry of Health in New Zealand plans to add influenza vaccination to its national immunization register in 2014, providing more accurate vaccination history for SARI cases than patient/caregiver recall.

Conflicts of interests

None declared.

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Ongoing increase in measles cases following importations, Japan, March 2014: times of challenge and opportunity

Takuri Takahashi,[a] Yuzo Arima,[a] Hitomi Kinoshita,[a] Kazuhiko Kanou,[a] Takehito Saitoh,[a] Tomimasa Sunagawa,[a] Hiroaki Ito,[a] Atsuhiro Kanayama,[a] Ayako Tabuchi,[a] Kazutoshi Nakashima,[a] Yuichiro Yahata,[a] Takuya Yamagishi,[a] Tamie Sugawara,[a] Yasushi Ohkusa,[a] Tamano Matsui,[a] Satoru Arai,[a] Hiroshi Satoh,[a] Keiko Tanaka-Taya,[a] Katsuhiro Komase,[b] Makoto Takeda[b] and Kazunori Oishi[a]

Correspondence to Yuzo Arima (e-mail: arima@niid.go.jp).

Since late 2013 through March 2014, Japan experienced a rapid rise in measles cases. Here, we briefly report on the ongoing situation and share preliminarily findings, concerns and challenges and the public health actions needed over the coming months and years.

Measles is a notifiable disease in Japan based on nationwide case-based surveillance legally requiring physicians to report all clinically diagnosed and laboratory-confirmed cases within seven days, but preferably within 24 hours. After a large outbreak in 2007–2008 (more than 11 000 cases reported in 2008 alone) and a goal of elimination by April 2015, a catch-up programme using the bivalent measles-rubella (MR) vaccine was offered for grades seven and 12 (ages 12–13 and 17–18 years) from April 2008 through March 2013. During this period, there was an estimated 97% decline in measles notifications, and the cumulative number of reported cases has been steadily declining over the last five years (732 cases in 2009, 447 cases in 2010, 439 cases in 2011, 293 cases in 2012 and 232 cases in 2013). However, since late 2013 through March 2014, the country experienced a resurgence only a year after a large rubella outbreak.[1,2] During epidemiologic week 48 of 2013 to week 10 of 2014, as of 13 March 2014, 183 measles cases were reported (141 laboratory-confirmed, 26 clinically diagnosed and 16 laboratory-confirmed modified measles cases); 92 of the cases were male (50%) with a median age of 12 years (range four months to 52 years). Cases have been reported throughout Japan.[3] While no deaths from measles were reported, a case of encephalitis associated with measles infection occurred.[3] With 171 cases reported during weeks 1–10 of 2014 (relative to 158 cases in 2009, 89 cases in 2010, 73 cases in 2011, 74 cases in 2012 and 52 cases in 2013 for weeks 1–10 for each respective year) there is concern that the declining trend will likely be reversed this year.

Among the 183 cases, 52 (28%) had recent overseas travel histories within three weeks before onset with the majority coming from the Philippines (n = 41), where measles cases began increasing in October–November 2013.[4] Among the 105 cases that were genotyped since week 48 of 2013, the majority were B3 (n = 99), a genotype that had not been detected in Japan until 2013[4,5] and the sole genotype detected in the Philippines in 2013 (n = 33).[4] Among the 41 cases with recent travel history to the Philippines, 39 were B3, one D9 and another unknown. Based on the available epidemiologic and genetic information, the recent increase since late November 2013 appears to be linked to the Philippines.[4,6,7] Other countries have also reported genotype B3 measles cases in travellers returning from the Philippines since late 2013, including Australia, Canada, Italy, New Zealand, the United Kingdom, and the United States.[8–10] Importantly, while transmission occurred locally in 128 of the cases (70%) during week 48 of 2013 to week 10 of 2014, the change in the proportion and rate of imported cases over time has reflected the evolving epidemiologic situation in Japan. Prior to the increase in notification rates, the proportion of cases believed to have been infected overseas was low at 7% (15/204) during weeks 1–47 of 2013, then rose to 52% (42/81) during week 48 of 2013 to week three of 2014 and then declined to 11% (10/92) during weeks 1–10 of 2014. While the notification rate of

[a] Infectious Disease Surveillance Center, National Institute of Infectious Diseases, Tokyo, Japan.
[b] Department of Virology 3, National Institute of Infectious Diseases, Tokyo, Japan.
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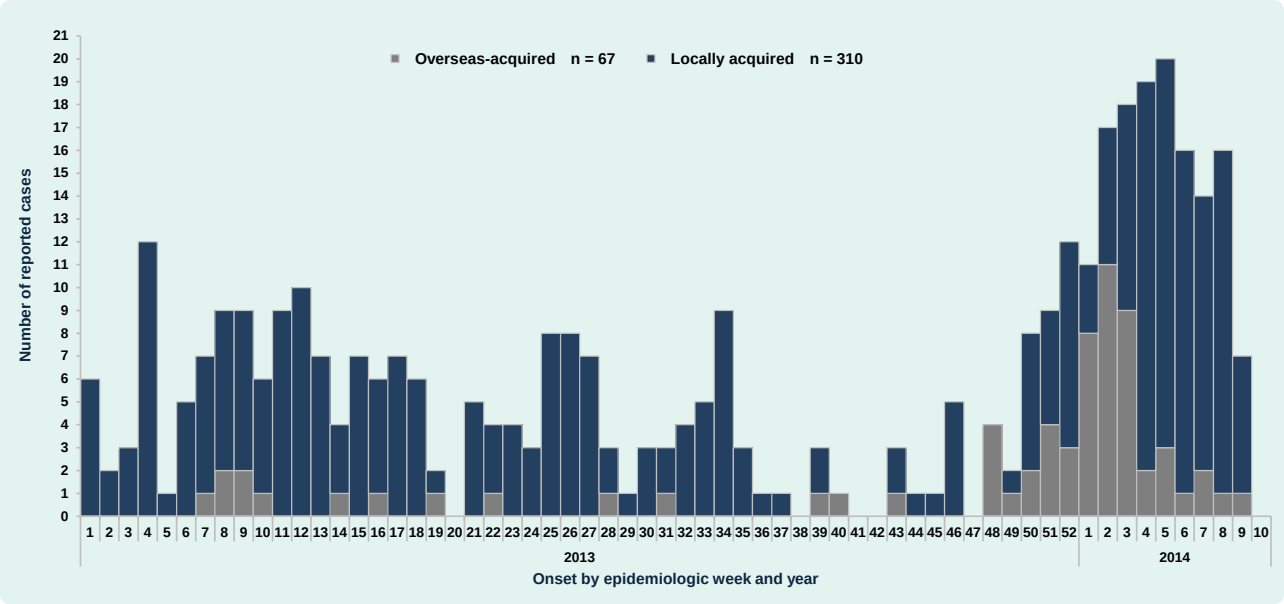
Figure 1. **Number of reported measles cases by onset by epidemiologic week, Japan, January 2013 to March 2014**



overseas-acquired cases rose and then declined during these respective periods, the rate for locally acquired cases continued to rise. Thus, while the recent increase began with overseas-acquired cases, the majority of the latest cases, also genotype B3, likely emerged as ongoing, locally acquired transmissions (**Figure 1**). In addition to family clusters, at least 22 cases were believed to have been infected nosocomially, and school-associated transmissions also emerged. Similarly, further transmissions from overseas-acquired cases associated with travel to the Philippines have been reported from the United Kingdom,[8] the United States,[9,11] and in the Mediterranean.[10]

Notably, among the 183 cases, 146 (80%) had either no or unknown history of measles vaccination. While nearly a quarter of the affected were aged one year or below (those not yet ready for vaccination and with waning maternal immunity), the large number of unvaccinated older paediatric and young adult cases are believed to have contributed to the ongoing transmission. Our preliminary findings point toward both the relative overall effectiveness of measles vaccination and that pockets of unvaccinated/susceptible populations remain, sustaining transmission following importation.

While there are limitations in the reported surveillance data, including potential underreporting and misdiagnosis, such missing or misclassified cases are unlikely to be differentially associated with importation status or with temporality and thus unlikely to alter our qualitative interpretation. Although clinicians may have tended to suspect measles for those with overseas travel, the fact that the recent increase was mostly due to cases without such travel supports the notion of a true increase due to ongoing locally acquired transmissions.

The measles situation in Japan warrants both timely and sustained public health response. Continued vigilance for imported cases is imperative, and at the same time there is a need to be alert against secondary transmission and respond rapidly to each suspected case. With Japan's announcement in 2013 easing visa requirements for visitors from South-East Asia[12] and with Tokyo's Haneda Airport increasing international flights,[13] the risk of importation will increase. Thus, sustained and routine measles vaccination, with high coverage to maintain herd immunity is essential. Travellers overseas should also ensure that they are vaccinated to prevent importation in the first place. MR vaccine is the ideal strategy to prevent infection from both viruses and prevent potentially severe outcomes such as measles encephalitis and congenital rubella syndrome. Japan's National Institute of Infectious Diseases, Ministry of Health, Labour and Welfare and other partners are actively communicating these key messages via the Internet, television and newspapers to the general public and to the medical and public health communities.[3]

While vaccination rates have vastly improved since 2007–2008, there is a need to better understand those who remain under or unvaccinated.

Japan is responding to a challenging measles situation and is about to enter its historic peak season in the spring. The current situation highlights the importance of both rapid response and routine public health activities. These messages should not be lost, especially at these opportune times. We are actively communicating with our fellow public health and medical practitioners to share timely measles information and re-emphasize the importance of MR vaccination.

Conflicts of interest

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